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PREDICTORS OF HEALTHCARE WORKERS' KNOWLEDGE, ATTITUDES AND PRACTICES ON UNCOMPLICATED MALARIA IN PRIMARY HEALTHCARE SETTINGS OF PLATEAU STATE, NIGERIA

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ABSTRACT: The quality of treatment and management of uncomplicated malaria depends on healthcare workers' and patients' characteristics, in addition to resource availability. This study assessed predictors of healthcare workers' knowledge, attitudes, and practices (KAP) on uncomplicated malaria in primary healthcare (PHC) facilities in Plateau state, Nigeria. Secondary data of 289 healthcare workers involved in the management of the disease in PHC facilities of Plateau state were used for the study. Also, data on the availability of material resources for managing the disease in the PHC facilities were collected using a facility review form (FRF). Multinomial logistic regression analyses were performed to identify predictors of healthcare workers' KAP on uncomplicated malaria. The findings revealed age (years old) ($p = 0.032$), occupation ($p = 0.004$), monthly salary ($p = 0.021$), availability of required drugs ($p = 0.046$), and practices ($p = 0.001$) as significant predictors of healthcare workers' knowledge on uncomplicated malaria, with only monthly salary ($p = 0.049$) predicting their attitudes on the disease and its management. Their gender ($p = 0.036$), age (years old) ($p < 0.001$), and duration of experiences ($p = 0.014$) also predicted their treatment practices rendered to patients. Healthcare workers' KAP was predicted by the availability of anti-malarial drugs and the studied respondents' characteristics. Interventions are recommended to make available the recommended ACTs and also increase respondents' KAP on the disease and its treatment and management.

INTRODUCTION: Malaria infection has been reported as one of the leading causes of morbidity and mortality in sub-Saharan Africa, with about 88% and 90% of the estimated global cases and deaths respectively occurring in the region [1, 2].

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Previous studies have shown that Nigeria had been responsible for not less than 25% of the disease's burdens in the region, with *Plasmodium falciparum* responsible for 98% of the cases in the country, resulting in about 60% of patients' visits to healthcare facilities [2, 3].

Overcoming this disease would imply healthcare workers appropriately rendering management practices in accordance with malaria treatment guidelines by ensuring diagnosis through the use of microscopes or rapid diagnostic test (RDT) before administration of the recommended artemether-

lumefantrine drugs or artesunate-amodiaquine to patients [2, 4]. Practicing otherwise might result in wrong diagnosis and prescriptions, or inadequate patients' instructions on how to take the medications, which have been reported as a major limiting factor encouraging patients' intentional or unintentional inappropriate intake of the medicines [5-7]. This has remained a major problem across the world, with worsening situations seen in developing countries, including Nigeria [8-10]. These have been linked to many factors, including the availability of needed resources for the management of the disease and healthcare workers' and patients' socio-demographic characteristics and related attributes such as knowledge, attitudes, and practices (KAP), especially in primary healthcare settings [11, 12]. An individual's knowledge on disease has been described as his/her understanding of the cause, sign, and symptoms, how to prevent and/or treat the disease, while individual's attitude could be expressed as the way he/she feels and beliefs toward the disease, while practice could be understood as the manifestation of such an individual's understanding and attitudes through the display of his/her actions in relation to the disease [13]. The purpose of this study was to assess factors that influence primary healthcare (PHC) workers' KAP on uncomplicated malaria management in PHC facilities in Plateau state, Nigeria.

MATERIALS AND METHODS:

Sources of Data: Two sets of data used in the present study included data on healthcare workers' characteristics [14] and availability of resources for treatment and management of uncomplicated malaria at the PHC facilities.

For the availability of resources, a short instrument known as facility review form (FRF) was self-administered on various facility in-charges of the 24 selected PHC facilities to get their responses on the availabilities of malaria treatment-related material resources in their facilities as recommended in the standard treatment guidelines, and their responses were respectively documented.

Study Variables: Healthcare workers' KAP were the dependent variables. Socio-demographics (gender, age, occupation, monthly income, and duration of experience in a year) and material resources (diagnostic materials, sources of information, and anti-malarial drugs) plus knowledge and attitudes scores categories were independent variables for practices outcome.

TABLE 1: HEALTHCARE WORKERS' CHARACTERISTICS (N = 289)

Variables	n (%)	Descriptive statistics
Gender		
Male	77 (26.64)	
Female	212 (73.36)	
Age (years old)		
Mean (± SD)		43.13 (± 11.17)
Median (IQR)		40 (10)
Minimum – Maximum		19 – 60
18 – < 25	29 (10.04)	
25 – < 55	188 (65.05)	
55 – 65	72 (24.91)	
Occupation		
RNM	62 (21.45)	
CHEW	92 (31.83)	
Junior CHEW (J-CHEW)	37 (12.80)	
Lab technicians	33 (11.42)	
Pharmacy technicians and others	65 (22.49)	
Duration of experience (years)		
Mean (± SD)		11.61 (± 67.8)
Median (IQR)		8 (5)
Minimum – Maximum		1 – 32
< 6	70 (24.22)	
6 – 10	100 (34.6)	
11 – 15	54 (18.69)	
>15	64 (22.15)	
Monthly Salary (Naira)		
Mean (± SD)		46, 413.5 (± 19,342.3)
Median (IQR)		34,500 (335,000)
Minimum – Maximum		14,000– 67,500
< 18,000	30 (10.38)	
18,000 – 50,000	134 (46.37)	
> 50,000	125 (43.25)	
Knowledge		
Mean (± SD)		6.87 (± 1.37)
Median (IQR)		7 (2)
Minimum – maximum		2 – 10
Poor	18 (6.23)	
Moderate	146 (50.52)	
Good	125 (43.25)	
Attitudes		
Mean (± SD)		23.12 (± 2.06)
Median (IQR)		24 (3)
Minimum – maximum		11 – 25
Poor	3 (1.04)	
Moderate	21 (7.27)	
Good	265 (91.69)	
Practices		
Mean (± SD)		13.32 (± 2.10)
Median (IQR)		14 (3)
Minimum – maximum		3 – 15
Poor	19 (6.57)	
Moderate	28 (9.69)	
Good	242 (83.74)	

Note: RNM = Registered nurse and midwife, CHEW = Community health extension worker, SD = standard deviation, IQR = interquartile range

Similarly, the influence of the independent variables on knowledge and attitudes outcome variables were, respectively, assessed by including attitudes and practices as independent variables for the knowledge outcome variable, while knowledge and practices were considered as independent variables for predicting attitudes outcomes of the respondents.

Statistical Analysis: The filled instruments were checked to ensure their completeness before they were manually entered into Microsoft Excel software based on appropriate coding and scoring formats and then screened to be sure that all information collected were correctly entered and consistent with the information on the originally filled instruments before analysis. Analyses of the data were carried out using the International Business Machines Corporation Statistical Package for Social Sciences® (IBM-SPSS®) version 23 software. The normality of the data was tested through Kolmogorov-Smirnov and Shapiro-Wilk test, and based on the recommendation of Ghasemi and Zahediasl [15], $p>0.05$ implied normal data distribution, while $p<0.05$ implied the contrary. The descriptive statistics test outcomes for the availability of material resources were presented while the respondents' socio-demographic characteristics and KAP scores were as reported by Ismail *et al*. [14] The tests for statistically significant differences ($p<0.05$) in healthcare workers' median KAP on uncomplicated malaria management across the independent variables were conducted using Mann-Whitney test for independent variables that were in two subgroups and Kruskal-Wallis analysis test for categorical variables which had three or more subgroups. Chi-square (χ^2) test for independence was used to determine the distribution of respondents' KAP across the independent variables and also examine associations between the categorical variables and different levels of KAP on uncomplicated malaria. Multinomial logistic regression was then used to determine the possible predictors of healthcare workers' KAP scores for categorical outcome variables.

The statistical significance ($p<0.05$) of each of the predictor variables on the outcome variables were presented by their odds ratio (OR) values with 95% confidence interval (95% CI). An OR of less than '1' signified respondents' less likelihood of having good KAP during uncomplicated malaria management, while a value greater than '1' implied respondents' likely ability to have good KAP [16].

RESULTS:

Material Resources at Healthcare Facilities: The results showed that most of the PHC facilities did not have the current malaria treatment guidelines [2] (62.50%) and essential drug lists (2013) (83.33%), although, presence of wall flowchart indicating the details of 2011 malaria treatment guidelines were seen in five facilities (20.83%). The availability of diagnostic equipment such as RDT sets (91.67%) and microscopes (87.50%) was high, with all facilities (100%) possessed thermometers **Table 2**.

TABLE 2: AVAILABILITY OF TREATMENT RESOURCES FOR UNCOMPLICATED MALARIA IN SELECTED PHC FACILITIES ACROSS PLATEAU STATE (N = 24)

Variables	Yes n (%)	No n (%)	Total n (%)
Sources of information			
Copy of 2015 standard treatment guidelines (STGs) for malaria	9 (37.50)	15 (62.50)	24 (100)
Wall flowchart with 2011 malaria treatment guidelines	5 (20.83)	19 (79.17)	24 (100)
Copy of 2013 national essential drug (NED) lists	4 (16.67)	20 (83.33)	24 (100)
Availability of diagnostic materials			
Thermometer	24(100)	0 (0)	24 (100)
Microscope	21 (87.50)	3 (12.50)	24 (100)
RDT set	22 (91.67)	2 (8.33)	24 (100)
Availability of anti-malarial drugs			
Artemether-lumefantrine tablet	20 (83.33)	4 (16.67)	24 (100)
Artesunate-amodiaquine tablet	6 (25.00)	18 (75.00)	24 (100)
Sulphadoxime-pyrimethemine (S-P) tablet	23 (95.83)	1 (4.17)	24 (100)
Quinine tablet	3 (12.50)	21 (87.50)	24 (100)
Quinine injection	14 (58.33)	10 (41.67)	24 (100)
Artesunate injection	7 (29.17)	17 (70.83)	24 (100)
Artemether injection	14 (58.33)	10 (41.67)	24 (100)
Chloroquine (CQ) injection	5 (20.83)	19 (79.17)	24 (100)
Other anti-malarial drugs	3 (12.50)	21 (87.50)	24 (100)

TABLE 3: DIFFERENCES IN HEALTHCARE WORKERS' MEDIAN KAP SCORES ACROSS INDEPENDENT VARIABLES (N = 289)

Variables		Median knowledge scores					Median attitudes scores					Median practices scores				
	n (%)	Mean rank	Median (IQR)	Z / χ^2	df	p-value	Mean rank	Median (IQR)	Z / χ^2	df	p-value	Mean rank	Median (IQR)	Z / χ^2	df	p-value
Gender				**- 0.17**		**0.866**			**- 2.38**		**0.017***			**- 3.17**		**0.002***
Male	77 (26.64)	146.32	7.00 (2.00)				126.14	23.00 (7.00)				120.10	13.00 (3.00)			
Female	212 (73.36)	144.52	7.00 (2.00)				151.85	24.00 (3.00)				154.04	14.00 (2.00)			
Age (years old)				**0.22**	**2**	**0.898**			**0.66**	**2**	**0.718**			**9.86**	**2**	**0.007***
18 – < 25	29 (10.04)	143.09	7.00 (2.00)				133.62	24.00 (4.00)				100.57	12.00 (3.50)			
25 – < 55	188 (65.05)	143.85	7.00 (2.00)				146.82	24.00 (3.00)				150.20	14.00 (3.00)			
55 – 65	72 (24.91)	148.78	7.00 (2.00)				144.83	23.50 (3.00)				149.33	14.00 (2.00)			
Occupation				**3.03**	**4**	**0.553**			**0.99**	**4**	**0.911**			**5.13**	**4**	**0.274**
RNM	62 (21.45)	148.02	7.00 (2.00)				152.85	24.00 (3.00)				161.41	14.00 (2.00)			
CHEW	92 (31.83)	139.08	7.00 (2.00)				140.17	23.50 (3.75)				142.16	14.00 (3.00)			
Junior-CHEW	37 (12.80)	130.64	7.00 (3.00)				142.04	24.00 (3.00)				126.84	13.00 (3.00)			
Lab-technician	33 (11.42)	153.56	7.00 (2.00)				143.61	23.00 (3.00)				135.83	14.00 (3.00)			
Pharm tech. /others	65 (22.49)	154.33	7.00 (1.00)				146.75	24.00 (3.00)				148.36	14.00 (3.00)			
Duration of experience (years)				**0.51**	**3**	**0.917**			**0.95**	**3**	**0.812**			**2.49**	**3**	**0.477**
< 6	70 (24.22)	148.17	7.00 (2.00)				143.61	24.00 (3.25)				133.33	14.00 (3.00)			
6 – 10	100 (34.60)	140.42	7.00 (2.00)				149.24	24.00 (3.00)				153.02	14.00 (3.00)			
11 – 15	54(18.69)	146.66	7.00 (2.00)				136.32	24.00 (4.00)				146.22	14.00 (3.00)			
> 15	65 (22.49)	147.26	7.00 (2.00)				147.18	24.00 (3.00)				144.22	14.00 (2.50)			
Monthly salary (Naira)				**8.40**	**2**	**0.015***			**8.20**	**2**	**0.017***			**2.88**	**2**	**0.237**
< 18,000	30 (10.38)	182.75	8.00 (1.00)				182.90	24.00 (1.00)				167.50	15.00 (3.00)			
18,000 – 50,000	134 (46.37)	135.83	7.00 (2.00)				145.30	24.00 (3.00)				144.84	14.00 (3.00)			
> 50,000	125 (43.25)	145.77	7.00 (2.00)				135.58	23.00 (4.00)				139.77	14.00 (3.00)			
Knowledge									**12.72**	**2**	**0.003***			**12.97**	**2**	**0.002***
Poor	21 (7.27)	4.00 (1.00)					128.43	23.00 (5.00)				107.19	13.00 (2.00)			
Moderate	149 (51.56)	7.00 (1.00)					131.07	23.00 (2.50)				135.58	14.00 (3.00)			
Good	119 (41.17)	8.00 (0.00)					165.37	24.00 (2.00)				163.47	15.00 (2.00)			
Attitudes				**3.39**	**2**	**0.182**								**3.26**	**2**	**0.196**
Poor	1 (0.35)	70.00	a					b				233.00	C			
Moderate	3 (1.04)	72.17	6.00					17.00				78.50	12.00			
Good	285 (98.61)	146.03	7.00 (2.00)					24.00 (3.00)				145.39	14.00 (3.00)			
Practices				**3.36**	**2**	**0.186**			**12.96**	**2**	**0.002***					
Poor	13 (4.50)	107.23	7.00 (2.50)				128.77	23.00 (2.50)					7.00 (2.00)			
Moderate	19 (6.57)	136.34	7.00 (2.00)				82.34	21.00 (3.00)					10.00 (2.00)			
Good	257 (88.93)	147.55	7.00 (2.00)				150.45	24.00 (3.00)					14.00 (2.00)			
Availability of drugs				**- 0.28**		**0.780**			**-1.07**		**0.287**			**- 0.22**		**0.827**
Non–ACT	49 (16.96)	147.92	7.00 (2.00)				133.72	23.00 (3.50)				147.29	14.00 (2.50)			
ACT	240 (83.04)	144.40	7.00 (2.00)				147.30	24.00 (3.00)				144.53	14.00 (3.00)			
Diagnostic materials				**- 0.18**		**0.860**			**- 0.81**		**0.416**			**- 1.34**		**0.181**
Thermometer	132 (45.67)	145.91	7.00 (2.00)				140.76	24.00 (3.75)				138.09	14.00 (3.00)			
RDT/Microscope	157 (54.33)	144.24	7.00 (2.00)				148.57	24.00 (3.00)				150.81	14.00 (3.00)			
Source of information				**- 0.30**		**0.766**			**- 0.36**		**0.719**			**- 0.32**		**0.753**
NED list	60 (20.76)	147.74	7.00 (2.00)				141.64	23.00 (3.00)				147.91	14.00 (3.00)			
STG	229 (79.24)	144.28	7.00 (2.00)				145.88	24.00 (3.00)				144.24	14.00 (3.00)			

Note: RNM = Registered nurse and midwives; CHEW = Community health extension workers; Pharm tech. /others = Pharmacy technicians and others; * = statistically significant at $p < 0.05$; df = degree of freedom; Z = Z-statistics; χ^2 = Chi-square; STG = Standard treatment guidelines; NED = National essential drug; ACT = Artemisinin-based combination therapy; RDT = Rapid diagnostic test; IQR = Interquartile range; a = Knowledge score is constant when attitude categories = poor. It has been omitted; b = Attitude score is constant when attitude categories = poor. It has been omitted; c = Practice score is constant when attitude categories = poor. It has been omitted.

The majority of the facilities (83.33%) had different types of artemether-lumefantrine tablet dose pack based on the age categories of patients. Almost all the PHC facilities (95.83%) had sulphadoxime-pyrimethemine tablets. Similarly, there were poor stocks of oral quinine (12.5%), but more than half (58.33%) of the PHC facilities had quinine and artemether injections in stocks. The availability of chloroquine and artesunate injections was noticed in about 20.83% and 29.17%, respectively. The findings derived from test for difference in healthcare workers' median KAP scores across independent variables and test of associations between healthcare workers' KAP scores and independent variables were shown in **Table 3** and **Table 4**, respectively.

TABLE 4: HEALTHCARE WORKERS' KAP SCORES CATEGORIZATION AND ASSOCIATION WITH INDEPENDENT VARIABLES (N =289)

	Knowledge scores			Attitudes scores			Practices scores		
Variables	**Poor**	**Moderate**	**Good**	**Poor**	**Moderate**	**Good**	**Poor**	**Moderate**	**Good**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Gender (Chi-square (χ^2) = 4.42, df = 8 p = 0.818)				**(χ^2= 13.48, df = 10 p = 0.198)**			**(χ^2= 15.41, df = 10 p = 0.018*)**		
Male	6 (2.08)	40 (13.84)	37 (12.80)	2 (0.69)	9 (3.11)	76 (26.03)	9 (3.11)	19(6.57)	61 (21.10)
Female	12(4.15)	106(36.68)	88 (30.45)	1 (0.35)	12(4.15)	189 (65.40)	10 (3.46)	9 (3.11)	181(62.63)
Age (years old) (χ^2 = 16.98, df = 16 p= 0.387)				**(χ^2 = 21.66, df = 20 p = 0.315)**			**(χ^2 =38.52, df = 20 p = 0.008*)**		
18 – < 25	2 (0.69)	15 (5.19)	11 (3.81)	0 (0)	6 (2.08)	23 (7.96)	7 (2.42)	6 (2.08)	16 (5.54)
25 – < 55	13 (4.50)	92 (31.83)	79 (27.34)	1 (0.35)	8 (2.77)	179 (61.94)	9 (3.11)	18(6.23)	161(55.71)
55 – 65	3 (1.04)	39 (13.5)	23 (7.96)	2 (0.69)	7 (2.42)	63 (21.80)	3 (1.04)	4 (1.38)	70 (22.49)
Occupation (χ^2 = 42.64, df = 32 p = 0.138)				**(χ^2 = 41.31, df = 40 p = 0.499)**			**(χ^2 = 38.55, df = 40 p = 0.037*)**		
RNM	1 (0.35)	37 (12.80)	24 (8.30)	0 (0)	3 (1.04)	58 (20.07)	1 (0.35)	3 (1.04)	63 (21.80)
CHEW	7 (2.42)	46 (15.92)	35 (12.11)	0 (0)	4 (1.04)	87 (30.10)	6 (2.08)	9 (3.11)	83 (28.72)
Junior-CHEW	2 (0.69)	21 (7.27)	13 (4.50)	1 (0.35)	6 (2.08)	33 (11.42)	6 (2.08)	6 (2.08)	33 (11.42)
Lab-technician	5 (1.73)	14 (4.84)	15 (5.19)	1 (0.35)	4 (1.38)	28 (9.69)	3 (1.04)	5 (1.73)	30 (10.38)
Pharm tech. /others	3 (1.04)	28 (9.69)	22 (7.61)	1 (0.35)	4 (1.38)	59 (20.42)	3 (1.04)	5 (1.73)	63 (21.80)
Duration of experience (years) (χ^2 = 23.91, df = 24 p = 0.921)				**(χ^2 = 31.42, df = 30 p = 0.000*)**			**(χ^2 = 28.46, df= 30 p = 0.026*)**		
< 6	3 (1.04)	34 (11.77)	31 (10.73)	1 (0.35)	4 (1.38)	65 (22.49)	5 (1.73)	7 (2.42)	67 (23.18)
6 – 10	7 (2.42)	51 (17.65)	42 (14.53)	1 (0.35)	6 (2.08)	93 (32.18)	7 (2.42)	10(3.46)	91 (31.49)
11 – 15	4 (1.38)	27 (9.34)	24 (8.30)	1 (0.35)	4 (1.38)	48 (16.61)	3 (1.04)	6 (2.08)	52 (17.99)
> 15	4 (1.38)	34 (11.77)	28 (9.69)	0 (0)	7 (2.42)	59 (20.42)	4 (1.38)	5 (1.73)	62 (21.45)
Monthly salary (Naira) (χ^2 = 16.64, df = 16 p = 0.005*)				**(χ^2 = 22.63, df = 20 p = 0.000*)**			**(χ^2 = 20.84, df = 20 p = 0.267)**		
< 18,000	1 (0.35)	9 (3.11)	21 (7.27)	0 (0)	6 (2.08)	36 (12.46)	4 (1.38)	3 (1.04)	24 (8.30)
18,000 – 50,000	10 (3.46)	71 (24.57)	51 (17.65)	1 (0.35)	8 (2.77)	140 (48.44)	9 (3.11)	14(4.84)	112(38.75)
> 50,000	7 (2.42)	66 (22.84)	53 (18.34)	2 (0.69)	7 (2.2)	129 (44.64)	9 (3.11)	11(3.81)	106(36.68)
Knowledge				**(χ^2 = 5.17, df = 4 p = 0.271)**			**(χ^2 = 3.10, df = 4 p = 0.542**		
Poor				1 (0.35)	0 (0.00)	17 (5.88)	8 (2.77)	3 (1.04)	7 (2.42)
Moderate				2 (0.69	11 (3.80)	133 (46.02)	5 (1.73)	10 (3.46)	131 (45.32)
Good				0 (0.00)	10 (3.46)	115 (39.79)	6 (2.08)	15 (5.19)	104 (35.99)
Attitudes	**(χ^2 = 5.17, df = 4 p = 0.271)**						**(χ2 = 3.73, df = 4 p = 0.444)**		
Poor	1 (0.35)	1 (035)	1 (0.35)				0 (0)	2 (0.69)	1 (0.35)
Moderate	6 (2.08)	9 (3.11)	6 (2.08)				0 (0)	1 (0.35)	2 0 (6.92)
Good	11 (3.81)	136 (47.05)	118 (40.82)				19 (6.57)	25 (8.65)	221 (76.47)
Practices	**(χ^2 = 10.93, df = 4 p = 0.024*)**			**(χ^2 = 3.73, df = 4 p = 0.444)**					
Poor	0 (0)	5 (1.73)	14 (4.84)	1 (0.35)	3 (1.04)	15 (5.19)			
Moderate	1 (0.35)	10 (3.46)	17 (5.88)	0 (0)	10 (3.46)	18 (6.23)			
Good	17 (5.88)	131 (45.33)	94 (32.53)	2 (0.69)	8 (2.77)	232 (80.27)			
Availability of drugs (χ^2 = 1.77, df = 2 p = 0.412)				**(χ^2 = 0.78, df = 2 p = 0.678)**			**(χ^2 = 2.33, df = 2 p = 0.312)**		
Non-ACT	2 (0.69)	29 (10.04)	18 (6.23)	0 (0)	1 (0.35)	48 (16.60)	4 (1.38)	2 (0.69)	43 (14.88)
ACT	19 (6.57)	120 (41.52)	101 (34.95)	1 (0.35)	2 (0.69)	237 (82.01)	9 (3.11)	17 (5.88)	214 (74.06)
Diagnostic materials (χ^2 = 3.66, df = 2 p = 0.161)				**(χ^2 = 4.60, df = 2 p = 0.100)**			**χ^2 = 1.80, df = 2 p = 0.406**		
Thermometer	1 (0.35)	34 (11.76)	25 (8.65)	1 (0.35)	0 (0)	59 (20.41)	1 (0.35)	3 (1.04)	56 (19.37)
RDT/Microscope	20 (6.92)	115 (39.79)	94 (32.53)	0 (0)	3 (1.04)	226 (78.20)	12 (4.15)	16 (5.54)	201 (69.55)
Source of information (χ^2 = 2.04, df = 2 p = 0.360)				**(χ^2 = 1.04, df = 2 p = 0.596)**			**(χ^2 = 1.45, df = 2 p = 0.485)**		
NED list	12 (4.15)	63 (21.80)	57 (19.72)	0 (0)	1 (0.35)	131 (45.33)	5 (1.73)	11 (3.81)	116 (40.14)
STG	9 (3.11)	86 (29.77)	62 (21.45)	1 (0.35)	2 (0.69)	154 (53.28)	8 (2.77)	8 (2.77)	141 (48.78)

Note: RNM = Registered nurse and midwives; CHEW = Community health extension workers; Pharm tech. /others = Pharmacy technicians and others; * = statistically significant at p < 0.05; df = degree of freedom; Z = Z-statistics; χ^2 = Chi-square; STG = Standard treatment guidelines; NED = National essential drug; ACT = Artemisinin-based combination therapy; RDT = Rapid diagnostic test

Multinomial Logistic Regression for Healthcare Workers' KAP Scores with Independent Variables: The results of multinomial logistic regression showed the strength of prediction of KAP scores by the independent variables (potential predictors) [17].

The results of -2 log-likelihood (-2LL) test **Table 5** showed values of 288.54 (χ^2 = 45.25, df = 19, p = 0.001) and 155.45 (χ^2 = 41.56, df = 19, p = 0.002) for the final regression model for knowledge and practices containing their respective predictors, respectively, and implied that the models could

significantly predict the outcome variables, while the value for the attitudes model (346.43 (χ^2 = 22.62, df = 19, p = 0.254)) indicated that the level of prediction of the outcome variable by the model was not statistically significant at p<0.05 compared to the intercept. On the other hand, the Chi-square goodness-of-fit test at p<0.05 for the three models: knowledge (χ^2 = 258.45, p = 0.112), attitudes (χ^2 = 258.66, p = 0.110) and practices (χ^2 = 210.45, p = 0.923) indicated p-values were greater than 0.05, which implied that the models fit the data well. Similarly, the pseudo-R-square values of 0.204, 0.241 and 0.367 confirmed that the model could respectively explain 20.4%, 24.1% and 36.7% of the healthcare workers' KAP variances that could be predicted from their independent variables. Furthermore, the models correctly classified the outcome variables of 74.7%, 66.8% and 90.0% of the healthcare workers as good (95.0%) or poor (29.2%) knowledge, 85.7% good or 40.5% poor attitudes, and 99.6% good or 12.5% poor practices, respectively.

TABLE 5: MULTINOMIAL LOGISTIC REGRESSION BETWEEN HEALTHCARE WORKERS' INDEPENDENT VARIABLES AND KAP SCORES (N = 289)

	Knowledge scores				Attitudes scores				Practices scores			
Effect	**MFC**	**LRT**			**MFC**	**LRT**			**MFC**	**LRT**		
	- 2LL	**χ^2**	**df**	**p-value**	**- 2LL**	**χ^2**	**df**	**p-value**	**- 2LL**	**χ^2**	**df**	**p-value**
Intercept	288.54	0.00	0	.	346.42	0.00	0	.	155.45	0.00	0	.
Gender	290.63	2.09	1	0.148	347.47	1.04	1	0.308	159.82	4.38	1	0.036*
Age (years old)	293.79	5.25	2	0.032*	346.96	0.53	2	0.767	173.40	17.95	2	0.000**
Occupation	304.19	15.75	4	0.004**	350.82	4.39	4	0.355	157.50	2.05	4	0.727
Duration of experience (years)	288.84	0.31	3	0.959	347.21	0.78	3	0.855	161.60	6.15	3	0.014*
Monthly salary (Naira)	293.56	5.02	2	0.021*	350.24	3.81	2	0.049*	155.65	0.21	2	0.901
Knowledge					349.95	3.52	2	0.172	158.76	3.32	2	0.191
Attitudes	291.03	2.49	2	0.287					158.42	2.97	2	0.226
Practices	303.28	14.74	2	0.001**	350.42	4.00	2	0.136				
Availability of drugs	292.52	3.99	1	0.046*	347.50	1.07	1	0.300	155.45	0.03	1	0.954
Availability of diagnostic materials	291.55	3.01	1	0.083	346.54	0.11	1	0.743	155.71	0.27	1	0.605
Availability of source of information	288.93	0.39	1	0.532	347.01	0.58	1	0.445	155.52	0.07	1	0.785

Note: - 2LL = -2 Log Likelihood of reduced model; χ^2 = Chi-square; LRT = Likelihood ratio tests; MFC = Model fitting criteria; * = statistically significant at p<0.05; ** = statistically significant at p<0.005

Table 6 displayed the overall level of significance and details strengths of prediction of the categorical outcome variables by the various predictor variables as indicated by their odds ratios (ORs) at 95% confidence interval (95% CI).

TABLE 6: DETAILS OF MULTINOMIAL LOGISTIC REGRESSION BETWEEN HEALTHCARE WORKERS' INDEPENDENT VARIABLES AND KAP CATEGORIES (N = 289)

	Knowledge scores		Attitudes scores		Practices scores	
Variables	**Exp(β) (95% CI)**	**p-value**	**Exp(β) (95% CI)**	**p-value**	**Exp(β) (95% CI)**	**p-value**
Intercept		0.000**		0.429		0.000**
Gender						
Male	0.73 (0.37 – 1.43)	0.358	0.77 (0.41 – 1.45)	0.415	0.35 (0.13 – 0.95)	0.039*
Female	Reference					
Age (years old)						
18 – < 25	6.51 (0.37 – 2.33)	0.022*	0.82 (0.24 – 2.75)	0.742	80.99 (8.17 – 802.62)	0.000**
25 – < 55	1.66 (0.72 – 3.82)	0.236	0.76 (0.36 – 1.60)	0.471	9.29 (1.57 – 55.02)	0.014*
55 – 65	Reference					
Occupation						
RNM	4.50 (1.50 – 13.49)	0.007*	0.46 (0.19 – 1.12)	0.088	0.74 (0.11 – 4.89)	0.757
CHEW	5.50 (2.15 – 14.06)	0.000**	0.86 (0.41 – 1.82)	0.701	1.59 (0.41 – 6.12)	0.500
J-CHEW	3.72 (1.30 – 10.65)	0.014*	1.17 (0.49 – 2.78)	0.724	2.07 (0.51 – 8.46)	0.312
Lab-technician	4.05 (1.36 – 12.10)	0.012*	0.93 (0.36 – 2.39)	0.873	1.80 (0.39 – 8.35)	0.453
Pharm technician/others	Reference					
Duration of experience (years)						
< 6	0.83 (0.27 – 2.55)	0.741	1.50 (0.54 – 4.18)	0.439	0.11 (0.02 – 0.71)	0.021*
6 – 10	0.82 (0.32 – 2.10)	0.673	1.39 (0.60 – 3.25)	0.445	0.44 (0.11 – 1.76)	0.247
11 – 15	0.99 (0.37 – 2.61)	0.979	1.38 (0.58 – 3.26)	0.463	0.36 (0.08 – 1.68)	0.195

> 15	Reference					
Monthly income (Naira)						
< 18,000	1.23 (0.59 – 2.59)	0.582	0.47 (0.22 – 1.01)	0.050	0.88 (0.25 – 3.15)	0.847
18,000 – 50,000	2.61 (1.09 – 6.24)	0.032*	0.68 (0.35 – 1.32)	0.250	0.77 (0.25 – 2.39)	0.652
> 50,000	Reference					
Knowledge						
Poor			1.34 (0.73 – 2.47)	0.343	2.03 (0.76 – 5.42)	0.159
Moderate			2.68 (0.88 – 8.19)	0.084	2.97 (0.71 – 12.50)	0.137
Good			Reference			
Attitudes						
Poor	1.55 (0.88 – 2.73)	0.134			0.49 (0.20 – 1.19	0.118
Moderate	2.9 (0.08 – 111.49)	0.567			1.95 (0.84 – 4.53)	0.115
Good	Reference					
Practices						
Poor	0.84 (0.28 – 2.49)	0.750	0.88 (0.25 – 3.04)	0.837		
Moderate	14.21 (3.04 – 66.44)	0.001**	2.79 (0.97 – 8.04)	0.057		
Good	Reference					
Availability of drugs						
Non–ACT	0.55 (0.30 – 1.00)	0.049*	1.31 (0.79 – 2.19)	0.300	0.98 (0.41 – 2.34)	0.955
ACT	Reference					
Diagnostic materials						
Thermometer	1.81 (0.93 – 3.53)	0.082	1.11 (0.60 – 2.03)	0.742	0.76 (0.26 – 2.22)	0.610
RDT/Microscope	Reference					
Source of information						
NED list	1.20 (0.68 – 2.11)	0.532	1.22 (0.74 – 2.02)	0.445	1.13 (0.47 – 2.70)	0.786
STG	Reference					

Note: * = statistically significant at p<0.05; ** = statistically significant at p<0.005; RNM = Registered nurse and midwives; CHEW = Community health extension workers; STG = Standard treatment guidelines; NED = National essential drug; ACT = Artemisinin-based combination therapy; RDT = Rapid diagnostic test

DISCUSSION: Healthcare personnel has major roles to play in ensuring patients get the required malaria medications when they visit PHC facilities by ensuring effective diagnosis and prescription of the recommended ACT with appropriate information counseled to patients on how to use the medicines for effective desired outcomes of therapy at minimal cost [2, 18]. The quality of these services required the availability of trained healthcare workers, in addition to the availability of required material resources in the PHC facilities, especially sources of information like treatment guidelines and essential drug lists, diagnostic materials, and the recommended medicines [2, 19]. The present study assessed the availability of these needed material resources in the selected PHC facilities and predictors of healthcare workers' KAP on uncomplicated malaria treatment and management.

The Kruskal-Wallis test showed a significant difference in healthcare workers' knowledge based on monthly salary. There were also significant differences in their attitudes based on their gender, monthly earnings, knowledge, and practices. Similarly, differences in their management practices were statistically significant across their gender, age (years old), and knowledge in **Table 3**. The Chi-square (χ^2) test for independence showed significant associations between healthcare workers' knowledge score and monthly salary and practices on uncomplicated malaria **Table 4**. There were also significant associations between management practices of the respondents with gender, age (years old), occupation, and duration of the experience (years). Many of the female healthcare workers possessed good practices (62.63%) in uncomplicated malaria management, and this pattern was in agreement with outcomes of a study conducted in Australia [20]. The community health extension workers (CHEW) group (28.72%) associated with good practices of uncomplicated malaria to patients, followed by registered nurse and midwives (RNW) group (21.8%).

This was in agreement with earlier reported roles of these categories of healthcare workers in providing basic healthcare to the communities [21-24]. The results also indicated that the majority of the healthcare workers that had been working for < 6 years and 6 – 10 years associated more with good attitudes in rendering services to patients than those who had been in the system for longer periods. This was in contrast with outcomes of reported studies, which indicated poor practices among workers who just graduated and started working [25] and better services by those who had been long in practices [26].

The results of multinomial logistic regression analysis revealed that healthcare workers' age, occupation, monthly salary, availability of required drugs, and practices were the significant predictors of knowledge on uncomplicated malaria, while their gender, age, and duration of experiences significantly predicted the outcomes of their practices for uncomplicated malaria-infected patients, with an only monthly salary that predicted their attitudes toward the disease and its management **Table 5**. These findings were in agreement with outcomes of similar studies that reported socio-demographic characteristics as significant predictors of healthcare workers' KAP [21] on malaria whereby female healthcare workers were more likely to perform better than males in rendering treatment to patients, and all the age groups were more likely to have good practices toward the disease and its management **Table 6**.

The observed better knowledge and practices rendered by most of younger healthcare workers compared to those who were in their retirement age was not surprising because their memories were still fresh compared to the elderly, but the result was contrasting with their duration of experiences, as most of the younger ones were new in the systems and were more likely to perform poorly compared to those who had been practicing for many years. This indicated that, although the zeal to perform optimally might still be there, most of them might just trying their best in order to impress their superiors whom they worked under. The observed better knowledge of CHEWs and RNM on the disease might be associated with their levels of exposure and experience in the management of the disease because most of them had been in practice for a long time and might be more familiar to patients' conditions more than the younger ones.

This observation was similar to the outcome of a study conducted in Kenya [27]. It most, however, be mentioned that the researchers were aware of the possibility of "Hawthorne" effects since the respondents knew that their attributes were under assessment, they might try to give the correct responses to the items which might be different from their real knowledge or practices as explained by Leonard and Masatu [28]. Financial inclination might also be responsible for the observed good knowledge since these categories of staff were among the highest-paid healthcare workers in the healthcare sector in the state, and this was confirmed by the observed influence of higher monthly payments on their knowledge in the present study compared to those that earned lesser amounts. Low salary earners might find it difficult to focus on their work considering the quantum of possible problems such as how to meet up their household need in terms of feeding, paying of children school fees, and family health needs, among others. On the other hand, the higher payment might serve as motivation to learn more and be more dedicated to their work with less distraction since they had enough to solve their personal and family matters.

CONCLUSION AND RECOMMENDATIONS:

The outcomes of this present study showed inadequate sources of information and required ACTs across the PHC facilities based on the treatment guideline requirements. Ismail *et al*., [14] had reported that the healthcare workers possessed moderate knowledge, good positive attitudes, and practices on uncomplicated malaria. The overall outcomes of inferential statistics through multinomial logistic regression indicated that healthcare workers' knowledge of uncomplicated malaria was predicted from age, occupation, monthly salary, availability of required drugs, and practices, while attitudes were significantly predicted from only monthly salary among the healthcare workers. Their practices were significantly predicted from gender, age, and duration of experiences.

In view to the major concern attached to correct medications in order to achieve the desired therapeutic outcomes, the mixed negative and positive influences of the identified predictors of respondents' KAPs during uncomplicated malaria management suggested that enhancement of mandatory continuing education programs on malaria for healthcare workers would enable them to have the required knowledge and skills to render the appropriate services to patients during the management of the disease. In addition, they should be encouraged to attend seminars, conferences, and other educational gatherings related to malaria disease and its management that would improve their practicing skills. Also, improving the welfare of the workers might

encourage them to learn more and also develop positive attitudes towards rendering quality services to patients. The same study should also be conducted across PHC, secondary, and tertiary healthcare facilities of Nigeria to generate more generalized information in the country for effective interventions toward malaria elimination.

A qualitative study to be conducted in the future is also recommended among healthcare workers to extract more behavioral characteristics and/or some of the predictors underlying their management practices that were not captured through quantitative data for the possibility of getting comprehensive results. In addition, such qualitative interviews might reduce "Hawthorne" effect, mostly experience during quantitative data collections.

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