National Health Mission
राष्ट्रीय स्वास्थ्य मिशन

सत्यमेव जयते
Ministry of Health & Family Welfare
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NHSRC
National Health Systems Resource Centre

Exemplars in Maternal and Newborn Health India Study

State Report: Uttar Pradesh

2024

EXEMPLARS IN GLOBAL HEALTH

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Countdown to 2030
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Exemplars in Maternal and Newborn Health India Study

State Report: Uttar Pradesh





CONTENTS

Figures

Tables

ACRONYMS

AARC	Average Annual Rate of Change
ANC	Antenatal Care
ANCq	Antenatal Care with Content
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
BCPM	Block Community Process Manager
BEmOC	Basic Emergency Obstetric Care
BMI	Body Mass Index
BMGF	Bill and Melinda Gates Foundation
CEmOC	Comprehensive Emergency Obstetric Care
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
CHC	Community Health Center
CMO	Chief Medical Office
CMS	Chief Medical Superintendents
CRM	Common Review Missions
CSSM	Child Survival and Safe Motherhood
DCPM	District Community Process Manager
DHS	District Health Society
DLHS	District Level Health Survey
DM	District Magistrates
EmOC	Emergency Obstetric Care
FOGSI	Federation of Obstetric and Gynecological Societies of India
FRU	First Referral Units
GBDS	Global Burden of Disease Study
GM	General Manager
HBNC	Home Based Newborn Care
HIV	Human Immunodeficiency Virus
HMIS	Health Management Information System
HMS	Higher Mortality States
HR	Human Resource
IAP	Indian Academy of Pediatrics
IHAT	India Health Action Trust
IIPS	International Institute for Population Sciences
IMNCI	Integrated Management of Neonatal and Childhood Illness
INR	Indian Rupee
JRM	Joint Review Missions
JSSK	Janani Shishu Suraksha Karyakaram
JSY	Janani Suraksha Yojana
KII	Key Informant Interviews
LMS	Lower Mortality States
LPG	Liquefied Petroleum Gas
LSAS	Life-saving Anaesthesia skills
MCEE	Maternal and Child Epidemiology Estimation
MCTS	Mother and Child Tracking System

MD	Doctor of Medicine
MDS	Million Death Study
MIS	Management Information System
MMR	Maternal Mortality Ratio
MNH	Maternal and Newborn Health
MOIC	Medical Officer In Charge
MPV	Mission Parivaar Vikas
NFHS	National Family Health Survey
NHM	National Health Mission
NMR	Neonatal Mortality Rate
NNF	Neonatology Forum
NRHM	National Rural Health Mission
NSSK	Navjaat Shishu Suraksha Karyakram
OOPE	Out-of-pocket expenditure
PCI	Per Capita Income
PHC	Primary Health Centre
PIP	Project Implementation Plan
PMSMA	Pradhan Mantri Surakshit Matritva Abhiyan
PNC	Postnatal Care
PPH	Post-Partum Hemorrhage
RCH I	Reproductive and Child Health I
RCH II	Reproductive and Child Health II
RKS	Rogi Kalyan Samiti
RMNCAH+N	Reproductive, Maternal, Newborn, Child and Adolescent Health plus Nutrition
RMNCH	Reproductive, Maternal, Newborn, and Child Health
RMNCH+A	Reproductive, Maternal, Newborn, and Child Health plus Adolescent Health
RRTC	Regional Resource Training Centre
SBA	Skilled Birth Attendant
SIFPSA	State Innovations in Family Planning Services Project Agency
SNCU	Special Newborn Care Units
SNRC	State Newborn Resource Centre
SRS	Sample Registration System
SSV	Sehat Sandesh Vahini
TFR	Total Fertility Rate
TSU	Technical Support Unit
UK- HSDP	United Kingdom- Health System Development Project
USAID	United States Agency of International Development
UNICEF	United Nations Children's Fund
UoM	University of Manitoba
UP	Uttar Pradesh
UPMSC	Uttar Pradesh Medical Supply Corporation
VHND	Village Health and Nutrition Day
VHSNC	Village Health Sanitation and Nutrition Committees
WHO	World Health Organization

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EXECUTIVE SUMMARY

The Exemplars in Maternal and Newborn Health study documents factors associated with rapid reductions in maternal and neonatal mortality over the past two decades. This international effort aims to understand positive outliers and inform policy and practice. India was selected as one of seven "Exemplar" countries and within India the analysis was extended to examine higher- and lower-mortality state clusters separately, and to closely look at six exemplary states: Maharashtra, Tamil Nadu, Rajasthan, Odisha, Uttar Pradesh and Madhya Pradesh. This report presents the Uttar Pradesh sub-study and provides background information on the broader India study and research methodology. Key findings for Uttar Pradesh are as follows:

- Uttar Pradesh made major progress in reducing maternal and newborn mortality between 2000 and 2018. The progress was greater than most other higher mortality states in India
- All major causes of neonatal death have reduced (infections, birth asphyxia, prematurity, and others)
- The gains in intervention coverage – antenatal care with contents, institutional deliveries, and c-sections among rural women – have been marked and are greatest during the National Rural Health Mission (NRHM) and National Health Mission (NHM) periods (post 2005)
- The public sector has driven this increase in coverage, accounting for nearly 90% of the increase in institutional deliveries
- Most of the increase in deliveries was at lower-level health facilities rather than public hospitals
- Neonatal mortality rates substantially reduced for babies born in lower-level health facilities, as well as in public and private hospitals
- 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 (Janani Suraksha Yojana, 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 NHM's quality improvement and capacity building initiatives for health workers, with particular focus on in-service upgrade training for nurses and auxiliary nurse midwives in basic emergency obstetric and newborn care, as well as post-partum haemorrhage training for doctors
    - Uttar Pradesh was the first state to introduce nurse mentorship for labour room nurses
    - Uttar Pradesh improved the quality of antenatal care and developed a model of providing antenatal care at a fixed time each month in government facilities at the block level (in community health centres) or village level (during Village Health and Nutrition Days) with the support of private sector doctors; the central government adapted this initiative for implementation in other states as well, 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 used 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, the Bill and Melinda Gates Foundation 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 the mother-child tracking system, which was updated to the Reproductive and Child Health (RCH) portal, then amalgamated for regular review 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 needs
- ASHAs were able to be more effective because of the supervision and supports put in place for them through block and district community process managers and online payment systems

BACKGROUND AND STUDY DESIGN

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 select 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), between 2000 and 2018, the maternal mortality ratio (MMR) dropped from 327 to 103 per 100,000 live births and the neonatal mortality rate (NMR) from 44 to 23 per 1,000 live births. 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 of this study was 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 study was implemented by a team led by the National Health Systems Resource Centre (NHSRC) in collaboration with the International Institute for Population Sciences (IIPS), the University of Manitoba (UoM), and the India Health Action Trust (IHAT). The Ministry of Health and Family Welfare, Government of India supported the study under the guidance of a steering committee, a technical working group, and a core implementation team.

The mixed methods study included 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 exemplar states within India of the pathways by which key drivers may have led to reductions in the states' NMR and 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 and exemplary states.

Study design

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).[3]

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 non-MNH issues that 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.

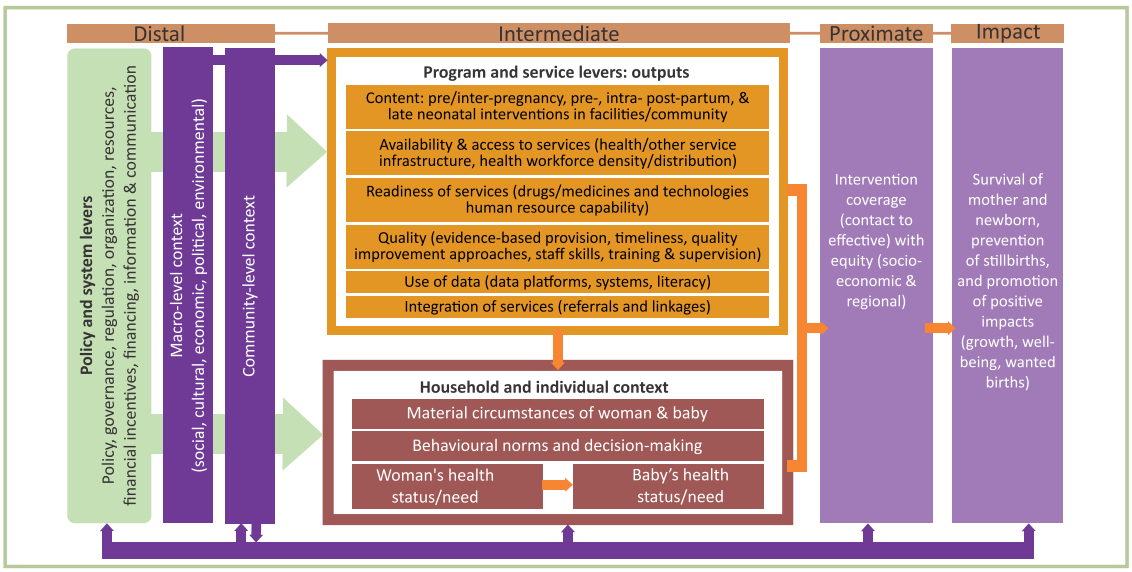
Macro- and community-level contextual factors (e.g., social, cultural, economic, political, or geographical) at the distal level may moderate the effects of health policy and system changes on program and service outputs for MNH and their impact on coverage of key MNH interventions and health outcomes. 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/needs of the women and babies concerned, which are seen to affect intervention coverage and mortality outcomes directly or indirectly.

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.

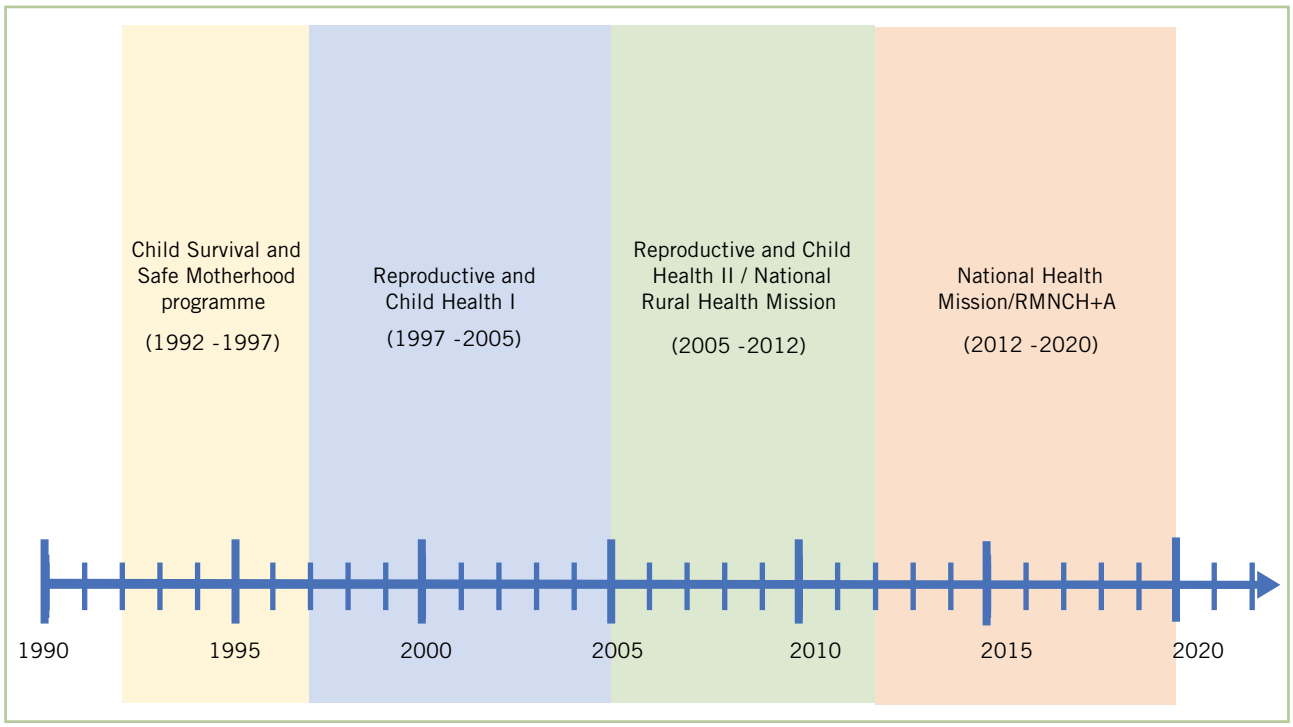
Figure 1: Conceptual framework for the study of drivers of the maternal and neonatal mortality decline, MNH Exemplars study



Identifying critical periods of policy change to guide analysis

The 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 understanding whether there were changes in pace of decline post-2000. To assess the possible impact of major policy and program changes 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 National Health Mission (NHM) from 2012 to 2020 (Figure 2). In addition, we assessed all annual or five-year time trends (depending on the indicator) for periods of acceleration or deceleration of the decline in the relevant indicator (using the average annual rate of change).

Figure 2: India's health policy periods



State clusters

We observed two distinct clusters of states based on the situation in 2000 and 2018: one of higher mortality states (HMS) with lower per capita income (PCI), and one of lower mortality states (LMS) with higher PCI (Figure 3). The two state clusters resulting from this approach were:

- Lower mortality with higher PCI (47% of India's population): Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, Telangana, and West Bengal
- Higher mortality with lower PCI (49% of India's population): Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, **Uttar Pradesh**, Uttarakhand (all of which were part of the Empowered Action Group, EAG), and Assam

Figure 3: Comparison of state-specific MMR and NMR levels in 2000 and 2018 by state per capita income

Note: West Bengal, with a similar MMR and NMR to the lower mortality states but lower per capita income in 2018 is included in the lower mortality/higher PCI cluster. Uttarakhand with a similar MMR and NMR to the higher mortality states, but higher PCI in 2018 is included in the higher mortality/lower PCI cluster.

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. At the time of state selection, we used 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).

All major (large population) states in the selection process were considered, although administrative reorganizations during the study period was 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 was based on SRS data, with its high consistency over time and availability for both indicators. The National Family Health Survey (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.

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 were 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 within the cluster. The sum of the maternal mortality and neonatal mortality AARCs is shown in Table 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 Assam and Bihar. 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 1: Average annual rate of change (AARC) for maternal mortality and neonatal mortality by state (SRS, 2000-17) (states ranked within state cluster by total AARC)

	MMR			NMR			Sum of AARCs	Rank
State	1999-2001	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	-5.00	59.5	33.0	-3.5	-8.5	4 (selected)
Bihar	400	149	-5.8	42.1	28.0	-2.4	-8.2	5
Assam	398	215	-3.6	47.2	22.0	-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	-11.2	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	-10.9	5
Gujarat	202	75	-5.8	42.4	21.0	-4.1	-9.9	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

Data sources

We used the SRS for maternal and neonatal mortality and fertility trends. The national household surveys including the National Family Health Survey[4] (NFHS, 5 rounds: NFHS-1 1992-93; NFHS-2 1998-99; NFHS-3 2005-06; NFHS-4 2015-16; and NFHS-5 2019-21), and the District Level Household Survey[5] (DLHS, 3 rounds: DLHS-1 1998-99; DLHS-2 2002-04; and DLHS-3 2012-14) were pooled for the trends in intervention

coverage and equity. For causes of death trends, we used the Million Death Study (MDS) for 2005/6, [6,7] and reviewed estimates from WHO/MCEE,[8] and the Global Burden of Disease Study (GBDS).[9]

For the qualitative component, we organized a national stakeholder meeting (length: 2 hours and 10 minutes) with 14 experts in June 2021 to identify key drivers of mortality decline. Key informant interviews (KIIs), averaging 1.5 hours were conducted during July-November 2021. We invited 21 experts active since 2000 in MNH policy and implementation from the government, donor organizations, private sector, civil society, and academic spheres, of which 13 consented. We held one round table discussion with state-level experts in the six selected exemplar states separately (n=11 participants each on average) in March-April 2022, to identify key policy and health system drivers of mortality declines (averaging 3.15 hours). All were conducted on Zoom in English, audio-recorded, and transcribed. Ethical approvals were obtained from the International Institute for Population Sciences [#33/2021] and University of Manitoba [#HS24416] review boards.

Analytical methods

We analysed quantitative trends by computing AARCs through regression analysis[10] for the different national policy periods. To measure antenatal care (ANC) with contents and intensity-related components, we computed a composite index called ANCq[11], which has a 13-point scale. After adaptation to India, our ANCq index consisted of the 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 vaccinations during pregnancy.

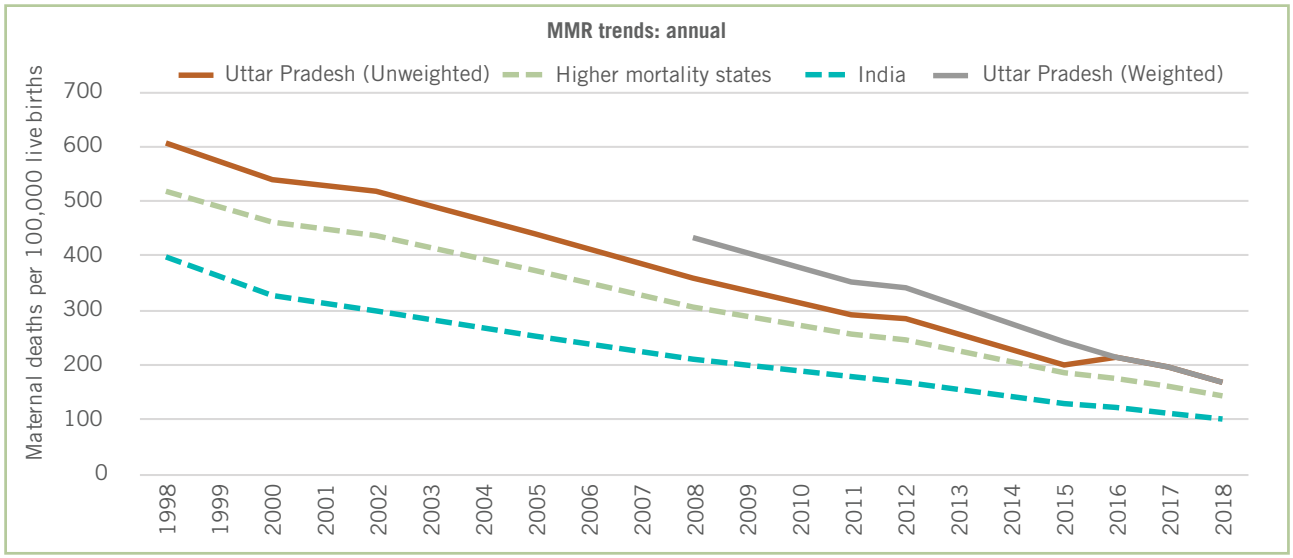
We coded the qualitative transcripts in Dedoose software using a codebook developed based on *a priori* topics, with additional emergent sub-codes. We shared synthesized results with key informants to finalize the results.

This report presents the results of these analyses for Uttar Pradesh according to the framework (Figure 1) 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 Uttar Pradesh over the last two decades. Then the study analyzed the linkages between drivers and outcomes to explain how major drivers combined to influence Uttar Pradesh's maternal and neonatal mortality declines.

MATERNAL AND NEONATAL MORTALITY TRENDS

During 1997-2018/19, Uttar Pradesh recorded much faster reductions in MMR than in NMR (AARC, of -6.4% versus -2.4%) (Figure 4, Table 2). However, the SRS seems to be underestimating the speed of MMR decline in the state because its estimates before 2015 were unweighted. In 2018, the MMR for the state was 167 maternal deaths per 100,000 livebirths (much higher than twice the 2030 SDG goal of 70) and the NMR was 30 per 1000 live births in 2019 (also more than twice the 2030 SDG goal of 12) (Figure 4). The fastest decline in both the MMR and NMR was observed during the NHM/RMNCH+A period (2012-18/19) with an AARC of -8.9% and -3.0%, respectively (Table 2). Although the MMR and NMR of Uttar Pradesh were consistently higher than those of higher mortality state cluster, the state ranked third among higher mortality states in the combined AARC for MMR and NMR (Table 1).

Figure 4: Uttar Pradesh's MMR (1998-2018) and NMR (1971-2019) levels and trends compared to higher mortality state cluster and all India (SRS)



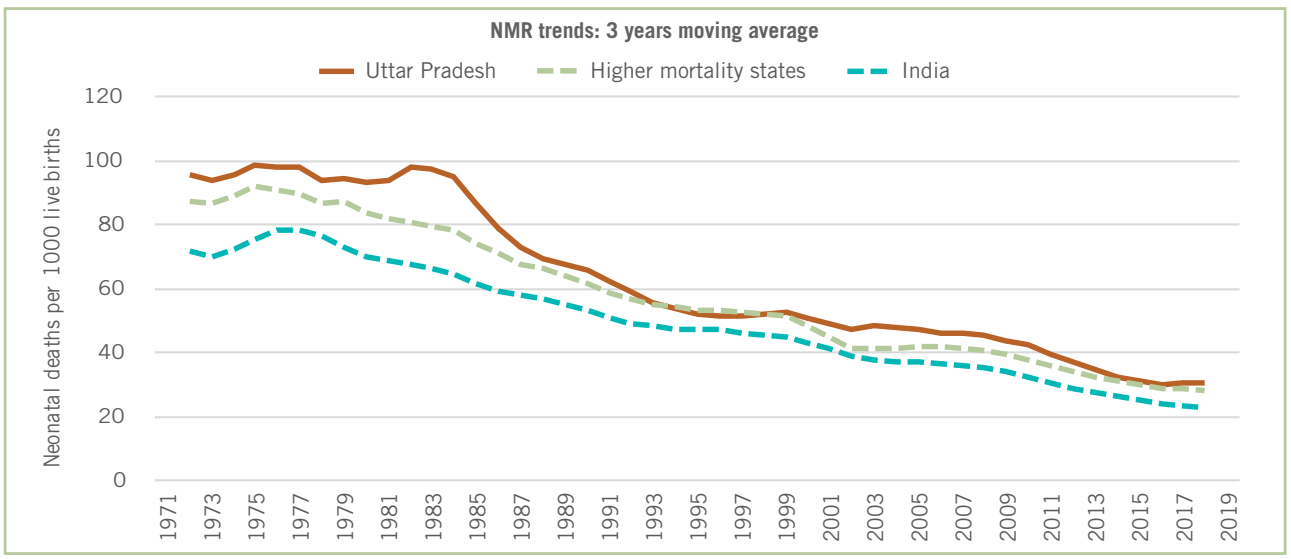


Table 2: Average annual rates of change (AARC) in MMR (1997-2018) and NMR (1971-2019), Uttar Pradesh, higher mortality state cluster and all India (SRS)

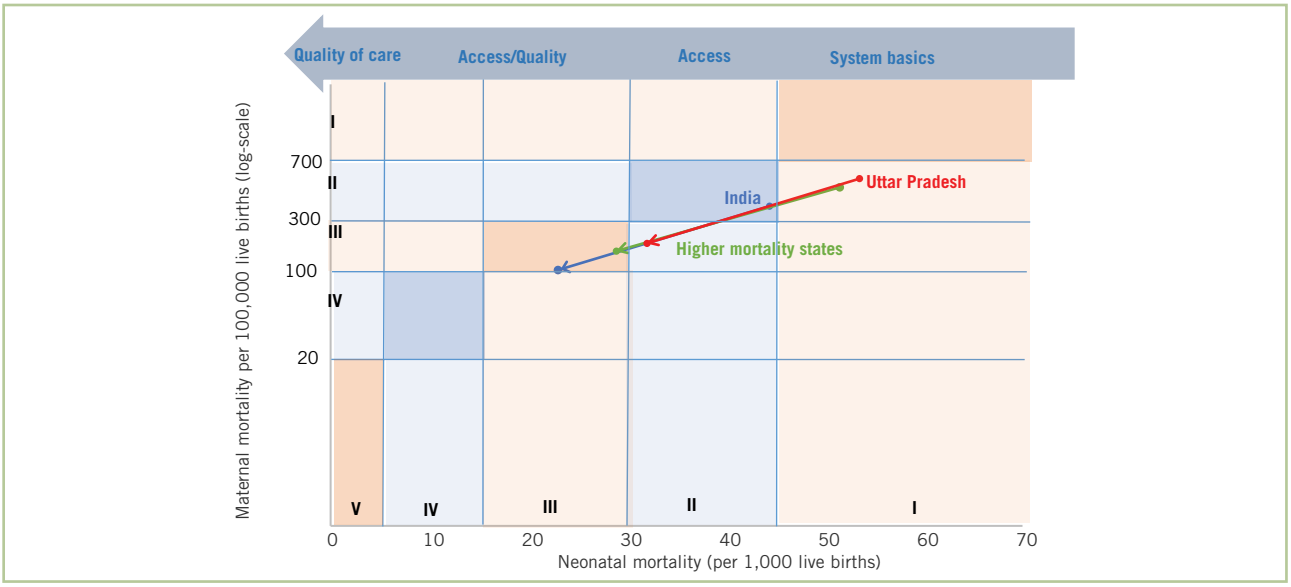
Policy period	Uttar Pradesh	Higher mortality states	India
AARC in MMR (%)			
1997-2005 (RCH I)	-4.6	-4.7	-6.4
2005-12 (RCH-II/NRHM)	-6.2	-6.0	-6.0
2012-18 (NHM/RMNCH+A)	-8.9	-8.8	-8.1
2000-18	-6.5	-6.4	-6.4
1997-2018 (Overall)	-6.4	-6.4	-6.8
AARC in NMR (%)			
1992-97 (CSSM)	-2.3	-1.2	-1.6
1997-2005 (RCH I)	-1.6	-3.1	-2.8
2005-12 (RCH-II/NRHM)	-2.9	-2.9	-3.4
2012-19 (NHM/RMNCH+A)	-3.0	-3.1	-3.9
2000-19	-3.0	-3.4	-3.7
1971-2019 (Overall)	-2.4	-2.7	-3.0

Maternal and neonatal mortality transition

Uttar Pradesh's success in reducing maternal and neonatal mortality is presented against a five-stage mortality transition model for maternal and neonatal mortality developed over the course of the Exemplars in MNH study (Figure 5). Stage I in this model indicates the highest levels of mortality, where access to services is extremely 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, health service 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 neonatal mortality, wherein mothers and newborns have universal access to high quality care and (almost) all preventable deaths are eliminated.

During 2000-18, 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 neonatal mortality by around 40% (Figure 5).

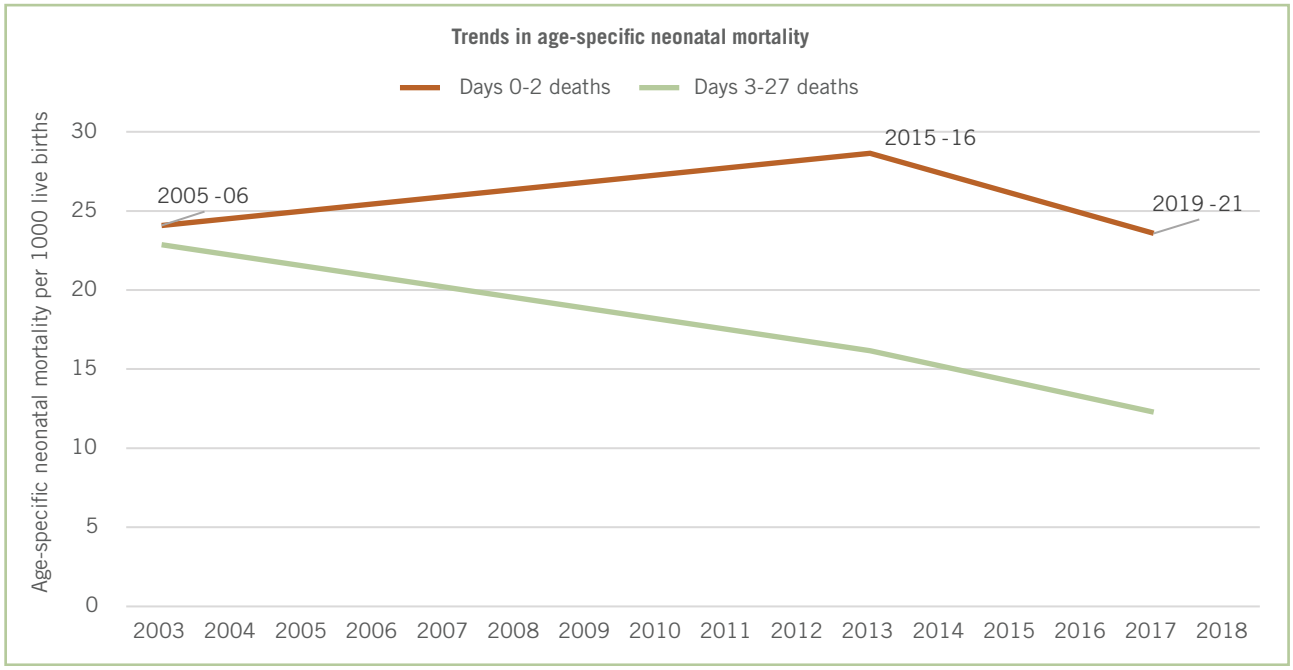
Figure 5: Mortality transition in Uttar Pradesh, higher mortality state cluster and all India (SRS 2000-18)

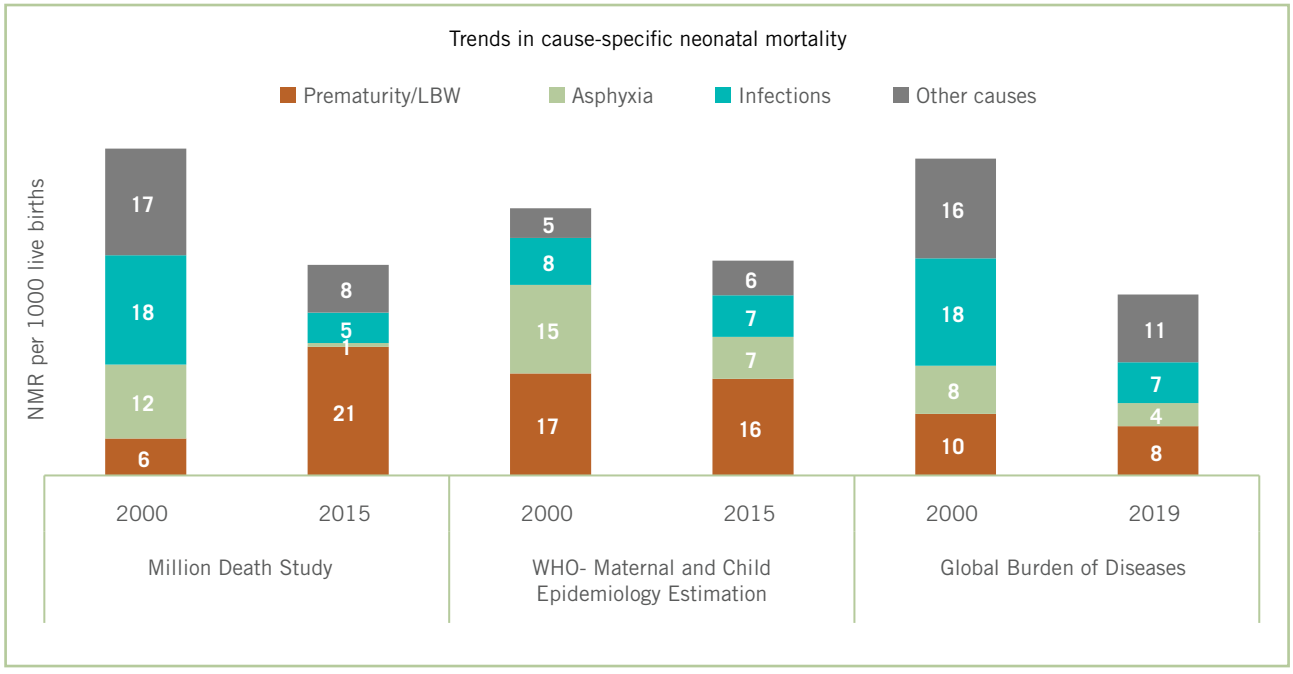


Age and cause-specific neonatal mortality

During 2003-18, Uttar Pradesh was successful in bringing down neonatal mortality on days 3 to 27, but experienced a very small decline in mortality on days 0-2 (Figure 6). Yet during 2013-18, the state recorded faster declines in neonatal mortality on days 0-2 (AARC of -4.9%, data not shown), indicating more recent improvements to intrapartum care and newborn's health status. The estimates from GBDS indicate that the state has recorded major declines in all leading causes with newborn infections including lower respiratory infections accounting for 49% of the total decline, birth asphyxia contributing 19% and preterm birth contributing another 9% to the total decline (Figure 6). A reduction in newborn infections including lower respiratory infections contributed most to the decline as per MDS and WHO/MCEE data as well. However, according to MDS data, there was an increase in neonatal mortality due to preterm births between 2000 and 2015.

Figure 6: Trends in age-specific neonatal mortality during 2013-18 (NFHS 2005-06, 2015-16 and 2019-21*) and cause-specific neonatal mortality during 2000-19 (global data 2000, 2015 and 2019), Uttar Pradesh



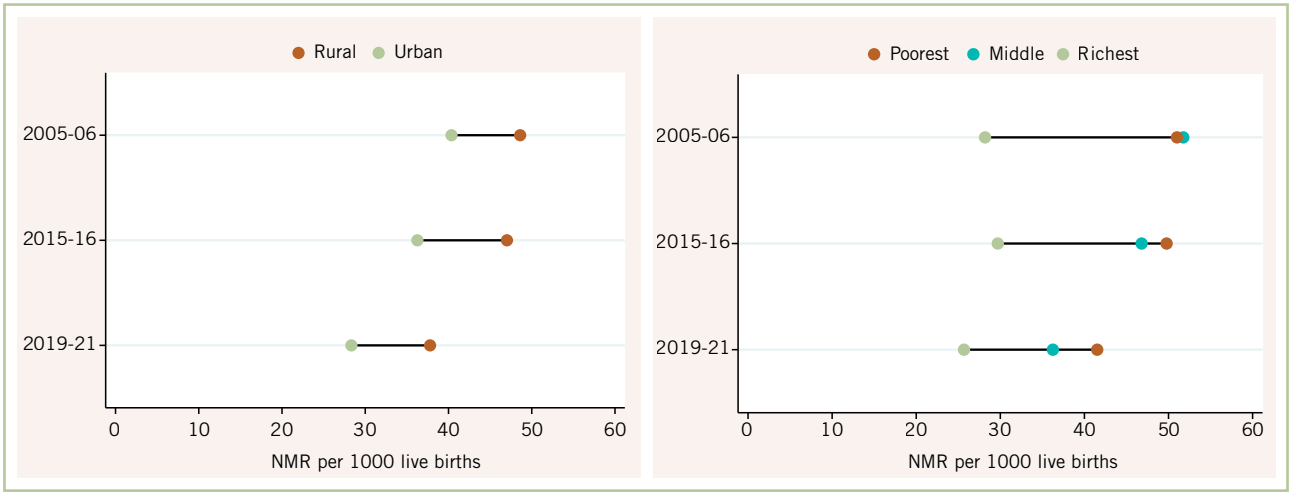


*We included mortality from births in the five years preceding each NFHS survey; we have taken the midpoint of this period as our data point hence NFHS 2019-21 provides data to 2018.

Equity in neonatal mortality

The NMR has reduced in both rural and urban areas, but the absolute difference between the rural and urban areas widened slightly. The state has succeeded only marginally in reducing the differences in NMR between household wealth tertile groups (Figure 7).

Figure 7: Trends in NMR by urban-rural residence and household wealth tertile, Uttar Pradesh (2005-06, 2015-16 and 2019-21)



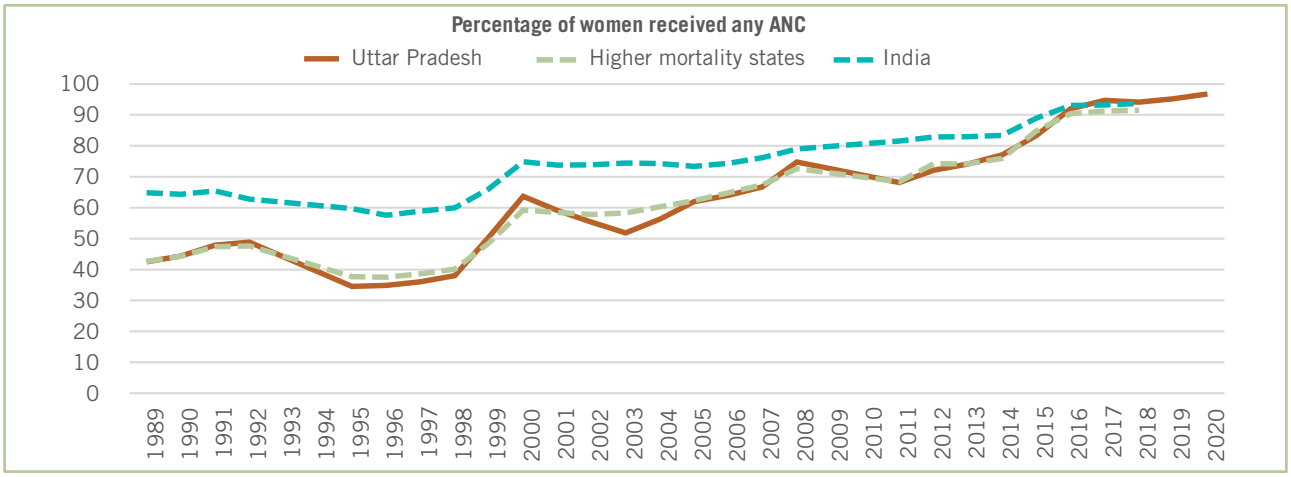
INTERVENTION COVERAGE AND EQUITY

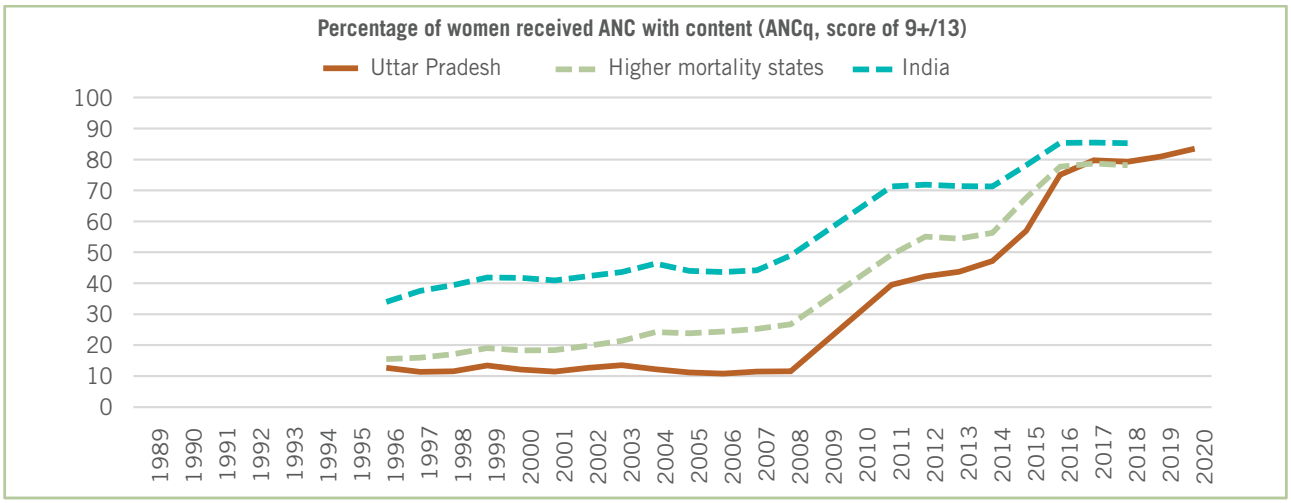
How did Uttar Pradesh achieve these major mortality reductions since 2000? In this section, we analyse the trends and equity in the coverage of key interventions in the state against the backdrop of the various national health policy periods.

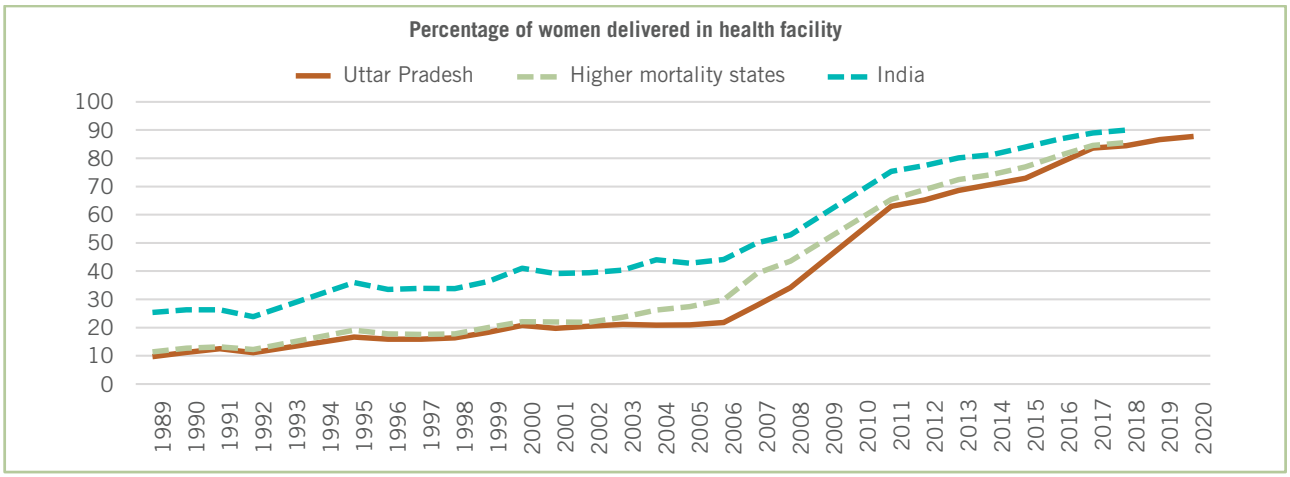
Antenatal and delivery care

The coverage of key interventions has improved in Uttar Pradesh according to pooled NFHS and DLHS data (Figure 8). The fastest increase in any ANC coverage was during the RCH-I period (1997-2005), whereas the coverage for ANC with contents and institutional delivery increased fastest during the RCH-II/NRHM period (2005-12), all reaching over 80% by 2020.

Figure 8: Trends in antenatal and delivery care coverage, Uttar Pradesh, higher mortality state cluster and all India (NFHS and DLHS pooled data, 1989-2020)

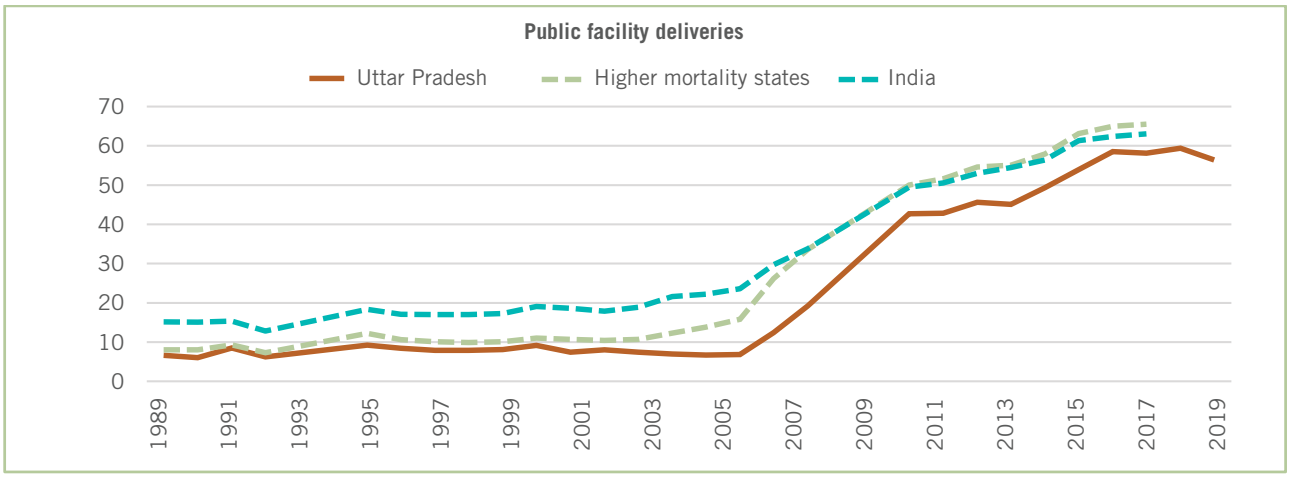


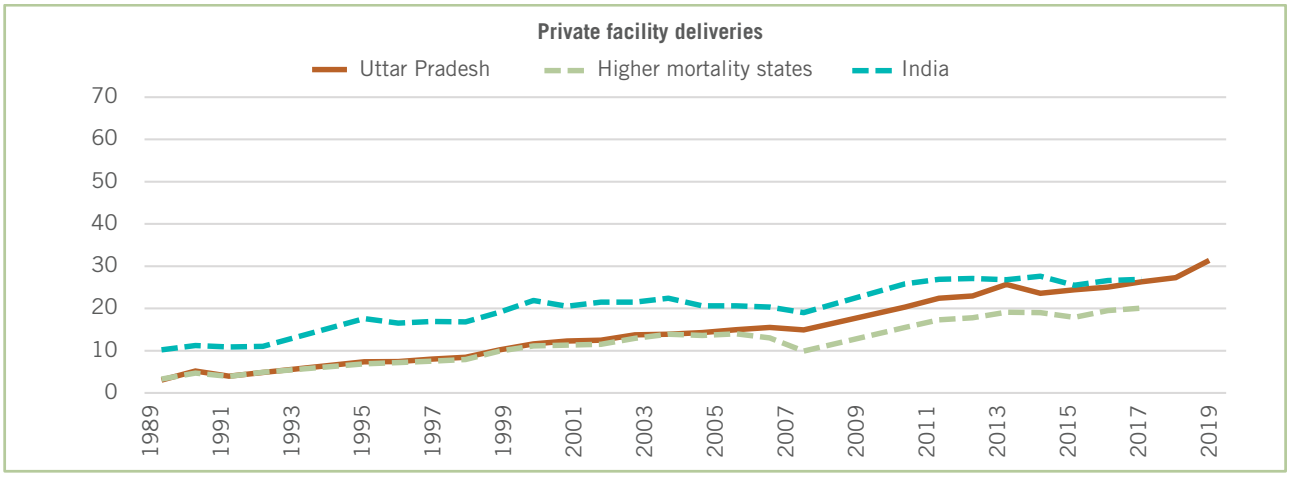




Increases in institutional deliveries were mainly driven by public facilities (Figure 9). The share of private facility deliveries to all institutional deliveries increased until 2006 (contributing about two-thirds of the institutional deliveries), but thereafter the share of public facilities increased substantially, reaching up to 68% in 2019. Nearly 90% of the increase in institutional deliveries was due to increases in public health facilities. The greatest increase in public facility deliveries was during the RCH-II/NRHM period (2005-12), with an AARC of 26.6% (data not shown).

Figure 9: Trends in public and private health facility deliveries among all deliveries, Uttar Pradesh, higher mortality state cluster and all India (NFHS and DLHS pooled data, 1989-2020)



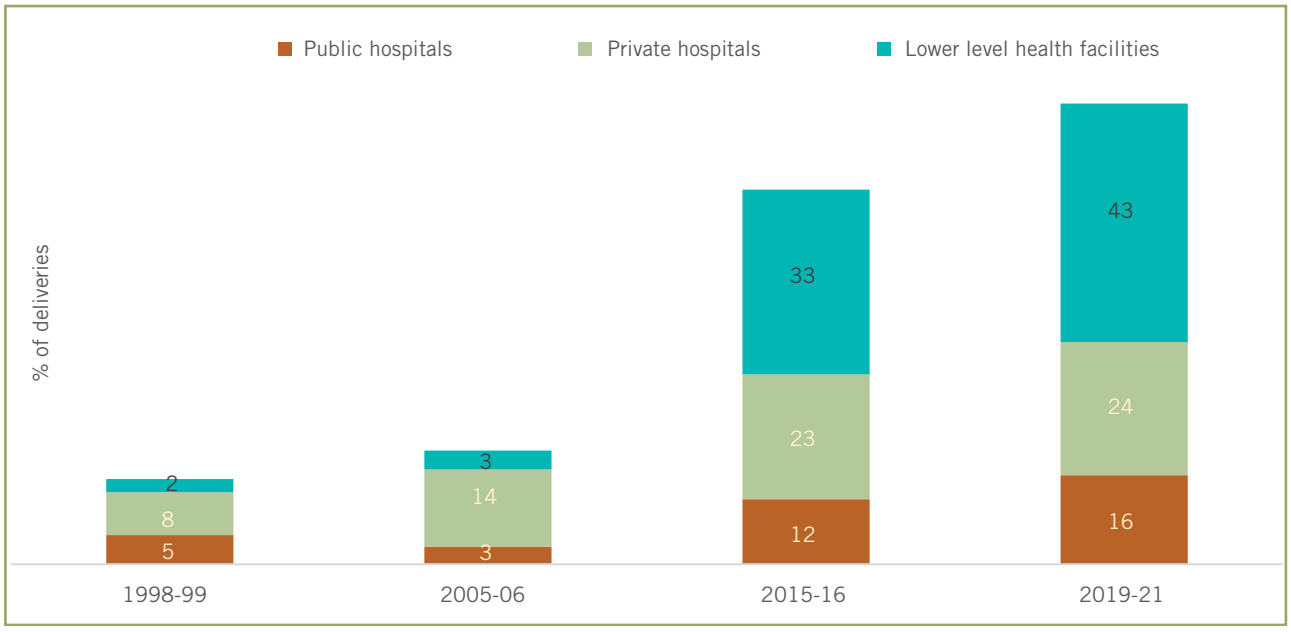


Uttar Pradesh's major increase in institutional delivery was possible because the rural and the poorest women were reached more over time, and disparities were reduced substantially (Figure 10).

Figure 10: Trends in institutional delivery by urban-rural residence and household wealth tertile, Uttar Pradesh (NFHS 1998-99, 2005-06, 2015-16 and 2019-21)

Since 2015-16, over 40% of all deliveries in Uttar Pradesh were conducted in lower-level health facilities (Figure 11). Hospital deliveries also tripled between 1998-99 and 2019-21 from 13% to 40% respectively. The national analysis indicated that NMR decline is strongly associated with increases in hospital deliveries (MNH Exemplar Study, National Report).

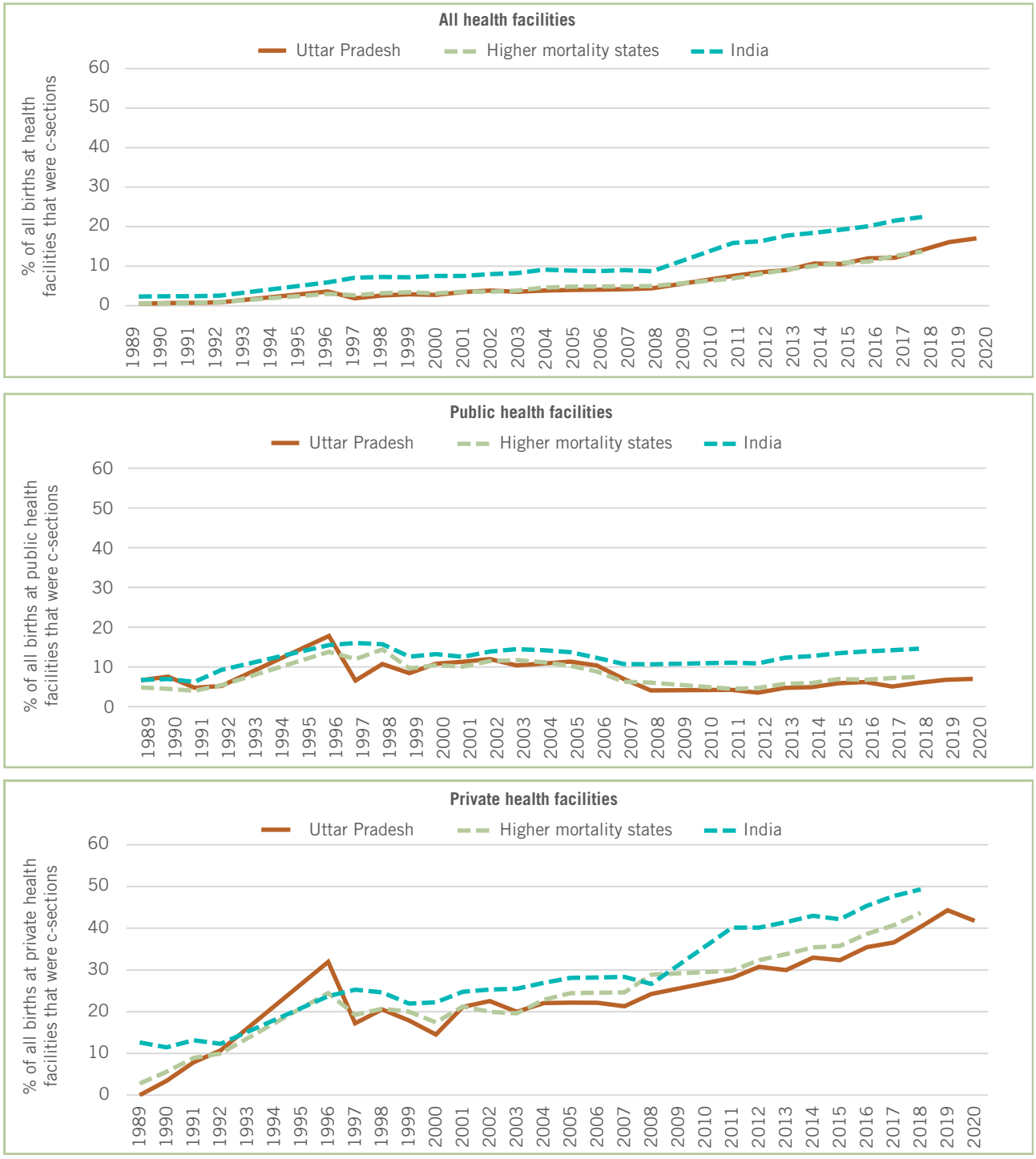
Figure 11: Trends in institutional delivery by health facility level, Uttar Pradesh (NFHS 1998-99, 2005-06, 2015-16 and 2019-21)



C-sections

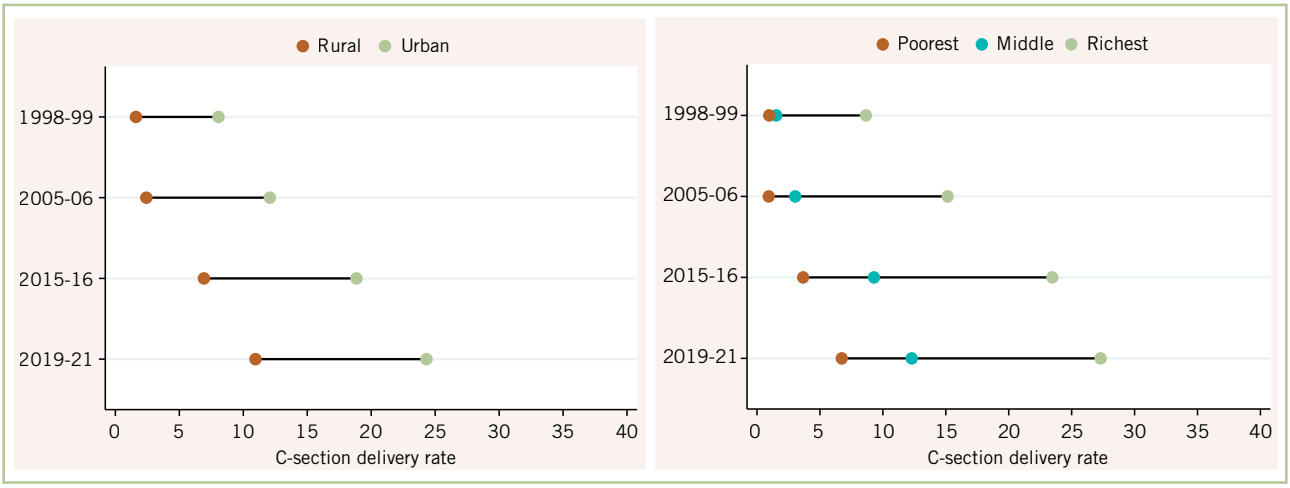
C-section rates have increased almost six-fold in Uttar Pradesh from about 3% in 2000 to 17% in 2020 (Figure 12). The greatest increase was in the RCH-II/NRHM period of 2005-12 (AARC of 10.8%, data not shown), which was primarily driven by increases in the c-section rates at private facilities (AARC of 4.7%). The share of private facilities in all c-section deliveries had reached 82% during the RCH-II/NRHM period. During this period, the c-section rate was five times as high among private facility deliveries as among public facility deliveries. The state has seen a considerable rise in c-section deliveries in the public health facilities in the recent years (2012-2020), faster than for all of India.

Figure 12: Trends in c-section delivery rates by health facility type, Uttar Pradesh, higher mortality state cluster and all India (NFHS and DLHS pooled data, 1989-2020)



About 10-15% of deliveries is considered an acceptable range for medically indicated c-sections.[12,13] By 2019-21, Uttar Pradesh recorded a seven-fold increase in c-section rates among rural women (reaching 11%) and among the poorest (reaching 7%), suggesting some persistent unmet need that must be addressed (Figure 13). C-section rates among the urban and the wealthy have tripled to 24% and 27% respectively, indicating over-use, particularly in the private sector.

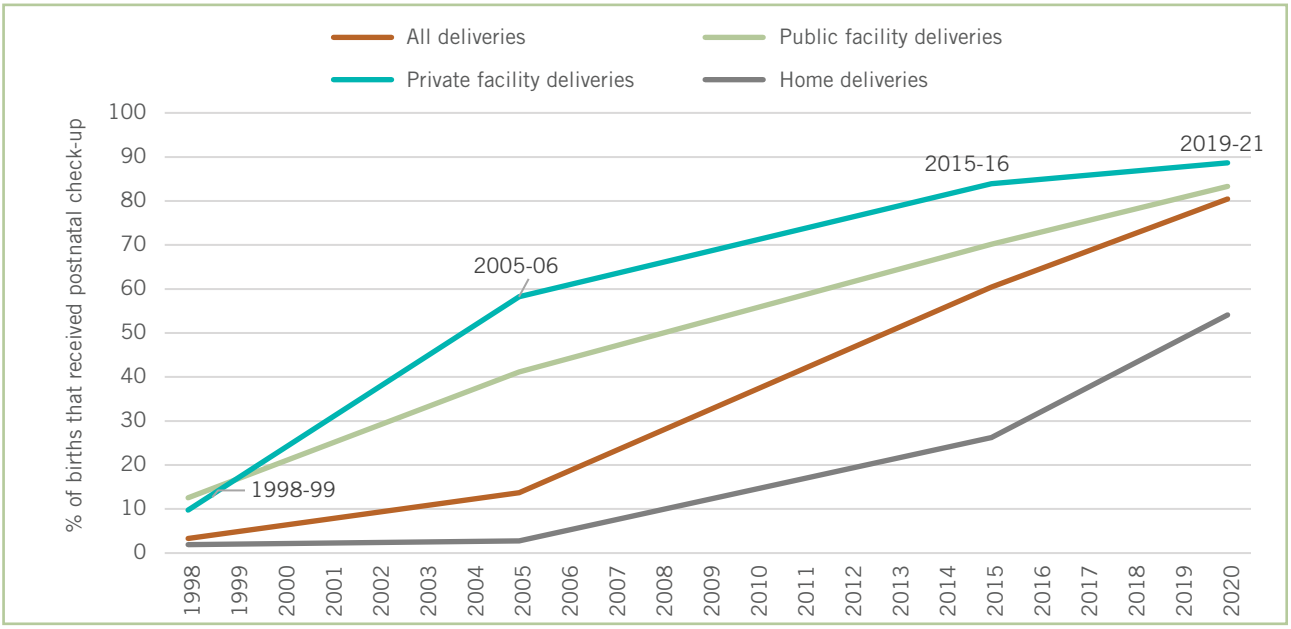
Figure 13: Trends in c-section delivery rates by urban-rural residence and household wealth tertile, Uttar Pradesh (NFHS 1998-99, 2005-06, 2015-16 and 2019-21)



Postnatal care and essential newborn care including early initiation of breastfeeding

Figure 14 presents the percentage of mothers and/or newborns in Uttar Pradesh who had a postnatal check-up within 48 hours of delivery, either in a health facility or at home by a trained professional such as a nurse, auxiliary nurse midwife (ANM), doctor or community health worker (Accredited Social Health Activist, ASHA). Coverage of any postnatal check-up (PNC) increased from 3% for births during 1998-99 to 81% for births during 2020-21. The PNC coverage in recent times has converged for women and newborns born in public and private health facilities, reaching 83% for those born in public facilities and 89% in private facilities. However, the coverage was lower for home deliveries at 54%.

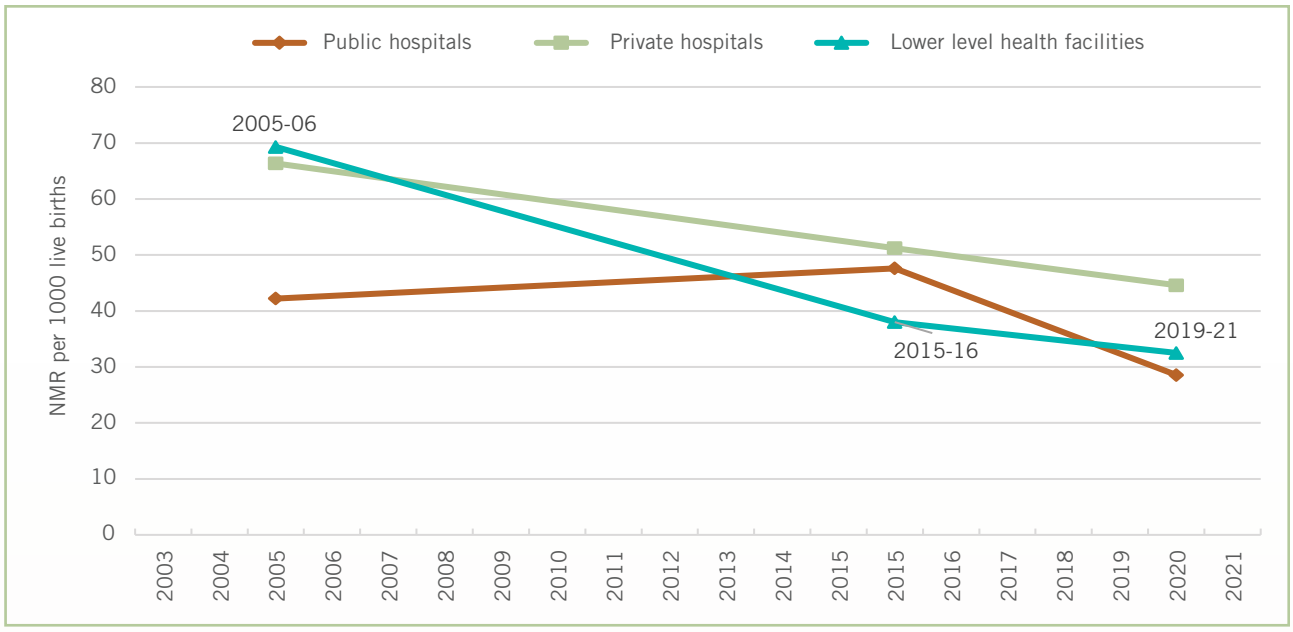
Figure 14: Postnatal care coverage for either the mother or the newborn within 0-2 days after delivery by place of delivery, Uttar Pradesh (NFHS 1998-99, 2005-06, 2015-16 and 2019-21)



NMR by place of delivery

During 2005-20, the NMR among institutional deliveries declined substantially in the state, more so among deliveries in lower-level health facilities than in hospitals (Figure 15) with AARC of -5.4% versus -2.8%, respectively, data not shown). The other health facilities include lower-level health facilities such as community health centres (CHCs), primary health centres (PHCs), health sub-centres (HSCs), and private non-hospitals. Although the NMR among private and public hospital deliveries declined at the same speed, mortality in 2020 was greater among private hospital deliveries (45 versus 29 per 1000 live births). It may be noted here that the samples for public hospital and lower health facility deliveries in 2005-06 were low. Thus, the observed changes in neonatal mortality in these birth locations between 2005-06 and 2015-16 are not statistically significant.

Figure 15: Trends in NMR among institutional deliveries by health facility level, Uttar Pradesh (NFHS 2005-06, 2015-16 and 2019-21)



DEMOGRAPHIC AND SOCIO-ECONOMIC CONTEXTUAL SHIFTS

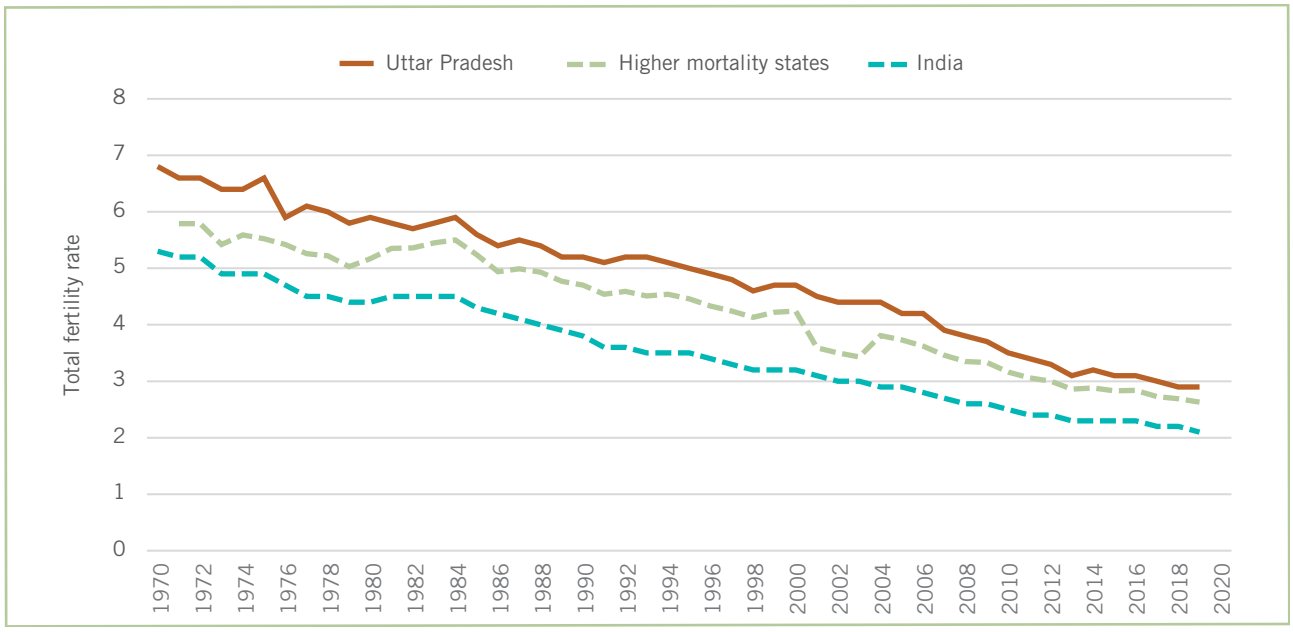
Household-level context

Fertility declines

The total fertility rate (TFR) in Uttar Pradesh has been declining from 5-6 children per woman during 1976-91 to less than 3 since 2018 (Figure 16). However, the total number of live births in the state increased slightly from 5.6 million in 2000 to 5.7 million in the 2018, due to the population momentum (data not shown). Since 2000, the state has consistently recorded slightly higher TFR levels than the higher mortality state cluster average. Fertility rates were overall higher in rural areas. However, the gap narrowed as the fertility rates declined faster in the rural than urban areas (data not shown).

Uttar Pradesh's fertility declines during 2000-18 contributed 42% and 55% of the maternal and newborn lives saved respectively, and 33% of the reductions in both MMR and NMR reductions, in our analyses using decomposition method[14] (data not shown).

Figure 16: Trends in total fertility rate, Uttar Pradesh, higher mortality state cluster and all India (SRS 1970-2019)

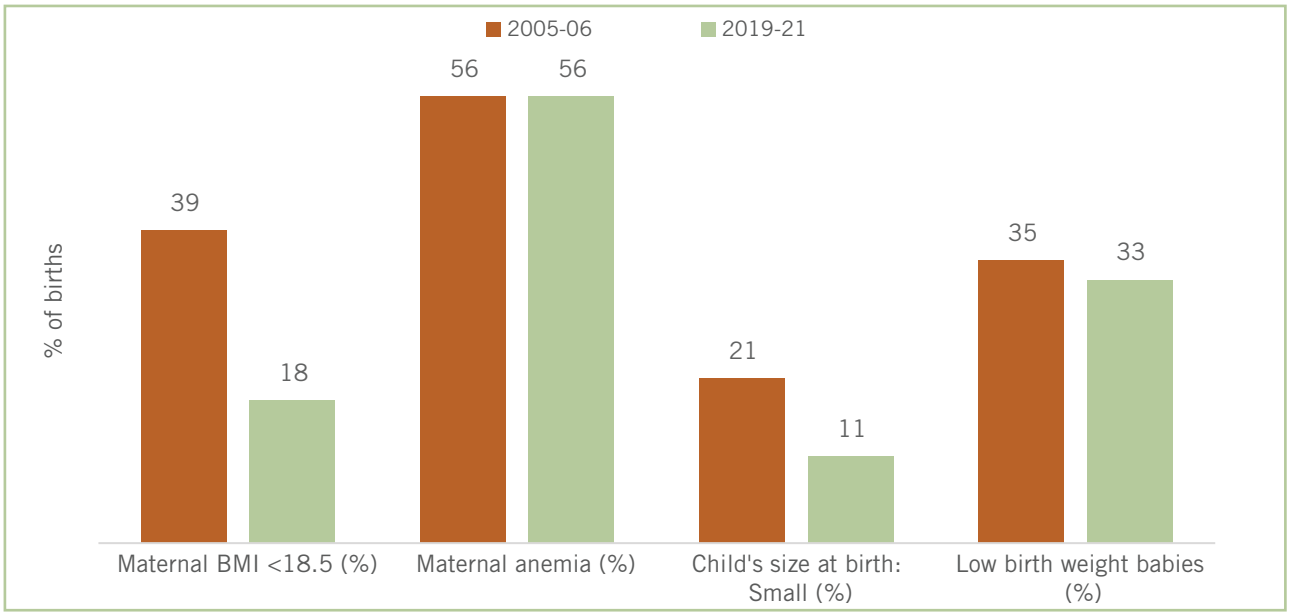


Nutritional status

Analysis of NFHS data showed that the proportion of births to women with a BMI lower than 18.5 (considered underweight) declined from 39% to 18% between 2005 and 2020 (Figure 17). The state did not observe any reduction in the proportion of women with anemia during the same period. Child's size at birth showed improvement; the proportion of women reporting that their newborn was small for gestational age declined

from 21% to 11% during the same period. However, the proportion of those reporting low-birth-weight babies showed only a two-percentage point decline, from 35% to 33%.

Figure 17: Trends in maternal nutrition, maternal anemia and reported child's size at birth and low birth weight babies, Uttar Pradesh (NFHS 2005-06 and 2019-21)



Women's empowerment and educational status

Age at first cohabitation (after marriage) in Uttar Pradesh has increased from a median of 17 to 19 years between 2005-06 and 2019-21 (Table 3). The increase was faster in rural than in urban areas, where it was higher in both the survey periods. The proportion of women with some education has also improved in this period, from 45% to 66% who were literate, and 34% to 60% who had secondary or higher education. The gaps also closed between rural and urban areas in female literacy rates and the proportion with secondary education, more so in case of the latter (the absolute difference in secondary education almost halved from 26 to 14 percentage points). Compared to births to women with some education, the NMR was higher among births to women with no education in both the survey periods, but also declined faster among the latter (data not shown).

In terms of decision-making roles, the proportion of women reporting that their husbands solely decided on their healthcare reduced from 22% to 16%, while those reporting joint decision-making with their husbands about their healthcare increased markedly from 37% to 74% between 2005-06 and 2019-21 (slightly higher in urban areas).

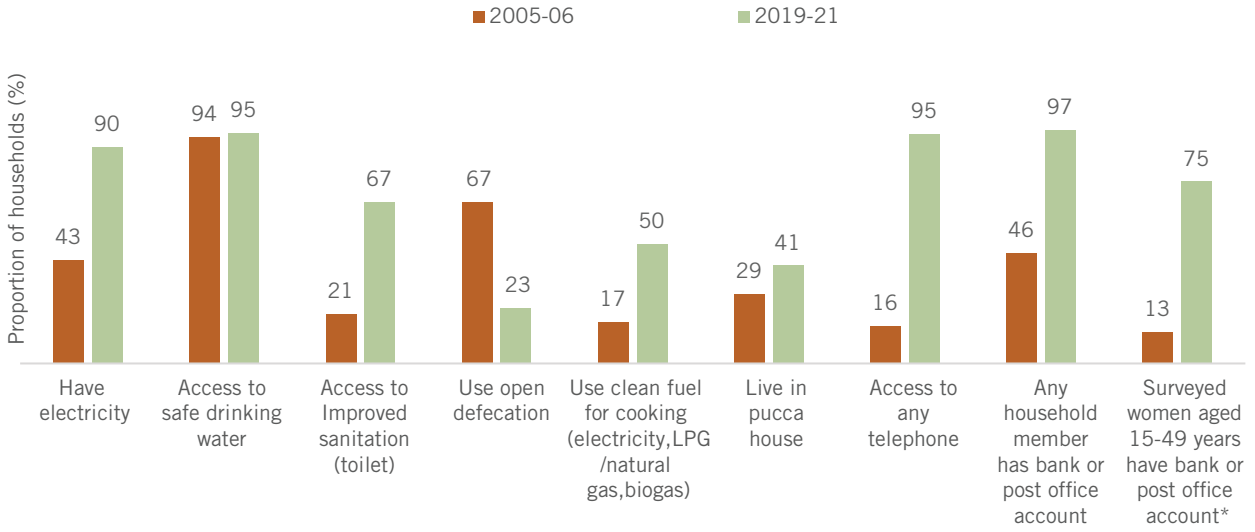
Table 3: Trends in selected indicators of women's empowerment, Uttar Pradesh overall and by place of residence (NFHS 2005-06 and 2019-21)

	Uttar Pradesh		Rural		Urban	
	2005-06	2019-21	2005-06	2019-21	2005-06	2019-21
Median age at first cohabitation among women aged 25-49 (in years)	16.9	18.7	16.6	18.4	18.2	19.7
Women aged 15-49 who are literate (%)	44.9	66.1	38.0	62.4	64.7	77.2
Women aged 15-49 with secondary or higher education (%)	34.2	60.3	27.5	56.8	53.5	70.5
Mainly husband decides on woman's health care (%)	21.8	16.2	22.2	16.9	20.7	13.9
Husband and wife jointly decides on woman's health care (%)	37.2	74.3	35.8	73.6	41.5	76.6

Community-level context

Households' access to basic amenities such as electricity, safe drinking water, improved sanitation, clean fuel for cooking, telephone/mobile and bank account has improved substantially in the state between 2005-06 and 2019-21 (Figure 18). Nearly 90% of the households now have electricity and 95% have access to safe drinking water. The percentage of households with access to improved sanitation more than tripled from 21% in 2005-06 to 67% in 2019-21. Concurrently, households reporting open defecation reduced markedly from 67% to 23%. Use of clean fuel for cooking nearly tripled from 17% in 2005-06 to 50% in 2019-21. Two-fifths of households now live in pucca houses and 95% have a telephone. The percentage of households reporting any member having a bank or post office account increased from 46% to 97% during the same period. The corresponding rise was even sharper for women aged 15-49 years (from 13% to 75%).

Figure 18: Trends in selected indicators of community development, Uttar Pradesh (NFHS 2005-06 and 2019-21)



* Percentage of womenaged 15-49 years having back/post office account is obtained among all women included in the state module.

Societal-level context

Economic growth and inequality reduction

Uttar Pradesh has experienced substantial economic growth in the past two decades. The per capita net state domestic product in Uttar Pradesh has risen rapidly, from INR 9,749 in 1999-2000 current prices[15] (which is equivalent to INR 33,670 when inflation adjusted to 2019 values[a]) to 65,704 in 2019-2020 (in 2019 INR).[16] However the state's Gini coefficient for consumption, a common measure of income inequality where 0 is perfect equality and 1 is total inequality, increased from 0.27 in 1994 to 0.31 in 2012.[17] The percentage of the population below the poverty line reduced from 41% in 2004-05 to 29% in 2011-12.[18] From 1998-99 to 2019-21, the state also experienced increased urbanization, with the proportion of the population living in urban areas increasing from 21% to 24%.

a The average annual rate of inflation for the period 2000-2020 is considered to be 6.47% (https://www.inflationtool.com/indian-rupee?amount=9749&year1=2000&year2=2020&frequency=yearly)

MAJOR HEALTH POLICY AND SYSTEMS DRIVERS

This section draws from consultations with policy experts, as well as policy and literature review, to present major health policies and health system drivers of improved maternal and newborn survival. We first present the state's efforts to increase MNH service availability and quality including (1) health care infrastructure and services, (2) human resources for health; (3) clinical and technical innovations and quality assurance; and (4) the role and regulation of the private sector. We then present the broader policy implementation and administrative reforms underpinning these changes to service availability and quality, including: (1) political will and leadership for MNH; (2) decentralized governance and financial flexibility; (3) accountability, progress review and data systems; (4) community participation and demand generation; and (5) partnerships.

Transitions in MNH service availability and access to quality

Expanding service availability, access, and integration

- The density of health sub-centres and primary health centres declined, but the density of community health centres increased in the state
- Janani Suraksha Yojana (JSY), the NRHM's conditional cash transfer program that incentivized institutional births for both the pregnant woman and the ASHA, drove a massive increase in facility deliveries in the mid-2000s
- Facility management systems in Uttar Pradesh were gradually strengthened to use NRHM funding to meet rising demand for institutional delivery
- The 108 and 102 emergency transportation system has been a major driver of improved access to facility-based healthcare
- Out of pocket expenditure for vaginal and c-section deliveries in the public sector remain unchanged

There was a steady increase in the density of community health centres until 2017, and a decline thereafter in Uttar Pradesh (Figure 19). The availability of rural health infrastructure in the state has been lower than the average among the higher mortality state cluster and for all India.

Figure 19: Trends in the density of health sub-centres, primary health centres and community health centres, per million population, Uttar Pradesh (Rural Health Statistics 1981-85 to 2019-20)

Improving access to care – both the facilities available and emergency transportation to reach facilities – was central to Uttar Pradesh's strategy. JSY, the NRHM's conditional cash transfer program that incentivized institutional births for both the pregnant woman and the ASHA, drove a massive increase in facility deliveries in the mid-2000s. This movement towards institutional delivery in Uttar Pradesh saw a major increase in deliveries at all levels of facilities. In the early period of the NRHM, facilities were overwhelmed.

> *Because lady doctors used to come to the meetings and they used to ask CMO [Chief Medical Office] also, 'What to do? We don't have gloves, we don't have instruments, we don't have table' […] Deliveries were multiplying. And ASHA was a really motivated force. […] They started coming in from 2006, and they started bringing deliveries… (Government health expert #2)*

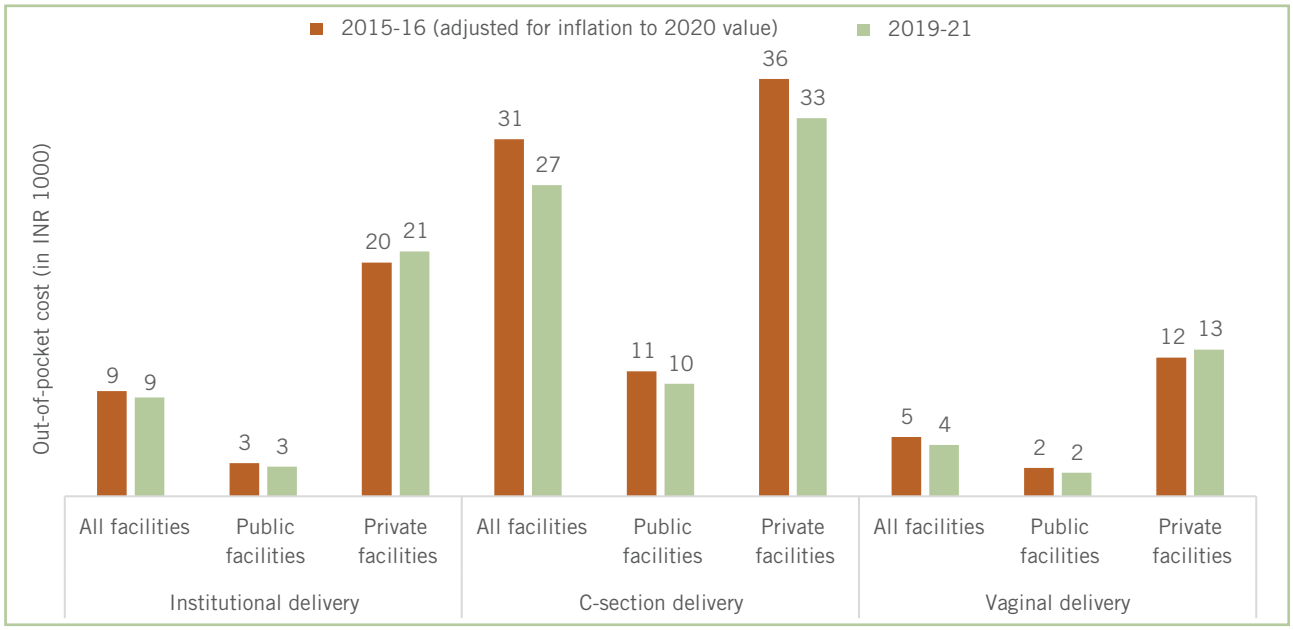
Over time, management systems were developed to use available NRHM funds and better handle the delivery volume. The state has pursued "infrastructure expansion" (Technical support organization #2) to meet the demand created by JSY. Uttar Pradesh planned for the expansion of first referral units (FRUs), although fewer than half achieved the intended functionality for comprehensive emergency obstetric and newborn care (CEmONC, or ability to offer blood transfusion and c-sections). Blood storage system were established at 100 FRUs.

Uttar Pradesh has developed Maternal and Child Health wings in each district, however experts noted that many lacked the human resources and equipment to fully function. The state has also developed Special Newborn Care Units (SNCUs) in almost every district since the initiative began in 2007 with the support of UNICEF. According to the experts, the lower level health facilities have been less successful in improving newborn care capacity.

In terms of emergency transportation, the introduction of the 102 and 108 ambulance services in 2012 "really improved our accessibility, from far flung areas" (Government health expert #1); this emergency transportation "was a great thing" (Government health expert #3).

Analysis of NFHS data suggests that the average out-of-pocket expenditure (OOPE) for delivery (including the OOPE for transport, hospital stay, drugs, diagnostics, and other) in Uttar Pradesh in constant 2020 rupees (i.e., 2015-16 cost adjusted for inflation to the 2020 value[b]) decreased marginally from Rs. 9131 to Rs. 8577 in 2019-21 (Figure 20). OOPE was 7-8 times higher in private than public facilities, and the increase from 2015-16 was 5% in private facilities. The average out-of-pocket costs paid for c-section deliveries were six times higher than that for a vaginal delivery, and the average costs for both vaginal and c-section deliveries in the state decreased by 13% each during 2015-16 and 2019-21. The was no change in the OOPE for public facility deliveries overall and vaginal deliveries specifically, and OOPE for c-section deliveries in the public sector declined.

Figure 20: Trends in average out-of-pocket cost (in INR 1000) paid for delivery by type of delivery and health facility type, Uttar Pradesh (NFHS 2015-16 and 2019-21)



Human resources for health

- Uttar Pradesh has implemented the centre's capacity building initiatives for health workers, with particular focus on in-service upgrade training for nurses and ANMs in basic emergency obstetric and newborn care, as well as post-partum haemorrhage training for doctors

b 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)

- Nurse mentoring started in Uttar Pradesh in 2014 in 25 high priority districts, and was scaled up to all 75 districts in 2019

Uttar Pradesh focused on capacity building, particularly for nurses and ANMs because they had a wider population impact than medical officers and specialists. Key capacity building exercises included the 21-day Skilled Birth Attendant (SBA) training, Integrated Management of Neonatal and Childhood Illness (IMNCI) training, Navjaat Shishu Suraksha Karyakaram (NSSK) training on neonatal resuscitation and essential newborn care, Daksh skill labs, Dakshata training, as well as a novel nurse mentoring initiative. Nurse mentoring and Dakshata were first implemented in Uttar Pradesh. Nurse mentoring was initiated in 2014 in 100 blocks of the state's 25 high-need districts by the Uttar Pradesh Technical Support Unit (UP TSU, implemented by University of Manitoba and India Health Action Trust and funded by Bill & Melinda Gates Foundation) and scaled up to all 75 districts after being found effective. After training a cadre of nurse mentors, these experts provided staff nurses in health facilities with hands-on labor room training (including on the use of the safe birth checklist) and supportive supervision. Dakshata, the national program, started in 2016 and provided three-day training in intrapartum and immediate post-partum and neonatal care to ANMs, doctors and nurses, followed by supplementary support in using the safe birth checklist.

Many doctors and specialists received a 24-week training in lifesaving anesthesia skills (LSAS), EmOC and post-partum hemorrhage (PPH) management. Regional Resource Training Centres (RRTCs) were set up to mentor FRUs and State Newborn Resource Centres (SNRCs) were set up to mentor SNCUs. These resource centres were composed of medical college faculty who provided on-site mentoring to specialists, doctors, and nurses.

The state made several policy changes to replace poor performing ANMs and ASHAs through new recruits and to increase rural recruitment and retention of medical specialists.

> *We had to hire better quality ANMs and ASHAs and we institutionalised a process of hiring them centrally, all the ANMs and probably in those 2-3 years at least when I was there, we hired not less than around 30-40,000 HR [human resources] in NHM. (Government health expert #1)*

Clinical/technical innovations, quality assurance, and procurement

- The state focused on improving ANC and the identification of high-risk pregnancies through Village Health and Nutrition Days for outreach care, training frontline workers and equipping them with blood pressure and hemoglobin measurement devices
- Uttar Pradesh developed a model of providing ANC at a fixed time each month in government facilities, with the support of private sector doctors, which the central government adapted into what is now Pradhan Mantri Surakshit Matritva Abhiyan
- Kangaroo mother care was scaled up across CHCs and district hospitals beginning in 2016
- 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 used to track women during referral
- Quality improvement efforts were supported by state's "quality division" consisting of divisional level quality consultants, district level quality consultants, hospital managers, and help desk managers
- Procurement has improved through the creation of the Uttar Pradesh Medical Supply Corporation (UPMSC) in 2018; equipment maintenance was strengthened through central management through one state-wide contract

Quality of ANC was improved in Uttar Pradesh, especially the identification of high-risk pregnancies through assessment of hemoglobin and blood pressure measurement. The ASHA program and development of Village Health and Nutrition Days bridged the gap between health services and communities. ANMs were supplied with hemoglobin monitors and electronic blood pressure instruments to help them identify high risk pregnancies. The state also created "Surakshit Matritva Saptah" or Safe Motherhood Weeks, which were later

adapted by the Government of India to become "Pradhan Mantri Surakshit Matritva Abhiyan" (PMSMA) or The Prime Minister's Safe Motherhood Program. Under PMSMA, women are offered antenatal care on a fixed day every month. Private sector doctors are brought into government facilities to support the program. Postpartum clinical innovation focused on ensuring the practice of kangaroo mother care in almost all CHCs and district hospitals.

The state's health system built a referral linkage system for high-risk pregnancies and intrapartum or postpartum emergencies, including PPH. Ambulance drivers were briefed on where to take high risk pregnancies, and increasingly were able to recognize requests for transportation from these patients because the woman's mobile number was linked with her pregnancy's risk status. When patients experienced emergencies such as PPH, they were transferred to the facility equipped to handle them. The new protocol required that the referral slip should be signed by the doctor who is on duty rather than the staff nurse. By requiring doctors to take responsibility for the transfer, more patients were transferred with intravenous drips in place, thereby reducing incidence of low volume shock during referral. The management of high-risk pregnancies and referrals was also strengthened through the creation of district team WhatsApp groups, wherein patients were tracked, and referral forms were shared.

The state focused extensively on intrapartum quality improvement since the NHM period, including through training health workers (discussed above) and implementing quality of care standards and protocols. Experts reported that Uttar Pradesh saw excellent coordination between NHM and medical colleges, in terms of implementing quality assurance protocols. LaQshya trainings were added, which built on the success of the earlier trainings.

> *Then LaQshya programme was brought in. That also helped. […] Everything combined, everything was combined and that I think helped in decreasing mortality. (Government health expert #3)*

The state developed a "quality division" with a human resource structure that included divisional level quality consultants, district level quality consultants, hospital managers, and help desk managers. Despite these efforts, quality of care remains an ongoing challenge, from the quality of ANC at the village health and nutrition days to hospital acquired infections, and to problems with the maternal death audit process, which is receiving ongoing attention.

The UPMSC was introduced in 2018 and rapidly improved the state's ability to "get the right medicines at the right time to the right place" (Government health expert #1). There remains a mix of local purchasing and central purchasing through the UPMSC. The state managed to improve medical equipment maintenance by putting out a tender for the entire state, and having all maintenance managed through that contract.

Role and regulation of private sector

- The state's private sector was not discussed as a major player in the state's progress on maternal and neonatal survival

Experts commented that "we have to see" whether the private sector will contribute to reducing maternal and newborn mortality in the state. With the arrival of the Ayushman Bharat national public health insurance fund, the role of the private sector may expand given that Ayushman Bharat insurance can be used at empaneled public or private hospitals. It is currently unclear whether the private sector will support the state's progress on MNH.

Policy implementation and administrative reforms

Political will and leadership for MNH

- State leaders showcased ownership and pride in their health programs, and were increasingly proactive in developing proposals and asking the centre for support
- Leaders were attentive to technical and programmatic issues, followed up on progress, and were open to collaborating with technical organizations such as USAID and BMGF
- The state government became very active in monitoring the districts and in turn the divisional program team developed strong supervision capacity
- Coordination between the administration and health officers was excellent

Maternal and neonatal survival in Uttar Pradesh were taken as a national priority; it was clear to leaders at the national level and in international organizations that India's progress was closely tied to Uttar Pradesh's progress. So "there was a silent understanding that Uttar Pradesh has to be helped and supported" (Government health expert #5). As a result, Uttar Pradesh was "flushed with funds" and "needed people with ideas and sub-programs so that we could use the money" (Government health expert #5). The state was therefore open to ideas and partnerships.

Experts reported that state-level government health actors showed ownership over and pride in their health system program and indicated that across all levels of the state health system there was top level political support for health initiatives. For example, the Chief Minister issued a letter to all Pradhans (local elected panchayat leaders) to attend a meeting organized by the Chief Secretary on improving ANC to identify and track all high-risk pregnancies. They were willing to push the central government for more support when they felt it was required. (However, experts felt that many medical officers and specialists lacked a similar sense of ownership.) Uttar Pradesh health system actors observed the beginning of a shift away from the central government "pushing" programs onto the state and towards the state "pulling" in support for their own programs. Under a push model, demands were placed on frontline health workers who were "exhausted" – which often led to health workers focusing more on reporting than actually performing, and programs "staggering" along (Government health expert #8). Under the pull model, "required" programs were being integrated and rolled out by frontline workers who had adequate support. This shift is incomplete, and lack of integration remains an issue. An example that experts provided was that screening programs may succeed in identifying cases for referral, but the system lacks the ability to care for those people who get referred.

Decision-making took an increasingly consultative approach, with technical groups engaged to present informed recommendations on tricky policy issues. Experts felt that there was a profound openness among government leaders to hear from and work with technical organizations such as USAID and BMGF.

> *In terms of leadership, […] I think first of all [a] very open, very very open, you know, approach. Both from administrative officials as well as technical, the technical leaders who are sitting here. So, as a partner if I go and I tell the GM [General Manager] child health that, okay, these are the issues with the SNCUs. Or if I go and tell the Mission Director, these are the issues, there is no defensiveness. So, the effort is to actually use that feedback and to improve. (Technical support partner #2)*

The state government became very active in monitoring the districts, checking the performance of PHCs and CHCs, and providing feedback to the district hospital and district medical officer. Senior leaders would visit and even spend the night at remote locations to understand "the gap" and develop ways to improve. Respondents reported that Uttar Pradesh developed strong supervision capacity among the divisional program team, and leadership capacity across all levels.

> *Leadership has been created at the state level, at the district level, at the block level and the hospital level, facility level. (Technical support organization #5)*

Coordination between the Uttar Pradesh administrative (led by an Indian Administrative Service officer) and technical (health secretary, General Manager and Deputy General Manager) arms was excellent. The administrative arm of Uttar Pradesh's government "would go out of the way to approve each and every proposal that we [technical officials] used to present" (Government health expert #5).

Decentralized governance and financial flexibility

- Uttar Pradesh's implementation of the NRHM's decentralization processes was made possible by the existence of strong divisional and district project management units
- After initially slow financial dispersal, Uttar Pradesh developed new financial management processes to use the NRHM funding to improve the capacity of health facilities to handle a higher case load, and to enable Village Health Sanitation and Nutrition Committees (VHSNCs) to spend their allocated untied funds
- The state implemented a partners' forum to manage the various development partners; these forums were eventually decentralized to the divisional level

Decentralization to the states (through project implementation plans, PIPs), districts, blocks, and facilities was strengthened through the NRHM, with guidance from the center. Decentralization enabled "planning at the root level" (Technical support organization #5). Uttar Pradesh increased District Magistrate involvement in health programming, including by involving them in health department meetings. Experts emphasized that UP had strong divisional project management units, which were already established when the district project management units were set up. District level management teams were able to tap into the strengths of these existing management teams.

Uttar Pradesh benefited from increased availability of funding for government health services and from improved financial management systems to use this funding effectively.

> *If you didn't have enough funds and if you had systems, you still wouldn't achieve the results. So, you needed the money, so the money was important. But having the funds without systems, again, wouldn't have done the deal. It's not one or the other, it is both. So having the right amount of funds and having the right system, to be able to use those funds optimally. (Technical support organization #2)*

It took Uttar Pradesh several years to develop new financial management processes to use the NRHM funding for health facilities and for VHSNCs. After JSY and then JSSK were introduced, health facilities were overwhelmed by demand but were unable to access the funding they needed. The money available through JSY and then JSSK was going to the Chief Medical Officers not to the Chief Medical Superintendents of District Hospitals, who were responsible for district hospitals. Experts reported that coordination between these two actors was often poor. Thus, Chief Medical Superintendents had no direct access to the funding they needed to improve district hospital capacity to cope with rapid increased demand, and instead had to ask the Chief Medical Officer for funds. Over time, Uttar Pradesh introduced financial flexibility that enabled Medical Officers In-Charge, Chief Medical Officers and Chief Medical Superintendents to each access and allocate funds based on local need.

> *Most importantly in my opinion was also a change in the financial management in Uttar Pradesh. We unleashed the NHM fund by allowing the flexi-pool to be used as a flexi pool. Which gave our MOICs and our CMOs and CMS a lot of flexibility to use the funds that they had. (Government health expert #1)*

For the first three to four years of the NRHM (approximately 2005-2010), the untied fund allocated to VHSNCs was not used; the Rs. 10,000 went to the Pradhan's account and was not spent by the Committee. The government strengthened facility and community level financial management to enable available money to be used. For example, funding was placed directly under the Chief Medical Superintendents to buy supplies for the facility. The VHSNC funding could be accessed through the Pradhan and ANM as joint signatories. It was ultimately possible for the government to put these new facility and community level financial management processes in place because of flexibility in the NRHM's governance and local state bodies.

We had to struggle very hard to put in systems. How could they utilise that money? How ASHAs could get money? And the result is that we had to change everything. […] We had to invent things and we had to invent processes and we had to put in. That was very easy because the flexibility was there with governing body and local state bodies. (Government health expert #2)

That was changed when JSSK came. And we had to put in so many guidelines for district and invent guidelines on day-to-day basis. And that was done, I think. (Technical support organization #4)

Management of development partners took place through a state-led health partners' forum; this process was decentralized to the divisional partners' forum.

Accountability, progress review and data systems

- Supervision and monitoring across the health system increased, particularly in-depth review of district progress by state-level leaders
- District Magistrates and technical partners were brought together by the District Health Society for regular progress review meetings
- 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 the Mother-Child Tracking Systems (MCTS), which then was updated to the Reproductive and Child Health (RCH) portal for regular review by decision-makers through dashboards
- Maternal deaths reviews were initiated, although experts speculated that only about 35% of maternal deaths are captured by them
- The NHM's financial flexibility enabled Medical Officers In-Charge (MO-IC), Chief Medical Officers (CMOs), and Chief Medical Superintendents (CMSs) to allocate funds based on local needs

Supervision and monitoring have improved from the state to the district to the block level. The state government also showed excellent preparedness for the Common Review Missions (CRMs) and Joint Review Missions (JRMs) that took place in Uttar Pradesh. While district and block leaders gained capacity in running review meetings, the largest change in monitoring came from the state to the district level. As mentioned above, state level health system actors would visit districts, convene meetings with district and division experts, and survey PHCs and CHCs. Findings from observations during site visits and analysis of data were discussed with the district hospital leads and district medical officer to motivate them and push for improvement.

…This is the reporting data, and this is the fact data, which we have observed in the district. That is a very effective monitoring and supervision at the district level. And it has given a very good thrust to the working officer at the district level, as well as the program implementer, what we have given the guidelines, what is going on in the field. (Government health expert #8)

These District Health Society (DHS) meetings became regular and were attended by District Magistrates (DMs) as well as technical partners, who were asked to share information on gaps and propose solutions.

The DMs are taking interest, and if partners go to them, you know, a lot of times the onus is now on the partners to be really ready with the right kind of information to help the administrative officials or the technocrats to take corrective measures. (Technical support organization #2)

Uttar Pradesh took a data-driven approach wherein interventions were developed after some amount of data analysis and assessment of evidence. Digital apps (such as the ASHA app) enabled each ASHA and high-risk pregnancy to be tracked. While these apps enabled managers to look into "granular details" they were particularly useful because they condensed data into dashboards (Government health expert #1). Once dashboards were developed in 2015, the state health system leadership institutionalized regular dashboard reviews. These reviews enabled rapid identification of problematic outliers, leading to problem solving.

And that [dashboard data review] had its own impact because then we could reach those CHCs which we probably would have left out. We could see, okay, in this particular district if we have 20 CHCs, 8 were supposed to be FRUs, but no institutional delivery is happening in 1. Now why? There was a doctor who was there, a gynae was there, there was a paediatrician who was in another CHC. They were not both put together. The moment you put them together it starts working. (Government health expert #1)

The state shifted from MCTS to the RCH Portal and increased its focus on data completeness. SNCU data and delivery room data are increasingly being digitized, integrated and monitored to assess the quality of care provided. The support division, which manages Uttar Pradesh's data systems (HMIS, MIS), "plays a role because whatever we are doing, if we are not seeing the result in terms of indicators, we are not able to see whether we are moving ahead or not" (Government health expert #7).
Experts reported that Uttar Pradesh's maternal death reviews are functioning, although they continued to take a punishment-oriented approach and capture only about 35% of the maternal deaths occurring in the state. Child death reviews are being started in many districts.

Community participation and demand generation

- Empowering the ANMs and ASHAs through additional training, reaching women through Village Health and Nutrition Days, and engaging communities through VHSNCs, all built community trust in the health system; together with JSY these interventions drove rapid increase in demand for maternal health services
- ASHAs were able to be effective because of supervision and support put in place for them through block and district community process managers, and online payment systems

ASHAs and ANMs were widely considered the central drivers of success for the state: "I think the biggest intervention which happened was, empowering the ANMs and the ASHAs" (Government health expert #1). The complementary roles of these two health functionaries were essential to increasing access to and uptake of basic maternal and child health care services.

What actually revolutionised the impact was the complementary role of ASHA and ANM. If you remove this, we virtually have nothing to show. (Technical support organization #5)

[…] The community mobilisation and the awareness creation, it is the key area where actually NHM worked. (Government health expert #7)

Everyone has spoken about ASHAs. And really they have, they have been the key driver whether it is maternal health, whether it is newborn health. (Lead in a technical support organization #2)

ASHAs and the JSY conditional cash transfer were vital to maternal and newborn survival because they reduced "delay one", i.e., the delay in seeking care from the home: "But the great moment came when JSY and ASHAs came. Because that was a turning point." (Government health expert #2).

The single most important thing that has driven the fall in the maternal mortality ratio, I feel, is the improvement in institutional delivery rates, which in turn I think, there are two reasons I would say to that, broadly one is the implementation of JSY, and there has been a lot of accountability-setting that has happened on the implementation of JSY from the early days. (Lead in a technical support organization #2)

One expert noted that the ASHA's positive impact was facilitated by Uttar Pradesh's "excellent" supervisory structure for the ASHA program, consisting of block community process managers (BCPMs) and district community process managers (DCPMs), and the online ASHA payment and verification system that has been implemented (Lead in technical support organization #2).

Village Health and Nutrition Days, led by the ANM and supported by the ASHA, were a foundational "outreach platform" (Technical organization #2) that brought services to the villages and encouraged greater uptake of ANC. While the implementation of VHNDs has been imperfect, the government pushed to update guidelines for this program starting in 2013 and has put a system for supportive supervision in place.

And I am not saying it [VHND} is perfect, uh, but we are at a level where at least the availability of equipment, of the logistics has remarkably increased. (Technical support organization #2)

As ANM, ASHA and nurse skills improved due to SBA training, IMNCI training and NSSK training, community trust has increased. The state also increasingly communicated with the people about the programs available to them. Trust in the health system and awareness of the available services was also strengthened in communities because of concurrent initiatives such as Mission Parivaar Vikas (MPV) and Sehat Sandesh Vahini (SSV). Home based newborn care was also recognized as a likely contributor to Uttar Pradesh's reduction in days three to 28 newborn mortality. Now 80% of newborns are visited. The creation of Village Health and Nutrition Committees and Rogi Kalyan Samiti [RKS, hospital management committees] also were said to have brought "small but important changes" (Technical support organization #5).

Partnerships

- The central government supported Uttar Pradesh with technical advice, guidance, programs, and protocols
- Numerous state-level initiatives strengthened the Uttar Pradesh health system, including the State Innovations in Family Planning Services Project Agency (SIFPSA), a capacity building initiative for family planning, the Uttar Pradesh Health System Strengthening Initiative, and the Uttar Pradesh Technical Support Unit (UP TSU)
- State medical colleges trained medical officers in LSAS and CEmOC and supported ASHAs' home-based newborn care (HBNC)
- Professional bodies, particularly the Neonatology Forum (NNF), the Uttar Pradesh chapter of the Federation of Obstetric and Gynaecological Societies of India (FOGSI), and the Indian Academy of Pediatrics (IAP) supported the state's progress
- Development partners were discussed extensively for their contributions, particularly BMGF, the World Bank, and UNICEF; the state managed these partners through regular partner forum meetings and by having partners "pool resources" to avoid duplicate or vertical programs

Partnerships with the centre, within the state, and with international organizations were emphasized as valuable to Uttar Pradesh's success.

I think openness and communication with your partners, is a very very valuable tool. Absolutely essential practice. (Government health expert #5)

[An] important input was identification of the stakeholders, identifying them, bringing them together, empowering them through knowledge, through resources, and through need for actually bringing all the stakeholders together for an objective change at the grassroots level so that the services could be availed and is accessible, and quality is improved. (Technical support organization #5)

Uttar Pradesh received vital support from the central government. Technical experts in Delhi supported the state's efforts to modernize labour rooms, develop the Surakshit Matritva Saptah and numerous other programs.

State medical colleges (including King George's Medical University and Queen Mary) were valued partners to the state government in providing LSAS, EMoC and PPH training for medical officers supporting home based newborn care training for ASHAs, and providing the technical expertise as Regional Resource Training Centres and State Newborn Resource Centres.

Definitely as [Government health expert #1] said, the involvement of medical colleges and the linking and integration of the public health doctors with the medical college faculty - that was a real game changer I would say. Medical college faculty had never visited these public health facilities; they never knew that these doctors are working in such adverse environment. So that linkage came, and it really worked. Now from four medical colleges we started, we came to eight and now we are across 75 districts with 16 medical colleges, sir. So, this is the ownership which actually the medical college people have taken over. (Lead in a technical support organization #1)

Professional bodies, particularly the Neonatology Forum (NNF), the Uttar Pradesh chapter of the Federation of Obstetric and Gynaecological Societies of India (FOGSI), and the IAP supported the state's progress.

Also at the state level, the SIFPSA capacity building initiative for family planning, the UP-Health System Strengthening Initiative, and the UP TSU all made major contributions to the state's progress. Since it was established in 2014, experts indicated that analysts from the UP TSU would continually bring information and suggestions to the Mission Director, and the Mission Director was "open enough to listen to them" (Government health expert #5). The UP TSU was emphasized as making important contributions particularly because of its ability to work in "an embedded manner" with the state government (Lead in a technical support organization #1).

International development partners were discussed extensively by the experts, particularly the World Bank', UNICEF, BMGF, Jhpiego, the European Commission, UK Health System Development Project (HSDP), and the State Innovations in Family Planning Services Project Agency (SIFPSA). In the NRHM period, the World Bank worked on a health system strengthening program. UNICEF was noted for conveying an ethos that improving indicators at scale requires "building a team" and "working at the granular level" (Government health expert #5). UNICEF supported IMNCI and NSSK training and the development of SNCUs. Jhpiego developed an "entire program on nurses' education, training" which had a "lot of positive outcomes" (Government health expert #5). BMGF was recognized as a partner in the Regional Resource Training Centres (RRTCs), for coordinating all the partners to ensure they were working effectively, and for supporting the development of the UP TSU in 2014.

> *We were lucky to have many partners in Uttar Pradesh. All partners were working on this field and MCH was everybody's priority. [..] We had an all partner forum at the state level, led by MD, and we used to have regular meetings, monthly, two monthly, and BMGF used to lead those meetings. […] And by organising that meeting, all those partners were made to contribute one way or the other. (Government health expert #2)*

One feature of UP's successful engagement with international partners was the state's ability to "pool resources" to avoid duplicate or vertical programs (Technical support organization #5).

> *We had many parallel programmes. European Commission programmes, UK-HSDP programme was there, HIV programme was there. So, a conscience effort was made to actually integrate and pool the resources, so that the vertical separations and those convergences were not being brought about, they were brought about, through this programme. The important aspect of goal setting, objectives, and what are the inputs that are needed to achieve those goals, that was important. (Government health expert #4)*

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

IMPLICATIONS FOR STRATEGIC PLANNING

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.

Comparing Uttar Pradesh's indicators at stage III (2017) against the median values for India's low mortality states in 2017 (Table 4) highlights the following key policy considerations:

- Moving towards India's lower mortality state (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 (3.0 versus 1.7), suggesting that substantial gains in survival could be achieved through continued fertility reduction including through family planning
- Uttar Pradesh needs to substantially expand access to 4+ ANC visits (43% versus 75% LMS), 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
- The institutional delivery rate in rural areas 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 the c-section rate 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)

Table 4: Summary of key indicators in 2000 and 2017 for Uttar Pradesh, and common characteristics of lower mortality states and countries in stage IV in 2017

Indicator	Uttar Pradesh		Lower mortality state cluster stage IV values, 2017	Median values for countries in stage IV, 2017
Year	2000	2017		
Stage	I	III		
Mortality				
Maternal mortality per 100,000 LB (SRS 2000-18)	539	167	73	43
Neonatal mortality per 1,000 LB (SRS 2000-18)	54	32	16	9
Neonatal mortality, home births (NFHS 2005-06 and 2019-21)	43	39	33	NA
Stillbirth rate per 1,000 births (SRS)	7	3	5	9
Cause pattern (neonatal) (MCEE 2000 & 2015)				
Infections (Group 1)	31	22	21	14
Health status[1] (Group 2)	35	53	57	70
Peri-partum (Group 3)	34	26	22	17
Fertility (SRS)				
Total fertility rate	4.7	3	1.7	2.2
Adolescent fertility (per 1000)	41	8	15	44
Coverage of interventions (NFHS+DLHS)				
ANC four or more visits (%)	9	43	75	89
Delivery in health facility (%)	21	84	96	95
Delivery in hospital (%)	16	40	71	78
C-sections (%)	3	12	34	26
Inequalities				
Neonatal mortality poor-rich gap (abs) (NFHS 2005-06 and 2019-21)	29	16	18	7
Delivery care, rural (%) (NFHS+DLHS)	16	83	95	91
Delivery care, poor-rich gap (abs) (NFHS 2005-06 and 2019-21)	-54	-18	-12	-12
C-section, poorest quintile (%) (NFHS 2005-06 and 2019-21)	1	5	15	17

[1] Includes prematurity, small for gestational age and congenital anomalies.
NA: Not available.

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