The Effect Of Training On Knowledge And Practices Of Vaccine Management Among Primary Health Care (PHC) Workers In Static Immunization Facilities In Ilorin, Nigeria

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Abstract:

Vaccine management problems include high vaccine wastage rates due to inadequate knowledge and skills of the staff managing the scarce resources, particularly at the peripheral health facility level. This study evaluated the effects of training on vaccine management knowledge and practices among PHC workers in Ilorin, Nigeria.

The study was quasi-experimental in design, conducted in three stages using multi-stage sampling technique to recruit 216 and 241 PHC workers into training intervention and control groups respectively. Pretested semi-structured questionnaire and an observational check list were used at pre-intervention and post-interventional training phases. Less than half (98) of the study and 110 (45.6%) of control respondents had adequate knowledge of vaccine management before intervention, while only 48 (22.2%) of the study and 102 (42.3%) of control respondents imbibed good vaccine management practices. There was statistically significant improvement in the vaccine management knowledge 182 (84.5%) and practices 156 (73.2%) of study respondents 3 months post intervention but with significant decline at 6 months post intervention. In the control group, there was no statistically significant improvement in knowledge and practices at the third and sixth months post intervention.

We conclude that training intervention has positive impact on vaccine management knowledge and practices among PHC workers in the study area. In addition to monitoring and supportive supervision, there is need for regular training and re-training of PHC workers to improve on their vaccine management knowledge and practices to ensure high standard of vaccine storage and handling.

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Introduction

The human immune system fights infections through two main mechanisms; namely passive and active immunization. In passive immunization, preformed antibodies (immunoglobulin) are introduce into the blood circulation to help wade off infectious foreign materials. On the other hand, active immunization is achieved through the introduction of vaccine into the human body. Vaccines are immuno-biological antigenic substances designed to produce specific protection against certain (vaccine preventable) diseases by stimulating the production of antibodies. [1] These vaccines are either prepared from live attenuated organisms, inactivated or killed organisms or extracted cellular fractions, toxoids or combination of these. More recent preparations are sub-unit vaccines and recombinant vaccines. Some vaccines are highly freeze-sensitive while others are heat-labile. Thus, they must be handled with care and subjected to optimal environmental conditions for them to retain their potencies.

Childhood immunization has been asserted to be the most successful public health intervention of the latest century as several morbidities and mortalities had, and could still, be averted through it.[2] Availability of potent vaccines in adequate proportions at all times is central to successful immunization programme; as such they have to be properly managed. In immunization service delivery, the term 'vaccine management' has five core components comprising of vaccine needs estimation (vaccine forecast), vaccine ordering, vaccine storage, vaccine use monitoring, and vaccine wastage limitation.[3] Maintaining the potency of the vaccines is an integral part of vaccine management. Storage of vaccines at optimal temperature helps to maintain the cold chain and by extension, the potency of the vaccine. IN recent times, it has become more important to prevent loss of vaccine potency during storage and handling as new and more expensive vaccines are being introduced, with at least one case, requiring a different approach to storage.[4]

It must be underscored that healthcare worker play a cardinal role in managing vaccine for immunization programmes. Hence, they require a sound knowledge of vaccine management. However, past studies done in Mozambique[13] and India [6-8] have observed varying degrees of gap in knowledge of

vaccine management among PHC workers. Similar assertions (of knowledge gap) have been made by some researchers in Nigeria.[4,9-13]

Poor vaccine management practices of healthcare workers have direct and indirect impact on immunization programme and control of Vaccine Preventable Diseases (VPDs). In Nigeria, VPDs recently accounted for about 22% of deaths of under-fives, translating to about 200,000 avoidable child deaths annually.[14] Poor vaccine storage and handling practices of PHC workers in some resource-poor countries in Africa had not only resulted in lack of sero-conversion but also fatal consequences in recipients when drugs stored together with vaccines in the same refrigerators were inadvertently administered as vaccines.[15] Surprisingly, poor vaccine management seemed not to be peculiar to resource-poor countries as evidenced by studies done in Ontario,[16] Taiwan[17] and Colombo[18] where various poor vaccine management practices had been elicited among PHC workers.

A direct relationship is said to exist between PHC workers' knowledge of various health programmes and their basic qualification and this has been demonstrated in previous studies. [9-13,19] Similarly, periodic training and supportive super vision have been shown to be effective means of updating PHC workers' knowledge on various healthcare programme packages. In other words, interventional training can serve as effective means of bridging the gaps in knowledge of PHC workers on various health issues and this assertion had been supported by some studies done in Nigeria[10-12] and Turkey.[13] Even though, PHC workers in this study area might have undergone certain interventional training on various aspect of immunization programme, there is still a dearth of local study on effect of training on vaccine management knowledge and practices of workers in the study area. This study therefore, set out to determine the effect of training intervention on vaccine management knowledge and practices of PHC workers in static routine immunization facilities in Ilorin, north-central Nigeria.

Methodology

The study was carried out in Ilorin which comprises 73 public PHC health facilities and 54 registered private HFs distributed in Ilorin South, Ilorin West and Ilorin East LGAs that made up the metropolis.[20] All the public and most private PHC facilities offer routine immunization (RI) services as a major component of their PHC package. As at the time of this study, there were 644 and 113 PHC workers in the public and private PHC facilities respectively directly involved in RI service delivery. A total of 230, 252 and 162 PHC workers were in Ilorin West, East and South LGAs public PHCs respectively. In the privately-owned PHCs, there were 36, 47 and 33 healthcare workers (directly involved in RI service delivery) in Ilorin West, East and South LGAs respectively.[21]

Using statistical formula for comparison of two proportions[22] (comparing the training intervention group with the control group), a minimum sample of 126 respondents was to be selected from each of the study (training intervention group) and control groups. However, all PHC workers who satisfied the inclusion criteria (those that have spent at least one month at the static routine immunization unit) and consented to participate in the study were eventually recruited. At the pre-interventional training phase, 216 and 241 PHC workers were in the study and control groups respectively. At 3-months post interventional training, 213 study and 212 control respondents were followed up, giving attrition rates of 1.4% and 7.8% respectively. At 6-months post intervention, 208 and 205 study and control respondents were followed up giving an attrition rate of 2.3% and 3.3% respectively.

This study was quasi-experimental in design with pre-intervention and post-interventional training phases. At the Pre- interventional training phase, a descriptive cross-sectional study was carried out among the study and control groups to generate base-line information on their socio-demographic data, and their knowledge of vaccine management. A pretested semi structured self administered questionnaire was administered to the study and control group. 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 phase of the study.

During the training intervention stage, the study group received a three - day training on vaccine management while the control group did not. A total of 8 sessions were held over a four - week period in four training centers. The resource persons included the researchers and the trained research assistants. A total of 25 participants were in each training group. A training module adapted from the World Health Organization (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. During the post interventional training stage, a descriptive cross sectional study similar to the pre-interventional 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.

All the 20 HFs in the study LGA and 29 HFs in the control LGA were assed using an observational checklist (OBL). The OBL was also used to assess the quantity and functionality of available vaccine cold

chain maintenance and monitoring equipments in the HFs. The 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 than vaccines in the refrigerators/ cold boxes.

Data were analyzed using EPI-INFO version 3.5.1 software package. 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.

The pre-interventional training data for study and control were compared. Comparison was also made between the baseline data and the 3 months and 6 month post interventional training data and a trend analysis of the three sets of data done. Chi-square test was used to determine the statistical significance of observed differences in the pre- and post-interventional training phases of the study. Level of significance was predetermined at p-value less than 0.05.

Results

The mean ages of respondents in the study and control groups were 38.5 ± 9.5 and 34.9 ± 8.8 years respectively. Community Health Extension Workers (CHEWs) were the predominant cadre of PHC workers in both groups but more nurses 66 (30.6%) were in the study group compared with control 55 (22.8%), table 1.

Before training intervention, 98 (45.4%) of the study respondents had adequate knowledge of vaccine

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 – 60**
Mean (years)	**38.5 ± 9.5**	**34.9 ± 8.7**
Sex Distribution		
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	28 (13.0)	16 (6.6)
Others(auxiliaryhealth workers)	23 (10.6)	11 (4.5)
Years of experience in routine immunization		
<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)

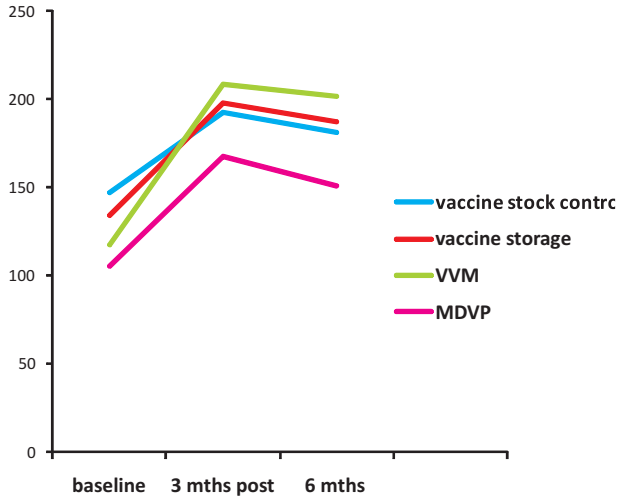

Figure : Trends of knowledge of various components of vaccine management among the study respondents

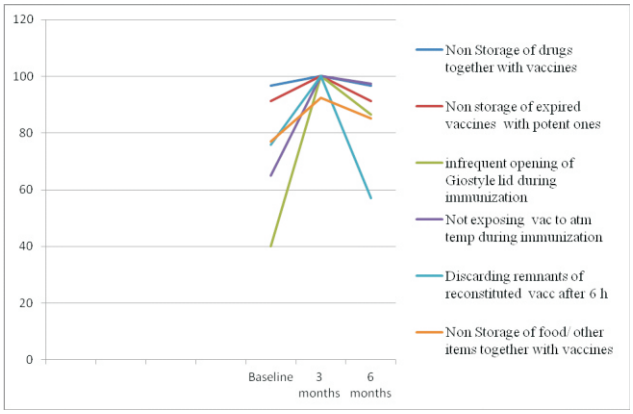

Fig2: Trend of vaccine management practices among respondents over 6 months period

Table 2: Trend of respondents' general knowledge of vaccine management

General knowledge of vaccine management	Study group			Control group		
	Pre-interv. N=216 n (%)	3 mths post N =213 n(%)	6 mths post N = 208 n(%)	Pre-interv. N =241 n(%)	3 mths post N = 212 n(%)	6 mths post N =205 n (%)
Adequate knowledge of vaccine management	98 (45.4)	182 (84.5)	169 (81.2)	110 (45.6)	93 (43.9)	84 (41.4)
Inadequate knowledge of vaccine management	118 (54.6)	31 (15.5)	39 (19.8)	131 (54.4)	119 (56.1)	121 (58.6)
Chi square for linear trend	**(χ^2=66.5; p-value < 0.001)**			**(χ^2= 0.9; p-value = 0.325)**		

Table 3: Trend of respondents' knowledge of various components of vaccine management

Correct Knowledge of Various aspects of vaccine manage-ment	Study group					Control group				
	Pre-I N=216 n (%)	3PoI N 213 n(%)	6 PoI N =208 n(%)	Chi square for linear trend	p-value	Pre-I N =241 n(%)	3 PoI N=212 n (%)	6 PoI N =205 n(%)	Chi square for linear trend	p-value
Multi-Dose Vial Policy (MDVP)	105 (48.6)	167 (78.4)	150 (72.1)	26.6	0.001	128 (53.1)	135 (63.7)	129 (62.9)	4.7	0.030
VVM interpretation	117 (54.2)	208 (97.7)	201 (96.6)	134.3	0.001	131 (54.4)	114 (67.9)	134 (65.4)	5.7	0.017
Optimal temperature for vaccine storage	134 (62.0)	198 (93.0)	187 (89.9)	55.2	0.001	233 (96.7)	206 (97.2)	202 (98.5)	1.5	0.224
Vaccine stock control	147 (68.1)	192 (75.6)	181 (87.0)	25.8	0.001	143 (59.3)	125 (48.1)	109 (53.2)	1.6	0.199

management. This proportion increased significantly to 182 (84.5%) at 3 months post intervention with a little decline to 169 (81.2%) at 6 months post intervention ($p < 0.001$) table 2. The observed differences in proportions in the control group were not statistically significant ($p = 0.325$) table 2. Regarding respondents' knowledge of various components of vaccine management, significant increase above baseline was observed in the study group at the third and sixth months post intervention $p < 0.001$. In the control group, no such significant increment was observed $P > 0.001$, table 3.

The line graph (figure 1) showed that the respondents' knowledge of vaccine vial monitor (VVM) was mostly improved upon followed knowledge of vaccine storage and vaccine stock control, while knowledge of multi-dose vial policy (MDVP) was least improved upon. Strikingly, the knowledge of the respondents in the study group regarding the various components of vaccine management, increased significantly from baseline levels by the end of the third month post training intervention (figure 1). Beyond this point, however, the respondents' level of knowledge started waning steadily (figure 1). This implied that the acquired knowledge may get back to baseline levels, if nothing is done to reverse the trend.

At the pre-interventional training stage, 22.2% (48) of the study respondents imbibed good vaccine management practices. This proportion rose significantly to 73.2% (156) barely 3-months post intervention with a decline to 68.3% (142) at 6-month post training intervention ($p < 0.001$). The proportions of control respondents who imbibed good vaccine management practices were 42.3% (102), 41.5% (88) and 41.5 % (85) at the pre-intervention, 3-months post intervention and 6-months post interventional training. However, the observed differences in proportion in the control group were not statistically significant ($p = 0.851$) table 4.

Table 5 shows the trends of respondents' vaccine management practices. In 30.8% (4) of the study HFs vaccines were stored in optimal temperature range ($+2^0$C to $+8^0$C) before the training intervention. The proportion of HFs with this good practice increased significantly to 92.3% (12) 3-months post

Table 4: Trend of vaccine management practices among respondents over 6 months

Overall vaccine management practices	Study group			Control group		
	Pre-interv. N=216 n (%)	3mth post N=213 n(%)	6 mths post N = 208 n(%)	Pre-interv. N=241 n (%)	3 mths post N =212 n(%)	6 mths post N =205 n(%)
Good vaccine management practices	48 (22.2)	156 (73.2)	142 (68.3)	102 (42.3)	88 (41.5)	85 (41.5)
Bad vaccine management practices	168 (77.8)	57 (26.8)	66 (31.7)	139 (57.7)	124 (58.5)	120 (58.5)
Chi square for linear trend	**(χ^2=91.8 ; p-value < 0.001)**			**(χ^2= 0.0; p-value = 0.851)**		

Table5: Trend of respondents' practices of various components of vaccine management

Good Practices of Various aspects of vaccine manage-ment	Study Health Facility					Control Health Facility				
	Pre-I N=20 n (%)	3PoI N 20 n(%)	6 PoI N 20 n(%)	Chi square for linear trend	p-value	Pre-I N =29 n(%)	3 PoI N=29 n (%)	6 PoI N =29 n(%)	Chi square for linear trend	p- value
Vaccine inventory	17 (85.0)	20 (100)	19 (95.0)	1.3	0.257	21 (72.4)	21 (72.4)	22 (75.9)	0.1	0.767
vaccine stock control	4 (30.8)	12 (92.3)	9 (76.9)	4.1	0.044	3 (37.5)	4 (50.0)	3 (37.5)	0.0	1.000
Not storing vaccines with food/drinks	3 (23.1)	5 (38.5)	3 (23.1)	0.0	1.000	3 (37.5)	4 (50.0)	2 (25.0)	0.3	0.613
Optimal vaccine temperature storage	4 (30.8)	12 (92.3)	10 (76.9)	607.0	0.014	2 (25.0)	3 (37.5)	3 (37.5)	0.3	0.604

intervention but later decreased to 76.9% (10) at 6-month post interventional training (p = 0.014). The observed differences in proportion in the control HFs were not statistically significant (p = 0.604). The line graph (figure 2) showed the respondents' vaccine management practices. Respondents' best practices were observed in the various aspects of vaccine management. However, these could not be sustained beyond the third month post training intervention as depicted by the graph. If nothing is done to reverse the trend, respondents vaccine management practices may soon revert to the baseline levels.

Discussion

Female respondents predominated both groups. This female dominance in PHC service delivery has been documented in previous studies.[23] This is a reflection of what obtains in most PHC facilities in Nigeria where Nursing profession and other allied professions like CHEW and Community Health Officers (CHO) are predominantly females.[23] Expectedly, CHEWs and nurses constituted the highest

proportion of respondents, accounting for over 67% of all respondents in the study area. This is essential because, as side from doctors, they are the cadre of health work force required for effective PHC service delivery in Nigeria.[23,24]

More than one-third (45.4%) of the respondents in the study group had adequate knowledge of vaccine management at baseline. This contrasts sharply with a similar study conducted in Enugu, Nigeria where only 24% of the study respondents had adequate before training intervention. Even though, knowledge on vaccine management components was high in both groups before training intervention, a significant improvement in the knowledge among the study group was observed ($p < 0.001$). This improvement in knowledge can be adduced to the training intervention received by the study group as there was no correspondingly significant improvement in knowledge of the control group ($p = 0.656$). Similar trends were observed in Enugu[10], Lagos[4] and Turkey.[13] In the Enugu[10] study, the 24% health workers with adequate knowledge of vaccine management at baseline increased significantly barely 2 weeks after training workshop to (86.7%) but declined to (70.7%) 18 months post intervention ($p < 0.001$); while no such improvement was observed in the control group ($p > 0.05$). In the Turkey study, Ersin[13] et al observed a significant increase in health workers knowledge at post interventional training just like what obtained in this study. Similarly, Munir et al in Lagos, Nigeria[4] reported a significant improvement in proportion of health workers from 5% at baseline to 84% post interventional training.

Trend analysis of vaccine management practices of study respondents revealed a significant improvement in the baseline observation of 22.2% to 73.2% at 3- months which later declined to 68.3% at 6-months post interventional training ($p < 0.001$). This improvement could be traced to the training intervention received by the study respondents, since no similar improvement was realized among the control respondents ($p = 0.851$). Again, this finding was consistent with the trends observed by Uzochukwu et al,[10] in their study among PHC workers in south-eastern Nigeria to assess the effects of educational intervention on vaccine storage and administration.

A careful observation of the line graphs depicting the trends of vaccine management knowledge and practices over time revealed a steady decline in the proportion of respondent that still retain the knowledge acquired during the training. This implied that the acquired knowledge may get back to baseline levels, if nothing is done to reverse the trend. These observations further underscored the fact that training and re-training coupled with supportive supervision are a vital clasp to improving health workers' knowledge and skill.

This training intervention has impacted positively on the knowledge of vaccine management among PHC workers providing RI services in the study area. This is evident by the over 30% improvement in the trend of their general knowledge of vaccine management over a six month period. Striking improvements in some specific aspects of vaccine management were also achieved by this study. After the training, a 30% improvement in the proportion of health workers with adequate knowledge of Vaccine Vial Monitor (VVM) interpretation, and Multi-Dose Vial Policy (MDVP) application was realized. In addition, an appreciable improvement was recorded in the proportion of health workers with correct knowledge of vaccine storage temperature (30%), knowledge of vaccines likely to be damaged at freezing temperature (50%) and how to perform and interpret the shake test (20%) on a vaccine vial suspect to have been exposed to freezing temperature.

The training also improved on the vaccine management practices as evident by the trend analysis which showed a sustained improvement in the practices at 3 months (50%) and 6 months (46%) above the baseline value of 22.2%. Whereas certain aspects of vaccine management practices such as twice daily monitoring and charting of vaccine temperature and maintenance of vaccines in optimal temperature range were greatly improved upon; there was no appreciable improvement regarding the practice of vaccine storage with other items and storage of vaccines on refrigerator door shelves. Even the proportion of respondents that displayed appreciable improvement at 3 months post intervention started waning by the sixth month post interventional training. This might be adduced to the infrequent supervisory visits as only 47 (21.8%) respondents in the intervention group had supervisory visit in the previous 6 months to the survey.

Conclusion

This study showed that training intervention has positive impact on vaccine management knowledge and practices among PHC workers in the study area; even though, vaccine management practices declined at 6 months post interventional training. There is need for regular training and re-training, in addition to monitoring and supportive supervision of health workers' vaccine management practices to ensure high standard of vaccine storage and handling.

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