



CARE OF PREMATURE NEONATE: CHALLENGES AND STRATEGIES TO IMPROVE THE NEONATAL OUTCOME

¹Mr. Raghu, V.A. and ²Dr. Manju Vatsa

¹Nursing faculty, College of nursing, AIIMS, Jodhpur
²Former Principal, College of Nursing, AIIMS, New Delhi

ARTICLE INFO

Article History:

Received 25th January, 2021
Received in revised form
08th February, 2021
Accepted 19th March, 2021
Published online 27th April, 2021

Key Words:

Prematurity, Mortality,
Morbidity,
Neurodevelopmental Delay.

ABSTRACT

Prematurity has become a global health problem, Newborn deaths account for 40 percent of all deaths among children under five years of age. Prematurity is the leading cause of newborn deaths especially in the first 4 weeks of life and it is the second leading cause of death after pneumonia in children under the age of five years. The major causes of newborn deaths in India are pre-maturity/preterm (43.7 percent); neonatal infections (20.8 percent); intrapartum-related complications/ birth asphyxia (19.2 percent); and congenital malformations (8.1per cent) and others 8.2%. 15 million premature babies are born annually all over the world and it accounts for more than 1 in 10 babies born preterm. In India, out of 27 million babies born every year (2010 data), 3.5 million babies born are premature. More than 80% of birth occurs at 32-37 weeks of gestation and die needlessly for lack of simple, essential care such as warmth and feeding support. Many survivors face a lifetime of disability, including cerebral palsy, neurodevelopmental delay, learning disabilities, visual and hearing problems. A premature baby requires sophisticate medical and nursing services to reduce neonatal mortality and morbidity. This review highlights the medical and nursing care of premature neonates and strategies to improve the neonatal care.

Copyright © 2021. Raghu and Manju Vatsa. 2021. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Mr. Raghu, V.A. and Dr. Manju Vatsa. "Care of premature neonate: challenges and strategies to improve the neonatal outcome.", 2021. International Journal of Current Research, 13, (04), 17019-17026.

INTRODUCTION

Prematurity has become a global health burden, Neonatal deaths account for 40 percent of all deaths among children under five years of age. Prematurity is one of the principal causes of neonatal deaths, especially in the first 28 days of life and next to pneumonia, prematurity is the second leading cause of death in children under the age of five years¹. The pre-maturity/preterm (43.7 percent); neonatal infections (20.8 percent); intrapartum-related complications/ birth asphyxia (19.2 percent); and congenital malformations (8.1per cent) and others 8.2% are the important causes of neonatal deaths in India. A study done by Sanjay Kumar Rao et.al reveals that Neonatal deaths contributed to 54.3% of infant deaths and 39% occurred on the first day of life. Birth asphyxia (31.5%) followed by low birth weight (LBW)/prematurity (26.5%) were the most common causes of neonatal death, while infection (57.8%) was the most common cause of post-neonatal death. The study also revealed that the care-seeking was delayed among 50% of neonatal deaths and 41.2% of post-neonatal deaths².

Annually, 15 million premature babies are born across the globe and it accounts for more than 1 in 10 babies born preterm. The incidence of preterm birth ranges from 5-18% across 184 countries. Globally, there are 11 countries with preterm birth rates of over 15%, out of 11 countries, two countries are in sub-Saharan Africa. The incidence of preterm birth in poor countries is 12% compared to 9% in higher-income countries. In India, out of 27 million babies born every year (2010 data), 3.5 million babies born are premature³. Around 80% of neonates born at 32-37 weeks of gestation and they loss the life needlessly because of lack of essential newborn care at birth but most of these deaths are preventable with simple and cost-effective care. Around 10-16 % of babies born at less than 32 weeks and in low resource countries most of these premature babies will die but these babies can be saved without intensive care services. Babies born below 28 weeks represent only 1-5%, they need intensive care service for saving the life of the baby¹. Across the globe more than 1.1 million babies die because of prematurity and its complications and many survivors faces lifetime disability and impairment including cerebral palsy, neurodevelopmental delay, learning disabilities, visual and hearing problems⁴.

The ambitious goal of care preterm neonates focuses on reducing preterm births and improving child survival. There was a drastic improvement in maternal and newborn care and reduce in MMR and NMR since, the Millennium development goals were set. Addressing preterm birth and preterm care is essential for accelerating progress towards Millennium Development Goal 4. Prematurity not only leads to mortality and morbidity; they are at high risk to contract the communicable disease and exert a heavy burden on families, society, and health care system. Hence, preterm birth is considered as largest single condition in the Global Burden of Disease⁵. Therefore, the Reviewer took initiative to write the review articles to knowledge among the care provider to improve the care for premature neonates.

Definition and classification

Prematurity: As per WHO the preterm is defines as babies born before 37 weeks of gestation with signs of lives or born less than 259 days from the first day of LMP irrespective birthweight. Prematurity is further classified as extremely preterm (<28 weeks), very preterm (28 - <32 weeks), and moderate preterm (32 - <37 weeks) completed weeks of gestation. Moderate preterm birth may be further subclassified as late preterm birth (34 - <37 completed weeks). The still birth is baby born less than 1000gm or less or 28 weeks of gestation without signs of life. It is seen that around 80% of the still birth in high income countries are born prematurely, this accounts for 5% of all preterm birth. Considering only alive preterm birth underestimate the burden of prematurity⁶.

Low birth weight: Low birth weight is defined as babies born with a birth weight of less than 2,500 g, irrespective of the period of their gestation. Low birth weight includes prematurity as well small for dates babies. In India the babies born with LBW accounts for 6 to 8 million annually. The high incidence of LBW babies in our country is accounted for by a higher number of intrauterine growth retardation (small-for-dates) rather than the preterm babies⁷.

Small for gestation age: Babies' birth weight falls below the 10th percentile of intrauterine growth chart is known as small for a date or Small for gestational age baby. They account for a higher number of LBW babies in India⁸.

Causes for preterm delivery: Chythra R Rao et. al. all Conducted a case-control study on 153 mothers in southern India to assess the risk factor for preterm, the result shows that the preterm birth rate was 9% and hypertensive disorder of pregnancy (21.4%), height less than 1.5 meter (16%), PROM (17.5%) and fetal distress (14.9%) were the risk factor associated with the preterm baby⁹.

Prevention of Preterm Delivery: Pregnancy and childbirth are critical windows of opportunity for providing effective interventions to improve maternal health and reduce mortality and disability due to preterm birth. The cost-effective intervention is family planning, empowering the women and girl especially for girls in regions with high rates of adolescent pregnancy, promoting better nutrition, environmental and occupational health are essential. Ensuring antenatal care for all pregnant women, including screening, diagnosis, and treatment of infections such as HIV and STIs, nutritional support, and counselling. Provide adequate screening and management of pregnant women at higher risk of preterm

birth, e.g., multiple pregnancies, diabetes, high blood pressure, or with a history of previous preterm birth. Promote behavioral and community interventions to reduce smoking, second-hand smoke exposure, and other pollutants and prevention of violence against women by intimate partners. Some of the studies shown that carrying heavy workloads and working for more than 5 days with long duration during antenatal period was associated with preterm delivery¹.

Assessment of gestational age: The gestational age of the baby can be assessed with the help of the new Modified Ballard scale which is a revised version of the Dubowitz scale. It can be used with newborns as young as 20 weeks of gestation. The Gestational age is identified by assessing the neuromuscular maturity and physical maturity. The intrauterine growth curve is used to classify infants according to birth weight and gestational age in which baby can be classified as LGA, SGA, and AGA¹⁰.

Diagnosis of prematurity of labor: Increased levels of placental alpha macroglobulin-1 and fetal fibronectin can predict the imminent spontaneous premature birth within 7 days among the mother who has the signs and symptoms of preterm labor. The short cervical length measured by transvaginal ultrasonography also helps to diagnose spontaneous preterm labor¹¹.

Recommended intervention during preterm labour to improve the neonatal outcome

-) Tocolytics agents to slow down labor such as oxytocin antagonist, betamemics, calcium channel blocker, and magnesium sulphate. The tocolytic agent could delay the labor for 24 to 48 hours, this period can be utilized for administration of corticosteroid and transportation of mother to the health care facility where NICU facility is available¹².
-) Many clinical trials prove that the antenatal corticosteroid was highly effective in reducing the RDS, IVH, and safe intervention for reducing neonatal mortality by 40%¹³.
-) Magnesium sulfate for neuroprotection and reduce cerebral palsy in childhood period¹⁵
-) Antibiotics for PROM to prevent early-onset neonatal sepsis.
-) Romero R, et al., 2018, and Berghella V., 2012 study results show that vaginal progesterone was associated with a significant reduction in risk of preterm birth less than weeks gestation (p=0.006). It also significantly reduces low birth weight, RDS, neonatal mortality and morbidity, and NICU admission with relative risks from 0.471-0.82¹⁴.
-) The use of a cervical pessary to lower rates of spontaneous preterm birth among women with a short cervix. (Goya et al., 2012) Placement of circumferential stitches on a structurally weak cervix cerclage reduces the risk of a preterm baby. (Haas, 2011; Barros et al., 2010).

Long term impact of preterm birth survivors

Physical effects

- J Visual impairment: around 25% of all extremely preterm have blindness or high myopia after retinopathy of prematurity and increased hypermetropia and myopia.
- J Hearing impairment: up to 5-10% of extremely preterm baby affected with hearing impairment.
- J Chronic lung disease of prematurity: around 40% of the extremely preterm baby affected with chronic lung disease results in reduced exercise tolerance.
- J Long term cardiovascular problem and non-communicable disease such as increased blood pressure, reduced lung function, increased rate of asthma, and growth failure in infancy, and accelerated weight gain in adolescence

Neurodevelopmental and behavioural effects

- J Mild disorder of executive functioning such as specific learning impairment, dyslexia and reduced academic achievement
- J Moderate to severe global developmental delay such as moderate to severe cognitive impairment, motor impairment and cerebral palsy.
- J Psychiatric and behavioural problem such as attention deficit hyperactive disorder, increased anxiety and depression

Family, economic and social problem: Impact on family such as psychosocial, emotional and economic problem as well risk of preterm birth in offspring. Impact on health care services such as cost of care during and acute and follow up care.^{16,17}

Care of preterm baby: Increasing evidence-based practice and advanced technology have reduced the risk of long-term impairment in preterm infants. The NICU care has been shifted from Invasive ventilation to Non-invasive ventilatory support. Many organizations such as AAP, IAP, NNF, and FOGSI recommend inutero transfer babies of high-risk mothers to hospitals where advanced NICU facilities are available. This is essential to ensure Golden hour and Golden Daycare is provided to neonate in the first hour of transition from the womb to the outside world. The immediate care in first 60 minutes and in the first 24 hours determines outcome of preterm delivery in the next few years of life that whether they survive with or without a disability.¹⁸

Management at the time of birth: Every delivery centre should have a newborn care corner with one paediatrician and fully prepared for neonatal resuscitation at the time of birth. The early recommended intervention for preterm babies is thermal care (drying, warming, skin to skin, and delaying bathing) and early initiation and exclusive breastfeeding. The delayed clamping of the cord helps in improving the iron stores of the baby. Neonatal resuscitation for the babies who do not breathe at birth. Elective intubation of extremely LBW babies (< 1000g) is practiced in some centres to support breathing and for prophylactic administration of exogenous surfactant. Vitamin K 0.5 mg should be given intramuscularly. The baby should be transferred to NICU as soon as breathing is established.

Monitoring preterm babies: The nurse should frequently monitor the clinical parameter such as vital signs with multi

signs monitor, activity and behaviour, color, tissue perfusion, ABG, fluid and electrolytes, feeding tolerance, signs of respiratory distress and infection, and daily weight gain¹⁷.

Maintenance of breathing: Maintaining a thermoneutral environment is crucial to reduce the metabolic and oxygen demand. The baby should be positioned with the neck slightly extended and the airway is cleared by gentle suctioning if needed. Precaution should be taken to prevent aspiration of secretion and feeds. The concentration of oxygen to be titrated to maintained spo₂ between 90 and 95% and paO₂ between 60 and 80 mm of Hg. Baby's respiration rate, rhythm, signs of distress, chest retraction, nasal flaring, apnoea, cyanosis, oxygen, saturation, etc. to be monitored at frequent intervals. Respiratory distress is the commonest problem in preterm babies. The mild respiratory distress needs supplemental warm and humidified oxygen with spo₂ monitoring. The moderate to severe respiratory distress can be managed with nCPAP without IMV. Surfactant (survanta) therapy is the treatment of choice along with nCPAP for the RDS baby. If the baby has metabolic acidosis, hypercapnia, hypoxia, or in case of severe respiratory distress baby requires mechanical ventilation with IMV mode¹⁶.

The retinopathy of prematurity: The retinopathy of prematurity can be prevented by judicious and cautious administration of Oxygen in the lowest ambient concentration and stopped as soon as its use is considered unnecessary. The target SpO₂ between 90%-95% and paO₂ between 60-80 mm Hg is set to prevent the prematurity of retinopathy. The other strategies to reduce the ROP are prevention of neonatal infection, breast milk feeding, and avoid unnecessary blood transfusion¹⁹.

Maintenance of stable body temperature: Prevention of hypothermia is the top priority in caring for preterm babies. The baby should be received in a pre-warmed radiant warmer or incubator. Hypothermia in a premature baby can be prevented by following the warm chain principle in the hospital. The Baby's skin temperature should be maintained within the range of 36.5 to 37.5 degrees Celsius. A baby birth weight of less than 1200gm should care in an incubator with 60 to 70 % humidity, oxygen, and a thermoneutral environment for better thermal control and prevent heat loss. Alternatively, the baby should be managed under a radiant warmer with a protective plastic cover. The extremely LBW baby should be covered with cellophane or a thin transparent plastic sheet to prevent convective heat loss and evaporative losses of water from the skin. Kangaroo mother care is provided when the baby's condition is stabilized¹⁶.

Maintenance of nutrition and hydration: Nutrition and hydration are a great concern in preterm babies. Preterm neonates are more prone to have dehydration due to immaturity of the renal system and hypoglycemia due to many factors. The Aim of feeding should be approximate to intrauterine growth. The approximate daily weight gain of the neonate should be 15gm/kg/day, it would require 130-175 kcal/kg/day. Breast milk contains 65-70 kCal/100 ml, therefore, a preterm would require at least 200 ml/kg/day of Breast milk to meet the needs. Early initiation of breastfeeding within one hour after birth has been shown to reduce neonatal mortality. Breast milk is the first choice of nutrition for all LBW and preterm babies. Most premature babies require extra support for feeding EBM with a cup, spoon, or gastric tubes (either oral or nasal) (Who, 2011a; lawn et al., 2001).

Table 1. Causes of premature birth¹

Spontaneous causes:			Induced causes
Sr no	Risk factor for spontaneous causes	Example	Maternal diabetes mellitus Severe heart diseases. Placental dysfunction with unsatisfactory fetal growth. Eclampsia, severe pre-eclampsia, and hypertension. Foetal hypoxia and foetal distress Severe Rh incompatibility Improper diagnosis of maturity in elective deliveries.
1	Age at pregnancy and pregnancy spacing	Adolescent pregnancy, advanced maternal age, or short interpregnancy interval	
2	multiple pregnancy	Increased rates of twin and higher order pregnancies with assisted reproduction	
3	Infection	Urinary tract infections, malaria, HIV, syphilis, bacterial vaginosis,	
4	Underlying maternal chronic medical conditions	Diabetes, hypertension, anaemia, asthma, thyroid disease	
5	Nutritional	Undernutrition, obesity, micronutrient deficiencies	
6	lifestyle/work related	Smoking, excess alcohol consumption, recreational drug use, excess physical work/activity	
7	Maternal psychological health	Depression, violence against Women. Stress	
8	Genetic and other	Genetic risk, e.g., family history cervical incompetence	

Table 1. Problems associated with preterm baby

Sr no	Problems in premature baby	Causes
1	Respiratory distress syndrome	Deficiency of lung surfactant and
2	Respiratory distress	Absence of gag reflex, under developed thoracic cage muscles and abdominal distension.
3	Intraventricular haemorrhage	Immature vascular bed and anoxic effect leads to rupture of tiny blood vessels in ventricle.
4	Feeding difficulties	lack of rooting, sucking reflexes and swallowing due to immature CNS
5	Regurgitation and aspiration	Uncoordinated sucking and swallowing reflexes, small capacity of stomach, incompetence of cardio-oesophageal junction and poor cough reflex.
6	Birth asphyxia	preterm babies are high risk to have perinatal birth asphyxia due to maternal and fetal causes.
7	Necrotizing Enterocolitis	Ischemia of immature intestine and formula feed
8	Prematurity of retinopathy	Preterm babies exposed to high concentration oxygen and hypoxia results in retinopathy of prematurity
9	Apnoea of prematurity	The immature respiratory control mechanisms these babies have a tendency for apnoeic spells.
10	Hypoglycaemia	The poor hepatic glycogen stores, delayed feeding, birth asphyxia and respiratory distress syndrome contribute to the development of hypoglycaemia
11	Infection:	lack of IgG, deficient complementary mechanism, cellular immunity, excessive handling, NICU environment and lack of skin barrier
12	Hyperbilirubinemia	Immaturity of liver and deficient UDGPT enzyme
13	Increase BUN due to low GFR and metabolic acidosis	Immaturity of renal system
14	Anemia of prematurity	Delay in producing red blood cells as the bone marrow is immature.
15	Toxicity of drugs	Poor hepatic detoxification and reduced renal clearance
16	Biochemical disturbances	Hypoglycaemia, hypocalcaemia, hypoproteinaemia, acidosis and hypoxia ^{16,17}

Table 2. Pattern of feeding in premature neonates

Age	Categories of neonates		
Birth weight	<1200gm	1200 to 1800gm	>1800gm
Gestation	<30 weeks	30 to 34 weeks	>34weeks
Initial.	IV fluids, try gavage feeding if not sick.	Gavage	Breast feeding, if unsatisfactory give katori spoon feed.
Later	Gavage	Katori spoon	Breast feed
Later	Katori spoon.	Breast feed	Breast feed
Later	Breast feed	Breast feed	Breast feed

Along with feeding, the neonate needs Non-nutritive sucking with empty breast or pacifier which facilitate development of sucking behavior and improves the digestion of enteral feeding²⁰. On first day the fluid requirement ranges from 60 to 100ml/kg (the difference from each category being 20ml/kg each). The daily increment in all group is around 15 ml per kg till day 9. Neonates need extra fluid requirement in case of phototherapy (15-20ml/kg/day) and radiant warmer (20-40 ml/kg/day)^{16,20,21}.

Prevention of infection: The infection is the big killer in premature neonates. Premature babies are more prone to infection due to many reasons. The late-onset neonatal sepsis can be prevented by adopting the good hospital policy which includes hand washing, card care using chlorohexidine, maintaining good hygiene, environment cleanliness, aseptic techniques while providing care, less minimally invasive procedure, sterilization and disinfection of equipment, microbiologic surveillance, well-trained staffing, screening of patient before admission into NICU and isolation of the infected patient.

Primary prevention of NEC: Preterm babies are more prone for NEC and the strategies to prevent NEC include antenatal glucocorticosteroids, breast milk feeding, cautious tropic feeding strategy, fluid restriction, and probiotics. Based on current research evidence, mixed flora probiotics, and breast milk feeding, would appear to be the most effective feasible methods in the prevention of NEC at present. Interventions that are promising, but have inadequate clinical data, including erythropoietin (EPO) and lactoferrin²².

Neurodevelopmental supportive care: The availability of sophisticated high technology has revolutionized the care of preterm and sick newborn babies. But the technology should not be allowed to become a barrier against the communication, compassion, and concern of the treating team and the family. Premature neonates need adequate sensory stimulation in the form of tackling, singing, cuddling, and gentle touch during care. Visual and auditory stimulation is given in the form of maternal recorded voice and KMC. A gentle touch, massage, cuddling, stroking, and flexing by the nurse or preferably by the mother provide useful tactile stimuli to the baby. Rocking a bed or placing a preterm baby on inflated gloves rhythmically rocked by a ventilator provides useful vestibular-kinaesthetic stimuli for the prevention of Apnoeic attacks of prematurity. Smoothing music has been shown to reduce the stress of procedures and enhance the weight gain velocity of preterm babies. This neurodevelopmental supportive care helps in enhancing the neurodevelopmental outcome of premature babies²³.

Immunizations: In stable preterm babies with birth weight more than 2000gm, the vaccines are administered as per the chronological age like term babies. The dose of vaccine should not be reduced. As there is no risk of acquiring vaccine preventable disease in NICU, the zero dose of BCG, OPV and HBV can be administered on the day of discharge from the hospital.²⁴.

Hyperbilirubinemia: Prevention of acute bilirubin encephalopathy requires appropriate clinical assessment, adequate breast feeding, interpretation of TSB concentration and phototherapy treatment²⁵.

Drug toxicity. It can be prevented by cautious and vigilant in drug dosage calculation and timely administration of drug.

Family centred care: Premature birth and NICU hospitalization negatively impact parent – infant interactions, which is associated with long term adverse effect. Individual family centered interactions have been associated with reduced parent stress and more positive parent infant interactions. Family centered NICU policies include welcoming families 24 hours/day, promotion of family participation in infant care, creation of parent advisory boards, implementation of parent support groups and comfortable rooming in areas for parents.

Family Support and education: The prolonged hospitalization of sick preterm babies in NICU is associated with emotional trauma, fear and anxiety and detachment. In addition to the physical stress and financial impact, the family dynamics is greatly disturbed. The parents' concerns should be handled with composure, kindness, and caring attitude of the health care team. The terrifying environment of NICU should be explained and family should be informed about the progress of the child and involved in the care of their baby²⁶.

Discharge counselling: Parents must be prepared for the fact that their baby is not likely to behave as a term baby. Research suggests that most of NICU parents report being ill – prepared for discharge with respect to recognizing signs of illness, employing effective calming strategies, being aware of typical and delayed development and using strategies to promote infant development. The family should be counselled daily before the discharge from the hospital.

Follow-up protocol

After discharge from the hospital, babies should be regularly followed up for assessment of the air way reactive diseases, Nutrition, weight gain, hearing, ROP screening and neurodevelopmental delay.

The follow schedules

-)] Infants with <1800g birth weight and/or gestation <35 weeks-
-)] After 3-7 days of discharge to check if the baby has been adjusted well in the home environment.
-)] Every 2 weeks until a weight of 3 kg (immunization schedule until 10-14 weeks to be covered in these visits)
-)] At 3, 6, 9, 12 and 18 months of corrected age and then every 6 months until age of 8 years²⁷.

In India there is a prescribed three tier system for providing neonatal services within infrastructure, equipment's, manpower and ancillary services²⁸.

Challenges in delivering care to preterm babies in India

-)] Lack of awareness among public
-)] Lack of implementation of essential newborn care and sick newborn care at PHC and FRU.
-)] Referral centers frequently fail to provide adequate care for sick neonates due to lack of resources.
-)] Poor infrastructure, resource limitations and lack of systematic care have been identified as contributing to poor neonatal outcomes among premature baby.

Table 3. Existing facility in India for neonatal care

Levels of neonatal care	Criteria	Setting	Services	Health personnel
Level-I Basic neonatal care(80%)	>34 weeks of GA > 1800 gm birth weight	Home Sub-center PHC Under: FBNC(NBCC) & HBNC	Basic care at birth Provision for warmth Maintenance of asepsis Promotion of breast feeding And stabilization of new-born	Mother Health care worker. ASHA worker
Level- II Special care newborn nursery (10-16%)	30-34 weeks of GA 1200-1800 gm	FRU District hospital Teaching institution Nursing home FBNC(NSU and SCNU)	Care of sick newborn Neonatal resuscitation Maintenance of thermoneutral environment IV infusion, phototherapy and EBT	Trained nurses and paediatrician
Level-III Intensive neonatal care (1-5%)	< 1200 gm < 30 weeks of GA	Regional centre Apex and Teaching institute (Intensive care unit)	Centers equipped with centralized oxygen and suction facilities, servo-controlled incubators, vital signs monitor, transcutaneous monitors, ventilators, infusion pumps. Advanced imaging test and performance of major surgery	skilled nurses and neonatologists.

Table 4. Facility based newborn care

FBNC facility	Services
Newborn Care Corners (NBCCs):	Immediate newborn care and stabilization of newborn.
Newborn stabilization Units (NBSUs) at Community health center /FRUs	stabilize sick newborn and management of specialized condition before referral to higher facilities centre.
Special Newborn Care Units (SNCUs)at district/sub-district hospitals	care for sick newborn (all types of care except assisted ventilation and major surgeries)
Home Based Newborn Care (HBNC)	HBNC includes essential newborn care for all newborn, special care of preterm and low-birth-weight babies; early detection of illness followed by referral ^{29,30} .

-) The lack of functioning medical equipment is another gap in low resource settings.
-) Need for more effort in identifying women at risk of preterm labor.
-) There is a need for innovative private-public partnership models.
-) Inadequate human resource in different health setting.
-) Lack of evaluation of health policies and program.
-) Lack of assessment of quality care and service.
-) Absence of accreditation of health facility in India.
-) Three-quarters of medical devices do not function in developing countries and remain unused within one year of installation.

Strategies to improve the preterm care

-) Decentralizing powers to the state level for rising health of mothers and babies.
-) The role of central government ought to be developing policies, technical superintendence, place and resource mobilization for rising health of mothers and babies.
-) Each state has to take proactive steps to deal with issues/gaps for operationalization and education translation of best practices for premature babies and guaranteeing equity of care.
-) The government should provide adequate infrastructure to provide health facilities to the sick neonates. This involves strengthening tertiary care services at medical schools, making secondary care as special care neonatal units at district and sub-district health facilities and enhancing the linkages among all the level.
-) Round-the-clock services and facilities for caring preterm or sick neonates.

-) Health Professionals need be update on evidence-based skill continuous basis by the use of E-learning and distance education schemes
-) Information technology should be linked with M-health use by Accredited Social Health Activist (ASHA)/ Auxiliary Nurse Midwife (ANM) for ensuring accountability, monitoring and data retrievals.
-) The government hospital at all the level need to undergo accreditation process to improve the quality of services and health facilities¹⁸.

Government action plan to improve the health of the preterm neonates:

The Government of India is building on a series of efforts, policy decisions, and programmes introduced over the past two decades to address maternal and newborn health. The Indian government has launched many programs such as CSSM, RCH-I and RCH-II, NRHM, RMNCH+A and India Newborn action plan (INAP) 2014. These programs mainly focused on the maternal and child health, which directly reduced the chances of premature birth and improve the care of neonates at the time of birth. Interventions under National Health Mission focusing on newborn care are JSY, IMNCI, NSSK, JSSK, SurakhitMatritvaAashwasan scheme-2019 and Facility based newborn care.

CONCLUSION

The preterm babies need sophisticated medical and nursing care to prevent and reduce the mortality and morbidity. The government has taken many initiatives and formed many policy and guideline to improve the neonatal outcome. Still governmental and non-governmental organization, health care members and public needs participation in implementing the policy and guidelines to reduce the neonatal mortality and morbidity rate due to prematurity.

REFERENCES

- WHO: Born too soon: The Global action report on preterm.[cited on Jan 2021] available on https://www.who.int/pmnch/media/news/2012/201204_born-too-soon-report.pdf
- Sankar, M. J. Neogi, S. B., Sharma, J. Chauhan, M., Srivastava, R., Prabhakar, P. K., et.al 2016. State of newborn health in India. *Journal of perinatology : official journal of the California Perinatal Association*, 36s3, S3–S8. <https://doi.org/10.1038/jp.2016.183>
- WHO: Every Newborn: An action plan to end preventable deaths; 2014. Available from <https://www.who.int/health-topics/newborn-health>
- Soleimani, F., Zaheri, F., & Abdi, F. 2014. Long-term neurodevelopmental outcomes after preterm birth. *Iranian Red Crescent medical journal*, 166, e17965. <https://doi.org/10.5812/ircmj.17965>.
- Nour NM. Premature delivery and the millennium development goal. *Rev Obstet Gynecol.* 2012;52:100-5. PMID: 22866189; PMCID: PMC3410509.
- Quinn, J. A., Munoz, F. M., Gonik, B., Frau, L., Cutland, C., Mallett-Moore, T., et al. Brighton Collaboration Preterm Birth Working Group 2016. Preterm birth: Case definition & guidelines for data collection, analysis, and presentation of immunisation safety data. *Vaccine*, 3449, 6047–6056. <https://doi.org/10.1016/j.vaccine.2016.03.045>
- Cutland CL, Lackritz EM, Mallett-Moore T, Bardaji A, Chandrasekaran R, Lahariya C, Nisar MI, et al. Low birth weight: Case definition & guidelines for data collection, analysis, and presentation of maternal immunization safety data. *Vaccine.* 2017 Dec 4;3548 Pt A:6492-6500. doi: 10.1016/j.vaccine.2017.01.049. PMID: 29150054; PMCID: PMC5710991.
- Sharma D, Shastri S, Sharma P. Intrauterine Growth Restriction: Antenatal and Postnatal Aspects. *Clin Med Insights Pediatr.* 2016 Jul 14;10:67-83. doi: 10.4137/CMPed.S40070. PMID: 27441006; PMCID: PMC4946587.
- Rao CR, de Ruiter LE, Bhat P, Kamath V, Kamath A, Bhat V. 2014. A case-control study on risk factors for preterm deliveries in a secondary care hospital, southern India. *ISRN Obstet Gynecol.* Mar 13;2014:935982. doi: 10.1155/2014/935982. PMID: 25006487; PMCID: PMC3976879.
- Lee AC, Mullany LC, Ladhani K, et al., 2016. Validity of Newborn Clinical Assessment to Determine Gestational Age in Bangladesh. *Pediatrics*.1381:e20153303. doi:10.1542/peds.2015-3303
- Bolotskikh V, Borisova V. 2017. Combined value of placental alpha microglobulin-1 detection and cervical length via transvaginal ultrasound in the diagnosis of preterm labor in symptomatic patients. *J Obstet Gynaecol Res.*, 438:1263-1269. doi:10.1111/jog.13366.
- Haas DM, Benjamin T, Sawyer R, Quinney SK. 2014. Short-term tocolytics for preterm delivery - current perspectives. *Int J Womens Health.*, 6:343-349. Published 2014 Mar 27. doi:10.2147/IJWH.S44048
- Anna Maria FP, Isabela CC, Jailson BC, Melania MR. Effectiveness of antenatal corticosteroids in reducing respiratory disorders in late preterm infants: randomised clinical trial. *BMJ.* 2011; 342: d1696. doi:10.1136/bmj.d1696
- Hassan SS, Romero R, Vidyadhari D, Fusey S, Baxter JK, Khandelwal M, et al. Vaginal progesterone reduces the rate of preterm birth in women with a sonographic short cervix: a multicenter, randomized, double-blind, placebo-controlled trial. *Ultrasound Obstet Gynecol.* 2011 Jul;381:18-31. doi: 10.1002/uog.9017. Epub 2011 Jun 15.
- De Silva DA, Synnes AR, von Dadelszen P, Lee T, Bone JN; MAG-CP, CPN and CNN collaborative groups, Magee LA. MAGnesium sulphate for fetal neuroprotection to prevent Cerebral Palsy MAG-CP-implementation of a national guideline in Canada. *Implement Sci.* 2018 Jan 11; 131:8. doi: 10.1186/s13012-017-0702-9. PMID: 29325592; PMCID: PMC5765609.
- Dr. M.L. Gupta Associate Professor Deptt. of Paediatric Medicine SMS Medical College & J.K. Lon Hospital, Jaipur. Care of Low Birth Weight LBW Babies. Module for training of specialist in pediatrics on newborn care.
- Institute of Medicine of the National Academies 2006. "Preterm Birth: Causes, Consequences, and Prevention." from <http://www.iom.edu/Reports/2006/Preterm-Birth-Causes-Consequences-and-Prevention.aspx>.
- HNN healthy newborn network: Is India's Healthcare System Failing Premature Babies Even Before They Are Born? November 17, 2018. [available] <https://www.healthynewbornnetwork.org/news-item/is-indias-healthcare-system-failing-premature-babies-even-before-they-are-born/>
- Retinopathy of Prematurity Treatment, Prognosis, Prevention, remedies of health community.com <http://www.healthcommunities.com/retinopathy-of-prematurity/children/treatment-for-rop.shtml>
- Hay W. W., Jr 2018. Nutritional Support Strategies for the Preterm Infant in the Neonatal Intensive Care Unit. *Pediatric gastroenterology, hepatology & nutrition*, 214, 234–247. <https://doi.org/10.5223/pghn.2018.21.4>.
- William W. Hay, Jr. Nutritional Support Strategies for the Preterm Infant in the Neonatal Intensive Care Unit. *Pediatr Gastroenterol Hepatol Nutr.* 2018 Oct; 214: 234–247.
- Lin HY, Chang JH, Chung MY, Lin HC. Prevention of necrotizing enterocolitis in preterm very low birth weight infants: is it feasible? *J Formos Med Assoc.* 2014 Aug;1138:490-7. doi: 10.1016/j.jfma.2013.03.010. Epub 2013 May 20. PMID: 23701837.
- Annapurna Dangeti. High Risk New Born. June 22, 2016. Available from https://docuri.com/download/high-risk-new-born_59bf38a0f581716e46c35e73_pdf
- Gagneur A, Pinquier D, Quach C. Immunization of preterm infants. *Hum Vaccin Immunother.* 2015;1111:2556-2563. doi:10.1080/21645515.2015.1074358.
- Brown AK, Kim MH, Wu PY, Bryla DA. Efficacy of phototherapy in prevention and management of neonatal hyperbilirubinemia. *Pediatrics.* 1995 Feb; 752 Pt 2:393-400.
- John P. Cloherty V Editi Manual of Neonatal care. lippincottwilliams&wilkins, a wolterskluwer 7th edition.2012.
- Pradeep Kumar, M.Jeeva Sankar, Savita Sapra, Ramesh Agarwal, Ashok Deorari and Vinod Paul. Division of Neonatology, Department of Pediatrics All India Institute of Medical Sciences Ansari Nagar, New Delhi. AIIMS-NICU protocols 2008 Follow-up of High-Risk Neonates.
- American Academy of Pediatrics Committee on Fetus And Newborn. Levels of neonatal care. *Pediatrics.* 2012 Sep;1303:587-97. doi: 10.1542/peds.2012-1999. Epub 2012 Aug 27. PMID: 22926177.

29. National Health Mission, Health & Family Welfare Services, Government of Karnataka. FACILITY BASED NEW BORN CARE: 2016 <https://karunadu.karnataka.gov.in/hfw/nhm/pages/fbnbc.aspx>.
30. Every Newborn: An action plan to end preventable deaths; World Health Organization 2014.
