Evaluation of the Cognitive Effect of Newborn Resuscitation Training on Health-care Workers in Selected States in Northern Nigeria

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**Abstract**

**Background:** Neonatal deaths contribute significantly to slower progress in under-5 mortality reduction. Lack of sufficiently trained birth assistants partly contributes to early neonatal deaths. Resuscitation training equips frontline health-care workers (HCWs) with requisite knowledge and skills to prevent birth asphyxia. **Objective:** The objective of this study was to evaluate the immediate impact of newborn resuscitation training on cognitive ability of HCWs. **Materials and Methods:** This is a descriptive observational study using pre- and posttraining scores obtained by HCWs who were participants in 1-day training on emergency newborn resuscitation. The Newborn Resuscitation Manual of the UK Resuscitation Council (2006) was used to train HCWs. The course included lectures, skill and scenario demonstrations using mannequins, and basic resuscitation equipment. Cognitive knowledge was evaluated using a pre- and post-training questionnaire. Participants’ scores were collated, analyzed, and results were presented as tables, charts, and descriptive statistics with \( P < 0.05 \) considered statistically significant. **Results:** A total of 293 HCWs completed the course (81 doctors and 212 nurse/midwives), with variable improvements of mean posttraining marks over the pretraining scores. Resident doctors obtained significantly higher mean pre- and post-training marks with lower mean difference than senior doctors and medical officers. The junior nurses obtained significantly higher mean pretraining scores compared to the senior nursing cadre, while the intermediate nursing cadre obtained significantly higher mean posttraining scores compared to senior nurses. **Conclusion:** Resuscitation training improved the knowledge of HCWs. Further evaluation could ascertain impacts on knowledge/skills’ retention and neonatal survival. Preservice training and continuing education for frontline HCWs who conduct deliveries are recommended.

**Keywords:** Neonatal, newborn, resuscitation, life support, training, knowledge, skills

**Résumé**

**Contexte:** les décès néonatals contribuent considérablement à ralentir les progrès de la réduction de la mortalité des moins de 5 ans. Le manque d’assistants à la naissance suffisamment formés contribue en partie aux décès néonatals précoces. La formation de réanimation équipe les travailleurs de la santé de première ligne (TS) de connaissances et de compétences nécessaires pour prévenir l’asphyxie des naissances. **Objectif:** l’objectif de cette étude était d’évaluer l’impact immédiat du nouveau-né formation de réanimation sur la capacité cognitive des travailleurs de la santé. **Matériaux et Méthodes:** il s’agit d’une étude descriptive d’observation utilisant pré- et après formation scores obtenus par les travailleurs de la santé qui participaient à une formation d’une journée sur la réanimation des nouveau-né d’urgence. Le manuel de réanimation nouveau-né du UK ressuscitation Council (2006) a été utilisé pour former les TS. Le cours comprenait des conférences, des compétences et des démonstrations de scénarios en Mannequins et équipement de réanimation basique. Les connaissances cognitives ont été évaluées à l’aide d’un questionnaire avant et après la formation. Les scores des participants ont été rassemblés, analysés et les résultats ont été présentés sous forme de tableaux, de graphiques et de...
Neonatal deaths contribute over 45% of all under-5 mortality globally.\(^1\) In 2012, West Africa had 28% of the global burden of under-5 deaths attributable to neonatal problems, with birth asphyxia and prematurity together causing two-thirds of these deaths.\(^2,3\) Nigeria was among the top three countries that contributed 40% of the global burden of neonatal deaths in 2012.\(^2,4\) Nigeria’s slower progress in neonatal death reduction was largely attributable to the high prevalence of birth asphyxia, which impeded the country’s advancement toward timely attainment of the Millennium Development Goal 4 (MDG4).\(^2,3\) This remains so partly due to inadequacy of skilled personnel who attend to deliveries, along with an inequitable distribution of the few skilled birth attendants in favor of urban areas and tertiary health facilities.\(^4,5\) Neonatal life support (NLS) training is a proven cost-effective intervention that could significantly reduce neonatal mortality through improvement of resuscitation skills of frontline HCWs.\(^6-14\)

Nigeria is the most populous country in Africa, with an estimated population of 182,202,000 and ranks as the 7th with the highest under-5 mortality, which is largely contributed to by a high burden of neonatal mortality.\(^1\) The country also has a health-care worker (HCW)/client ratio of 2.0/10,000 population (2014),\(^15\) and a pediatrician workforce with 492 (2011),\(^13\) all of which corroborate the severe shortage of HCWs. With 7,133,000 annual live births, the country has a hospital delivery rate of 36% and skilled birth attendants’ presence in 38% of deliveries; these inadequacies in health-care workforce contribute to one of the highest under-5 and neonatal mortality rates globally. With under-5 and neonatal mortality rates of 109 and 34 per 1000, respectively,\(^16\) the country was thus unable to reach the 75% MDG reduction benchmarks for under-5 mortality at the end of the MDG period. This deficit, together with inadequate training of health personnel, has led often to frequent redeployment and relocation of HCWs who often lack postbasic skills on newborn care to labor and delivery units. For instance, in Southwest Nigeria, up to 72.6% of nursing staff in secondary health-care facilities were found to have worked in the labor room and special care baby unit within the previous 5 years while only 14.0% had attended neonatal resuscitation training course.\(^17\) This contrasts with the situation in the UK where it is mandatory for HCWs who conduct deliveries to attend a course in neonatal resuscitation followed by a refresher course every 4 years in line with the accreditation guidelines.\(^18\) Trained and motivated HCWs are essential to the provision of equitable and resilient health services while chronic staff shortages could slow down progress toward desirable achievements.\(^19\) The importance of capacity building on neonatal resuscitation cannot be therefore overemphasized. We therefore aimed to evaluate the cognitive impact of NLS training on HCWs who attend deliveries in hospitals across Northern Nigeria.

**Materials and Methods**

**Study areas**

The team conducted seven sessions of the training workshops for a total of 316 HCWs from 44 secondary and tertiary health facilities, which included 34 general hospitals, three teaching hospitals, one federal medical center (FMC), two specialist hospitals, and four comprehensive health centers spread across six states in Northern Nigeria (Jigawa, Gombe, Kano, Kaduna, Niger, and Bauchi).

**Study design**

This is a cross-sectional descriptive study aimed at evaluating the immediate cognitive impact of training on neonatal resuscitation based on the UK Resuscitation Council Guidelines for frontline HCWs,\(^14\) (doctors, nurses, and midwives [MWs]) involved in attending to deliveries in health-care facilities across states in Northern Nigeria.

**Study duration**

The ten training workshops were held at different periods between January 2009 and December 2015, and 25–30 staff from contiguous health facilities within the same state were often trained as a class at the same time for administrative convenience and proximity, as the training team visited the different states.

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**Sample size determination and sampling technique**

A homogeneous purposive sampling was used based on the
shared characteristics of participants, all of who work in service areas where deliveries of newborn infants take place in their hospitals. The participants were invited for the training by their facility management by virtue of their place of work, i.e., those who work in the delivery and neonatal units/wards and the operation theaters or maternity units where deliveries take place. The sample was therefore made up of the total number of HCWs who participated in the training workshop. All those who had full attendance at the various components of the training (pretest, lectures, skill stations, scenarios, airway competency, and posttest) were included. Those who did not participate in any of the stated training components or tests were not certified and were therefore excluded from the analysis.

The composition of the participants included doctors, nurses, and MWs serving in public facilities including general and teaching hospitals. The medical officers (MOs) practicing in secondary hospitals comprised medical graduates with no additional qualification or specialist training and serve in nonacademic settings in contrast to resident doctors undergoing specialist training in teaching hospitals and FMCs. These tertiary facilities provide apprenticeship training for the Fellowship of the Nigerian and West African Postgraduate Medical Colleges under the mentorship and tutelage of consultant fellows. The senior MOs (SMOs) also serve in the state-owned general hospitals, mainly as administrative and clinical supervisors overseeing the health-care services provided by the MOs. The most senior cadre of nurses comprises chief nursing officers (CNOs) and assistant CNO (ACNOs) who provide administrative and supervisory roles in their facilities. The intermediate and junior cadres of nurses constitute the nursing/midwifery workforce, with the former consisting of principal nursing officers (PNOs) and senior nursing officers (SNOs), while the latter include nursing officers (NOs) and MWs.

**Method and tools used for training**

Participants were trained in batches of 25–30 per class per day, over a period of 3 to 6 days in each facility and each batch had a combination of doctors and nurses/MWs irrespective of their rank. The methods for the NLS training included didactic lectures, airway management, skill stations demonstrating the components skills of resuscitation, and scenarios simulating real-life delivery situations. The training items include sets of inflatable mannequins, Laerdal’s ambu bag and mask, neonatal laryngoscopes, oropharyngeal tubes, and fresh umbilical cord among others. The content of the UK Resuscitation Council Provider Manual (2006 Edition)[14] was used to train batches of HCWs at 1-day workshops from January 2009 to December 2015. At the end of the workshop, participants were offered training certificates after writing the posttraining test and provided with a copy of the newborn resuscitation algorithm along with a delivery kit containing bag and mask breathing unit and other essential items recommended for immediate newborn care in developing countries[17] (cord clamps, cotton drapes, mackintosh, cotton wool, methylated spirit, disinfectant, bleach, kidney dishes, cord clamping forceps, and a pair of scissors).

**Training facilitators**

The facilitators were trained and certified in the NLS training of trainers’ course conducted by instructors of the UK Neonatal Resuscitation Council, as part of a medical training initiative in collaboration between the University Teaching Hospital where the facilitators of the NLS training practice and the Stockport NHS Foundation Trust, Greater Manchester, UK. The workshops were jointly organized and conducted by a UK-based registered charity trust of Nigerians, the African Healthcare Development Trust (AHDT) and the team of NLS training facilitators at the University Teaching Hospital Department of Paediatrics. For each round of the training, participants were drawn from both the host hospital and other hospitals in the same state.

**Method and tools of assessment**

The pre- and posttraining tests were “true” or “false” type standardized questions drawn from the core components of the course as contained in the NLS Course Provider Manual.[14] The questionnaire consists of a total of forty items reflecting the three domains of knowledge, attitude, and skills, and the questions were derived from components of the training topics with one mark allocated for each correct response and zero allocated to wrong responses. There were 12 questions from “physiology of newborn resuscitation,” 13 questions from “airway competence,” 7 questions from “chest compressions,” and 8 questions from “oxygen administration, intravenous access, use of drugs, and resuscitation equipment,” giving a total of 40 questions. The tally of marks obtained for each participant was converted to percentage of total (with 40 marks equivalent to 100%).

The same training methods, assessment, and study questionnaires were employed at all the training sessions. The results of pre- and posttraining tests for each session were compiled and later merged into a single database from which the analysis was made. Participants were certified as trained on NLS only after completing all the course components including airway skill competency tests and the posttraining test.

**Data analysis**

The marks obtained by participants at the pre- and post-training tests for workshops conducted over the 7-year period were collated and data were entered into Microsoft® Excel for Mac, 2011 (Version 14.1.0), cleansed, and analyzed using SPSS software version 20 (IBM Corp., Armonk, NY, USA). Results were presented as percentages, means and standard deviations, tables, and charts with $P < 0.05$ regarded as the level of significance. We used a paired t-test to determine if the change in knowledge score within each group and between one group and the other before and after the training was statistically significant. The Ethics and Research Committee of the authors’ teaching hospital approved this study.
RESULTS

Distribution of participants
Of the 316 HCWs who participated, 293 completed the course and these comprised 81 (25.6%) doctors and 212 (67.1%) nursing/midwifery staff, while 7.3% did not complete the training and were neither certified nor included in the analysis. Participants came from 44 health facilities of which 90.9% were state-owned secondary (general and specialist) hospitals with 62.9% of the trainees, while 37.1% came from tertiary hospitals (three teaching hospitals and one FMC). Majority of the participants were nurses/MWs, who were also predominantly female, forming 73.4%. Conversely, there were more male (76.2%) than female doctors in contrast to a predominance of females (73.1%) in the nurses/MWs cadre. Those who formed 7.3% who were excluded from the analysis (13 participants) included six doctors (two females and two males from two teaching hospitals plus two males from two general hospitals) and seven nurses (four females from three general hospitals and one male plus two females from a teaching hospital).

Subcategories of participants
A breakdown of subcategories of participants according to their rank showed that there were more junior nurses/MWs while resident doctors in training (registrars) predominated among doctors. The proportion of senior doctors was 14.3% in contrast to 28.9% of senior nurses [Table 1].

Pre- and posttraining scores of subcategories of participants by rank
Figure 1 shows the pre- and post-training test scores of 81 doctors. The residents obtained higher mean scores of both tests and lower mean score difference compared to both senior medical and MOs.

The mean pre- and post-course scores were 53.9% (±10.6) and 82.7% (±5.2) for MOs, 65.6% (±8.5) and 85.9% (±5.9) for resident doctors, and 56.3% (±13.1) and 76.5% (±11.3) for SMOs, respectively. Figure 2 shows the pre- and post-training test scores of 212 nursing staff who took both pre- and post-training tests. The junior cadre of nurses obtained higher mean scores with lower mean difference between the pre- and post-training tests compared to the intermediate and senior nursing cadres.

Table 1: Distribution of professional categories of participants by rank

| Rank        | n (%) |
|-------------|-------|
| Doctors’ cadre |       |
| Senior PMO/SMO | 12 (14.3) |
| Intermediate Residents | 38 (45.2) |
| Junior MOs | 34 (40.5) |
| Total | 84 (100.0) |
| Nursing cadre |       |
| Senior CNO/ACNO | 67 (28.9) |
| Intermediate PNO/SNO | 47 (20.3) |
| Junior NO/MW | 118 (50.8) |
| Total | 232 (100.0) |

PMO=Principal medical officer, SMO=Senior medical officer, CNO=Chief nursing officer, ACNO=Assistant chief nursing officer, PNO=Principal nursing officer, SNO=Senior nursing officer, NO=Nursing officer, MW=Midwife, MOs=Medical officers

Table 2: Mean scores and mean differences in pre- and post-training results between doctors and nurses

| Parameter | Doctors (n=81) | Nurses/MWs (n=225) | P  | t     |
|-----------|----------------|---------------------|----|-------|
| Mean pretraining percentage score±SD | 59.8±11.4 | 58.3±9.9 | 0.13* | 1.1274 |
| Mean posttraining percentage score±SD | 83.3±7.4 | 73.6±7.5 | 0.000001 | 9.0127 |
| Mean score difference percentage±SD | 23.5±10.8 | 15.2±10.6 | 0.000001 | 5.9267 |

*NS=Not significant. SD=Standard deviation, MWs=Midwives

Figure 1: Pre- and posttraining scores of categories of doctors

Figure 2: Pre- and posttraining scores of subcategories of nurses/midwives
Table 3: Within-group mean scores and mean differences in pre- and post-training results among doctors’ and nurses’ cadres

| Mean percentage score | MOs    | Residents | t     | P    |
|-----------------------|--------|-----------|-------|------|
| Pretraining           | 53.9   | 65.6      | 5.0466| 0.00019|
| Posttraining          | 82.7   | 85.9      | 2.3593| 0.0106 |
| Mean difference       | 28.8   | 20.3      | 3.5799| 0.00032|
| Mean percentage score | SMOs   | Residents | t     | P    |
| Pretraining           | 56.3   | 65.6      | 2.8886| 0.0029 |
| Posttraining          | 76.5   | 85.9      | 3.8172| 0.0002 |
| Mean difference       | 20.2   | 20.3      | 0.0498| 0.4803*|
| Mean percentage score | MOs    | SMOs      | t     | P    |
| Pretraining           | 56.3   | 53.9      | 0.6034| 0.2748*|
| Posttraining          | 76.5   | 82.7      | 2.4551| 0.0093 |
| Mean difference       | 20.2   | 28.8      | 2.4543| 0.0092 |
| Mean percentage score | CNOs/ACNOs | PNOs/SNOs | t     | P    |
| Pretraining           | 56.1   | 58.3      | 1.0682| 0.2877*|
| Posttraining          | 71.8   | 74.5      | 2.0146| 0.04634|
| Mean difference       | 15.7   | 16.2      | 0.2543| 0.7998*|
| Mean percentage score | CNOs/ACNOs | NOs/MWs  | t     | P    |
| Pretraining           | 56.1   | 58.3      | 2.5518| 0.0116 |
| Posttraining          | 71.8   | 73.9      | 1.7302| 0.0854*|
| Mean difference       | 15.7   | 15.6      | 0.9220| 0.0358*|
| Mean percentage score | PNOs/SNOs | NOs/MWs  | t     | P    |
| Pretraining           | 58.3   | 58.3      | 0.7586| 0.2246*|
| Posttraining          | 74.5   | 73.9      | 0.5018| 0.6165*|
| Mean difference       | 16.2   | 15.6      | 0.0341| 0.3040*|

*NS: Not significant. MOs=Medical officers, SMOs=Senior medical officers, CNOs=Chief nursing officers, ACNOs=Assistant chief nursing officers, PNOs=Principal nursing officers, SNOs=Senior nursing officers, NOs=Nursing officers, MWs=Midwives

The analysis carried out assessed within-group differences in scores for doctor cadre separately from nurse cadre. The mean scores pretraining, postraining and the mean score difference for resident doctors were significantly higher than those for MOs. In addition, the mean pre- and postraining scores for residents were significantly higher than those for SMOs, but the mean score differences were similar [Table 3]. The mean postraining scores and score difference for SMOs were also significantly higher than those for MOs.

Table 3 also shows that among the nurses/MWs, the scores were similar except for significantly higher mean postraining scores of the intermediate cadre (PNOs/SNOs) compared to the most senior cadre (CNOs/ACNOs) and higher mean pretraining scores of the junior cadre (NOs/MWs) compared to the most senior nursing cadre (CNOs/ACNOs).

**Discussion**

This study found variations in baseline knowledge among HCWs practicing in different facilities across Northern Nigeria, all of whom possess reasonable albeit insufficient level of baseline knowledge on newborn resuscitation. This is evident by the mean pretraining marks, in which all of the trainees scored below 60%. The MOs scored the least among doctors, this being a group serving in secondary health facilities. In the secondary facilities, most uncomplicated vaginal deliveries are routinely conducted by nurses/MWs, which might have limited the MOs’ exposure and their ability to recall basic (pretraining) concepts. Among nurses, the most senior cadre scored the least mean pretraining marks compared to the intermediate and junior nurses, which may be a reflection of less exposure and ability to recall among the senior cadres, majorly involved in supervision rather than being in the frontline for service delivery. Similar reports from studies in Nigeria also found poorer baseline knowledge among nurses and MWs regarding the appropriate interventions for birth scenarios requiring newborn resuscitation.[7,18]

Among doctors, residents scored significantly higher mean pre- and post-training marks compared to MOs and SMOs. This may be attributable to their clinical exposure in the fellowship training, characterized by posting rotations to labor and newborn units where they routinely conduct deliveries and perform newborn resuscitation to fulfill requirements for their postgraduate clinical posting. The mean pretraining score for MOs was not significantly different from that of the senior doctors (SMOs). These lower mean pretraining scores for the latter two cadres suggest a need for targeted periodic refresher training on newborn resuscitation. It has been identified that training and refresher trainings for HCWs involved in taking deliveries are the key components among strategies that have the potential to contribute to reduction in the burden of neonatal mortality on a wider scale.[19,16,19]

The MOs’ cadre obtained the second highest mean postraining score and the highest mean difference between the pre- and post-training scores, significantly higher than that for all other
skills at the training, knowledge, and application of acquired knowledge by virtue of more frequent contact with delivery scenarios at work.

Although there was no significant difference in mean pretraining marks scored among doctors and nursing staff, the doctors obtained significantly higher mean postraining score and higher mean difference between the two tests. Impliedly, this may suggest a difference in the speed of comprehending pathophysiologic concepts and their clinical application, considering the more elaborate undergraduate curriculum unique to medical doctors’ training compared to nursing training. Our findings compare closely to those of a training program for newborn resuscitation in Nigeria, which showed knowledge improvements from mean scores of 65.4%–95.9% and 66.6%–88.0% for doctors and nurses/MWs, respectively.[18]

While this report demonstrated a positive impact of training on the cognitive knowledge of participants, its obvious limitation is that it can neither be concluded that such knowledge translates into proficiency in practice nor does it guarantee the retention of knowledge for a definite time span beyond the immediate postraining period. All of these can only be objectively assessed using a prospective study design to evaluate medium- and long-term postraining knowledge and skill retention as well as the impact on neonatal mortality outcomes. It has been demonstrated that among resident doctors whose postraining scores improved significantly compared to pretraining, worsening of test scores occurred by 6 months, while the ability to correctly intubate newborns during emergency resuscitation scenarios deteriorated over a 1-year period.[20] Similarly, a study that evaluated training outcomes among MWs in Ghana showed statistically significant increase in mean test scores from 56% pretraining to 71% postraining, with no significant difference in knowledge retained between the immediate postraining score and mean score 9 months’ postraining.[21]

This report has obvious limitations related to its methodology that include lack of assessment components for practical resuscitation skills acquired at the training, knowledge, and skill retention and assessment of outcomes of resuscitation carried out by trained participants. However, a subsequent study is being planned to assess knowledge and skill retention along with comparison of neonatal outcomes in the beneficiary facilities before and after the training.

Despite the limitations, our findings establish that a gap exists in the knowledge of newborn resuscitation among frontline health-care providers in Northern Nigeria, albeit with encouraging ability to learn, evidenced by significant improvements in baseline knowledge immediately after training across all cadres of staff. The findings also make a case for strategic policy for training at job entry with at least bi-annual refresher training for relevant frontline staff on NLS. This necessarily has to be accompanied by provision of enabling environment and appropriate facilities to help reduce the contribution of birth asphyxia to neonatal morbidity and mortality. Although these strategies require political commitment and sustainable funding, the lifesaving benefits for neonates would greatly outweigh the expenditure of resources dedicated for such an investment.

**Conclusion**

NLS training significantly improved cognitive knowledge of HCWs on newborn resuscitation even as the extent of its retention and practical application were not determined. Inclusion of this training in preservice (undergraduate) training curricula and as part of continuing professional development for all HCWs providing maternal and newborn services is recommended.

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**Conflicts of interest**

There are no conflicts of interest.

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