J Afric Neonatal 2025;3: 107 - 113

ORIGINAL

Immediate care at birth and neonatal resuscitation in the African Neonatal Network

Olufunke Bolaji
Iyabode Olabisi Florence Dedeke
Samuel Olu Ajigbotosho
Victoria Nakibuuka
Janipher Nakyanzi
John Baptist Nkuranga
Pamela Henderson
Helina Selam
Erika M. Edwards
Danielle E. Y. Ehret
Melissa Muparamoto
Nyaradzo Nyamburi
Elizabeth Siraha
Gemechis Wari
Susan Niermeyer
Misrak Tadesse
Alexander G. Stevenson

https://dx.doi.org/10.4314/jan.v3i3.7

Received: 1st July 2025
Accepted: 7th July 2025

Olufunke Bolaji (✉)
Samuel Olu Ajigbotosho
Federal Teaching Hospital,
Ido-Ekiti, Nigeria
Email: olufunke.bolaji@gmail.com

Iyabode Olabisi Florence Dedeke
Federal Medical Centre, Abeokuta,
Nigeria

Victoria Nakibuuka
Janipher Nakyanzi
St. Francis Nsambya Hospital,
Kampala, Uganda

John Baptist Nkuranga
University of Rwanda/African
Health Sciences University, Kigali,
Rwanda

Pamela Henderson
Alexander G. Stevenson
African Neonatal Association,
Kigali, Rwanda

Helina Selam
Vermont Oxford Network,
Burlington, Vermont, USA

Abstract: *Introduction:* Immediate care for the newborn at birth is crucial to prevent neonatal morbidity and mortality from intrapartum related events. These deaths need to be addressed for African nations to achieve targets for Sustainable Development Goal 3.2.
Methods: Fourteen hospitals in the African Neonatal Network responded to an annual facility survey and a health facility survey co-developed by faculty in the African Neonatal Network and Vermont Oxford Network. All analyses use descriptive statistics.
Results: In 10 (71%) of facilities, midwives in the labour and delivery units were most likely to provide routine resuscitation and essential newborn care of both low-risk and high-risk births. Eleven (79%) of 14 hospitals had a guideline or protocol stating that every healthcare worker involved with births should receive neonatal resuscitation training. For the transfer of inborn infants from the delivery room to the neonatal unit, 9 (64%) hospitals reported having 100% oxygen, 8 (57%) CPAP, 6 (43%) continuous pulse oximetry, and 1 (7%) blended oxygen more than 90% of the time. All the hospitals reported consistent availability of equipment for resuscitation like preterm and term masks; however, self- inflating bags were consistently available in 93% of facilities. Equipment for thermoregulation, such as radiant warmers and garments for kangaroo mother care were consistently available in 71% of the facilities.
Conclusions: As ANN units strive to meet SDG 3.2, this study shows that there is room for improvement with regards to the human resources and equipment available for neonatal resuscitation in these facilities.

Keywords: Infant, Newborn; Infant, Preterm; Resuscitation; Midwifery; Neonatal Nursing; African South of Sahara; Global Health

Résumé: *Introduction:* Les soins immédiats prodigués au nouveau-né à la naissance sont essentiels pour prévenir la morbidité et la mortalité néonatales liées aux événements survenant pendant l'accouchement. Il est impératif de s'attaquer à ces décès pour que les pays africains puissant atteindre les objectifs de la cible 3.2 des Objectifs de développement durable.
Méthodes: Quatorze hôpitaux membres du Réseau Néonatal

Erika M. Edwards
Danielle E. Y. Ehret
Vermont Oxford Network and University of Vermont, Burlington, Vermont, USA

Melissa Muparamoto,
Nyaradzo Nyamburi
Mbuya Nehanda Maternity Hospital, Harare, Zimbabwe

Elizabeth Siraha
Great Zimbabwe University, Zimbabwe

Gemechis Wari
St. Paul's Hospital Millenium Medical College, Addis Ababa, Ethiopia

Susan Niermeyer
University of Colorado School of Medicine, Aurora, Colorado, USA

Misrak Tadesse
Vermont Oxford Network and Johns Hopkins University School of Medicine, Baltimore, Maryland, USA

Africain ont répondu à une enquête annuelle sur les établissement sainsi qu'à une enquête sur les structures de santé, co-développée par les membres du corps professoral du Réseau Néonatal Africain et du Vermont Oxford Network. Toutes les analyses ont ét éréalisées à l'aide de statistiques descriptives.
Résultats: Dans 10 établissements (71 %), les sages-femmes des unités de travail et d'accouchement étaient les plus susceptibles de prodiguer la réanimation de routine et les soins essentiels au nouveau-né, tant pour les naissances à faible risque que celles à haut risque. Onze hôpitaux (79 % sur 14) disposaient d'une directive ou d'un protocol stipulant que tout professionnel de santé impliqué dans les accouchements devait recevoir une formation en reanimation néonatale. Concernant le transfert des nouveau-nés nés sur place de la salle d'accouchement vers l'unité néonatale, 9 hôpitaux (64%) ont déclaré disposer d'oxygène à 100 %, 8 (57 %) de CPAP, 6 (43 %) de l'oxymétrie de pouls continue et 1 (7 %) d'oxygène mélangé plus de 90 % du temps. Tous les hôpitaux ont signalé une disponibilité constante du matériel de réanimation, tel que des masques pour prématurés et à terme ; toutefois, les insufflateurs autoremplisseurs étaient disponibles de manière constante dans 93 % des établissements. Le matériel de thermorégulation, tel que les réchauffeurs radiants et les vêtements pour le peau-à-peau selon la method kangourou, était disponible de façon constante dans 71 % des établissements.
Conclusions: Alors que les unités du Réseau Néonatal Africain s'efforcent d'atteindre la cible 3.2 des ODD, cette étude montre qu'ilexisteune marge d'amélioration en ce qui concerne les resources humaines et l'équipement disponibles pour la reanimation néonatale dans ces établissements.

Introduction

The transition from intrauterine to extrauterine life is the most critical physiologic adaptation in human life. The establishment of breathing represents a profound shift from dependence on placental respiration to the self-sustaining system of gas exchange in the infant lung.[1]

There are an estimated 10 million newborns annually who do not make this transition well and consequently do not breathe at birth. Globally 2.3 million babies die in the first 28 days of life and an estimated 12% of under-five deaths are due to intrapartum related events (also called birth asphyxia). Sub-Saharan Africa, where annual neonatal deaths have stagnated at about 1 million, bears the greatest burden of under-five deaths in the world. Evidence shows that these under-five deaths are increasingly concentrated in the neonatal period.[2,3]

Dol *et al.* in their recent systematic review and meta-analysis provided evidence on the timing of overall and cause specific neonatal mortality. The highest proportion (39.1%) of neonatal deaths occur in the first 24 hours of life and birth asphyxia was linked to two-thirds of those deaths occurring in the first 24 hours of life.[4] Berkelhameret al. in their review article on neonatal resuscitation in low resource settings argued that while it is frequently reported that 10% of newborns require support or stimulation to breath at birth, the percentages of babies requiring support to breathe in some rural settings may actually be as high as 16-21%.[5]

The highest burden of asphyxiated babies is in low- and middle-income countries (LMICs) where the health facilities may not have the capacity to provide basic resuscitation.[6,7] Neonatal resuscitation is defined as the set of interventions required at the time of birth to support the establishment of breathing and circulation. The training programs on neonatal resuscitation, the Neonatal Resuscitation Program (NRP) and Essential Newborn Care Course (ENCC), have found widespread acceptance globally as practical tools to improve newborn survival and reduce deaths from adverse intrapartum events.[8] Lee *et al.* in a systematic review, meta-analysis and Delphi estimation of mortality effect estimated that neonatal resuscitation and training in health facilities reduces intrapartum-related deaths in term babies by 30%.[9] There is, however, limited research from LMICs on neonatal resuscitation, with the majority being of small sample size that have limited grade of evidence. Application of research from high income countries to LMICs may not be feasible due to differences in environment, socioeconomic, nutrition, facilities for monitoring of mothers and newborns.[10] There is also a dearth of current evidence on the coverage of neonatal resuscitation: the personnel, the level of training, and the access to equipment for those personnel undertaking this highly important intervention in the countries where most neonatal deaths occur.

As the year 2030 draws near, it has become exigent that countries in sub-Saharan Africa need to accelerate their interventions for the care of the newborn around the

time of birth to achieve the Sustainable Development Goals of reducing neonatal mortality to ≤ 12/1000 live births by 2030. In this study, we seek to understand the landscape of neonatal resuscitation practices as it relates to the personnel, the training, availability of equipment, and the logistic support across the 14 ANN member hospitals in five sub-Saharan African countries.

Methods

Data were collected in 14 ANN member hospitals across five countries: Ethiopia, Nigeria, Rwanda, Uganda, and Zimbabwe.

Vermont Oxford Network (VON) conducts an annual survey for members that was co-developed with ANN faculty members, which includes information on the hospital setting, number of beds and admissions, staffing, obstetric service, follow-up clinic, resuscitation and essential newborn care, transfers and transport, family-centred care, services provided by the neonatal unit, guidelines in the neonatal unit, quality assurance/ continuous quality improvement, and level of neonatal care. Participation in the membership survey is mandatory. The responses used for this manuscript are from 2023.

In October 2023, the ANN conducted an electronic-based health facility assessment to collect more detailed information on buildings and facilities, medications, diagnostics and consumables, equipment, staffing, governance, thermal regulation and foetal transition, nutrition, family-centred care and kangaroo mother care, infection prevention and control, and perceived priorities.

Tables of hospital-level measures include data from both the membership survey and the health facility assessment. All analyses are descriptive.

The collaborative QI project and subsequent assessments received individual and hospital institutional research and ethics review approvals at the start of the collaborative and learning initiative.

Results

Staffing and Staff Training

In 10 (71%) of 14 facilities, midwives in the labour and delivery units were most likely to provide routine resuscitation and essential newborn care of both low-risk and high-risk births. Only about a third of these procedures are conducted by paediatric residents, paediatricians, or neonatologists (Table 1). Eleven of fourteen hospitals (79%) had a guideline or protocol stating that every healthcare worker involved with births should receive neonatal resuscitation training. Eleven hospitals (79%) reported that neonatal resuscitation guidelines, admission assessment guidelines, and hypothermia management or temperature support guidelines were used consistently.

Table 2 shows the proportion of healthcare providers who have attended formal, in-person neonatal resuscitation training within the preceding two years, grouped by professional roles and experience levels. In most hospitals, at least 90% of specialist nurses had received training in the last two years while two hospitals had fewer than 10% of midwives receiving such training.

Almost all hospitals reported having a formal resuscitation training program for junior doctors joining the unit (Table 3). However, four hospitals reported not having a formal training program for new nurses. About 50% of hospitals reported that junior doctors and nurses had formal resuscitation courses with about two-thirds of hospitals reported in-person tutorials were given by other members of the neonatal team. In over 70% of the hospitals, there was no formal system to train junior doctors and nurses in newborn resuscitation.

Overall, four hospitals (29%) reported that 61% or more of the nursing staff attended Emergency Obstetric and Newborn Care (EmONC) or Essential Newborn Care training in the past five years, while five hospitals (36%) reported that 61% or more of the medical staff attended such training (Table 4).

Delivery Room Care and Transfer to Neonatal Unit

Thirteen of 14 hospitals reported that inborn and outborn transfers occurred “as soon as possible” while 1 hospital reported that outborn transfers needed to be reviewed by a member of the neonatal team first. For the transfer of inborn infants from the labour ward or operating room to the neonatal unit, most hospitals reported having oxygen (9, 64%), CPAP (8, 57%) and continuous pulse oximetry (6, 43%) available more than 90% of the time. Only 1 (7%) hospital reported the use of blended oxygen consistently. Measures to prevent hypothermia such as plastic bag/wrap, hats, heated and humidified respiratory gases, heated incubators or radiant warmers, and transferring mothers with infants in the kangaroo position, were less likely to be used. (Fig 1)

Equipment

All the hospitals reported consistent availability of equipment such as preterm and term masks. However, self-inflating bags were consistently available in 93% of the facilities. Equipment for thermoregulation, such as radiant warmers and garments for kangaroo mother care (KMC), were consistently available in 71% of the facilities.

Table 1: Responsibility for routine resuscitation and essential newborn care at 14 African Neonatal Network member hospitals

	Routine resuscitation		Preterm resuscitation		Essential newborn care	
	#	%	#	%	#	%
Midwife	10	71	9	64	10	71
Labour& delivery nurse	5	36	3	21	6	43
General practitioner	4	29	5	36	3	21
Pediatrician/ neonatologist	4	29	5	36	2	14
Pediatric resident	3	21	5	36	3	21

Note: Responses were “check all that apply”. Percentages do not add to 100%.

Fig 1: African Neonatal Network hospitals reporting occurrence of interventions >90% of the time during transfer of VLBW infant from labour to neonatal unit

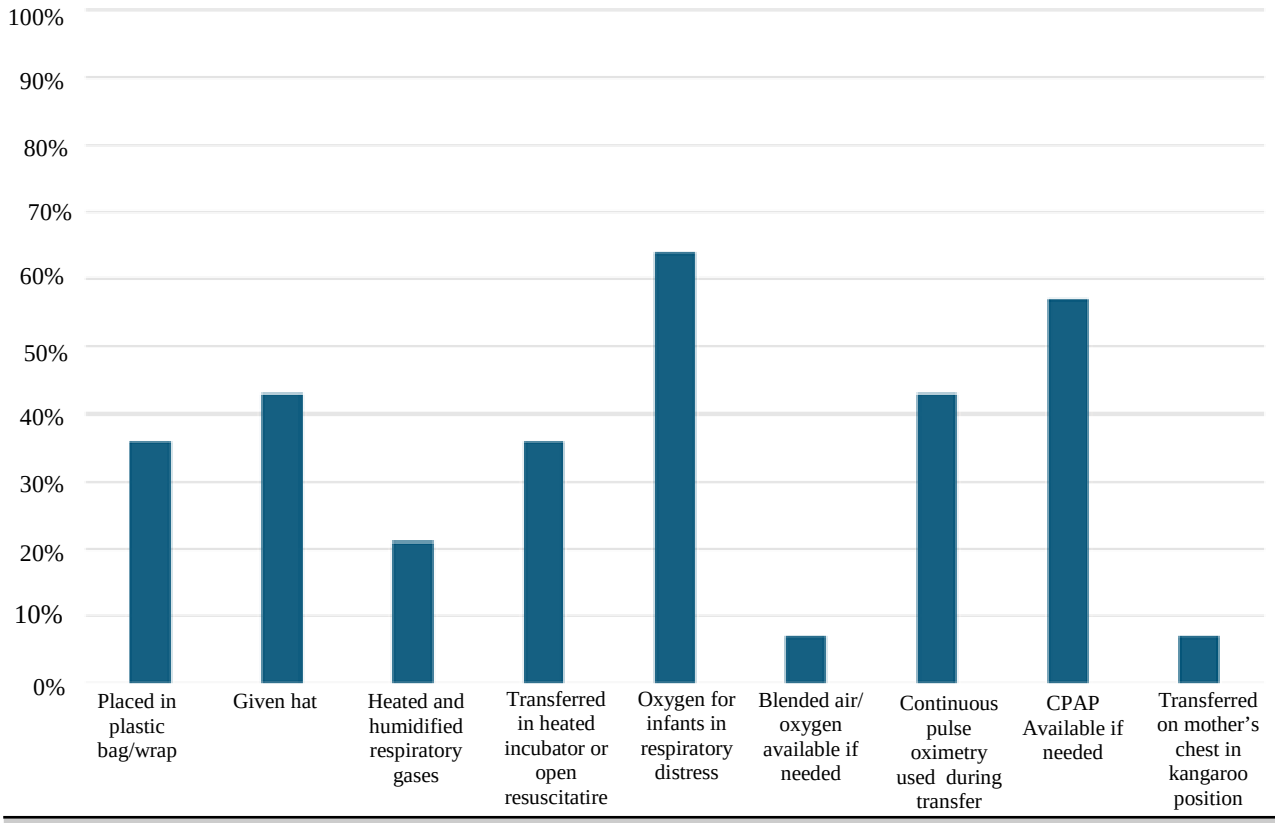

Table 2: Percent attended an in-person, formal resuscitation training in last two years at 14 African Neonatal Network member hospitals

	Senior doctors > 5 years since graduation		Junior doctors < 5 years since graduation		Specialist nurses		Midwives	
	#	%	#	%	#	%	#	%
<=10%	0	0	0	0	2	14	2	14
11 to 40%	0	0	0	0	0	0	1	7
41 to 60%	3	21	3	21	3	21	2	14
61 to 90%	3	21	5	36	2	14	4	29
>=91%	5	36	3	21	7	50	4	29
NA	3	21	3	21	0	0	1	7

Table 3: Resuscitation training for junior doctors and nurses joining unit at 14 African Neonatal Network member hospitals

	Formal course lasting >2 hours with hands on training and skills assessment on mannequins		In person tutorial given by another member of the neonatal team		Written or video learning resources		Spend time attached to more senior team member to perform neonatal resuscitations together		No formal system	
	#	%	#	%	#	%	#	%	#	%
Junior Doctors										
Yes	8	57	9	64	4	29	9	64	1	7
No	3	21	4	29	7	50	4	29	11	79
NA	3	21	1	7	3	21	1	7	2	14
Nurses										
Yes	7	50	10	71	5	36	12	86	4	29
No	7	50	4	29	9	64	2	14	10	71

Table 4: Training on Emergency Obstetric and Newborn Care (EmONC) or Essential Newborn Care course in past 5 years at 14 African Neonatal Network

Percent of staff trained	Nurses		Medical Staff	
	#	%	#	%
>90%	1	7	1	7
61% to 90%	3	21	4	29
41% to 60%	5	36	3	21
11% to 40%	2	14	4	29
≤10%	3	21	2	14

Table 5: Consistently available equipment for neonatal resuscitation and thermoregulationat 14 African Neonatal Network member hospitals

	In Delivery Room		In Neonatal Unit	
	#	%	#	%
Thermometer	14	100	14	100
Preterm sized masks	13	93	14	100
Term sized masks	13	93	14	100
Electric suction device	13	93	12	86
Manual suction device	11	79	11	79
Self-inflating bag	11	79	13	93
Clock or timer	11	79	11	79
Blankets	11	79	12	86
Radiant warmers	10	71	12	86
Isolettes	8	64	11	71
Garments for kangaroo mother care	5	36	11	71

Discussion

Although many successes have been achieved globally in the implementation of neonatal resuscitation and reduction of neonatal mortality, bottlenecks to replicating those successes remain in low-resource settings typified by the hospitals in the ANN. Our results on the inconsistent availability of equipment such as those required for thermoregulation align with what had been reported earlier by Enweronu-Laryea et al. on how critical it was that systems prioritize areas for improvement such as the availability of essential commodities, improving workforce and well-integrated health.[11]

The workforce available for neonatal resuscitation in our ANN facilities were largely the nurses and midwives, the majority of whom had not attended formal training programs on neonatal resuscitation or EmONC in the preceding 2 or 5 years respectively. This finding is not unique to the ANN as a recent pooled level of neonatal resuscitation skills among healthcare providers (HCPs) in East Africa was reported to be 48%. The systematic review also identified regional differences in the availability of neonatal resuscitation skills.[12] Disu et al., however, reported that NRP was a well-subscribed training among nurses and doctors in Nigeria. It must be pointed out though that Disu et al.'s report was following 5 years of consistent AAP sponsored trainings on NRP.[13]

The science of neonatal resuscitation as detailed by NRP recommends the use of CPAP when respiratory distress persists after initial resuscitation despite establishment of a normal heart rate and spontaneous respiration. This is because CPAP use reduces the risk of subsequent intubation, surfactant use and ventilator days.[14,15] However, just over half of our ANN facilities reported consistent availability of CPAP if needed. This may be related to the cost, consumables, accessories, maintenance and electrical needs of CPAP devices in LMICs. Other materials for thermoregulation and resuscitation were also sparsely available as had been similarly reported by Lunze and Hamer.[16] It is also important to note that appropriate interventions for immediate care at birth including materials for KMC during neonatal transfer, availability of protective clothing or devices are often neglected in many low resource settings and thereby increasing the risk of neonatal mortality from hypothermia.[17]

Conclusion

This study shows that there is room for improvement with regards to the human resources, equipment and resources available for neonatal resuscitation in ANN facilities. Trained human resources for neonatal resuscitation and respiratory support such as CPAP were not consistently available in the facilities. There is no doubt that high quality resuscitation immediately after birth can reduce the risks of morbidity and mortality from perinatal asphyxia. This paper has highlighted the need for all hands to be on deck to address the key elements in the quality of neonatal resuscitation provided

regarding human resources, the environment and equipment. This stance will rightly position the ANN units to help countries achieve Sustainable Development Goal 3.2.

Acknowledgments

We are indebted to our colleagues at the following hospitals who submit data to VON on behalf of infants and their families: St. Paul's Millennium Medical College, Addis Ababa, Ethiopia; Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia; Tirunesh Beijing Hospital, Addis Ababa, Ethiopia; Assosa Hospital, Asosa, Ethiopia; Hawassa Referral Hospital, Awassa, Ethiopia; Ayder Hospital, Mekelle, Ethiopia; Federal Teaching Hospital Ido-Ekiti, Ekiti, Nigeria; Sacred Heart Hospital, Abeokuta, Nigeria; King Faisal Hospital, Kigali, Rwanda; Mengo Teaching Hospital, Kampala, Uganda; St Francis Nsambya Hospital, Kampala, Uganda; Lubaga Hospital, Kampala, Uganda; Murambinda Mission Hospital, Harare, Zimbabwe; Neocare Baby Hospital, Harare, Zimbabwe.

Funding: Bill and Melinda Gates Foundation INV-042791

References

1. Hillman N, Kallapur SG, Jobe A. Physiology of transition from intrauterine to extrauterine life. *Clin Perinatol. 2012 Dec;39(4):769–83.*
2. Singhal N, Bhutta ZA. Newborn resuscitation in resource-limited settings. Seminars in Fetal and Neonatal Medicine. *2008 Dec 1;13(6):432–9.*
3. Lawn JE, Manandhar A, Haws RA, Darmstadt GL. Reducing one million child deaths from birth asphyxia – a survey of health systems gaps and priorities. *Health Res Policy Syst. 2007 May 16;5:4.*
4. Dol J, Hughes B, Bonet M, Dorey R, Dorling J, Grant A, et al. Timing of neonatal mortality and severe morbidity during the postnatal period: a systematic review. *JBI Evidence Synthesis. 2023 Jan;21(1):98–199.*
5. Berkelhamer SK, Kamath-Rayne BD, Niermeyer S. Neonatal resuscitation in low-resource settings. *Clin Perinatol. 2016 Sep;43(3):573–91.*
6. Lawn JE, Lee AC, Kinney M, Sibley L, Carlo WA, Paul VK, et al. Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done? *Int J Gynaecol Obstet. 2009 Oct;107:S5–19.*
7. Wall SN, Lee AC, Niermeyer S, English M, Keenan WJ, Carlo W, et al. Neonatal resuscitation in low-resource settings: What, who, and how to overcome challenges to scale up? *Int J Gynaecol Obstet. 2009 Oct;107:S47–64.*
8. Niermeyer S. From the Neonatal Resuscitation Program to Helping Babies Breathe: Global impact of educational programs in neonatal resuscitation. *Semin Fetal Neonatal Med. 2015 Oct;20(5):300–8.*
9. Lee ACC, Cousens S, Wall SN, Niermeyer S, Darmstadt GL, Carlo WA, Keenan WJ, Bhutta ZA, Gill C, Lawn JE. Neonatal resuscitation and immediate newborn assessment and stimulation for the prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. *BMC Public Health. 2011 Apr;11(Suppl 3):S12.*
10. Nimbalkar AS, Shukla VV, Phatak AG, Nimbalkar SM. Newborn care practices and health seeking behavior in urban slums and villages of Anand, Gujarat. *Indian Pediatr. 2013 Apr;50(4):408–10.*
11. Enweronu-Laryea C, Dickson KE, Moxon SG, Simen-Kapeu A, Nyange C, Niermeyer S, Begin F, Sobel HL, Lee ACC, von Xylander S, Lawn JE. Basic newborn care and neonatal resuscitation: a multi-country analysis of health system bottlenecks and potential solutions. *BMC Pregnancy Childbirth. 2015;15 Suppl 2 (Suppl 2):S4.*
12. Eyeberu A, Yadeta E, Mezmur H, Motuma A, Debella A. Neonatal resuscitation skill among health care providers in Eastern Africa: A systematic review and meta-analysis. *Global Pediatr. 2025 Mar 1;11:100248.*
13. Disu EA, Ferguson IC, Njokanma OF, Anga LA, Solarin AU, Olutekunbi AO, Ekure EN, Ezeaka VC, Esangbedo DO, Ogunlesi TA. National neonatal resuscitation training program in Nigeria (2008-2012): *A preliminary report. Niger J Clin Pract. 2015 Feb;18(1):102.*
14. Dunn MS, Kaempf J, de Klerk A, de Klerk R, Reilly M, Howard D, Ferrelli K, O'Conor J, Soll RF; Vermont Oxford Network DRM Study Group. Randomized trial comparing 3 approaches to the initial respiratory management of preterm neonates. *Pediatr. 2011 Nov;128(5):e1069-1076.*
15. Kirpalani H, Nelin L, Abman SH. Extending nasal continuous positive airway pressure for preterm infants: new targets for an old device. *Am J Respir Crit Care Med. 2025 Apr;211(4):550–1.*
16. Lunze K, Hamer DH. Thermal protection of the newborn in resource-limited environments. *J Perinatol. 2012 May;32(5):317–24.*
17. Mullany LC. Neonatal hypothermia in low-resource settings. *Semin Perinatol. 2010 Dec 1;34(6):426–33.*