Predictors of vaccine management practices among primary healthcare workers (PHCWs) in Ilorin, North Central Nigeria.

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Abstract

Objective: Worldwide, vaccines are becoming more expensive as new ones are being introduced to the immunization schedule. Inspite of this, researches have revealed poor vaccine management practices among health workers. This study aimed to determine the predictors of vaccine management practices among PHCWs providing routine immunization services in static health facilities in Ilorin, north central Nigeria.

Methods: This quasi-experimental study was conducted among 216 intervention and 241 control groups of PHCWs using multi stage sampling technique; pretested questionnaire and an observational checklist. Data were analyzed using EPI-INFO software package. Level of significance was predetermined at a p-value of less than 0.05.

Results: The mean age of study respondents was 38.5 ± 9.5 years. Factors having positive influence on vaccine management practices include prior training exposure (p = 0.001), years of experience in immunization (p = 0.012) and baseline knowledge of vaccine management (p = 0.015). In addition, regularity of supervisory visit (0.008), adequacy/regularity of vaccine supply (p = 0.001), vaccine 'bundling' (p = 0.013) and type of health facility (p = 0.005) positively influenced respondents' vaccine management practices. However, basic qualification of health workers (p = 0.096) and availability of data tools (p = 0.628) had no significant influence on respondents' vaccine management practices.

Conclusion: Training exposure and years of experience in routine immunization have positive influence on vaccine management practices of PHCWs. On-the-job supervision of health workers should be conducted at least bi-annually.

Key words: Predictors, Vaccine management practices, PHCWs

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Prédicteurs de pratiques de gestion des vaccins chez les travailleurs de soins de santé primaires (PHCWs) à Ilorin, Nord Nigeria Central.

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Résumé

Objectif: Dans le monde entier, les vaccins sont de plus en plus cher que les nouveaux sont introduits dans le calendrier de vaccination. Malgré cela, des recherches ont révélé des pratiques de gestion des vaccins pauvres parmi les travailleurs de la santé. Cette étude visait à déterminer les prédicteurs de pratiques de gestion des vaccins chez les PHCWs fournissant des services de vaccination de routine dans les établissements de santé statiques à Ilorin, le centre-nord du Nigeria.

Méthodes: Cette étude quasi-expérimentale a été menée entre 216 et 241 interventions de contrôle des groupes de PHCWs en utilisant plusieurs techniques d'échantillonnage de la scène; questionnaire prétesté et une liste de contrôle d'observation. Les données ont été analysées à l'aide du progiciel EPI-INFO. Le niveau de signification a été prédéterminé à une valeur p inférieure à 0,05.

Résultats: L'âge moyen des répondants de l'étude était de 38,5 ± 9,5 années. Les facteurs ayant une influence positive sur les pratiques de gestion de vaccins comprennent une exposition antérieure de formation (p = 0,001), des années d'expérience en matière d'immunisation (p = 0,012) et les connaissances de base de la gestion des vaccins (p = 0,015). En outre, la régularité de la visite de supervision (0,008), l'adéquation / régularité de l'approvisionnement en vaccins (p = 0,001), le vaccin «regroupement» (p = 0,013) et le type d'établissement de santé (p = 0,005) influencé positivement les pratiques de gestion des vaccins des répondants. Cependant, la qualification de base des travailleurs de la santé (p = 0,096) et la disponibilité des outils de données (p = 0,628) n'a eu aucune influence significative sur les pratiques de gestion des vaccins des répondants.

Conclusion: l'exposition de la formation et des années d'expérience dans la vaccination de routine ont une influence positive sur les pratiques de gestion des vaccins de PHCWs. Sur le tas supervision des agents de santé doit être effectué au moins deux fois par an.

Mots clés: prédicteurs, les pratiques de gestion des vaccins, PHCWs

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INTRODUCTION

Management of vaccines in immunization service delivery comprises of estimation of vaccine needs (vaccine forecast), ordering of vaccines, storage of vaccines, monitoring vaccine use and limiting vaccine wastage (1). Globally, vaccines and immunization programmes are becoming increasingly more expensive with the addition of new vaccines to the National Immunization Programmes (2). Ironically, there has been an increase in demand for vaccines by the developing countries while its supply has continued to decline (3). Hence, several immunization programmes have been truncated due to irregular vaccine supply (2). Inspite of the limited access to vaccines in many developing countries, a high vaccine wastage rates have been observed (4,5). This has been linked to inadequate knowledge and skills of the staff managing the scarce vaccines, particularly at the peripheral health facility level (4,5).

Knowledge and practice of routine immunization (RI) service providers regarding vaccine management have implications on childhood immunization. Studies conducted locally (6,7) and regionally (8-11) have shown varying degree of gaps in vaccine management knowledge of health workers and these have direct and indirect impact on immunization programme and control of Vaccine Preventable Diseases (VPDs). In Nigeria, VPDs currently account for about 22% of deaths of under-fives, translating to about 200,000 avoidable child deaths annually (12).

Globally, childhood immunization could avert an estimated 3.2 million deaths and prevent about 23 million Disability Adjusted Life Years (DALYs) annually (4). Hence, healthcare workers handling vaccines for routine immunization need to be well acquainted with the knowledge and skills required to maintain the potency of vaccines in order to achieve the desired results of vaccination. For instance, practices such as proper implementation of the Multi-Dose Vial Policy (MDVP) have been found to significantly reduce vaccine wastage rate particularly at service delivery level (13). Similarly, the use of new technology like the Vaccine Vial Monitor (VVM) and the Cold Chain Monitor (CCM) have also played crucial roles not only in detecting cold chain problem but also in reducing vaccine wastage and in preventing the administration of heat damaged vaccines (13,14).

The use of VVM could make it possible to administer about 1.4 billion more doses of vaccines in remote settings, thereby saving over 140,000 lives and reducing morbidity for countless others (15,16). Similarly, the use of VVM could save the global community about US $5 million per year (17). These laudable properties of VVM are achievable only if healthcare workers are properly trained on the use (13,17-19), with a consequent reduction in immunization programme costs (4). Realizing the huge benefit inherent in childhood immunization, several attempts have been made to train PHCWs on various aspects of vaccine storage, handling and cold chain maintenance.

Despite the several training programmes conducted for PHCWs providing routine immunization services in Ilorin metropolis, their vaccine management practices are still defective. It is probable that certain other factors apart from training have immense influence on the vaccine management practices of health care workers. This study therefore set out to investigate the factors influencing the vaccine management practices of health care workers providing routine immunization services in Ilorin, North-central Nigeria.

METHODOLOGY

The study was carried out in Ilorin between May and November 2010 among health workers in 73 public PHC facilities and 54 registered private health facilities (HFs) distributed in Ilorin South, Ilorin West and Ilorin East Local Government Areas (LGAs) that made up the metropolis. All the public PHC facilities offer routine immunization (RI) services as a major component of their PHC package. This study was quasi-experimental in design with pre-intervention, intervention and post-intervention phases. The study population was all PHCWs in public and private HFs in the study area that were ever involved in routine immunization service delivery. Two out of the three LGAs were selected by simple random sampling by balloting. The selected LGAs were further assigned into study and control groups by balloting method. A minimum sample size of 126 was arrived at using formula using the formula for comparison of two proportions (comparing the intervention group with the control group) thus:

$$\{n = (U + V)^2 \{P_1 (100-P_1) + P_2 (100-P_2)\} \ldots\ldots\ldots (20).$$
$$(P_1 - P_2)^2$$

Where P_1 = 24% (prevalence of PHCWs who have good knowledge of vaccine storage and

administration)…(6) and P_2 = 44% (a difference of 20% improvement in knowledge of vaccine management is anticipated), U = Standard normal deviate (SND) corresponding to the power of 90% =1.28 and V = Standard normal deviate corresponding to the confidence level of 95% for a two tailed test=1.96. However, all PHCWs who were ever involved in RI service delivery and had spent at least 6 months on the job were included; giving rise to 216 study and 241 control respondents.

At the Pre- intervention stage, a descriptive cross-sectional study was carried out among the study and control groups to generate base-line data on their socio-demographic information, and their knowledge of vaccine management. Questionnaires were administered to the intervention population (216 PHCWs) in Ilorin West as well as the control group (241 PHCWs) in Ilorin East. The participants were administered questionnaires at their respective duty posts during working hours. The data generated at this stage was used to design the training intervention that was done in the second stage of the study. An observational checklist (OBL) also was used to collect data through observation of practices such as, the opening and closing of the refrigerators/ cold boxes, the presence of temperature charts, the reading of thermometers and the presence of other products apart from vaccines in the refrigerators/ cold boxes. The OBL was also used to assess the quantity and functionality of available vaccine cold chain maintenance and monitoring equipments in the HFs.

During the intervention stage, the study group received 3-day training on vaccine management while the control group did not. Four training centers were chosen and each training group comprised of 25 participants. Training lasted three hours per day starting from 12noon to 3pm. A training schedule adapted from the WHO training guide on vaccine management was used. The training sessions were conducted in English and were made as interactive as possible. Questions/ comments were entertained at the end of each topic discussed. A total of 8 sessions were held over a 4-week period so as to adequately cover the study group. The training resource persons were the researchers and trained research assistants.

The post intervention stage: A descriptive cross sectional study similar to the pre-intervention study was repeated amongst the study and control groups at the third and sixth month post-intervention using the same questionnaire used during the pre-intervention stage.

Ethical consideration: Ethical approval was obtained from the Ethical Review Committee of the University of Ilorin Teaching Hospital. Informed consent was also obtained from the participants and they were assured of confidentiality at every stage of the study. The questionnaire was made up of three sections namely; socio-demographic characteristics, knowledge of vaccine management and questions addressing vaccine management practices. Respondents' knowledge and practices regarding vaccine management were scored and graded. A correct answer was awarded a score of one point while a wrong answer was scored zero point. The maximum scores for knowledge and practices were 46 and 18 respectively, while the minimum score was zero in both cases. For knowledge, the grading was categorized into 'adequate' for respondents that scored between 23 and 46 points; and 'inadequate' for those respondents that scored below twenty-three [0-22] points. Respondents who scored eight points or less [0-8] were categorized as having 'bad' practices while those that scored nine points and above [9-18] were regarded as having 'good' practices.

Statistical Analysis: Data were analyzed using EPI-INFO version 3.5.1 software package. The pre-intervention data for study and control were compared. Chi-square test was used to determine the statistical significance of observed differences in the pre- and post- intervention phases of the study. Level of significance was predetermined at p-value less than 0.05.

RESULTS

The mean age of respondents in the study and control groups were respectively 38.5 ± 9.5 and 34.9 ± 8.8 years. Female respondents were more than 80% in both groups. Community Health Extension Workers (CHEWs) were the predominant cadre of RI service providers in both groups but more nurses 66 (30.6%) were in the study group compared with control 55 (22.8%), table 1. More than half 76 (58.9%) of study and 102 (61.4%) of control respondents that attended training on vaccine management prior to the survey had adequate knowledge of vaccine management ($p = 0.001$ and $p < 0.001$

respectively), table 2. Similarly, higher proportions of respondents with 11-20 years work experience as RI service provider had adequate knowledge of vaccine management in both study and control groups ($p = 0.012$ and 0.046) respectively), table 2.

Higher proportions of CHEW and CHO respondents had adequate knowledge of vaccine management in both the study (20.4% and 14.3%) and control (44.9% and 50.0%) groups respectively. These findings were not statistically significant (p- values > 0.05), table 2. Less than 30% of the health facilities (HFs) in the study area had adequate vaccine storage and cold chain monitoring equipments. The most widely available vaccine equipment in the study area is the giostyle. The study LGA has 25 while the control has 31. Only 8 (40%) of the 20 study HFs and 3 (10.0%) of the 29 control HFs had functioning refrigerators for vaccine storage as at the time of study (figure 1). This is grossly inadequate for static health facilities (HFs). The standard practice is to have at least one functioning refrigerator dedicated for vaccine storage in any health facility. Only 3 of the 8 refrigerators in the study HFs are solar powered (figure 1). Considering the erratic power supply in the study area, solar refrigerators would be more suitable than electrically powered refrigerators.

Table 3 shows the vaccine cold chain monitoring practiced of study respondents as observed during the survey. There was no designated officer/ health worker to look after all the 21 refrigerators observed. Only 6 refrigerators were used exclusively for vaccine storage as 15 were also used to store food and medications. Twice daily temperature charting was strictly adhered to in 4 out of the 6 refrigerators. Vaccines were stored at optimal temperature in 7 out of the 21 refrigerators and cold boxes. Vaccines stored in all the refrigerators and cold boxes had their VVM labels intact. However, 8 of the refrigerators contained vaccines with VVM stages III and IV stored alongside those in stages I & II.

In the study group, RI service providers with 11 to 15 years work experience form the largest proportion 24 (60.0%) with good vaccine management practices ($p = 0.039$). Similarly in the control group, 43 (64.2%) respondents with 11 to 15 years work experience imbibed good vaccine management practices ($p < 0.001$). It can be deduced that the work experience as RI service providers had positive influence on the vaccine management practices of the study and control respondents, table 4a.

Even though, more respondents with Nursing Science degree in the study group imbibed good vaccine management practices, the finding was not statistically significant ($p = 0.096$), table 4a. This implied that the vaccine management practices of respondents are not influenced by their basic qualifications.

Higher proportions (71.4%) of study and (62.4%) of control respondents in public HFs imbibed good vaccine management practices, while smaller proportions (30.8%) of study and (25.8 %) of control respondents in private HFs displayed good vaccine management practices. These differences were statistically significant in both the study and control group ($p = 0.005$ and $p < 0.001$) respectively, table 4b.

Only 48.8% of study and 38.7% of control respondents who had regular and adequate vaccine supply at their disposal imbibed good vaccine management practices, while only 20.8% of study and 22.2% of control with irregular and inadequate vaccine supply at their disposal displayed good vaccine management practices. These differences were statistically significant ($p = 0.001$ and $p < 0.001$) for study and control groups respectively, table 4b.

Only 42.2% of study and 38.0% of control respondents who had 'bundled' vaccine supply imbibed good vaccine management practices, while none of study and only 36.6% of control that did not have 'bundled' vaccine supply displayed good vaccine management practices. These differences were statistically significant ($p = 0.013$ and $p = 0.003$), table 4b.

DISCUSSION

This study showed female dominance in PHC service delivery. This is a reflection of what obtains in most PHC facilities in Nigeria where Nursing profession and other allied professions like CHEW and CHO are dominated by females (21). Majority of the respondents in both groups are married; and this is in keeping with the age distribution which showed that most of the health workers are adults and as such, would be expected to have been married. As one would expect, the CHEWs and the Registered Nurse/Midwives constituted the highest proportion of respondents, accounting for over 67% of all respondents in the study area. This is essential because, aside from doctors, they are the cadre of health work force required for effective PHC service delivery in Nigeria (21, 22).

Majority (91.2%) of the study respondents were aware of vaccine management. This might not be unconnected with the fact that vaccine management topics, such as vaccine storage and handling, cold chain management, VVM interpretation and use of MDV policy are usually discussed in seminars or training workshops on immunization service delivery. In addition to print and mass media, training workshops and seminars organized by Government or Health Agencies such as WHO, EU-PRIME and UNICEF, are effective sources of knowledge acquisition to PHCWs. This was further corroborated with the finding in this study which revealed that up to 93% of PHCWs in both groups acquired knowledge on vaccine management through these sources before intervention.

Safe vaccine storage practices entail refrigeration of vaccines in optimal temperature range within the refrigerator; and ensuring that other items aside from vaccines are not kept in the vaccine refrigerators (23). Unlike findings in studies done in Spain (24), Atlanta Georgia (25), Taiwan (26), Sri- Lanka (27), Ethiopia (28) and Mozambique (29) where all (100%) HFs; and in Italy (76%) (30) had at least one functioning refrigerator, only 40% of study and 10% of control HFs had vaccine refrigerators in this study (table 3). This finding agrees with the trend observed in Lagos by Munir et al (7) where only 10% of privately owned HF had functioning vaccine refrigerators. The abysmally low proportion of HFs with vaccine refrigerators portends the suboptimal vaccine storage and handling practices in the study area and its attendant implication on vaccine efficacy.

This study observed that only 30% of study and 25% of control HFs had functioning thermometers in their vaccine storage equipment before training. These findings were lower than findings reported in HFs elsewhere - 57% in Sri-Lanka (27), 50% in Spain (24), 100% in Mozambique (29), 97% in Ethiopia (28), and 47% in Taiwan (26). Report from study done in Lagos revealed that none of the HFs had thermometers in their vaccine refrigerators (7). This might be because the study was done in privately owned HFs where emphasis is on profit maximization thereby making it rather difficult to conform to standard practice in every aspect of health care service delivery.

Observations in this study revealed that only 30% of study and 25% HFs stored vaccines within the optimal temperature range. This may not be unconnected with the fact that the health workers in the study area were constrained by inadequate vaccine management equipment at their disposal. Unlike HFs elsewhere (24,25) (27-29), most of the study HFs were lacking in basic vaccine management equipment such as vaccine refrigerators and thermometers (figure 1). The lack of or inadequacy of such equipment will unavoidably, limit the extent to which good vaccine management practices can be imbibed. This finding contrasted sharply with the observations of Bell (25) and Berhane (28) where 95% and 90% of HFs respectively stored vaccines within optimal temperature range. However, the finding was similar to the report of Joao et al (29) where most HFs were observed to have stored vaccines out of the optimal temperature range. Similarly, in Taiwan 22% HFs stored vaccines in suboptimal temperature (26). The observed low proportion of HFs in the study area storing vaccines in optimal temperature implied that the potency of vaccines is being jeopardized. If vaccines administered to clients had lost potency during storage and handling, then high vaccination coverage would have little or no effect. However, post intervention observation revealed about 60% improvement in the proportion of study HFs storing vaccines within the recommended temperature ($p = 0.001$) compared to the control where no such improvement was observed ($p = 1.000$).

In order to detect variations in vaccine temperature promptly, a twice daily temperature monitoring and recording is advocated (31,32). This study observed that only 23% of study HFs and 12% of control HFs kept up to date vaccine temperature monitoring charts. This observation still boils down to the lack of adequate vaccine management materials/equipments in the study area. This proportion is abysmally low when compared with the 58% reported in Ethiopia (28) and 46% reported in Taiwan (26). The finding from this study is higher than that of Mozambique (29) where most HFs did not have up to date record of vaccine temperature chart, and that of Italy (30), where none of the HFs kept any vaccine temperature record. In Sri-Lanka, 40% of HFs monitored vaccine temperature on a daily rather than twice daily basis (27). At post intervention, significant improvement (about 40% above baseline) in proportion of study HF that kept and recorded vaccine temperature twice daily ($p = 0.04$) was observed compared to the control HFs where no significant improvement was recorded ($p = 0.449$).

Careful attention to vaccine storage and handling is essential to ensure optimal potency of vaccines. In this study, 76.9% of study HFs and 62.5% of control HFs stored other items in vaccine refrigerator. This finding is consistent with observations in Sri-Lanka (27) (76%), Taiwan (26) (93.7%) and in Enugu (6), (71.4%). Similarly high proportion of HFs stored other items with vaccines in Lagos (7), Italy (30) and Mozambique (29). Post intervention observation revealed no significant decline in the practice among the study HFs ($p = 0.670$) as compared to the control HFs ($p = 1.000$).

These findings corroborate the pervasiveness of the practice of storing other items with vaccine, especially in developing countries where health resources are usually limited in supply. The frequency of HFs storing other items in vaccine refrigerators also portends that supportive supervision of health workers is not adequate in most parts of the world. The widespread habit of storing other items in vaccine refrigerators has resulted in fatal consequences in Malawi, Algeria and Yemen, as health workers often mistakenly administered such items as vaccines to prospective immunization recipients (31).

Storing vaccines or other items on refrigerator door shelves encourages more frequent opening of the refrigerator. This can lead to temperature variation within, which could affect vaccine efficacy. This study observed in 25% of study HF and 33% of control HFs that vaccine or other items were stored on refrigerator door shelves. Higher trends were observed in Italy (30) and Enugu, Nigeria (61.9%) (6). The relatively low trend observed in this study may be adduced to the low sample size. This could also explain why the post intervention observation in both study and control HFs were not different ($p = 0.449$ and 0.386).

Administration of expired vaccines is dangerous as it may evoke adverse drug reactions in addition to lack of sero-conversion in the recipients. This study observed that 15% of study HFs and 25% of control kept expired vaccine together with potent ones. This contrasts with the trend observed by Munir' et al (7) where all the HFs had the vaccine expiry dates intact, although 80% of the vaccines were in either stage III or IV of VVM. Post intervention observation revealed that all the HFs in both groups no longer stored expired vaccines in their vaccine refrigerators.

Ideally, inventory of all vaccines should be done on monthly basis to help detect expired vaccines and for a more rational placement of order (32). This study observed that 85% of HFs in the study area have vaccine record book. Of these, 70% kept well balanced and up to date records. This agrees with the trend observed in Enugu (66.7%) (6) but contrasts with findings in Italy (30) where lower trend was observed. In Mozambique, none of the HFs had vaccine inventory (29). Post intervention observation revealed marginal but insignificant difference in the improvement observed in the HFs in both groups ($p = 0.229$ and 1.000).

Analysis of baseline data collected in this study revealed that prior training attendance had positive influence on vaccine management knowledge, and consequently vaccine management practices of respondents in both the study and control groups. At baseline, 58.6% of study and 61.4% of control respondents who had prior training on vaccine management had adequate knowledge of vaccine management ($p = 0.001$ and $p < 0.001$ respectively). Similarly, 63.6% of study and 54.8% of control respondents who had attended training on vaccine management before this study demonstrated good vaccine management practices respectively (p - values < 0.001).

Although, training health care providers is often identified as a first step to revitalizing health services, supportive supervision is a proven approach that helps transfer knowledge to practice and that ensures that learning continues beyond the traditional training setting. Through routine visits, supervisors can provide follow-up training to improve performance and solve other systemic problems that contribute to poor vaccine management practices. In this study, only 47 (21.8%) of the respondents in the intervention group had supervisory visit in the previous 6 months to the survey. This study revealed that such supervisory visits had positive influence on vaccine management practices of study and control respondents ($p = 0.008$ and $p < 0.001$ respectively). This finding was consistent with findings from a study done in Indonesia (33).

This study also examined the relationship between respondents' knowledge of vaccine management and to what extent the knowledge acquired translates to good practices. Only 52.4% of study and 48.2% of control group with adequate knowledge of vaccine management imbibed good vaccine management practices (p-values = 0.015 and 0.003 respectively). The deductions from these findings are that while training helps to improve on

knowledge of health workers, the knowledge may not necessarily translate to good practices. Barring other factors, supportive supervision of health workers should complement training in order to bring about sustained behaviour change in the health work force which will later inform good vaccine management practices.

This study discovered that respondents' work experience as routine immunization service provider impacted positively on their knowledge and practice of vaccine management. A significantly higher proportion of respondents in the study area who had spent between 10 to 20 years as RI service providers had better knowledge and imbibed good vaccine management practices than others who had probably spent less ($p = 0.012$ and 0.039). This may be due to the fact that those respondents with 10 to 20 years work experience may have been opportune to attend several seminars or training where issues relating to vaccine management may have been discussed. In addition, they may have also benefited from several on the job training during the routine supervisory visits and as such gather experience over the years. Through those fora, this category of health workers would have improved on their vaccine management knowledge.

Contrary to findings from previous study done in India (8), the health workers' vaccine management knowledge and practices are not influenced by their basic qualifications in this study. There was no significant difference in knowledge of vaccine management demonstrated by the different cadre of health workers in the study area ($p = 0.771$). A probable reason for this occurrence might be that the school curriculum in Nigeria unlike India does not include in-depth information on immunization and vaccine management. This argument further underscores the need for training and re-training in addition to supportive supervision of all health workers especially on issues bothering around immunization service delivery irrespective of their educational background. While the type of health facility ($p = 0.096$ and 0.000), bundling ($p = 0.013$ and 0.003); and regularity/adequacy of vaccine supply ($p = 0.001$ and $p < 0.001$) tend to have positive bearing on vaccine management practices of health workers in the study and control groups; this study did not establish any significant relationship between availability of data tool ($p = 0.354$ and 0.468) and vaccine management practices of RI service providers.

Only 22.2% of the study population imbibed good vaccine management practices in general before intervention. Health workers' years of experience in immunization and training exposure had positive influence on their knowledge of vaccine management while their basic qualifications do not.

Vaccine management practices of health workers in this study were positively influenced by their prior training exposure, years of experience in immunization, baseline knowledge of vaccine management, regularity of supervisory visit, adequacy/regularity of vaccine supply, vaccine 'bundling' and type of health facility. There was no significant association between basic qualification of health workers and their vaccine management practices. Similarly, no significant association was established between availability of data tools and health workers' vaccine management practices.

Periodic training and retraining of the PHCWs in the study area on vaccine management is advised. In addition, regular monitoring and supportive supervision of health workers' vaccine management practices by health administrators in the LGA and State Ministry of Health (SMoH) is imperative in order to ensure high standard of vaccine storage and handling practices.

The LGA management should provide suitable cold chain monitoring equipment to the health facility in adequate quantities in the study area, while conducting cold chain inventories at least annually, to ensure prompt repair of faulty equipment. There is need for the Cold Chain Officers at various levels to 'bundle' vaccines and materials during supply to encourage optimal vaccine use and handling practices among health workers.

REFERENCES

1. USAID. Managing vaccines at health facility level: Immunization essentials, A practical field guide. 2003; USAID. Washington DC. 101-124.
2. Lal P, Malhotra R, Gautan VP, Mehra M. Assessment of functioning of Pulse Polio Kendras and house to house activity in Delhi: is there any hope for improvement? Journal of Common Diseases 2003; 35 : 266 – 272
3. Centers for Disease Control and Prevention (CDC). Morbidity and Mortality Weekly Report (MMWR).Vaccine Preventable Deaths and the Global Immunization Vision and Strategy, 2006—2015. May 2006; 55 (18): 511-515. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5518a4.htm. Accessed on 16/ 11/ 2011.
4. Osagbemi GK, Samson A, Olu OO. Cold chain management and vaccine handling: A study of the Knowledge of immunization workers in

Ilorin, Kwara State, Nigeria. Centre point (Science edition) 1997; 12(1): 101-108.
5. Department for International Development. The state of Routine Immunization services in Nigeria and reason for current problems. FBA Health System Analysts. 2005; p 16-23
6. Uzochukwu BSC, Onwujekwe OE. Vaccine storage and administration among PHC workers in south- east Nigeria: Effect of Educational intervention. A power point presentation at the 2nd International conference on improving Use of Medicines. Chiang Mai, Thailaland. ICIUM 2004.
7. Munir BA, Kola-korolo O, Bankole MN, Iboma GO, Ademola OA, Shittu LAJ. The impact of health facility monitoring on cold chain management practices in Lagos, Nigeria. Journal of Public Health and Epidemiology. 2010 July; 2 (4): 78-81
8. Bairwa A, Meena KC, Gupta PP. Knowledge, attitude and practice of health workers in immunization. Indian Pediatrics, 1995 Jan;32(1):107-8.
9. Takker Y, Woods S. Storage of vaccines in the community: weak link in the cold chain. BMJ.1992; 304 (6829): 756-8
10. Chudasama RK. Awareness about vaccine vial monitor at pulse polio booths. Indian Pediatr. 2007 Dec; 44 (12): 919-20.
11. Policy Project/Nigeria. Child Survival in Nigeria: Situation Response and Prospect: Key Issue. Abuja Policy Project. 2002; p 13- 18
12. WHO. Monitoring vaccine wastage at country level: guidelines for programme managers. WHO document. WHO document. WHO/V&B/03.18. 2003; p18
13. Nelson CM, Wibisono H, Purwanto H, Mansyur I, Moniaga V, Widjaya A. Hepatitis B vaccine freezing in the Indonesian cold chain: evidence and solutions. Bull World Health Organ. 2004 Feb; 82(2):99-105.
14. Vaccine Immununization News. Vaccine vial monitors take guesswork out of immunization. 1996 Jun; (1):7-8.
15. World Health Organization (WHO). Monitoring vaccine wastage at country level: guidelines for programme managers. WHO document. WHO document. WHO/V&B/03.18. 2003; p18
16. Health Tech historical profile .Vaccine Vial Monitors. June 2005; p 4-7
17. World Health Organization (WHO). Weekly Epidemiology Record.2000; 4(75): 31.
18. World Health Organization (WHO). Making use of vaccine vial monitors. Flexible vaccine management for polio supplementary immunization activities. World Health Organization. WHO/V&B/00.14. 2000;
19. World Health Organization (WHO). Key elements for improving supplementary immunization activities for polio eradication. WHO/V&B/00.22.2000;22
20. Kirkwood B. Essentials of Medical Statistics (Ed). Oxford, UK: Blackwell Scientific Publications; 1998. 215- 216
21. Obionu CN. Primary Health Care for developing countries. 2007. 2nd Ed. Enugu. Ezu books Ltd, 1 – 24
22. Olikoye RO, Soroungbe AO, Oyegbite KS, Bamisaye A. Strenghtening PHC at the Local Government level: the Nigerian Experience. 1991. 1st Ed. Lagos. Academy press, 1-7.
23. Immunization action coalition. Checklist for safe vaccine handling and storage. Available at http:/ www.org/ catg.d/ p 3035. Pdf. Item # p 3035 (7/08). Accessed on 18/05/2011.
24. Ortega MP, Astasio AP, Albaladejo VR, Gómez RML, de Junes PJR, Domínguez RV. Vaccine storage cold chain at primary care centers in one area of Madrid: keeping the chain intact and degree of knowledge. Rev Esp Salud Publica. 2002 Jul-Aug;76(4):333-46
25. Bell KN, Hogue CD, Manning C, Kendal AP. Risk factors for improper vaccine storage and handling in private providers' offices. Paediatrics. 2001 Jun; 107 (6): E100
26. Pai HH, Ko YC. Vaccine storage practices in primary care physicians' offices in Taiwan. Kaohsiung J. Med Sci. 1999 May; 15 (5): 274-9
27. Senanayake MP, de Silva TU. Vaccine storage conditions in clinics in Colombo. Ceylor Med J. 1997 Dec; 42 (4): 173-5
28. Berhane Y, Demissie M. Cold chain status at immunisation centres in Ethiopia. East Afr Med. 2000 Sep;77(9):476-9
29. Joao CTM, Bjune G. Cold chain management: Knowledge and practices in primary health care facilities in Niassa, Mozambique. *The Ethiop. J. of Health Dev.2007;* 21 (2): 130-135
30. Grasso M, Ripabelli G, Sammarco ML, Manfredi STM, Quaranta A. Vaccine storage in the community: a study in central Italy. Bull WHO. 1999; 77 (4): 352-5
31. National Programme on Immunization (North Central Zonal Office). Report on Routine Immunization.2005; p3-5
32. Immunization action coalition. Checklist for safe vaccine handling and storage. Available at http:/ www.org/ catg.d/ p 3035. Pdf. Item # p 3035 (7/08). Accessed on 18/05/2011.
33. EricaW, Kathy H. Preventing cold chain failure: vaccine storage and handling. JAMC. 2006;171 (9): 1050

Table 1: Socio-demographic characteristics of respondents

Socio-demographic Variables	Pre- intervention	
	Study group {N= 216} n (%)	**Control group {N = 241} n (%)**
Age groups (years)		
< 20	3 (1.4)	2 (0.8)
20 - 29	41 (19.0)	75 (31.1)
30 - 39	45 (20.8)	81 (33.6)
40 - 49	99 (45.9)	74 (30.8)
50 – 59	26 (12.0)	8 (3.3)
≥60	2 (0.9)	1 (0.4)
Range (years)	18 – 61	18 – 6M
Mean (years)	P8.R – V.R	P4.V – 8.7
pex aistribut ion		
Female	196 (90.7)	197 (81.7)
Male	20 (9.3)	44 (18.3)
Cadre		
CHEW	78 (36.1)	149 (61.8)
CHO	21 (9.7)	10 (4.1)
RN/M	66 (30.6)	55 (22.8)
B.Sc Nursing	28 (13.0)	16 (6.6)
Auxiliary health workers	23 (10.6)	11 (4.5)
Experience in RI (yrs)		
<1	45 (20.8)	20 (8.3)
1 – 5	89 (41.2)	112 (46.5)
6 – 10	55 (25.5)	72 (29.8)
11 – 15	17 (7.9)	23 (9.6)
16 – 20	8 (3.7)	8 (3.3)
≥21	2 (0.9)	6 (2.5)
Range (years)	0 – 42	0 – 6P
Mean (years)	V.V –8.4	6.6 – 6.6

Table 2: Factors Influencing Respondents' Knowledge of Vaccine Management

Variables	**Adequate knowledge of vaccine management**	
	Study group N= 216 n (%)	**Control group N= 241 n (%)**
Ever had training	N=118	N= 120
Yes	76 (58.9)	102 (61.4)
No	32 (36.8)	18 (24.0)
	$\mathbf{F}^2$ = 10.18; df = 1; p = 0.001	$\mathbf{F}^2$ = 28.98; df = 1; p < 0.001
Work experience in RI		
<1	20 (52.6)	11 (28.9)
1 – 5	22 (47.8)	27 (55.1)
6 – 10	10 (22.2)	27 (51.9)
11 – 15	22 (55.0)	29 (61.7)
16 – 20	19 (57.6)	22 (57.9)
≥21	5 (35.7)	7 (41.2)
	$\mathbf{F}^2$ = 4.61; df = 5; p = 0.012	$\mathbf{F}^2$ = 11.28; df = 5; p = 0.046
Cadr e of health workers		
CHEW	16 (20.4)	67 (44.9)
CHO	3 (14.3)	5 (50.0)
RN/M	15 (22.7)	24 (45.5)
B.Sc nursing	4 (14.3)	4 (25.0)
OTHERS (auxiliary staff)	6 (26.1)	2 (18.2)
	$\mathbf{F}^2$ = 1.81; df = 4; p = 0.771	$\mathbf{F}^2$ = 9.86; df = 4; p = 0.079

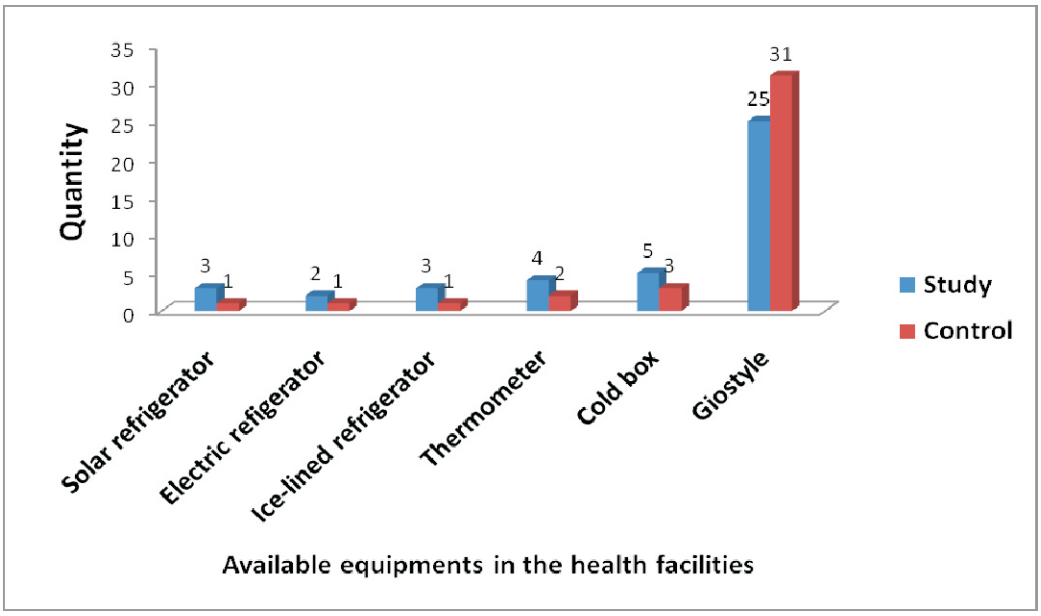

Figure 1. Available vaccine cold chain equipments in the health facilities before and after intervention

Table 3: Observed vaccine cold chain monitoring practices of respondents

Observation	N = 21 (%)	
	Yes	No
Designated person looking after fridge/ cold box	0 (0.0)	21 (100.0)
Functional thermometer in fridge / cold box	6 (28.6)	15(71.4)
Temperature monitored at least daily and recorded	4 (19.0)	17 (81.0)
Up to date temperature monitoring chart on fridge / cold box	4 (19.0)	17 (81.0)
Stored vaccine found in optimal temperature range (+2 to $+8^0$C)	7(33.3)	14 (66.7)
Vaccine vials with VVM labels intact	21 (100.0)	0 (0.0)
Unusable vaccines with VVM stages III & IV stored with useable (stages I & II) vaccines	8 (38.1)	13 (61.9)
Expired vaccines found in fridge / cold box	2 (9.5)	19 (90.5)
Food items and drugs stored in fridge /cold box	15 (71.4)	6 (28.6)

Table 4a: Factors Influencing Respondents' Vaccine Management Practices

Variables	**Good Vaccine Management Practices**	
	Study group N= 216 n (%)	**Control group N= 241 n (%)**
Baseline knowledge		
Adequate	65 (52.4)	53 (48.2)
Inadequate	33 (35.9)	39 (29.8)
	$F^2 = 5.84$; df = 1; p = 0.015	$F^2 = 8.59$; df = 1; p = 0.003
Ever had RI training		
Yes	82 (63.6)	91 (54.8)
No	33 (37.9)	21 (28.0)
	F2 = 13.72; df = 1; p < 0.001	F2 = 14.94; df = 1; p < 0.001
Supervisory visits		
< 6 months	28 (59.6)	40 (72.7)
≥6 months	64 (37.9)	62 (33.3)
	F2 = 7.08; df = 1; p = 0.008	F2 = 26.99; df = 1; p < 0.001
Vacc. Ledger available		
Yes	115 (58.4)	129 (58.4)
No	9 (47.4)	10 (50.0)
	F2 = 0.23; df = 1; p = 0.628	F2 = 0.53; df = 1; p = 0.468
Work experience in RI		
1 – 5	17 (44.7)	11 (35.5)
6 – 10	17 (37.0)	12 (36.4)
11 – 15	14 (31.1)	17 (30.9)
16 – 20	24 (60.0)	43 (64.2)
≥21	17 (51.5)	12 (34.3)
	3 (21.4)	8 (40.0)
	$F^2 = 11.69$; df = 5; p = 0.039	$F^2 = 22.73$; df = 5; p < 0.001
Cadre of workers		
CHEW	31 (39.7)	64 (43.0)
CHO	8 (38.1)	4 (40.0)
RN/M	25 (37.9)	25 (45.5)
B.Sc Nursing	12 (42.9)	5 (31.3)
Auxiliary staff	7 (30.4)	7 (46.7)
	F2 = 7.88; df = 4; p = 0.096	F2 = 1.72; df = 4; p = 0.788

Table 4b: Factors Influencing Respondents' Vaccine Management Practices

Variables	Good Vaccine Management Practices	
	Study group N= 216 n (%)	**Control group N= 241 n (%)**
Type of health facility		
Private	4 (30.8)	8 (25.8)
Public	145 (71.4)	131 (62.4)
	$F^2 = 7.63$; df = 1; p = 0.005	$F^2 = 14.80$; df = 1; p < 0.001
Regularity of vaccine supply		
Regular	82 (48.8)	48 (38.7)
Irregular	10 (20.8)	26 (22.2)
	$F^2 = 11.95$; df = 1; p = 0.001	$F^2 = 37.64$; df = 1; p < 0.001
Bundling of vaccines with materials		
Yes	92 (42.2)	76 (38.0)
No	0 (0.0)	15 (36.6)
	$F^2 = 6.16$; df = 1; p = 0.013	$F^2 = 9.00$; df = 1; p = 0.003