

KNOWLEDGE AND PRACTICE OF VACCINE LOGISTICS MANAGEMENT AMONG PRIMARY HEALTHCARE WORKERS IN ENUGU STATE, NIGERIA

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ABSTRACT

The laudable immunization programmes aimed at disease prevention require good knowledge and practice of vaccine logistics management among primary healthcare workers who are the custodians and administrators of these vaccines. This study assessed the knowledge and practice of vaccine logistics management among Primary Healthcare Workers in Enugu State, Nigeria. It was a descriptive cross-sectional study among 160 randomly selected primary healthcare workers. Interviewer-administered semi-structured pre-tested questionnaire was used and data was analyzed using SPSS version 22.0. Overall knowledge and practice of vaccine logistics management of respondents were 54.4% and 75.6% respectively. More respondents in the age group of 36-45 years (69.6%), females (55.6%), males (43.8%), tertiary education (54.5%) and 6-10 years of experience (64.4%) had good knowledge. There was statistically significant association of overall knowledge of vaccine logistic management and age p-value = 0.000, years of experience p-value = 0.013 and marital status p-value = 0.009. However, it was not significant for gender p-value = 0.368 and educational level p-value = 0.573. Respondents in age group of 36-45 years (85.8%), females (78%), males (50.0%), secondary and tertiary education (76.9%) and more than 11 years of experience (87.1%) had good practice. There was statistically significant association of overall good practice of vaccine logistic management and age p-value = 0.003, gender p-value = 0.012 and years of experience p-value = 0.000. However, no significant association with educational level p-value = 0.104 and marital status p-value = 0.169. Majority of respondents (36.3%) had no formal training, 30.6% had formal training with 66.3% preferring training every six months. Gaps in knowledge and practice of vaccine logistics management still exist among the respondents which regular training, supportive supervision, and availability of vaccine logistics Standard Operating Procedures will go a long way to close.

Key Words: Vaccine logistics, Immunization, Primary Healthcare Workers, Knowledge, Practice.

INTRODUCTION

The motivation of Expanded Programme on Immunization (EPI) of the World Health Organization (WHO) was basic and direct, which is to deliver various vaccines to all children through a basic timetable of child visits to the health centers to control and destroy vaccine-preventable diseases", (Mariannie 2020). This laudable immunization programme requires a good knowledge and practice of vaccine logistics management among the primary healthcare workers who are the custodians and administrators of these vaccines to achieve the goal of reaching every child with potent vaccine. Logistics Management is the part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirement. It is an integrating function, which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions including marketing, sales manufacturing, finance, and information technology" (CSCMP 2011).

Vaccine logistics management is very important in the achievement of this laudable goal and it involves the planning, coordination, and execution of activities related to distribution, storage, handling, and administration of vaccines. These activities involve the cold chain system which ensures that vaccines get to the end user safely, efficiently, and effectively. "The system of transporting, storing and distributing vaccines in a potent state at the recommended temperature from the point of manufacture to the point of use is the cold chain", (Rao *et al.*, 2012). The various aspects of vaccine logistics management include vaccine supply chain management, vaccine cold chain management, vaccine inventory management, vaccine distribution and storage facilities management. Vaccine preventable diseases are still

the most common cause of childhood mortality, with an estimated 3 million deaths every year, mainly in Africa and Asia, (Abubakar et al., 2021).

Vaccines are known to be immuno-biological substances which produce specific protection against a given disease by stimulating active production of antibody and other immune mechanisms which fight the disease-causing organism anytime it enters into the body of the individual. Importance of immunization was further stressed as "vaccination across the life course can also contribute to significantly lowering the use of antibiotics, thereby reducing the spread of antimicrobial resistance", (Tate, J. et al., 2019). Globally, the vast majority of people have received at least some vaccines during infancy, childhood, adolescence, and/or as adults, (Laupèze et al., 2021). The immune system is thus programmed by environmental exposures that have long-term implications for health, (Liston et al., 2016). Vaccines are highly thermo-sensitive materials whose potency requires a functional cold chain system which is dependent on the ability of health care workers to effectively manage the system toward eliminating vaccine-preventable diseases (Wasiu et al., 2021). Vaccines are products that protect us against serious, often deadly diseases, by helping our body's natural defense - the immune system - to fight them off (UNICEF 2023). One of the major targets of the United Nations' third Sustainable Development Goals (SDGs), is to ensure access to safe, effective, quality, and affordable essential medicines and vaccines, for all.

This target is critical to achieving universal healthcare coverage just as effective health product supply chains are indispensable in ensuring access to quality medicines and vaccines (Victory et al., 2022). Vaccines are also critical to the prevention and control of infectious disease outbreaks. They underpin global health security and will be a vital tool in the battle against antimicrobial resistance, (WHO 2024). The knowledge of vaccine logistics management among Primary Health Care Workers (PHCWs) is relatively low and may have affected the effectiveness in discharging their duties in ensuring that vaccines are potent

at the point of administration to guaranty effectiveness. This research focused on the general knowledge and specific practices related to vaccine logistics management among primary health care workers, providing insight into how effectively procedures are being implemented, thus contributing to better vaccine management and safe vaccination services.

Research Questions

- i. Are the Primary Healthcare Workers knowledgeable about vaccine logistics management in Enugu State?
- ii. What is the practice of vaccine logistics management among Primary Healthcare Workers in Enugu State?
- iii. Are the Primary Healthcare Workers in Enugu State trained on vaccine logistics management?
- iv. What are the challenges affecting practice of vaccine logistics management among PHCWs in Enugu State?

Research Objectives

- i. Assess knowledge of vaccine logistics management among Primary Healthcare Workers in Enugu State.
- ii. Determine practice of vaccine logistics management among Primary Healthcare Workers in Enugu State.
- iii. Determine what percentage of PHCWs in Enugu State are trained on vaccine logistics management.
- iv. Determine challenges of vaccine logistics management among PHCWs in Enugu State.

METHODS

Enugu State is located in South East Geo-Political Zone of the country. It was created in 1991 and is bordered to the North by Kogi and Benue States, to the West by Anambra State, to the South by Abia State, and to the East by Ebonyi State. The State has a total population of 5,711,692 estimated from the 2006 population census figure. It is made of 17

LGAs and 291 political wards with 988 Health Facilities (HFs) including private and public, with 734 of HFs offering routine immunization. The study was a descriptive cross-sectional study conducted among primary healthcare workers in Enugu State. Interviewer-administered semi-structured questionnaire was used to assess the socio-demographic information, knowledge and practice of vaccine logistics management, status of training on vaccine logistics management and challenges of vaccine logistic management.

The sample size was determined using a sample size calculation formula known as Yamane's Formula:

$n = N / (1 + N(e)^2)$ Where;

n = the sample size

N = study population (number of RI offering HFs (226) in the 6 LGAs randomly selected)

e = the margin of error in the calculation

Therefore, $n = 226 / (1 + 226(0.05)^2)$

$= 144.4 = 145$.

Taking into consideration non-response of 10% of 145 = $145 \times 1.1 = 159.5$ approximated to 160

Multistage sampling technique was used in the selection of respondents. The first stage was the random selection of 6 LGAs from the 3 senatorial zones (2 per senatorial zone). The second stage was the random selection of 80 wards from the 6 LGAs. Thirdly, 160 HFs offering routine immunization were random selected. The random selection was done using the excel rand array function. Data was collected with the administration of pre-tested semi-structured questionnaire by trained research assistants on how to administer the questionnaire to the respondents across the 160 HFs. The completed questionnaire and data generated were manually sorted, reviewed for correctness, completeness and appropriateness. The cleaned data was entered into the computer using the Statistical Package for the Social Sciences (SPSS) version 22.0 for Statistical Computing. Descriptive statistics such as frequencies and summary statistics were used to describe the relevant variables in the study population to summarize the data, and results were presented via

frequency tables. The confidence level was set at 95%, while a pre-determined p-value < 0.05 was considered statistically significant for knowledge and practice of vaccine logistics management. Ethical approval to conduct the study was obtained from Enugu State Research Ethics Committee. Verbal informed consent was taken from each participant and they were assured of their right to withdraw their participation anytime they felt uncomfortable.

FINDINGS

Socio-Demographic Characteristics of Respondents

Majority of respondents were females (90%), within 36 - 45 years age range (43.1%), and married (81.9%). Among the respondents were those with tertiary education, Senior Community Health Extension Workers (SCHEWs), Junior Community Health Extension Workers (JCHEWs) and Nurses/Midwives. There was a fair distribution of years of experience among the respondents with higher proportion who had more than 11 years of work experience (Table 1).

Table 1: Socio-Demographic Characteristics of Respondents

Variables	Frequency n = 160	Percentage
Sex		
Male	16	10
Female	144	90
Age (years)		
< 35	48	30
36 - 45	69	43.1
46-55	43	26.9
Marital Status		
Single	22	13.8
Married	131	81.9
Divorced	3	1.9
Widowed	4	2.5
Position/Title		
JCHEW	33	20.6
SCHEW	77	48.1
CHO	23	14.4
Nurse/Midwife	27	16.9
Years of Experience		
< 1	9	5.6
1 - 5	30	18.8
6 - 10	59	36.9
≥ 11	62	38.8
Level of Education		
Primary	1	0.6
Secondary	13	8.1
Tertiary	146	91.3

Knowledge and Practice of Vaccine Logistics Management

On the overall knowledge and practice of vaccine logistics management among the respondent, 54.4% of respondents had good knowledge, while 75.6% had good practice. Notably, the proportion of respondents with poor knowledge is relatively high (45.6%).

Table 2: Knowledge and Practice of Vaccine Logistics Management

Variables	Good F (%)	Poor F (%)
Overall knowledge of vaccine logistics management	87 (54.4)	73 (45.6)
Overall practice of vaccine logistics management	121 (75.6)	39 (24.4)

Knowledge of vaccine logistics management and socio-demographic characteristics

More respondents 69.6% in the age group of 36-45 years had good knowledge of vaccine logistics management compared with other age groups of 45 -55 years and less than 35 years. Females (55.6%) had good knowledge compared with male counterparts 43.8%. Proportion of respondents with tertiary education who had good knowledge was 54.5%, secondary (61.5%), and postgraduate (33.3%). Varied degree of knowledge of vaccine logistics management were exhibited by respondents based on years of experience where 38 (64.4%) with 6-10 years of experience had good knowledge compared with those with other years of experience. Greater number of the married respondents 78 (59.5%) had good knowledge of vaccine logistics management compared with others. There was statistically significant association of overall knowledge of vaccine logistic management and age, p value = 0.000, years of experience, p value = 0.013 and marital status, p value = 0.009. However, it was not statistically significant for others (gender and education), (Table 3).

Table 3: Knowledge of Vaccine Logistics Management and Socio-demographic Characteristics

Variables	Good		P value
	Poor	Frequency (%)	
Age (years)			
<35	15 (31.3)	33 (68.8)	0.000
36-45	48 (69.6)	21 (30.4)	
46-55	24 (55.8)	19 (44.2)	
Gender			
Female	80 (55.6)	64 (44.4)	0.368
Male	7 (43.8)	9 (56.3)	
Educational level			
Primary	0 (0)	1 (100)	0.573
Secondary	8 (61.5)	5 (38.5)	
Tertiary	79 (54.1)	67 (45.9)	
Years of Experience			
< 1	1 (11.1)	8 (88.9)	0.013
1 - 5	13 (43.3)	17 (56.7)	
6 - 10	38 (64.4)	21 (35.6)	
≥ 11	35 (56.5)	27 (43.5)	
Marital Status			
Single	5 (22.7)	17 (77.3)	0.009
Married	78 (59.5)	53 (40.5)	
Divorced	1 (33.3)	2 (66.7)	
Widowed	3 (75.0)	1 (25.0)	

Practice of Vaccine Logistics Management and Socio-Demographic Characteristics

On socio-demographic characteristics of respondents and practice of vaccine logistics management, 85.8% of respondents in the age group of 35-45 years had good practice compared with other age groups. Female respondents (78%) had good practice than the males (50%). Those with secondary and tertiary education (76.9%) had good practice. Respondents with more than 11 years of experience (87.1%) had good practice compared with others. The married respondents (77.9%) had good practice. There was statistically significant association of overall good practice of vaccine logistic management and age, p-

value = 0.003, gender, p-value = 0.012 and years of experience, p-value = 0.000. However, there was no significant association with educational level and marital status (Table 4).

Table 4: Practice of Vaccine Logistics Management and Socio-demographic Characteristics

Variables	Good F (%)	Poor F (%)	P-value*
Age (years)			
<35	28 (58.3)	20 (41.7)	0.003
36-45	59 (85.5)	10 (14.5)	
46-55	34 (79.1)	9 (20.9)	
Sex			
Female	113 (78.5)	31 (21.5)	0.012
Male	8 (50.0)	8 (50.0)	
Educational level			
Primary	0 (0)	1 (100)	0.104
Secondary	10 (76.9)	3 (23.1)	
Tertiary	111 (76.0)	35 (24.0)	
Years of Experience			
< 1	3 (33.3)	6 (66.7)	0
1 - 5	16 (53.3)	14 (46.7)	
6 - 10	48 (81.4)	11 (18.6)	
> 11	54 (87.1)	8 (12.9)	
Marital Status			
Single	13 (59.1)	9 (40.9)	0.169
Married	102 (77.9)	29 (22.1)	
Divorced	2 (66.7)	1 (33.3)	
Widowed	4 (100.0)	0 (0.0)	

*P-value obtained from chi-square test

Source: Author's Field Work

Training on Vaccine Logistics Management

Less than half of the respondents (30.6%) had formal training while majority (36.3%) had no formal training, but had informal and on-the-job training from supervisors during supportive supervision. The need for regular training on vaccine logistics management was expressed by

majority of respondents (66.3%), requesting that formal training be conducted every six months (Table 5).

Table 6: Training on Vaccine Logistics Management

Variables	Frequency n=160	Percentage
Have you received any formal training in vaccine logistics management?		
Yes	49	30.6
No	31	19.4
I received informal training through self-study of Cold Chain management SOPs/manual	22	13.8
I received on-the-job training from supportive supervision by supervisors	58	36.3
How often do you think vaccine logistics management training should be conducted?		
Variable		
Once a year	25	15.6
Every six months	106	66.3
Only when new vaccines are introduced	26	16.3
When there is a problem with vaccine distribution	3	1.9

Source: Author's Field Work

DISCUSSIONS

Whether Vaccine Preventable Diseases (VPDs) prevalence would reduce or not depends on the quality of vaccination services and these are related to several factors including adequate knowledge among health workers regarding cold chain management, (Wasiu et al., 2021). This study assessed the knowledge and practice of vaccine logistics management among primary health care workers (PHCWs) in Enugu state Nigeria. This study revealed that a significant percentage of respondents (90%) were females compared with 10% of males and this is in line with the WHO's Health Workforce Working paper where it was reported that women form 70% of workers in the health and social sector, and women's representation in the most highly paid health occupations has been improving steadily since 2000, (Boniol et al.,

2019). High percentage (81.9%) of respondents were married which agrees with a study finding where majority of the respondents were 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 (Ameen *et al.*, 2016).

On knowledge, 54% of the respondents had good knowledge of vaccine logistics management, this is consistent with other studies where more than 50% of respondents had good knowledge of vaccine logistics management. These include studies conducted in a resource-limited setting of Sheger, Oromia, Ethiopia which revealed that good knowledge of vaccine cold chain management was 58% (Lucha *et al.*, 2024), and other studies in Dalocha District of Silt'E Zone, Ethiopia (54%), (Feyisa D, *et al.*, 2022), in public health facilities in Ethiopia (56%), (Mohammed *et al.*, 2021), in Bale Zone, Southeast Ethiopia (54.6%), (Woldemichael *et al.*, 2018), in a study to know health professionals' knowledge, 53.58%, (Zone G, 2021) and in central Ethiopia (56%), (Rogie *et al.*, 2013). On the other hand, the finding in this study is not consistent with findings from other studies where less than 50% had good knowledge of vaccine logistics management, including studies which showed that 48% of vaccine handlers had good knowledge of cold chain and vaccine management (Gebretnsae *et al.*, 2022), studies in east Gojam zone of Amhara region (38.3%), (Bogale *et al.*, 2019), in Tigray region, Northern Ethiopia (48%), (Gebretnsae *et al.*, 2022) and in Ibadan, Oyo State, Nigeria (43%), (Dairo *et al.*, 2016).

Findings from this study show that more respondents (69.6%) in the age group of 36-45 years had good knowledge compared with other age groups of 46-55 years (55%) and less than 35 years (31.1%) who had good knowledge of vaccine logistics management. This follows that age has significant association with knowledge of vaccine logistics management (p value = 0.000) with decrease in knowledge with increase in age. This is likely due to the fact that the older age group (46-55 years) was trained long time ago compared with the younger age

group (36-45 years) coupled with the fact that majority of the respondents did not have formal training on vaccine logistics management. This is also in agreement with the findings where age was found to be a determinant of knowledge of cold chain management in a study as knowledge decreases with increase in age (Wasiu et al., 2021)). Also, association between age and vaccine management knowledge was statistically significant with p value of 0.006 (Victor et al., 2013). Although high percentage (55.6%) of female respondents had good knowledge of vaccine logistics management compared with their male counterparts (43.8%), this study revealed that gender had no significant association with vaccine logistics management with p value of 0.368. This follows the finding that, respondents' gender has no significant effect on vaccine management knowledge (P value = 0.5257), (Victor et al., 2013). With respect to educational level and knowledge of vaccine logistics, 61.5% of respondent with secondary education and 54.1% of respondents with tertiary education had good knowledge.

The above was corroborated with the fact that vaccine logistics management has no significant association with educational level P value = 0.573. The possible reason for higher proportion of respondents with secondary compared with those with tertiary education having good knowledge could be due to the fact that roles played by the PHCWS are functional roles which are the same for every staff at the level of the PHC facility. The different levels of knowledge would have been acquired by the respondents through informal training, self-study and on-the-job-training provided by supervisors during supportive supervisory visit to the PHC facilities. The number of years of experience had statistically significant effect on knowledge of respondents (p value = 0.013) with 64.4% of respondents in the range of 6-10 years of experience and 56% of respondents in the age range of 11 years and above had good knowledge of vaccine logistics management.

On practice, 75% of respondents had good practice of vaccine logistics management from practice and experience despite the fact that, 36.3% of respondents did not undergo formal training. This agrees with the finding that regular hands-on training is very important as this will give healthcare workers the opportunity to obtain up-to-date information on cold chain management in line with the world's best practices (Wasiu et al., 2021)). Finding from this study is consistent with proportion of PHCWs who had good practice of vaccine logistics management in studies involving PHCWs in Nigeria (77.2%), (Wasiu et al., 2021), in Ibadan, Oyo State, Nigeria (66.1%), (Dairo et al., 2016), and in Wolaita Zone, Ethiopia (61%), (Offices et al., 2023). Age with p value of 0.003 had statistically significant association with good practice of vaccine logistics management where 85.8% respondents in age group of 35-45 years, 79.1% of those in the age groups of 46-55 years and 58.3% in less than 35 years had good practice of vaccine logistics management.

Years of experience with p value of 0.000 showed to have significant association with good practice of vaccine logistics management and there was progressive increase in percentage of respondents with years of experience [< 1 years (33.3%), 1-5 years (53.3%), 6-10 years (81%) and ≥ 11 years (87.1%)]. On the other hand, educational level p value = 0.104 had no significant association with good practice of vaccine logistics management. This is further clarified with 76.9%) of respondents with secondary and 76.0% of respondents with tertiary education who had good practice. This is in line with the finding that, basic qualification of health workers ($p = 0.096$) had no significant influence on respondents' vaccine management practices (Ameen et al., 2016).

Training and retraining of PHCWs are very important in building capacity for good knowledge and practice of vaccine logistics management however, only 30.6% of the respondents were formally trained on vaccine logistics management while higher proportion (36.3%) received informal training through self-study. Need for formal training agrees with finding that

trainings related to EPI service providers played a role in their knowledge, vaccine storage and transport, and vaccine and cold chain management practices (Ergetie *et al.*, 2023).

CONCLUSION

The results of the study indicated that slightly more than half of the respondents had good knowledge of vaccine logistics management leaving the rest with poor knowledge. On the other hand, majority of the respondents had good practice of vaccine logistic management. High number of the respondents had no formal training with informal training as the main source of training obtained from self-learning and on-the-job training provided by supervisors during supportive supervision to the health facilities. Majority of the respondents therefore raised the need for formal training every six months to enhance their knowledge and practice of vaccine logistics management. Non-availability of Standard Operating Procedures for vaccine logistics management, lack of proper storage equipment and lack of temperature monitoring devices constituted the major challenges hindering knowledge and practice of appropriate vaccine logistics management in Enugu State.

RESEARCH GAPS

Reliance on self-reported data may have introduced social desirability and recall biases, as participants might have provided responses perceived as favorable rather than accurately reflecting their actual knowledge and practices. The cross-sectional design of the study captures information at a single point in time and therefore does not allow for assessment of changes in knowledge or practices over time, nor the establishment of causal relationships.

RECOMMENDATIONS

In view of the study findings and conclusions, State Primary Health Care Development Agency, partners, and other stakeholders should conduct formal training on vaccine logistics management regularly, supportive supervision and on-the-job training, provide appropriate

vaccine logistics management tools to enhance knowledge and practice of vaccine logistics management among PHCWs.

CONFLICT OF INTEREST

No conflicts of interest in conducting this study.

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Appendix 1: Ethical Approval**ENUGU STATE MINISTRY OF HEALTH
RESEARCH ETHICS COMMITTEE****Ref. No.: MH/MSD/REC21/789****Date: 14th April, 2025**

The Researcher,
Pharm Obute Joseph,
World Health Organisation,
31/34 Ishielu Street,
Independence Layout,
Enugu.

Sir/Madam,

Re: Knowledge and Practice of Vaccine Logistics Management Among Primary Health Care Workers (PHCWs) in Enugu State, Nigeria

I refer to your request for permission to carry out a study / research on the above health issue and to inform you that approval has been granted to you.

Ethical Guideline

- You are to keep to the principles of informed consent by obtaining a signed/ thumb printed informed consent of subjects, parents/ legally accepted representative.
- You are to deposit one (1) copy of the result of your study to the research ethics committee of the State Ministry of Health.
- This approval is valid for one year with effect from the date of signing.


Dr. Okenwa Uchechukwu
Secretary
Research Ethics