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Assessment of health workers knowledge of neonatal transport services in Southern Nigeria: A pre-and post-intervention study

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Abstract: *Background:* Sick or at-risk newborns delivered out-of-hospital in Nigeria often require a transfer to higher levels of care. However, these newborns are usually doubly challenged with being commuted using substandard transport modalities to referral centres in urban areas, which significantly affects survival. Whether healthcare workers in low-resourced settings know about efficient neonatal transport services remains unknown, justifying the need for this study.
Methods: This was a pre- and post educational intervention study carried out among healthcare workers from 28 health facilities in Port Harcourt Metropolis. Healthcare workers' knowledge of pre-transport stabilization, appropriate referral, and in-transit care of at-risk and sick neonates was assessed using a structured questionnaire. Educational training was conducted through modules adapted from the National Comprehensive Newborn Care guidelines. Data was analyzed using SPSS Version 23 and the effect of training was assessed using a paired t-test.
Results: The mean pre-test knowledge score was 55.82%±12.5% and the mean post-test knowledge score was 85.27%±18.3%. There was a statistically significant increase in mean knowledge scores [Mean difference: -29.45; 96% CI: (-41.61 to – 17.30); p= 0.0001], with a significant [p= 0.024] increase in knowledge scores in the 'appropriate referral' domain.
Conclusion: There is suboptimal knowledge of neonatal transport services among health workers in Southern Nigeria. Training significantly improved their knowledge of pre-transport stabilization, appropriate referral, and in-transit care in neonatal transport. There is a need to formulate a standard training curriculum for neonatal transport and train healthcare workers in the effective modes of neonatal transport, including the use of the Kangaroo mother position.

Keywords: Neonatal transport, Sick neonates, Neonatal transport team, Training, Nigeria

Résumé: *Contexte:* Au Nigeria, les nouveau-nés malades ou à risque nécessitent souvent d'être transférés vers des structures sanitaires de référence. Cependant, ces nouveau-nés sont généralement confrontés à des moyens de transport inappropriés vers ces centres de référence des zones urbaines. Ce qui affecte considérablement leur survie. Le niveau de connaissance des professionnels de la santé dans les régions à faibles ressources vis-à-vis des moyens de transport étant peu connue ; ce qui justifie la nécessité de cette étude.
Méthodologie: Il s'agit d'une étude pré- et post-intervention éducative, menée auprès du personnel de santé de 28 établissements de soins de la métropole de Port Harcourt. Les connaissances du personnel en matière de la stabilisation avant le transport, la référence appropriée et les soins en cours de transport des nouveau-nés à risque et malades ont été évaluée à l'aide d'un questionnaire structuré. La formation a été dispensée à l'aide des modules basés sur les lignes directrices nationales sur les soins complets aux nouveau-nés. Les données ont été analysées à l'aide

du logiciel SPSS version 2.3 et l'effet de la formation a été évalué à l'aide d'un test t apparié.
Résultats: Le score moyen des connaissances avant le test était de 55,82%±12,5% et le score moyen des connaissances après le test était de 85,27%±18,3%. Il y a eu une augmentation statistiquement significative des scores moyens de connaissances [Différence moyenne : -29,45 ; IC 96% :(-41,61 à - 17,30) ; p= 0,0001], avec une augmentation significative [p= 0,024] des scores de connaissances dans le domaine de "la référence appropriée".
Conclusion: La connaissance des conditions appropriées de transport néonatal est faible chez les agents de santé du sud du Nigeria. La formation a amélioré de manière significative leurs connaissances sur la stabilisation avant le transport, la référence appropriée et les soins pendant le transport. Il est nécessaire de formuler un programme de formation standard pour le transport des nouveau-nés et de former les agents de santé aux modes efficaces de transport, y compris l'utilisation de la position de la mère Kangourou.

Mots-clés: Transport néonatal, nouveau-nés malades, équipe de transport néonatal, formation, Nigeria

Introduction

Neonatal transportation is collaborative teamwork between the neonatal transport team, and caregivers at the referring and receiving (referral) facilities such that there is good ongoing communication to allow for prompt resuscitation, stabilization, and safe retrieval of the neonate promptly.[1] Safe transportation of the sick neonate requires that the transporting team members be knowledgeable and skilled in the delivery of care appropriate to the needs of the critically ill neonate.[1] Similarly, retrieval of sick neonates by a dedicated expert team has been shown to result in better conditions on arrival at the referral facility compared to facility-based transport services.[2] A successful inter-facility transport of sick neonates requires a high index of suspicion to identify high-risk pregnancies, newborns at risk of deterioration and sick neonates.

The composition of neonatal transport teams varies, involving diverse combinations of healthcare professionals such as Senior Residents or Neonatal Nurses, Registered Nurses, and Paramedics. The Transport Team must possess besides knowledge, a comprehensive proficiency in key competencies, including but not limited to, intubation, intravenous access insertion, umbilical/ arterial catheter placement, chest tube insertion, and resuscitation techniques.[1] The facilitation of an effective Neonatal Transport System (NNT) necessitates the organizers' commitment to establishing a conducive work environment for the Neonatal Transport Team (NNTT), achieved through strategic considerations such as optimal work design, active engagement, and comprehensive training initiatives.[3]

Similarly, effective neonatal transfers demand careful consideration of the presence and functionality of essential equipment in appropriate quantities. The equipment encompasses a range of items critical for neonatal care, such as a neonatal ambulance furnished with a transport incubator, a continuous positive airway pressure (CPAP) machine with nasal prongs, and a portable ventilator.[1] Additionally, provisions for airway maintenance are essential, including suction devices, oxygen, compressed air, oxygen masks, infusion equipment, and consumables. The paramount objective of the transport team revolves around promptly and securely retrieving sick newborns and conveying them to advanced medical facilities. This process necessitates meticulous attention to timing and safety throughout the transportation journey and thus buttresses the need for healthcare workers to be abreast with recent evidence-based recommendations.[1]
Several studies have documented the causes of neonatal morbidity and mortality in Nigeria.[4,5] Despite multiple strategies and intervention programmes such as the Safe Motherhood Initiative, Essential Newborn Care, and Comprehensive Newborn Care, Nigeria's neonatal mortality rate (NMR) which is currently at 35 per 1000 live births has only changed little in the past two to three decades.[6] The limited availability of neonatal intensive care units (NICU) across the country which are often operating at full capacity, also implies that sick neonates may be transported from one NICU facility to another before accessing needed care. As a result, a distressing number of neonates either arrive at referral centres in a hypothermic state, significantly increasing their risk of mortality, or tragically, are pronounced deceased upon arrival.[4,7–9] However, attention has not fully been drawn to out-of-hospital deliveries and neonatal transport with about two-thirds of deliveries occurring outside formal settings where transfer of at-risk and sick neonates is often inevitable. There is a dearth of literature on neonatal transport services in Nigeria and to the best of the authors' knowledge, no study has evaluated health workers' (HCWs) knowledge of neonatal transport in Nigeria. This study therefore aimed to evaluate the effect of training on pre-transport stabilization, referral practice and in-transit care of at-risk and sick neonates as components of efficient neonatal transport on health workers' knowledge scores in Nigeria.

Materials and Methods

Type of Study

Before and after educational interventional study

Study site

Rivers State is situated in the south-south part of the Niger Delta Region of Nigeria and is made up of 23 Local Government Areas (LGAs). The state capital is Port Harcourt Metropolis, which comprises Port Har

Harcourt city LGA and Obio-Akpor LGA respectively. In Port Harcourt, there are 28 Primary health centres (PHCs): [13 in PHALGA and 15 in Obio-Akpor LGAs] that provide round-the-clock obstetric and Level I newborn services. The state also has 2 government-owned tertiary hospitals, 2 secondary health facilities and 11 private facilities providing at least Level II neonatal care services.[10]

Study period

This training was part of a 2-staged study involving key healthcare workers in 28 health facilities conducted on the 14th of December 2023.[11]

Training Process and Modules Taught: The educational intervention [training workshop] on efficient neonatal transport had three sub-themes: Pre-transport stabilization, Appropriate referral, and In-transit care of at-risk and sick neonatal transport. Pre- and post-training tests were administered to assess the effect on HCW's knowledge. Modules were taught by authors who are national-certified comprehensive newborn care trainers. Modules and questions were from the Federal Ministry of Health's recommended Manual for Comprehensive Newborn Care.[12] The 15 (best of four) question sets used in the pre and post-test were adapted from the recommended manual and were grouped into three main categories with each subsection consisting of 5 questions. Each question answered correctly was scored 1 point and any wrong answer was scored 0. Total scores were converted to a percent and the pass cut-off score was taken as 70%.

Statistical Analysis

Data was analyzed using SPSS Version 23. The effect of training on healthcare workers' knowledge of the components of efficient transport based on participants' performance scores was analyzed using a paired t-test and Cohen-d score determined.

Ethical approval for the study was permitted by the University of Port Harcourt, the Rivers State Hospitals Management Board (RSHMB) and the Rivers State Primary Health Care Management Board (RSPHCMB). Verbal informed consent was also obtained from the facility heads of the private hospitals. Participants from six PHCs did not complete the intervention post-test and were excluded from the final analysis.

Results

Sociodemographic characteristics of participants in the study

There were 28 healthcare workers representing the facilities where they practised who participated in the study, the majority were females (82.1%). Concerning age, eleven participants (39.3%) were in the fifth decade (40 – 49 years). More than half 16 (57.1%) had tertiary education as the highest level of education attained; About a third of participants had worked for between 11 – 15 years in a paediatric/ neonatal department (Table1).

Table 1: Sociodemographic characteristics of participants, Type and Level of care of selected health facilities

Characteristics	Frequency N = 28	Percent (%)
Sex		
Female	25	82.1
Male	3	11.9
Age (Years)		
30-39	7	25.0
40-49	10	35.7
50-59	11	39.3
Educational level		
Tertiary	16	57.1
Postgraduate	12	42.9
Professional qualification		
Medical Officer	12	42.9
Nurse/Midwife	10	35.7
Paediatrician	6	21.4
Number of years of experience		
5-10		
11-15	5	17.9
16-20	9	32.1
21-25	3	10.7
26-30	5	17.9
>30	4	14.3
Type of health facility	2	7.1
Private	7	25.0
Public	21	75.0
Level of healthcare services rendered		
Primary	12	42.9
Secondary	9	32.1
Tertiary	7	25.0

HCWs' knowledge of obstetric and neonatal indications for referral to a higher level of care

Maternal heart failure, gestational diabetes mellitus, and Preeclampsia/Eclampsia were the leading indications for obstetric referrals reported by 25 respondents (89.3%), 24 (85.7%) and 23 respondents (82.1%) respectively (Table 2). For indications for neonatal referrals, 26 respondents (92.9%) reported critical congenital heart diseases as the lead indication for neonatal referrals to higher levels of care. Loss of consciousness, dysmorphic features at birth and reduced urine output in neonates were reported by 23 respondents (82.1%) as indications for neonatal referral to higher centres (Table 2).

Table 2: HCWs' knowledge of obstetric and neonatal indications for referral to a higher level of care

Obstetric Indications	Frequency N = 28	Percent (%)
Maternal heart failure	25	89.3
Gestational Diabetes mellitus	24	85.7
Preeclampsia/Eclampsia	23	82.1
Hypertension in pregnancy	22	78.6
Preterm labour	22	78.6
Placenta praevia	21	75.0
Chorioamnionitis	21	75.0
Preterm/Prelabour Rupture of Membrane	20	71.4
Multiple pregnancies	20	71.4
Unfavourable maternal pelvis	20	71.4
Previous multiple caesarean section	20	71.4
Abnormal presentation in labour	18	64.3
Co-existing Uterine Fibroid	17	60.7
Neonatal Indications	*Frequency (N=28)*	*Percent (%)*
Critical Congenital Heart Diseases	26	92.9
Abdominal distension	24	85.7
Loss of consciousness	23	82.1
dysmorphic features at birth	23	82.1
Reduced Urine output	23	82.1
Birth asphyxia	22	78.6
Prematurity	22	78.6
Seizures	21	75.0
Vomiting/Passage of bloody stool	21	75.0
Cyanosis	21	75.0
Delayed passage of meconium	21	75.0
Respiratory distress	20	71.4
Weakness	18	64.3
Low birth weight	18	64.3
Pallor	17	60.7
Jaundice	17	60.7
Poor suck	16	57.1
Hypoglycaemia	16	57.1

Participants knowledge of the composition of the Transport Team, Support Equipment and In-transit care during neonatal transportation in Port Harcourt

As shown in Table 3, participants from most health facilities correctly identified Nurses as members of NNTT. However, less than 50% identified Pediatricians, Medical Officers (42.9%), and anaesthetists (32.1) as members of the NNTT. Although over 60% included oxygen sources, less than 20% of the participants identified CPAP, transport incubator and neonatal ventilator as supportive equipment needed for neonatal transport. Twenty-one (75.0%) of participants listed vital signs monitoring, about 50% included blood sugar monitoring and correction of hypoglycaemia while only 7 (25.0%) included administration of epinephrine and caffeine citrate as part of in-transit care of at-risk and sick neonate respectively.

Table 3: Participants' Knowledge of the composition of the Transport Team, Support Equipment and In-transit care during neonatal transportation

Characteristics	Frequency N = 28	Percent (%)
Members of a neonatal transport team[a]		
Nurse	18	64.3
Paediatrician	13	46.4
Medical officer	12	42.9
Transport technician	10	35.7
Anaesthetists	9	32.1
Nurse assistant	8	28.6
Neonate's relatives	1	3.6
Support Equipment available for transporting a neonate		
Oxygen	17	60.7
CPAP Machine	5	17.9
Resuscitator	5	17.9
Neonatal Ventilator	4	14.3
Transport Incubator	4	14.3
Possible Transit care actions for neonates on referral [a]		
Vital signs monitoring	21	75.0
Correction of hypoglycaemia	16	57.1
Blood sugar monitoring	15	53.6
Intravenous fluid administration	14	50.0
*PPV	11	39.3
Administration of Epinephrine	7	25.0
Administration of Caffeine citrate	7	25.0

[a] *Multiple choices apply *CPAP- Continuous Positive Airway Pressure ** Positive Pressure Ventilation*

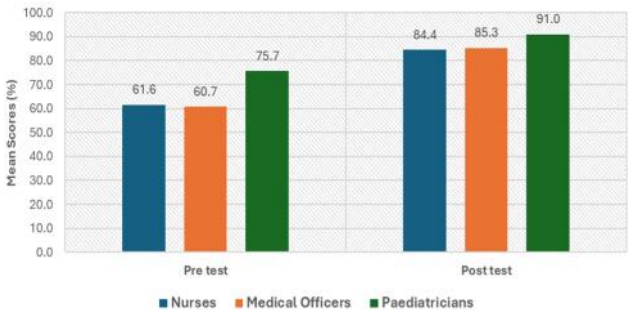
HCWs Mean Knowledge Scores before and after educational intervention

The mean baseline (pretest) knowledge score was 55.82% ± 12.5%. Immediately after the educational intervention, the mean post-test knowledge score was 85.27% ± 18.3%. There was a statistically significant increase in mean knowledge scores [Mean difference (-29.45); 96% CI: (-41.61 to – 17.30); p= 0.0001].

HCWs Mean knowledge scores when stratified by cadre of participants

The paediatricians had higher mean knowledge pretest and posttest scores compared to the other professional cadres. However, the higher scores were not significantly different when compared to the other cadres. For pretest scores: (Paediatrician Vs Medical Officer; 65.25± 16.70 Vs 54.88 ± 15.49; t = -1.090; p= 0.2989) and (Paediatrician Vs Nurses; 65.25± 16.70 Vs 52.67± 10.65; t = -1.663; p= 0.1246). Similarly, for posttest scores (Paediatrician Vs Medical Officer; 91.5± 11.05 Vs 84.4 ± 11.33; t = -1.050; p= 0.3163) and (Paediatrician Vs Nurses; 91.5± 11.05 Vs 84.4 ± 8.41; t = 1.283; p= 0.2257).

Fig 1: Mean knowledge scores by cadre of participants



Also, as seen in Figure 1, the mean knowledge scores stratified by cadre of HCWs demonstrated that for the 9 nurse and 9 Medical Officer participants, there was a statistically significant increase in mean knowledge posttest scores compared to pretest scores (52.67 ± 10.65 Vs 84.4 ± 8.41; t=7.015; p= <0.0001 and (54.88 ± 15.49 Vs 84.4 ± 11.33; t=4.615; p=0.0003) respectively. Likewise, for the four Paediatricians in the study, there was a statistically significant increase in the mean knowledge pretest scores compared to the mean knowledge posttest scores (65.25± 16.70 Vs 91.5±11.05; t=2.622; p=0.0395).

HCWs' absolute aggregate knowledge scores categorised into the three main domains

An assessment of HCWs' absolute aggregate knowledge scores categorised into the three main domains revealed that the 'Appropriate Referral' domain had the lowest pre-training scores but was also the most improved (p= 0.024) post-training when compared to the other domains. Overall, the aggregate pre-test scores were sub-optimal but significantly improved (P=0.008) after immediate post-training as depicted in Table 4.

Table 4: Assessment of HCWs' absolute aggregate knowledge scores categorised into the three main domains

Domain	Pre-test (n=22)	Post-test (n=22)	t-test	P-value
Appropriate Referral				
Q1: Safest way to transfer at-risk foetus/ sick neonates	5	21		
Q2: Who decides to transfer sick neonate	14	21		
Q3: Information communication	16	19		
Q13: Kangaroo Mother Care Transport	17	22		
Q15: Two-way referral between referred/referral	6	20		
Subtotal	58	103	3.5301	0.024*
Pre-transport stabilization				
Q4: Respiratory management during pretransfer stabilization	22	22		
Q5: Cardiovascular stability	12	10		
Q6: Category of babies not requiring trained medical accompaniment	21	20		
Q8: Components of appropriate referral of at-risk neonates	19	22		
Q12: Important steps to minimise asphyxia	12	14		
Subtotal	86	88	0.4313	0.688
In-transit care of at-risk and sick neonatal transport				
Q7: Concerning neonatal transfer, which is true?	9	15		
Q9: Best mode of transporting at-risk neonates in PH metropolis	21	22		
Q10: What health personnel should ensure during inter-facility transfer	11	20		
Q11: Appropriate steps to be carried out during transit	20	21		
Q14: Most important intra-transport care for sick neonates?	22	22		
Subtotal	83	100	1.9437	0.124
Overall	227	291	3.0956	0.008*

Discussion

This study sought to assess healthcare workers' knowledge of neonatal transport services and the indications for transfer and in-transit care of at-risk and sick neonates. The study found that although participants from surveyed facilities demonstrated a good knowledge of obstetric and neonatal indications for the transfer of at-risk and sick neonates, there was a paucity of knowledge concerning the required supportive equipment and in-transit care. Similarly, apart from vital signs monitoring, participants' knowledge of in-transit care (blood glucose monitoring, administration of caffeine citrate, and maintenance fluid management were sub-optimal. This is plausibly due to the lack of formal training on the three key components (pre-transport stabilization, appropriate referral, and in-transit care) of efficient neonatal transport. This was buttressed by earlier studies in Nigeria [4,13] which found that no aspect of referral was adequate (communication, pre-transport stabilization or the actual transportation) among the cohort of neonates transferred from any type of peripheral or tertiary facility to the referral centres.

Predictable was the observation that paediatricians appeared to be more informed – earning higher baseline scores – compared to other cadre of the healthcare team. However, in comparison, the higher scores did not reach statistical significance. This highlights the need for focused training in this under recognized aspect of newborn care. Post educational intervention, there was a significant increase in all the participants' knowledge scores with the most improved aspect being in the

'appropriate referral' domain. Our findings hold significant relevance within our context and warrant attention.

We observed that healthcare workers exhibited inadequate knowledge of the two-way referral system and faced communication challenges. Additionally, there was uncertainty regarding who should initiate the transfer of sick neonates and which healthcare personnel should be present to ensure cardiovascular stability during the transfer process, with these aspects scoring the lowest. These findings have critical implications, such as delays in initiating inter-facility transfers, an inability to respond promptly to sudden emergencies during transit, and the risk of referral hospitals being ill-prepared to receive sick neonates due to poor communication, all of which can contribute to neonatal morbidity and mortality.

Furthermore, our observations suggest that the lack of knowledge regarding appropriate referrals extends to the underutilization of proven, evidence-based, and cost-effective neonatal transport practices, such as the kangaroo mother care (KMC) method, despite its endorsement by the Federal Ministry of Health. Although an earlier study in Nigeria found that only 53.5% practice KMC it did not assess its use for neonatal transport.[14] This aligns with a recent systematic review of neonatal transport practices in sub-Saharan Africa,[15] which found that KMC, despite its known benefits for improving neonatal outcomes, is not being widely employed. To address these issues, there is a clear need for improved training of HCWs, which could serve as a key factor in enhancing neonatal outcomes[15].

Training of health manpower is an effective means of building capacity and improving the quality of care. In their 2013 study in South Africa, Nsibande and colleagues[16] investigated the efficacy of the referral system among community health workers. They discovered a strong compliance rate, as 95% of referred mothers arrived at the referral urban health centres. The authors proposed that community health workers could take the lead in enhancing newborn health outcomes. In our study, the training was carried out by qualified resource persons and adapted from the national guideline on newborn referral/transportation which brought about significant improvement in health workers' knowledge scores. Although the authors did not find any other studies within sub-Saharan Africa specifically addressing the training of HCWs on neonatal transport, our findings were consistent with improving knowledge scores as was noted in an earlier educational interventional study among HCWs in Rivers State where health workers were trained on basic neonatal resuscitation which was aimed at improving neonatal survival immediately after birth.[10] Nevertheless, a verbal discussion with the Director of training at the College of Health Technology – centre for training Community Health Workers and medical paramedics in Rivers State, revealed that there is no formal training programme on neonatal transport services in the institution. While there is an ongoing move to reactivate the emergency ambulance response services in Rivers State, policy makers and stakeholders should be alerted on the need to also provide service coverage for the sick and at-risk newborns within and outside the State.

Conclusion

This is the first study in Nigeria to address the impact of inefficient neonatal transport practice as a major driver of the poor neonatal indices in the country. We evaluated the HCWs knowledge of the indications for neonatal transport services and assessed the immediate effect of training on their knowledge of the key components of neonatal transport (pre-transport stabilization, appropriate referral and in-transit care) in Port Harcourt Metropolis, Rivers State Nigeria.

Recommendations

There is an urgent need to develop an educational curriculum for the training of emergency neonatal transport personnel in Nigeria. There is need for a statewide training of HCWs involved in delivery services and the care of neonates on the three components of efficient neonatal transport. Furthermore, there is an urgent need to provide well-equipped neonatal ambulances stationed at strategic locations across the state connected to uninterrupted 24/7 communication services linked to referring and receiving facilities. A public enlightenment campaign on the benefits of KMC's position as a safe mode of neonatal transport is highly recommended especially in resource-constrained settings, like Nigeria. A wider study in the state and across the nation can be carried out to obtain a broader perspective to further elucidate the magnitude of the problem.

Limitations of the Study

Despite being a pioneer study in this setting which has given an insight into NNTS in Southern Nigeria, it is not without limitations. We only assessed the immediate effect of training on the knowledge of healthcare workers – we were unable to longitudinally assess the impact of the study on referral patterns and neonatal outcomes going forward.

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