

Improvements in Essential Newborn Care and Newborn Resuscitation Services Following a Capacity Building and Quality Improvement Program in Three Districts of Uttar Pradesh, India

Manoja Kumar Das, Chetna Chaudhary, Sadhu Charan Mohapatra¹, Vinod Kumar Srivastava², Najam Khaliq³, Santosh Kumar Kaushal⁴, Rajesh Khanna⁴, Surojit Chatterji⁵

The INCLEN Trust International, New Delhi, ¹Department of Community Medicine, SGT University, ²Save the Children, Gurgaon, Haryana, ³Department of Community Medicine, Hind Institute of Medical Sciences, ⁴Save the Children, Lucknow, ⁵Department of Community Medicine, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

Abstract

Background: Neonatal death remains a global challenge contributing to 45% of underfive deaths. With rising institutional delivery, to accelerate decline in neonatal mortality rate (NMR) improvement in the quality of perinatal care requires attention. **Objectives:** This implementation research targeted improving service delivery readiness for quality of newborn care at public health facilities in three districts of Uttar Pradesh, India, with high NMR. **Materials and Methods:** This before-after study assessed the facility readiness and quality of newborn services at 42 health facilities. The changes in 26 signal functions for routine and emergency obstetric and newborn care were tracked. **Results:** There was marked improvement in newborn service availability: skilled birth attendants (51%), resuscitation (30%), and kangaroo mother care (27%) at these facilities. A multifold rise in newborn resuscitation efforts and documentation ($n = 4431$ vs. $n = 144$ in preintervention period) with high success rate (98.6%) was observed. There was also improvement in obstetric care services including partograph use (31%) and active management of third stage of labor (46%). However, several infrastructural indicators (electricity, water supply, toilets, and sanitation) remained unchanged. **Conclusion:** Overall improvements were observed in the majority of the signal functions for perinatal care and newborn resuscitation efforts. There was a limited impact on the infrastructural and supervision components.

Keywords: Capacity building, newborn care, quality of care, resuscitation

INTRODUCTION

worldwide, 2.7 million infants die in the neonatal period, with almost 1 million neonatal deaths on the day of birth, and close to 2 million in the 1st week of life.^[1] Significant progress has been made globally in improving child survival with the underfive mortality rate during 1990 and 2015.^[2] However, the global decline in neonatal mortality from 1990 to 2015 has been slower than that of postneonatal mortality: 47 points compared with 58 points.^[2,3] Neonatal deaths account for 45% of underfive deaths and continues to be a global challenge.^[4,5] India accounts for nearly 30% of the global burden of neonatal deaths.^[6] Neonatal mortality rate (NMR) continues to be high at 28/1000 livebirths and contributes to 55% of all underfive deaths.^[1,7,8] The 1st day and 1st week after birth remains the

highest risk periods with nearly 50% and 75% of neonatal deaths, respectively.^[1,8] globally, the main direct causes of neonatal death are estimated to be preterm birth (28%), severe infections (26%), and asphyxia (23%).^[1] About 18%–20% of neonatal deaths in India are due to birth asphyxia.^[1,9,10] It has been estimated that simple, cost-effective health-facility based interventions can reduce neonatal mortality by as much

Address for correspondence: Dr. Manoja Kumar Das, The INCLEN Trust International, F1/5, Okhla Industrial Area, Phase 1, New Delhi - 110 020, India. E-mail: manoj@inclenrust.org

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Das MK, Chaudhary C, Mohapatra SC, Srivastava VK, Khaliq N, Kaushal SK, *et al.* Improvements in essential newborn care and newborn resuscitation services following a capacity building and quality improvement program in three districts of Uttar Pradesh, India. *Indian J Community Med* 2018;43:90-6.

Received: 23-05-17, **Accepted:** 01-03-18

Access this article online

Quick Response Code:



Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.IJCM_132_17

as 25%–30%.^[1,11] Research conducted as part of the every newborn action plan and the 2014 every newborn Lancet series demonstrated that two key intervention packages: (1) Care around birth and (2) care for small and sick newborns could avert more than 40% and 30% of neonatal deaths, respectively.^[12,13] It is estimated that optimal quality of care around childbirth and in the neonatal period could avert about 113,000 maternal deaths, 531,000 stillbirths, and 1.3 million newborn deaths by 2020.^[11] Therefore, it is of utmost important that health facilities be equipped to provide essential newborn care with quality to tackle the enormous burden of neonatal mortality. While community-based research is receiving attention and investment, rigorous evaluation and research on facility-based interventions are lagging behind. Few research studies conducted on health facility and services indicated improvement in the quality of essential newborn care services following the interventions.^[14]

The Government of India under National Rural Health Mission (NRHM) has launched various initiatives for giving high priority to neonatal health and reducing preventable newborn deaths. There has been multifold rise in institutional deliveries, but without proportionate change in perinatal outcomes.

An implementation research aimed at improving the newborn resuscitation efforts targeted at reducing intrapartum neonatal deaths and stillbirths through skill improvement and enabling system strengthening measures at the district and subdistrict level public health facilities in three districts of Uttar Pradesh. The current paper focuses on the changes in readiness of the public health facilities for delivering the perinatal and newborn services and the resuscitation efforts made after for nonbreathing babies at these public health facilities after the intervention.

MATERIALS AND METHODS

Study setting

The project was implemented in three districts (Gonda, Aligarh, and Raebareli) of Uttar Pradesh with high NMR (45–53/1000 live births), higher than the state average.^[15,16] These districts were selected considering the regional representation, west, central, and east in consultation with the state government. In each district, all the public health facilities including the district hospital (DH), sub-DH (SDH), first referral units (FRUs), community health centers (CHCs), and primary health centers (PHCs) conducting delivery were included in this study. The intervention package included improving facility readiness for newborn care, training of the birth attendants (on essential newborn care and newborn resuscitation using the modified 3 days module), establishment of skill laboratories for practice (4 units in each district) and supportive supervision. All the birth attendants in the district including the doctors, nurses, and auxiliary nurse midwives (ANMs) were trained on essential newborn care and newborn resuscitation using the modified 3 days module. The supporting team members, at

these facilities including the pharmacy, store, data, supervision, and administrative team members, were also orientation on the system strengthening components directed at perinatal and newborn care.

Study design

A before and after study design was adopted to assess the changes in the facility readiness status for perinatal and newborn service delivery at the public health facilities.

Data collection

From each district, 14 health facilities (including all levels) with maximum institutional delivery load were assessed. Data for preintervention phase were collected during August 2014 in two districts, and May 2015 in one district and postintervention phase was collected during May 2016 in all districts. The intervention package was implemented during September 2014–May 2016 in two districts and May 2015–May 2016 in one district. The facility assessment tool focused on the infrastructure, training facilities, workforce, service delivery related to delivery and newborn care, practices, protocols, guidelines followed, communication, supplies, referral, and transport facility, documentation and reporting, and monitoring and supervision at the facilities. Facility assessment had several components: Record review, information from key informants, and direct observation of the specific areas of facilities using a structured tool, which was developed in reference to the Indian Public Health Standards (IPHS). We used 26 maternal and newborn care signal function indicators, focusing on delivery, and postnatal care for assessing the readiness of the facilities for both routine and emergency care in health facilities.^[17] These 26 signal functions included general services and facilities (4 functions), routine obstetric care (3 functions), basic emergency obstetric care (5 functions), comprehensive obstetric care (2 functions), routine newborn care (3 functions), basic emergency newborn care (6 + 1 function), and comprehensive emergency newborn care (2 functions).^[17] For sharing with the districts and state program managers, a facility readiness dashboard was prepared under eight components including infrastructure, services, drugs, equipment, supplies, infection control practices, provider knowledge, and skill and availability of guidelines for case management. We categorized the scores (percentages out of the items enquired) under three categories; $\geq 75\%$ (ability to deliver majority of the items) coded as green, 51%–74% (ability to deliver some of the items) coded as yellow, and $\leq 50\%$ (inability to deliver majority of the items) coded as pink. Data on the services provided including total deliveries, livebirths, resuscitation attempted for nonbreathing babies, birth asphyxias, and unsuccessful resuscitations efforts (babies could not be revived) were collected from these health facilities as reported under Health Management Information System and review of the labor room registers. The service delivery data for intervention period (October 2014–March 2016 for Gonda and Aligarh districts and April 2015–March 2016 for Raebareli district) were compared with equal preintervention

period (April 2013–September 2014 for Gonda and Aligarh districts and April 2014–March 2015 for Raebareli district) to document the changes. The data collection was done by a three-member facility data collection team (three teams per district) led by a senior investigator (doctor) and assisted by two research assistants, who had undergone training along with the hands-on practice on study methodology and the study tools. Multilevel quality assurance measures were put in place including field level monitoring and supervision. The data collected was checked by the team leaders at field level and subsequently by central quality assurance team.

Data management and analysis

Double data entry was done using customized data entry and quality check software (using php and mysql platform). The entered data were matched by the software, and on complete matching, it was passed to the final database. Descriptive statistics were used to summarize the facility, health staff, and

population characteristics. The infrastructure and services for mothers and newborns focusing on the signal functions were derived. The proportions were compared using Chi-square test. Data were analyzed using STATA software (StataCorp LLC, Texas, USA).

Research ethics

This study was reviewed and approved by INCLIN Institute Ethics Committee. Approval from the National Rural Health Mission (NRHM), Uttar Pradesh and permissions from the district health authorities were obtained.

RESULTS

Characteristics of the health facilities surveyed

A total of 42 public health facilities (3 DHs, one SDH, 29 CHCs/FRUs, and 9 PHCs) in three study districts were assessed. At these facilities, 135,910 deliveries during

Table 1: Scores^s of the signal functions for maternal and newborn care (n=42)

Services/signal functions	Preintervention (%)	Postintervention (%)	Change (%)
General services and facilities			
24×7 service availability	93	93	0
Availability of skilled birth attendants [@]	45	96	51 [±]
Referral and communication tools	95	98	3
Reliable electricity and water supply, clean toilets	69	82	13
Routine obstetric care			
Management of labor using partograph	7	38	31 [±]
Active management of 3 rd stage of labor	40	86	46 [±]
Infection prevention measures	44	38	-6
Basic emergency obstetric care			
Parenteral magnesium sulfate for PIH	57	71	14
Assisted vaginal delivery	10	9	-1
Parenteral antibiotics for maternal infection	86	95	9
Parenteral oxytocic drugs for hemorrhage	84	88	4
Manual removal of retained placenta	83	67	-16
Comprehensive emergency obstetric care			
Surgery (e.g., cesarean section)	12	19	7
Blood transfusion	6	9	3
Routine newborn care			
Thermal protection	78	83	5
Immediate and exclusive breastfeeding	82	98	16 [±]
Hygienic cord care	89	98	9
Basic emergency obstetric care			
Antibiotics in prolonged PROM	84	90	6
Corticosteroids in preterm labour	35	55	20 [±]
Resuscitation of nonbreathing baby	56	86	30 [±]
KMC for premature/very small babies	73	100	27 [±]
Alternative feeding, if baby unable to breastfeed	47	52	5
Injectable antibiotics for neonatal sepsis	35	38	3
PMTCT if HIV-positive mother	10	16	6
Comprehensive emergency newborn care			
Intravenous fluids	19	38	19 [±]
Safe administration of oxygen	29	62	33 [±]

^sScores for the signal functions are indicated in percentage out of the total items checked, [@]Availability of at least one skilled staff at the time of visit,

[±]Absolute change in score (pooled for the three districts) for the item, [±]The change is statistically significant ($P < 0.005$). PIH: Pregnancy-induced hypertension, KMC: Kangaroo mother care, PROM: Premature rupture of membrane, PMTCT: Prevention of mother-to-child transmission, HIV: Human immunodeficiency virus

the preintervention period and 133,627 deliveries during the intervention period were documented. The DHs were handling about one-third of the total delivery load for the districts. More than half (55%–60%) of the deliveries were being conducted by the CHCs/FRUs. The PHCs were conducting about 10%–20% of the deliveries in the districts. Only few deliveries were happening at the subcenters. During April 2015–March 2016, about 4% and 5% of the deliveries at DHs and SDHs, respectively, resulted in stillbirth compared to 3% still-birth rate at CHCs/PHCs.

Status of signal functions for maternal and newborn health service delivery

The status of signal functions for obstetric and newborn service delivery at the surveyed facilities is summarized in Table 1. Some improvements in majority of the components under general service availability were observed. The increase in proportion of trained skilled birth attendants (SBAs) by 51% was encouraging. Remarkable change was observed for emergency newborn care, especially the resuscitation of nonbreathing baby, kangaroo mother care (KMC) for small

babies, and use of corticosteroids for preterm labor (rise by 30%, 27% and 20%, respectively). There was no noticeable improvement in infrastructure except the availability of functional toilets. There was a quantum jump in the routine obstetric care including use of partograph and active management of third stage of labor (rise by 31% and 46%, respectively). Some change in routine newborn care was observed across the facilities, but no change in the infection prevention measures. While reliable electricity and water supply remained the key deficiencies, improvement in functional clean toilet (rise by 52%) was observed.

Infrastructure, availability of equipment, and supplies

The status of infrastructure, equipment, instruments, medicines, and supplies at the health facilities surveyed and changes between preintervention and postintervention is given in Table 2. It was apparent that status of availability of equipment, supplies including medicines and other items have not changed much during the intervention period and even the DHs were not fully equipped with functional equipment to handle the newborns. Almost all the CHCs and PHCs were deficient

Table 2: Changes in status^s of equipment, medications and laboratory tests for obstetric and newborn (n=42)

Items assessed	Preintervention (%)	Postintervention (%)	Change (%)
Equipment for obstetric care			
Delivery kit/tray	52	76	24 [±]
Ventouse apparatus	4	17	13
Speculum for examination	78	90	12
Obstetrics forceps	21	31	10
Vacuum extractor	4	71	67 [±]
Scissors/sterile blade	67	98	31 [±]
Manual vacuum aspirator	60	77	17
Equipment for newborn care			
Infant weighing scale	96	95	-1
Radiant warmer	92	100	8
Self-inflating bag and mask	84	98	14 [±]
Mucus suction kit	92	81	-11
Oxygen hood	37	43	6
Oxygen concentrator	12	24	12
Medications for obstetric and newborn care			
Injections oxytocin	80	81	1
Injections magnesium sulfate	68	55	-13
Injections diazepam	92	71	-21
Injections iron sucrose	55	76	21 [±]
Injections Vitamin K	40	57	17 [±]
Injections corticosteroids	96	86	-10
Laboratory tests			
Pregnancy test kit	88	86	-2
Malaria test kit	36	62	26 [±]
Hemoglobin	96	88	-8
Dextrostix	28	62	34 [±]
Urine dipstick	88	90	2
Syphilis test kit	43	48	5
HIV test kit	39	69	30 [±]
Blood grouping kits	40	79	39 [±]

^sPercentage of the health facilities with availability of the assessed parameters/items, [±]The change is statistically significant ($P<0.005$). HIV: Human immunodeficiency virus

Table 3: Changes in facility readiness scores (facility level wise)

Parameters	Preintervention				Postintervention			
	DH/SDH (n=4) (%)	CHC/FRU (n=32) (%)	PHC (n=6) (%)	Total (n=42) (%)	DH/SDH (n=4) (%)	CHC/FRU (n=29) (%)	PHC (n=9) (%)	Total (n=42) (%)
Infrastructure								
Delivery care	91	72	72	78	89	84	85	86
NB care	77	42	57	59	84	60	66	70
Signal functions								
Delivery care	76	57	37	57	82	65	57	68
NB care	77	42	47	55	53	43	29	42
Essential drugs								
Delivery care	77	50	54	60	79	58	59	65
NB care	63	36	59	53	84	46	51	60
Equipment and supplies								
Delivery care	89	74	62	75	87	72	74	78
NB care	66	42	52	53	83	62	68	71*
Following infection control and prevention procedures								
Delivery care	72	34	32	46	39	38	38	38
NB care	51	21	20	30	28	25	27	27
Availability of guidelines								
Delivery care	41	45	21	35	36	54	43	44
NB care	77	52	26	52	53	42	29	41
Provider knowledge on newborn care including resuscitation								
Doctors	52	48	44	48	61	47	45	51
Nurses	50	37	35	40	58	52	53	54
Provider skills on newborn care including resuscitation								
Doctors	38	21	2	20	83	68	44	65*
Nurses	25	16	4	15	71	65	62	66*
Summary (1-8)	64	43	39	48	67	55	52	58

*The change is statistically significant ($P < 0.005$). Factors taken into account for deciding the score have been described in annexure 3, scores for the signal functions are indicated in percentage out of the total items checked

Score: $\geq 75\%$

Score: 51%-74%

Score: $\leq 50\%$

DH: District hospital, SDH: Subdistrict hospital, CHC: Community health center, FRU: First referral unit, PHC: Primary health center, NB: Newborn

in the preparedness for managing emergency obstetrics care and even routine newborn cases. The equipment availability for newborn care, including radiant warmer, resuscitation equipment, and oxygen concentrator, improved at these facilities. The ready availability of delivery kits, bag and mask for resuscitation, IV cannulas for newborns/pediatric patients, Vitamin k injections, and linens for newborns improved. Out of the facilities assessed, 75% of the facilities had SBA as well as neonatal resuscitation guidelines in the labor room. Partograph was available in one-third of the labor rooms.

Human resources

Almost all the facilities had shortage in manpower and none had desired skilled staff as per IPHS. At least one doctor and at least one nurse/ANM were available at each facility. Specialists (pediatrician and obstetricians) were available at the DHs, SDH, and few CHCs/FRUs. Although all the facilities had doctors available at the CHC/FRU/PHCs, their involvement in delivery and newborn care was minimal. Nurses/ANMs were conducting almost all the deliveries at

these facilities. Through the intervention, the trained and SBA number were improved significantly.

Infection prevention and control practices

About 2-fold rise in the handwashing practice was observed among staffs in labor rooms in two districts). Rise in the handwashing practice was also observed in third district. There was minimal change in the disinfection practice for reusable equipment/devices such as neonatal resuscitation bag and face mask, laryngoscope, suction apparatus, surgical instruments, and thermometer. No remarkable change was observed in segregated biomedical waste management across the facilities and the districts.

Supervision at health facilities

No definite schedule for supervisory visit was observed although once in 1–2 months frequency was reported. In the 6 months preceding assessment, almost all of facilities received a supervisory visit. Mostly the supervisory visits focused on the programmatic performance review and limited enquiry related to the labor room and newborn service delivery.

Table 4: Impact on the resuscitation practices in the districts

District	Parameters	Preintervention [@]	Postintervention [#]	P
Gonda	Deliveries (n)	60,192	58,196	
	Live births, n (%) [§]	57,839 (96.1)	56,250 (96.7)	0.001
	Resuscitation attempted, n (%) [§]	52 (0.1)	2088 (3.6)	0.0001
	Birth asphyxia cases, n (%) [^]	6 (11.5)	359 (17.2)	0.3765
	Resuscitation unsuccessful, n (%) [^]	41 (78.8)	13 (0.6)	0.0001
Aligarh	Deliveries (n)	37,372	37,627	
	Live births, n (%) [§]	36,584 (97.9)	37,091 (98.6)	0.001
	Resuscitation attempted, n (%) [§]	24 (0.1)	1042 (2.8)	0.0001
	Birth asphyxia cases, n (%) [^]	4 (16.7)	644 (61.8)	0.0001
	Resuscitation unsuccessful, n (%) [^]	19 (79.2)	32 (3.1)	0.0001
Raebareli	Deliveries (n)	38346	37804	
	Live births, n (%) [§]	37,101 (96.8)	36,707 (97.1)	0.0062
	Resuscitation attempted, n (%) [§]	68 (0.2)	1301 (3.4)	0.0001
	Birth asphyxia cases, n (%) [^]	6 (8.8)	769 (59.1)	0.0001
	Resuscitation unsuccessful, n (%) [^]	59 (86.8)	15 (1.2)	0.0001
Pooled	Deliveries (n)	135910	133627	
	Live births, n (%) [§]	131,524 (96.8)	130,048 (97.3)	0.0001
	Resuscitation attempted, n (%) [§]	144 (0.1)	4431 (3.3)	0.0001
	Birth asphyxia cases, n (%) [^]	16 (11.1)	1772 (40)	0.0001
	Resuscitation unsuccessful, n (%) [^]	119 (82.6)	60 (1.4)	0.0001

[@]Preintervention period: April 2013-September 2014 for Gonda and Aligarh districts and April 2014-March 2015 for Raebareli district, [#]Postintervention period: October 2014-March 2016 for Gonda and Aligarh districts and April 2015-March 2016 for Raebareli district, [§]Proportion of the total deliveries documented, [^]Proportion of the total resuscitation attempts made

Changes in facility readiness scores compared to baseline survey

The facility readiness dashboard scores are shown in Table 3. It was obvious that only the DHs and SDH had the ability to deliver majority of the desired services for obstetric and newborn care; primarily related to the infrastructure, essential drugs, and equipment and supplies availability. Almost all of the other facilities (CHCs/FRUs/PHCs) were not ready for majority of the service areas for the delivery and newborn care including resuscitation. As evident from the comparative tables, since baseline, the readiness functions and parameters for the facilities in the districts have improved across the facilities. The progress in readiness status for the facilities, especially for the knowledge and skills of the service providers including newborn resuscitation, was very encouraging. No change in infection control practices was observed.

Newborn resuscitation efforts

As reflected in Table 4, there was a marked rise in resuscitation attempts by the SBAs following capacity building program. Following the training, 4431 (3.3%) resuscitation attempts were documented with 2.8%–3.6% across the districts. While a large proportion (58.6%) of these resuscitation efforts resulted in successful revival, 40% had birth asphyxia requiring referral to higher facilities, and 1.4% cases could not be revived. These resuscitation outcome changes were significant.

DISCUSSION

This implementation project documented the status of routine and emergency obstetric and newborn service readiness of the

public health facilities and changes with capacity building and supportive supervision. Significant improvement was observed in the target intervention areas; routine obstetric care, emergency newborn care, resuscitation of nonbreathing baby, and KMC for small babies. Tremendous improvement in skill level of birth attendants and documentation of newborn service delivery was noted. Multifold rise in resuscitation attempts with >50% success rate was documented. The functionality status of newborn care equipment (radiant warmers, self-inflating bag and masks, and oxygen concentrator) improved. Minimal change in emergency obstetric services readiness, availability of equipment, medication, and supplies was observed. Reliable electricity, water supply, clean, and functional toilets continued as challenges. Although improvement in handwashing practice in labor room was noticed, there was minimal change in other infection control practices and biomedical waste handling.

A study in Tanzania reported a significant improvement in facility-level quality of essential newborn care services (39%–73%; $P < 0.0001$).^[18] In Uganda, a study reported rise in institutional deliveries (3151–4115). Although equipment functionality status was high, medications stock-out was observed at >60% of health facilities.^[19] Our study could not document the impact on neonatal mortality and final outcome of the birth asphyxia cases.

This project documented feasibility and positive impact of improving quality of maternal and newborn services at public health facilities through catalytic capacity building and system strengthening efforts at scale. The state health system received

the changes positively and expanding the intervention to other districts. Integration of cross-service and system interventions may further the impact and sustenance of the improvements at the public health facilities for achieving targeted maternal and newborn health indicators.

Acknowledgment

We acknowledge the support of National Health Mission, Uttar Pradesh, and the health functionaries at the health facilities in the three districts of Uttar Pradesh.

Financial support and sponsorship

This study was financially supported by the United States Agency for International Development (USAID) through the Save The Children, India.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- World Health Organization. WHO Estimates of Global Causes of Death 2000-2012. Department of Health Statistics and Information Systems. Geneva: World Health Organization; 2014. Available from: http://www.who.int/healthinfo/global_burden_disease/en/. [Last accessed on 2017 Jan 28].
- Levels and Trends in Child Mortality: Report 2015 Estimates Developed by the UN Inter-Agency Group for Child Mortality Estimation. Available from: https://www.unicef.org/media/files/IGME_Report_Final2.pdf. [Last accessed on 2017 Jan 28].
- UNICEF, WHO, World Bank, and UN-DESA Population Division. Levels and Trends in Child Mortality 2015; 2015. Available from: http://www.who.int/maternal_child_adolescent/documents/levels_trends_child_mortality_2015/en/. [Last accessed on 2017 Jan 28].
- UNICEF Progress Report 2015, Committing to Child Survival: A Promise Renewed. Available from: https://www.unicef.org/publications/files/APR_2015_9_Sep_15.pdf. [Last accessed on 2017 Jan 28].
- Ahman E, Zupan J. Neonatal and Perinatal Mortality: Country, Regional and Global Estimates 2004. Geneva: World Health Organization; 2007.
- Oestergaard MZ, Inoue M, Yoshida S, Mahanani WR, Gore FM, Cousens S, *et al.* Neonatal mortality levels for 193 countries in 2009 with trends since 1990: A systematic analysis of progress, projections, and priorities. *PLoS Med* 2011;8:e1001080.
- Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, *et al.* Every newborn: Progress, priorities, and potential beyond survival. *Lancet* 2014;384:189-205.
- Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, *et al.* Global, regional, and national causes of child mortality in 2008: A systematic analysis. *Lancet* 2010;375:1969-87.
- Baqui AH, Darmstadt GL, Williams EK, Kumar V, Kiran TU, Panwar D, *et al.* Rates, timing and causes of neonatal deaths in rural India: Implications for neonatal health programmes. *Bull World Health Organ* 2006;84:706-13.
- Million Death Study Collaborators, Bassani DG, Kumar R, Awasthi S, Morris SK, Paul VK, *et al.* Causes of neonatal and child mortality in India: A nationally representative mortality survey. *Lancet* 2010;376:1853-60.
- Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L, *et al.* Evidence-based, cost-effective interventions: How many newborn babies can we save? *Lancet* 2005;365:977-88.
- Bhutta ZA, Das JK, Bahl R, Lawn JE, Salam RA, Paul VK, *et al.* Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet* 2014;384:347-70.
- World Health Organization. Every Newborn: An Action Plan to end Preventable Newborn Deaths, 2013. Geneva: World Health Organization; 2014. Available from: http://www.apps.who.int/iris/bitstream/10665/127938/1/9789241507448_eng.pdf?ua=1. [Last accessed on 2017 Jan 28].
- Bahl R, Martinez J, Ali N, Bhan MK, Carlo W, Chan KY, *et al.* Research priorities to reduce global mortality from newborn infections by 2015. *Pediatr Infect Dis J* 2009;28:S43-8.
- Sample Registration System, Government of India. 2009. Available from: http://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/SRS-Bulletin-October-2009.pdf. [Last accessed on 2017 Jan 28].
- Annual Health Survey, Government of India. 2010 – 2011. Available from: http://www.censusindia.gov.in/vital_statistics/AHSBulletins/Factsheets.html. [Last accessed on 2017 Jan 28].
- Gabrysch S, Civitelli G, Edmond KM, Mathai M, Ali M, Bhutta ZA, *et al.* New signal functions to measure the ability of health facilities to provide routine and emergency newborn care. *PLoS Med* 2012;9:e1001340.
- Makene CL, Plotkin M, Currie S, Bishanga D, Ugwi P, Louis H, *et al.* Improvements in newborn care and newborn resuscitation following a quality improvement program at scale: Results from a before and after study in Tanzania. *BMC Pregnancy Childbirth* 2014;14:381.
- Namazzi G, Waiswa P, Nakakeeto M, Nakibuuka VK, Namutamba S, Najjemba M, *et al.* Strengthening health facilities for maternal and newborn care: Experiences from rural Eastern Uganda. *Glob Health Action* 2015;8:24271.