



## Availability, Storage, Handling and Administration of Vaccines in Community Pharmacies: Southwest Nigeria as a Case Study

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article.

### Abstract

**Background:** Vaccines have been instrumental in thwarting the spread of infectious diseases and have been a major public health success. Community pharmacies are a critical resource for success of any immunization programme. However, pharmacists' involvement in immunization programme in Nigeria has not been thoroughly investigated. This study assessed the involvement of pharmacists in immunization services.

**Methodology:** A cross-sectional survey was conducted among community pharmacists, using a structured pre-tested questionnaire. The survey tool, which consisted of 72-item questions spread over five different domains, assessed vaccine availability in community pharmacies and pharmacist's knowledge on vaccine. This (knowledge) addresses vaccine handling and administration as well as storage. The questionnaire was administered to selected community pharmacies by a combination of physical interview and electronic version through Google form link sent to pharmacist's WhatsApp platform. Association between patients' socio-demographics and some variables of interest was determined using Chi-square statistic.

**Result:** One hundred and ninety-one (191) pharmacists responded to the questionnaire (99.5% response rate). About half, one hundred and three (53.93%) of the respondents were aged between 31 and 50 years. One hundred and twenty-nine (67.54%) of the pharmacists had B.Pharm degree as the highest level of education. There was a significant association between pharmacists' age ( $\chi^2 = 30.5$ ,  $p < 0.01$ ), years of experience ( $\chi^2 = 25.9$ ,  $p < 0.01$ ), level of education ( $\chi^2 = 19.6$ ,  $p < 0.05$ ) and knowledge on vaccine handling and administration. Also, significant association ( $p < 0.01$ ) existed between pharmacists' age ( $\chi^2 = 45.1$ ), years of experience ( $\chi^2 = 45.3$ ), level of education ( $\chi^2 = 31.6$ ) and knowledge of vaccine storage. Furthermore, there was a significant association ( $p < 0.01$ ) between being trained as a vaccine administrator and level of knowledge on vaccine storage ( $\chi^2 = 57.8$ ) as well as handling and administration ( $\chi^2 = 45.2$ ).

**Conclusion:** Pharmacists' level of education and training (as vaccine administrator) were key factors in pharmacists' involvement in immunization care service.

**Keywords:** Administration, Community Pharmacists, Vaccine handling, Vaccine storage

## INTRODUCTION

Plotkin et al. (2018) and WHO (2021) highlighted critical issues in immunization exercises around the world. Firstly, declining rates (below the desired targets) of immunization among people remain a weighty concern for public health globally. Secondly, owing to lack of adequate data, concerns about side effects, false beliefs, and vaccine reluctance among the people, suboptimal vaccination rates still remain in multiple areas around the world. This is regardless of abundant evidence that immunization is one of the most effective interventions for impeding morbidity and mortality rate.

The World Health Organization (WHO) estimates that vaccinations save the lives of 2 - 3 million people each year, and increased vaccination coverage could annually prevent an additional 1.5 million premature deaths globally (WHO, 2017). Yet various barriers and challenges limit vaccination coverage resulting in the frequent occurrence of vaccine preventable diseases (Ozawa et al., 2019). Gaps in vaccination coverage are particularly glaring across low- and middle-income countries (LMICs) where large variations in coverage are observed (Restrepo-Mendez et al., 2016). Uncertainty about vaccination is a threat that can severely endanger vaccination campaign, execution and success (Rosselli et al., 2017). It is essential to consider programmatic and policy interventions to improve access to vaccines using a broad based approach incorporating all stakeholders (including pharmacists) in the healthcare sector.

Worldwide, majority of patients first seek care from pharmacies and drug shops. This is because community pharmacists are often perceived as affordable and trusted providers who offer therapeutic interventions on drug and medication efficacy, safety and appropriate regimen (Khalid et al., 2020). The flexibility of pharmacies' operating schedules also makes them more attractive to patients who face time constraints in accessing healthcare services (Mayora et

al., 2018). Pharmacists' role in vaccination and immunization currently varies across countries in the world due to what obtains and what is expected (Yusuff et al., 2021). Usually, pharmacists are expected to play active roles in ensuring the safe supply, storage, administration and dispensing of vaccines. In addition, legally, they are to organize vaccination activities and campaigns. This hitherto underscores the advocacy of FIP (2016) for pharmacist's involvement in immunization as well as the integration of community pharmacies in national healthcare policies, which will alleviate the burden of other healthcare professionals while increasing access to vaccinations.

In Nigeria, vaccines are administered across a wide range of government and private hospitals, yet pharmacies (and/or pharmacists) are not involved in the administration of vaccines and this has posed a great limitation to the uptake of vaccines (Yusuf et al., 2021). As limited data are available regarding the expertise and practices of Nigerian pharmacists in providing immunization services, this study assessed pharmacist's knowledge on and the availability of vaccine in Nigerian community pharmacies (CPs).

### Objective of the Study

The broad objective of this study is the examination of the availability, administration and handling as well as storage of vaccine in Nigeria by community pharmacists. Specifically, this study:

- i. assessed the availability of vaccines at community pharmacies,
- ii. evaluated the level of knowledge of community pharmacist on storage of vaccines,
- iii. examined the storage condition of vaccine at pharmacies,
- iv. determined the level of involvement of community pharmacist in the handling and administration of vaccines.

selected five States of South-west Nigeria. The Pharmacy Council of Nigeria (PCN) is the registration authority for pharmacist in Nigeria.

### Study Design

A cross-sectional survey was carried out among registered community pharmacists in South-West Nigeria to assess the level of availability and the involvement of community pharmacists in the handling and administration as well as storage of vaccines.

## METHODOLOGY

### Study Site

The study was conducted in the South West geopolitical zone of Nigeria. It is one of the six geopolitical zones in Nigeria representing both geographic and political region of the country. It comprises of six states – Ekiti, Lagos, Oyo, Ogun, Ondo and Osun. The study site comprised five of the (six) South-west states (Lagos, Oyo, Ogun, Ondo and Ekiti states).

### Study Population

The study population was registered pharmacists currently practicing in community pharmacies in the

**Inclusion/Exclusion Criteria**

Registered community pharmacists practicing in community pharmacies across Southwest Nigeria were considered in this study. However, pharmacists who have not spent up to a year in community pharmacy practice were excluded.

**Sample Size**

The sample size was determined using the Fisher’s formula to adequately represent the population being studied. In order for this present study to yield a smaller error margin, cognizance was taken on a previous studies conducted in Lagos State, South-west Nigeria, where the availability of vaccine in community pharmacies was found to be 84.2% (Fowowe and Aina, 2016). On the basis of this, a prevalence level of 85.4% was assumed for the current study; thus, the sample size was calculated as 192.

**Sampling Technique and Recruitment Procedure**

Multistage sampling procedure was adopted for this study. In the first stage, using simple random sampling, five states were selected in South West Nigeria. In the second stage, based on convenience, the capital cities of the selected states were purposively sampled. In third stage, LGAs in the metropolitan areas of each capital city were selected. In the last stage, using the list of registered communities as sampling frame, eight CPs were selected with simple random sampling technique from each of the selected LGAs. The respondents selected per State were determined as follows:

$$n_i = \left(\frac{L_i}{L}\right) n_0 \quad \text{----- (ii)}$$

where:  $n_i$  is number of respondent selected in  $i^{th}$  State,

$L_i$  = number of LGAs in the (capital) city metropolis of  $i^{th}$  State,

**RESULTS**

A total sample of 191 community pharmacists was interviewed. Majority, 132 (69.1%) of the pharmacists had average knowledge of vaccination - related activities concerning storage, handling and administration. More than half, 147 (77%) of the (191) respondents asserted that vaccine was available in their pharmacies; details are shown in Table 2. Details of the participants’ demographics are as shown in Table 3. Age, years of practice experience and

$L$  = total number of metropolitan LGAs in selected State capitals ( $L = 24$ ),

$n_0$  = as defined previously.

Therefore, the distribution of the selected respondents is as shown in Table 1

In all, one data set was discarded due to incomplete and (in some instances) inadequate responses. A total of 191 questionnaires that were found suitable were used for data analysis; this implies a response rate of 99.5%.

**Questionnaire**

A 72-item questionnaire, which was carefully developed and pretested for a solid validation procedure was used as the survey tool. It was separated into five domains comprising section A - E. Data elicited with the questionnaire include respondents’ demographic data and other variables of interest. Data processing and analysis were handled with Statistical Package for Social Sciences (SPSS Version 25) software.

**Data Collection**

Primary data were solicited from respondent pharmacists using the survey tool. A combination of physical contact and Google form (link) were used to make the survey tool available to pharmacists from the selected CPs. The link was shared with respondents through WhatsApp platforms.

**Data Analysis**

The analysis was achieved using descriptive statistics, Chi-square test (to determine the relationship between demographic variables and all other variables of interests).

academic qualification of the respondents had significant association ( $p < 0.05$ ) with CPs’ knowledge on vaccine administration and handling. Also, as depicted in Table 3, having a pharmacy located in either rural or urban area had significant association ( $p < 0.01$ ) with pharmacist’s knowledge on vaccine administration and handling.

**Table 1: Distribution of Respondents per Selected South-west Nigerian State**

State	City	No. of LGA	Sample Size (5% $\alpha$ -Level)	Responses
Lagos	Ikeja	8	64	64
Oyo	Ibadan	11	88	87
Ogun	Abeokuta	2	16	16
Ekiti	Ado-Ekiti	1	8	8
Ondo	Akure	2	16	16
Total		24	192	191

**Table 2: Categorization of Vaccine Availability and Respondent’s Knowledge on Vaccine Handling and Administration; and Storage**

*Level	Availability		Knowledge	
	Frequency	Percent	Frequency	Percent
Low	0	0.0	17	8.90
Average	126	85.7	132	69.11
High	21	14.3	42	21.99
Total	147	100.0	191	100.00

\* Based on the assumption of normal distribution [ $N(\mu = 0, \sigma^2 = 1)$ ]; the criteria for classification of respondents into different availability and knowledge level is as follows:

$X_i \leq \mu_i - \sigma_i$  → Low;  
 $\mu_i - \sigma_i < X_i < \mu_i + \sigma_i$  → Average;  
 $X_i \geq \mu_i + \sigma_i$  → High.

where:

$X_i$  = score,

$\mu_i$  = mean score,

$\sigma_i$  = standard deviation of score,

$i = 1$  or  $2$ ,

$i = 1$  = availability,

$i = 2$  = knowledge.

**Table 3: Relationship between Respondent’s Socioeconomic Characteristics, Pharmacy Features and Knowledge on Vaccine Handling and Administration (n = 191)**

Characteristic	Low	Average	High	Total	$\chi^2$ (p-Value)
	n (%)	n (%)	n (%)	n (%)	
Age					
≤30	1 (5.88)	36 (27.27)	25 (59.52)	62 (32.46)	
31-40	7 (41.18)	45 (34.09)	13 (30.95)	65 (34.03)	
41-50	5 (29.41)	32 (24.24)	1 (2.38)	38 (19.90)	30.526***
51-60	4 (12.88)	17 (12.88)	1 (2.38)	22 (11.52)	(0.0000)
≥61	0 (0.00)	2 (1.52)	2 (4.76)	4 (2.09)	
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Sex					
Male	7 (41.18)	67 (50.76)	22 (52.38)	96 (50.26)	0.650
Female	10 (58.82)	65 (49.24)	20 (47.62)	95 (49.74)	(0.7230)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Years of experience					
<6	1 (5.88)	35 (26.52)	23 (54.76)	59 (30.89)	25.9720***
6-10	4 (23.53)	51 (38.64)	12 (28.57)	67 (35.08)	(0.0000)
11-20	9 (52.94)	35 (26.52)	3 (7.14)	47 (24.61)	
>20	3 (17.65)	11 (8.33)	4 (9.52)	18 (9.42)	

Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Marital status					
Married	1 (5.88)	25 (18.94)	11 (26.19)	37 (19.37)	
Engaged	16 (94.12)	80 (60.61)	9 (21.43)	105 (54.97)	
Widowed	0 (0.00)	2 (1.52)	1 (2.38)	3 (1.57)	38.4270***
Divorced	0 (0.00)	3 (2.27)	0 (0.00)	3 (1.57)	(0.0000)
Single	0 (0.00)	22 (16.22)	21 (50.00)	43 (22.51)	
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Academic qualifications					
B.Pharm	9 (52.94)	86 (65.15)	34 (80.95)	129 (67.54)	
Pharm.D	7 (41.18)	25 (18.94)	4 (9.52)	36 (18.85)	19.6390**
WAPCP	0 (0.00)	0 (0.00)	2 (4.76)	2 (1.05)	(0.0120)
M.Pharm	0 (0.00)	11 (8.33)	1 (2.38)	12 (6.28)	
Ph.D	1 (5.88)	10 (7.58)	1 (2.38)	12 (6.28)	
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Place of study					
Nigeria	17 (100.00)	128 (96.97)	42 (100.00)	187 (97.91)	1.8260
Abroad	0 (0.00)	4 (3.03)	0 (0.00)	4 (2.09)	(0.4010)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Type of pharmacy					
Chain pharmacy	8 (47.06)	43 (32.58)	11 (26.19)	62 (32.46)	2.4060
Independent pharmacy	9 (52.94)	89 (67.42)	31 (73.81)	129 (67.54)	(0.3000)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Pharmacy location					
Urban	11 (54.71)	105 (79.55)	21 (50.00)	137 (71.73)	14.1690***
Rural	6 (35.29)	27 (20.45)	21 (50.00)	54 (28.27)	(0.0010)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	

As shown in Table 4, getting trained on vaccine, mode of training, being a trained vaccine administrator and trainer all had significant association ( $p < 0.01$ ) with pharmacist's knowledge on vaccine administration and handling.

As revealed in Table 5; age, years of experience, marital status and academic qualification of pharmacists had a significant association with CPs' knowledge on storage ( $p < 0.01$ ). Also, training on vaccine, mode of training on vaccine, being a trained vaccine administrator and the trainer all had

significant association with CPs' knowledge on storage of vaccines ( $p < 0.01$ ). Furthermore, age, years of experience, and marital status of pharmacists showed a significant association with knowledge of pharmacists on CPs' involvement in vaccine storage, handling and administration ( $p < 0.01$ ). Also, there was significant association ( $p < 0.01$ ) between being trained on vaccine, mode of training, the trainer and knowledge of pharmacists on CPs' involvement in vaccine storage, handling and administration.

**Table 4: Relationship between Respondent's Vaccine Training and Knowledge on Vaccine Administration and Handling (n = 191)**

Variable	Low n (%)	Average n (%)	High n (%)	Total n (%)	$\chi^2$ (p-Value)
Trained on vaccine					
Yes	13 (76.47)	100 (75.76)	9 (21.43)	122 (63.87)	42.0390***
No	4 (23.53)	32 (24.24)	33 (78.57)	69 (36.13)	(0.0000)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Vaccine admin training programme (mode of training)					
Internship	3 (17.65)	13 (9.85)	1 (2.38)	17 (8.90)	
Online/Virtual	10 (58.82)	65 (49.24)	0 (0.00)	75 (39.27)	
Workshop	0 (0.00)	9 (6.82)	0 (0.00)	9 (4.71)	
Hospital	0 (0.00)	2 (1.52)	1 (2.38)	3 (1.57)	
Seminar	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	
Academic Lecture	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	65.6820***
Workshop & seminar	0 (0.00)	1 (0.76)	3 (7.14)	4 (2.09)	(0.0000)

Not applicable	4 (25.53)	32 (24.24)	33 (78.57)	69 (36.13)	
Others	0 (0.00)	8 (6.06)	4 (9.52)	12 (6.28)	
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Trained as a vaccine administrator					
Yes	13 (76.47)	91 (68.94)	5 (11.90)	109 (57.07)	45.1710***
No	4 (23.53)	41 (31.06)	37 (88.10)	82 (42.93)	(0.0000)
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	
Vaccine admin trainer					
PSN	3 (17.65)	11 (8.33)	0 (0.00)	14 (7.33)	
ACPN	10 (58.82)	65 (49.24)	0 (0.00)	75 (39.27)	
Pharma-Alliance	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	
Community Health Practitioner	0 (0.00)	1 (0.76)	1 (2.38)	2 (1.05)	
WHO	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	
Foreign agency /govt/educ. institution	0 (0.00)	0 (0.00)	2 (4.76)	2 (1.05)	68.4510***
Senior colleague	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	(0.0000)
Senior vaccine administrator	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	
Self-trained	0 (0.00)	2 (1.52)	2 (4.76)	4 (2.09)	
ACPN & Foreign agency /govt/educational inst.	0 (0.00)	1 (0.76)	0 (0.00)	1 (0.52)	
Pharma-Alliance, community Health Practitioner, Hospital, WHO & Foreign agency/govt/educational institution	0 (0.00)	7 (5.30)	0 (0.00)	7 (3.66)	
Not applicable	4 (23.53)	41 (31.06)	37 (88.10)	82 (42.93)	
Total	17 (100.00)	132 (100.00)	42 (100.00)	191 (100.00)	

**Table 5: Respondent's Socioeconomic Characteristics, Pharmacy Features, Vaccine Training and \*Vaccine Matters (n = 191)**

Characteristic	<sup>1</sup> Storage	<sup>1</sup> Involvement
Age	45.110*** (0.0000)	35.7660*** (0.0000)
Sex	0.2970 (0.8620)	3.5390 (0.1700)
Years of experience	45.3050*** (0.0000)	27.5130*** (0.0000)
Marital status	59.3830*** (0.0000)	33.057*** (0.0000)
Academic qualifications	31.5990*** (0.0000)	9.3350 (0.315)
Place of study	1.7370 (0.4200)	1.2440 (0.5370)
Type of pharmacy	4.1970 (0.123)	0.8190 (0.664)
Pharmacy location	2.4100 (0.3000)	1.9720 (0.3730)
Trained on vaccine	40.1150*** (0.0000)	14.6730*** (0.0010)
Vaccine admin training programme (mode of training)	89.7540*** (0.0000)	48.9040*** (0.0000)
Trained as a vaccine administrator	57.7790*** (0.0000)	15.4130*** (0.0000)
Vaccine admin trainer	98.8350*** (0.0000)	60.8960*** (0.0000)

\* This entails respondent's knowledge on storage and knowledge on pharmacist's involvement in vaccine storage, handling and administration.

<sup>1</sup>Chi-square statistic; figures in parenthesis are probability values.

As shown in Table 6, 126 (85.7%) of the pharmacists who stocked vaccine had average level of vaccine availability in their pharmacies while 21 (14.3%) participants were categorized as having high vaccine availability. However, there was no significant association between pharmacy vaccine availability and respondent's socioeconomic characteristics.

As depicted in Table 6, features of pharmacy had no association with vaccines' availability in CPs. However, as shown in Table 7, being trained on vaccine and vaccine administration had a significant association ( $p < 0.01$ ) with vaccines' availability in CPs while mode of training and trainer did not.

**Table 6: Respondent's Socioeconomic Characteristics and Pharmacy Vaccine Availability (n = 147)**

Characteristic	Average	High	Total	$\chi^2$ (p-Value)
	N (%)	N (%)	N (%)	
Age				
≤30	39 (30.95)	11 (52.38)	50 (32.46)	7.6830 (0.1040)
31-40	41 (32.54)	7 (33.33)	48 (34.03)	
41-50	30 (23.81)	0 (0.00)	30 (19.90)	
51-60	15 (11.90)	3 (14.29)	18 (11.52)	
≥61	1 (0.79)	0 (0.00)	1 (2.09)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Sex				
Male	59 (46.83)	11 (52.38)	70 (47.62)	0.2230 (0.6370)
Female	67 (53.1)	10 (47.62)	77 (52.38)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Years of experience				
<6	33 (26.19)	11 (52.38)	44 (29.93)	6.9630 (0.0730)
6 – 10	46 (34.51)	6 (28.57)	52 (35.37)	
11 – 20	35 (27.78)	4 (19.05)	39 (26.53)	
>20	12 (9.52)	0 (0.00)	12 (8.16)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Marital status				
Married	19 (15.08)	5 (23.81)	24 (16.33)	8.7600 (0.0670)
Engaged	78 (61.50)	7 (33.33)	85 (57.82)	
Widowed	2 (1.59)	0 (0.00)	2 (1.36)	
Divorced	3 (2.38)	0 (0.00)	3 (2.04)	
Single	24 (19.05)	9 (42.86)	33 (22.45)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Academic qualifications				
B.Pharm	80 (63.49)	16 (76.19)	96 (65.31)	2.5260 (0.6400)
Pharm.D	25 (19.84)	4 (19.05)	29 (19.73)	
WAPCP	1 (0.79)	0 (0.00)	1 (0.68)	
M.Pharm	10 (7.94)	0 (0.00)	10 (6.80)	
Ph.D	10 (7.94)	1 (4.76)	11 (7.48)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Place of study				
Nigeria	122 (96.83)	21 (100.00)	143 (97.28)	0.6850 (0.4080)
Abroad	4 (3.17)	0 (0.00)	4 (2.72)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Type of pharmacy				
Chain pharmacy	44 (34.92)	5 (23.81)	49 (33.33)	1.0000 (0.3170)
Independent pharmacy	82 (65.08)	16 (76.19)	98 (66.67)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Pharmacy location				
Urban	91 (72.22)	14 (67.67)	105 (71.43)	0.2720 (0.6020)
Rural	35 (27.78)	7 (33.33)	42 (28.57)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	

**Table 7: Respondent's Vaccine Training and Vaccine Availability (n = 147)**

Features	Average	High	Total	$\chi^2$ (p-Value)
	N (%)	N (%)	N (%)	
Trained on vaccine				
Yes	93 (73.81)	9 (42.86)	102 (69.39)	8.1190*** (0.0040)
No	33 (26.19)	12 (57.14)	45 (30.61)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Vaccine admin training programme (mode of training)				
Internship	16 (12.70)	0 (0.00)	16 (10.88)	13.5350 (0.0600)
Online/Virtual	59 (46.83)	5 (23.81)	64 (43.54)	
Workshop	5 (3.97)	1 (4.76)	6 (4.08)	
Hospital	2 (1.59)	0 (0.00)	2 (1.36)	
Academic Lecture	1 (0.79)	0 (0.00)	1 (0.68)	
Workshop & seminar	3 (2.38)	0 (0.00)	3 (2.04)	
Not applicable	33 (26.19)	12 (57.14)	45 (30.61)	
Others	7 (5.56)	3 (14.29)	10 (6.80)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Trained as a vaccine administrator				
Yes	86 (68.25)	6 (28.57)	92 (62.59)	12.1050*** (0.0010)
No	40 (31.75)	15 (71.43)	55 (37.41)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	
Vaccine administration trainer				
PSN	13 (10.32)	0 (0.00)	13 (8.84)	13.7830 (0.2450)
ACPN	58 (46.03)	5 (23.81)	63 (42.86)	
Pharma-Alliance	1 (0.79)	0 (0.00)	1 (0.68)	
A community Health Practitioner	1 (0.79)	0 (0.00)	1 (0.68)	
WHO	1 (0.79)	0 (0.00)	1 (0.68)	
Foreign agency/govt/educational institution	2 (1.59)	0 (0.00)	2 (1.36)	
A senior colleague	1 (0.79)	0 (0.00)	1 (0.68)	
A senior vaccine administrator	1 (0.79)	0 (0.00)	1 (0.68)	
Self-trained	3 (2.38)	0 (0.00)	3 (2.04)	
ACPN & Foreign agency/govt/educational institution	1 (0.79)	0 (0.00)	1 (0.68)	
Pharma-Alliance, community Health Practitioner, Hospital, WHO & Foreign agency/govt/ educational institution	4 (3.17)	1 (4.756)	5 (3.40)	
Not applicable	40 (31.75)	15 (71.43)	55 (37.41)	
Total	126 (100.00)	21 (100.00)	147 (100.00)	

**DISCUSSION**

The proportion of pharmacists that had average knowledge on vaccine related issues portends the likelihood of substantial interest in vaccine administration and handling by CPs. This finding is in

concord with that of Fowowe and Aina (2016) and Sakr et al. (2021). The confirmation of some level of vaccine availabilities in pharmacies by respondents indicates that Nigerian (Community) Pharmacies are



involved to an extent in vaccine provision for the citizens. Thus, given that community pharmacies represent a healthcare centre in the community (where vaccine can be administered to the public), pharmacists are afforded the opportunity of being very well informed about vaccine product characteristic, manufacturing specificities and complexity, vaccine research and development as asserted by Schwerzmann et al. (2017). Pharmacists will consequently be needed to play a great leading role in vaccine administration in the community.

Age as a significant factor underscores the fact that youthful pharmacists tend to have higher knowledge than the older ones on vaccine handling, administration and storage; youths are said to be more innovative than older people. Also, years of experience as a significant factor of pharmacists' knowledge on vaccine handling, administration and storage signifies that pharmacists who are young in practice tirelessly seek for knowledge because in order to grow their pharmacy they strive to industriously provide cutting edge services as asserted by Sakr et al (2021) and as was reported in 2018 by Gerges et al., where young pharmacists felt obliged to provide immunization in order to keep employment. Academic qualification of pharmacists being a significant factor of knowledge on vaccine handling, administration and storage indicates that pharmacists with basic qualification had higher knowledge than those with higher qualification due to restrictions to area of

interest at specialist level. This was supported by Muhammed et al in 2022 whose study showed there was positive correlation between knowledge level and CPs intention to provide vaccination services. Thus, a specialist narrows down in specific rather than general area of pharmacy while CPs with basic qualification will want to explore all avenues to expand his roles in their practice.

Training is a significant factor influencing the knowledge of pharmacists on vaccine handling, administration and storage in CPs. Vaccine administration required competent know-how; hence, pharmacists who attended training on vaccine had better knowledge of vaccine handling, administration and storage. This is reiterated by the fact that respondent's socio-economic characteristics were insignificant factors with regards to knowledge on vaccine handling, administration and storage while training had significant association with knowledge. This implies that irrespective of age or years of experience, a pharmacist will not be able to competently provide vaccine and vaccination services to the public. This result is in consonance with that of Sakr et al. (2021) and Yusuf et al. (2021).

These findings reiterate the vital role pharmacists, particularly CPs, can serve in immunization/vaccination programmes as opined by Sakr et al. (2021), Yusuf et al. (2021), and Paudyal et al. (2021).

## CONCLUSION

Pharmacists are veritable human resource in the management of immunization programmes since they are well educated healthcare professionals who should be fully involved in vaccination services. However, training and retraining of pharmacists is germane for effective vaccine handling, administration and management by these professionals.

The major asset of this study is the categorization of the CPs in terms of knowledge of vaccine handling, administration and storage. However, the study had data limitations for cause-effect analysis. Some CPs declined participating in the study. This is on the basis that premium attention should be placed on core pharmaceutical care issues (such as extemporaneous drug preparation) rather than vaccination.

## ETHICAL CONSIDERATIONS

Approval with registration number (NHREC/28/11/2017) was obtained from the Health Research Ethics Committee (HREC) of Olabisi

Onabanjo University Teaching Hospital, Ogun State before the commencement of this study.

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