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Knowledge, use of mRDT, and malaria control practice among health care workers in three Local Government areas of Kano state, North-Western-Nigeria.

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Abstract:
Background*: Malaria is still highly prevalent among rural communities in Kano state, north-western Nigeria, and significant gaps persist inappropriate preventive practices, with the percentage of households in Kano state with ITNs and LLINs remain a dismal low. Though there has been increased availability of diagnostic testing such as malaria rapid diagnostic test (mRDT) in Nigeria, However, the mRDT rate in many communitiesstudied is still far short of recommendations. Studies on knowledge, use of mRDT, and malaria control practices by health workers in Kano State have not been fully explored hence the need for it.*
Materials and Methods*: This is a cross-sectional study of healthcare workers conducted in 80 primary healthcare facilities of 3 metropolitan Local Government areas of Kano state-Nigeria. Healthcare workers (280) were systematically selected with a sampling interval of 3, with the first healthcare worker chosen randomly and interviewed using a self-administered questionnaire. Questions were asked on demographic information, knowledge of mRDT, use of mRDT, and use of malaria control practices. Analysis was performed using windows excel version 10 and Statistical Package for Social Sciences (SPSS) version 25.0. ANOVA & independent student's T-test was used to compare mean scores for knowledge, use of mRDT, and malaria control practices. Possible associations between the independent variables and knowledge of mRDT, use of mRDT, and malaria control practice were assessed using binary logistic regressions level P < 0.05 considered significant.*
Results*: Two hundred and sixty-three health workers completed the self-administered questionnaire with a response rate of 94%. Ninety-two percent of respondents (92) % had good knowledge of MRDT with a mean score of 98.7% (SD: 0.124), while 62% demonstrated good use of mRDT with a mean score of 80% (SD: 0.171) and 211 (80%) indicated good malaria control practices with a mean score of 81.4% (SD:0.1733). The differences between means score for knowledge was statistically significant (P<0.05) between the 21-30 age groups & 41 years and above, (adjusted p value= 0.0053); 31-40 years and 41 years and above (adjusted p-value= 0.0236) were statistically significant while the differences between means among the various age groups for the use of mRDT was statistically significant (p<0.05) significant only between 18-20 years and 31-40 years (adjusted p-value= 0.0068). Factors associated with good knowledge of mRDT are 21-30 years age group (AOR:0.082; p=0.001), primary school level education (AOR:10.9982; p=0.033), while factors associated with good usage of mRDT is 15-20 years age group (AOR:0.36; p=0.033) while factor associated with good malaria control practice are those with Diploma as their highest qualification (AOR:2.208; p=0.019). Knowledge of mRDT was seen to be a predictor of good usage of mRDT (AOR:0.197; p=0.033) and good malaria control practices (AOR:0.166; p=0.000).*
Conclusion: *Most Healthcare workers demonstrated a good knowledge of mRDT, with only a fair number demonstrating good usage of MRDT. A good number of health workers are also seen to have shown good malaria control practices.*
Key Word*:Malaria; mRDT; Control; Kano.*

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I. Introduction

There was an estimated 229 million malaria cases were reported in 2019 from 87 malaria-endemic countries, with the WHO African Region (AFRO) contributing to about 94% of the cases (215 million).[1] This figure shows a 6% rise from the Global technical strategy (GTS) for malaria 2016-2030 baseline of 218 million in 2015. Nigeria accounts for 27% of the global malaria count.[1] Malaria remains a major public health problem in Nigeria, with 97% of the population at risk.[2,3] According to the National malaria emergency strategic plan (NMEP) 2014-2020, malaria accounts for about 60% of outpatient's visits and 30% of hospitalization in Nigeria.[4]

There is a steady decline in the percentage of total global malaria death among children aged under five years from 84% in 2000 to 67% in 2019.[1] Though malaria death in the WHO African region reduced by 44% compared to the 2000 value, Nigeria contributes to 23% of malaria fatality rate in 2019.[1]Even with progress in a reduction in malaria incidence, the world is off track by 37% as at 2019 for the 2020 GTS morbidity milestone while the AFRO region is off track for morbidity and mortality by 37% and 25% respectively.[1] Nigeria has not achieved a reduction in malaria incidence in 2020 compared to 2015 values.[1] Thus, Nigeria reports more death due to malaria than any country in the world.[3]

The World Health Organization (WHO) initiated test, treat, and track (T3) malaria strategy to support malaria-endemic countries.[5]Strategies for malaria control remains the use of malaria rapid diagnostic tests(mRDT), treatment with ACTs, control through the use of ITNs/LLINs, indoor residual spraying, and prevention of malaria in pregnancy.[6] Significant difference between public and private healthcare workers on adherence to malaria diagnosis and treatment guidelines still exists [7] Malaria testing is necessary to help health workers make an informed and quick decision on malaria diagnosis.[8]

Malaria diagnosis using microscopy is currently the gold standard.[2] However, malaria rapid diagnostic tests (mRDTs) were developed to simplify the diagnosis in regions without access to functional microscopy.[9]MRDT is a viable approach to increasing access to malaria diagnostic testing[10] with apparent advantages over others testing methods which include accurate, rapid diagnostic tests for malaria (mRDTs) that requires limited training and is an opportunity to increase access to the correct diagnosis.[11]Other advantages of mRDT Kits over other methods of diagnosis (PCR-based and nucleic acid amplification tests-NAA tests) are that they require no capital investment or electricity, are simple to perform, and are easy to interpret.[12]MRDT has demonstrated a poor sensitivity (58%) but a very good specificity (97%), as shown by a study in Kano state Nigeria.[13] Other studies demonstrated its poor sensitivity but good specificity.[14]Eighty-four percent (84 %) of the total rapid diagnostic tests (RDTs) were distributed by national malaria programmes (NMPs) from 2010-2019 in sub-Saharan Africa[1].Though there has been increased availability of diagnostic testing such as malaria rapid diagnostic test (MRDT) in Nigeria, however, malaria/MRDT rate in the communities is still far short of recommendation.[15]

The successful push towards the parasitological diagnosis of malaria in Africa, mainly with rapid diagnostic tests (mRDTs), has reduced the over-prescribing of artemisinin-based combination therapies (ACT) to malaria test-negative patients.[16]There is still a limitation of presumptive malaria treatments compared tomRDT by microscopy[17]and the possibility of missing a high proportion of malaria cases those using current mRDTs.[17]

Vector control is the primary way to prevent and reduce malaria transmission. The use of insecticide-treated mosquito nets has proven to be an effective approach form of malaria prevention. In 2018, an estimated half of all people at risk of malaria in Africa were protected by an insecticide-treated net, compared to 29% in 2010.[1] The use of ITNs is presently considered a very cost-effective method of malaria prevention in highly endemic countries like Nigeria.[18] However, ITN coverage has been at a standstill since 2016. Indoor spraying with residual insecticides (IRS) is another method of prevention.Globally, IRS protectionis known to declined from a peak of 5% in 2010 to 2% in 2018, with decreases seen across all WHO regions, apart from the WHO Eastern Mediterranean Region.[1] The declines in IRS coverage are known to occur as countries switch from the usual pyrethroid insecticides to a more expensive alternative to mitigate mosquito resistance to pyrethroids. There has been an increase in ITN use in sub–Saharan Africa by 5% in 2019 compared with 2000 values.[1] Under the NMEP's malaria strategic plan 2014-2020, Nigeria aims for universal coverage for ITNs of all at risk populations[4], and the ownership has increased from 42% in 2010 to 50% in 2013.[3,18]Since 2000, progress in malaria control has resulted primarily from expanded access to vector control interventions, particularly in sub-Saharan Africa.[1]

Antimalarial medicines are also be used to prevent malaria.[2] For travelers, malaria can be prevented through chemoprophylaxis.[2] For pregnant women living in moderate-to-high transmission areas, WHO recommends intermittent preventive treatment with sulfadoxine-pyrimethamine for them at each scheduled antenatal visit after the first trimester. Similarly, for infants living in high-transmission areas of Africa, three doses of intermittent preventive treatment with sulfadoxine-pyrimethamine are recommended, delivered alongside routine vaccinations.[2] The proportion of under 5-year-olds who were not prescribed ACT was

averagely 41.8% across various sites. It was observed that the odds of not being prescribed an ACT were 2–3 times higher for patients in settings with lower transmission intensity (using test positivity as a proxy) compared to areas of higher transmission.[16]Survey data had shown that use of ACTs had increased from a baseline of 39% to 81% when all the children with fever for whom care was sought were considered.[19]

Study have shown that malaria is highly prevalent among rural Hausa communities in Kano state, north-western Nigeria.[18,20]Despite high levels of knowledge and attitudes in the study area, significant gaps persist inappropriate preventive practices, particularly the use of ITNs.[21]The proportion of households in Kano state with ITNs and LLINs remain a dismal low of 33.8 %and 33.6%, respectively.[18]It is important that to identify innovational and unified control measures should be identified and implemented to reduce the burden of malaria in communities. Community mobilization and health education regarding the importance of using ITNs to prevent malaria and save lives should be considered.[20]Studies in Zamfara state Nigeria showed a high proportion of health workers with good knowledge of mRDT.[22]. Malaria prevalence remains un-expectedly high despite the fact that Household control of interventions .[23]Contemporary literature has shown that studies on knowledge, use of mRDT, and malaria control practices have not been fully explored in Kano state.

Despite the high knowledge of the disease in the study area, a significant knowledge gap exists in the best preventive

strategies. Health education that will focus on the use of insecticide-treated nets is necessary to control the disease.[21]

The general objective was to investigate the knowledge of mRDT, usage of MRDT, and malaria control practice by healthcare workers in 3 Local government areas (LGAs) of Kano State, Nigeria.

The specific objectives of the study were to

1. Ascertain the knowledge of mRDT among primary health care (PHC) workers in the LGAs
2. To determine the level of usage of mRDT among healthcare workers
3. To determine the level of implementation of malaria control practices among health workers
4. To determine if any, the association between independent variables with mRDT knowledge, mRDT usage, and malaria control practices among PHC workers

II. Material and Methods

This is a cross-sectional study of health care workers conducted in 3 metropolitan Local Government areas of Kano state (Dala, Nassarawa, and Ungogo) purposely selected based on DHIS2 2016[24]data with the highest reported confirmed malaria data(highest endemicity of malaria). These LGAs comprise a combined total population of 2,254,171 based on a projection from 2006 census figures [25]with a total of 80 primary health care facilities and a staff strength of 1034 healthcare workers. The study was conducted between the period of June to August 2018.

Study Design: This is a cross-sectional prospective study amongprimary healthcare workers'

Study Location: Primary healthcare facilities of Dala, Nassarawa, and Ungogo Local Government areas of Kano state north-western Nigeria

Study Duration: June 2018 to August 2018

Sample size: 280Healthcare workers

Sampling Technique: Purposive sampling technique for health facilities and systematic sampling for respondents

All the 80 health facilities in the three local government areas were purposely visited for the study. Health workers interviewed were systematically selected with a sampling interval of 3, with the first health care workers selected randomly until the target of 280 were reached to get the required number of health care workers based on a total Health workers population of 1034.

Sample size estimation: Using a Cochran's for large populations.[26]We obtained a sample size of 380

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is 5% (the desired level of precision at 95% confidence level)
- p (is assumed to be 0.5 the (estimated) proportion of the population which has the attribute in question)
- q is 1 – p.

Correcting for a smaller population (1034), Cochran's formula is used.

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$$

Here n_0 is Cochran's sample size recommendation, N is the population size, and n is the new, adjusted sample size. Our new sample calculation becomes 280.

Inclusion criteria:

1. Respondents must be above 18 years old
2. Must have worked as a healthcare worker for at least two years
3. Facilities are those that have been trained and supplied with commodities for RDT testing

Exclusion criteria:

1. Unwilling to sign an informed consent form
2. General hospitals, Private health facilities, Pharmacies, and registered patent medicine stores pharmacies were excluded from the study.

Procedure methodology

Data Collection: Data was collected using hard copies of a self-administeredstructured questionnaire to 280 healthcare workers systematically selected. Data were collected from 20 health facilities in Dala LGA, 24 from Nassarawa LGA, and 36 from Ungogo LGAs. The questionnaire consusts of four sections which include demographic data, knowledge of mRDT, usage of mRDT, and malaria control practices. The questionnaire was pretested among healthcare workers in 2 health facilities within Kano municipal outside the study area. Three trained research assistants, including the principal investigator, assisted in and supervised the data collection. Six questions were asked on knowledge of mRDTand the usage of mRDT, and five questions on the use of malaria control practices. For every correct response, 1 point was awarded and 0 for an incorrect response. The scores were converted into percentages and using a three-point Likert's scale rating, and the blooms cut off point as modified[27]; scores were grouped with percent scores rated asgood when a score is >=80%, fair between 50 and 79%, and a poor score below 50% for knowledge of mRDT, usage of mRDT and use of malaria control practices.

Statistical analysis

Data entry and analysis were performed using windows excelversion 10 and Statistical Package for Social Sciences (SPSS) version 25.0 (SPSS Inc., Chicago, IL, USA). Data of the study were summarized using frequency tables, means, and standard deviations (SDs), Standard error of means (SEM) adjusted odds ratio, p-values where applicable. ANOVA & independent student's T-test was used to show a comparison between mean scores for knowledge, use of mRDT, and malaria control practices. Possible associations between the independent variables and knowledge of mRDT, use of MRDT, and malariacontrol and practice were assessed using binary logistic regressions level with P <0.05 consideredsignificant.

Ethical Considerations

The study was approved by Health ethical review committee,Ministry of Health, Kano State Nigeria, with approval number (NHREC/03/17/2018). Written informed consent was obtained from each participant using hard copies of the informed consent forms.

III. Result

Two hundred and sixty-three health workers completed the self-administered questionnaire with a response rate of 94%. As seen in Table 1, One hundred and thirteen respondents (43%) were males while one hundred and fifty (57%) were females. Respondents with a diploma as their highest qualification (47%) were the largest interviewed (n=124), while approximately 1% (n=2) of the health workers interviewed were school drop out. 21-30 years constitute the largest age group interviewed, representing 45%(n=119).

Table 1. Socio-demographic characteristic (N=263)

Variables	Frequency (%)	
Age of respondents		
21-30 years	119	(45)
18-20 years	69	(26)
31-40 years	37	(14)
41 and above years	38	(15)
Gender		
Male	113	(43)
Female	150	(57)
Highest Educational level of respondents		
Attended informal school	16	(6)
School drop-out	2	(1)
Primary school	48	(18)
Diploma	124	(47)

Table 2. Frequency of scores by variables

		Knowledge of mRDT					
	total response	**Good (Frequency)**		**fair (Frequency)**		**bad (Frequency)**	
state summary	**263**	**241**	**(92)**	**15**	**(6)**	**7**	**(3)**
Age of respondents							
18-20 years		61	(88)	6	(9)	2	(3)
21-30 years		116	(97)	2	(2)	1	(1)
31-40 years		35	(95)	2	(5)	0	(0)
41 and above years		29	(76)	5	(13	4	(11)
Total		**241**	**(92)**	**15**	**(6)**	**7**	**(3)**
Gender							
Male		104	(92)	5	(4)	4	(4)
Female		137	(91)	10	(7)	3	(2)
Total		**241**	**(92)**	**15**	**(6)**	**7**	**(3)**
Highest Educational level of respondents							
Attended informal school		14	(88)	1	(6)	1	(6)
School drop-out		2	(100)	0	(0)	0	(0)
Primary school		39	(81)	6	(13)	3	(6)
Diploma		121	(98)	3	(2)	0	(0)
Secondary school education		36	(84)	4	(9)	3	(7)
First degree and above		29	(97)	1	(3)	0	(0)
Total		**241**	**(91.6)**	**15**	**(6)**	**7**	**(3)**
		Use of mRDT					
	total response	**Good (Frequency)**		**fair (Frequency)**		**bad (Frequency)**	
state summary	**263**	**164**	**(62)**	**73**	**(28)**	**26**	**(10)**
Age of respondents							
18-20 years		48	(70)	14	(20)	7	(10)
21-30 years		77	(65)	38	(32)	4	(3)
31-40 years		18	(49)	10	(27)	9	(24)
41 and above years		21	(55)	11	(29)	6	(16)
Total		**164**	**(62)**	**73**	**(28)**	**26**	**(10)**
Gender							
Male		74	(66)	31	(27)	8	(7)
Female		90	(60)	42	(28)	18	(12)
Total		**164**	**(62)**	**73**	**(28)**	**26**	**(10)**
Highest Educational level of respondents							
Attended informal school		11	(69)	5	(31)	0	(0)
School drop-out		2	(100)	0	(0)	0	(0)
Primary school		32	(67)	12	(25)	4	(8)
Diploma		77	(62)	34	(27)	13	(11)
Secondary school education		24	(56)	12	(28)	7	(16)
First degree and above		18	(60)	10	(33)	2	(7)
Total		**164**	**(62)**	**73**	**(28)**	**26**	**(10)**
		Malaria Control Practice					
	total response	**Good (Frequency)**		**fair (Frequency)**		**bad (Frequency)**	
Age of respondents	**263**	**211**	**(80)**	**41**	**(16)**	**11**	**(4)**
21-30 years		92	(77)	23	(19)	4	(4)
18-20 years		60	(87)	6	(9)	3	(4)
31-40 years		28	(76)	7	(19)	2	(5)
41 and above years		31	(82)	5	(13)	2	(5)
Total		**211**	**(80)**	**41**	**(16)**	**11**	**(4)**
Gender							
Male		89	(79)	21	(18)	3	(3)
Female		122	(81)	20	(14)	8	(5)
total		**211**	**(80)**	**41**	**(16)**	**11**	**(4)**
Highest Educational level of respondents							
Attended informal school		13	(81)	2	(13)	1	(6)
School drop-out		2	(100)	0	(0)	0	(0)
Primary school		37	(77)	8	(17)	3	(6)
Diploma		103	(83)	19	(15)	2	(2)
Secondary school education		29	(67)	10	(24)	4	(9)
First degree and above		27	(90)	2	(7)	1	(3)
Total		**211**	**(80)**	**41**	**(16)**	**11**	**(4)**
Secondary school education						43	(16)
First degree and above						30	(11)

Table 2 showed that 241(92) % had good knowledge of mRDT with a mean score of 98.7% (SD: 0.124) while 164 (62%) demonstrated good use of MRDT with a mean score of 80% (SD: 0.171) and 211 (80%) demonstrated good malaria control practices with a mean score of 81.4% (SD:0.1733).

Table 3 shows a comparison of mean scores (ANOVA & independent student's T-test) for knowledge of mRDT, use of mRDT, and malaria control practices of the various variables. Results have shown that only the differences between means among the various age groups for knowledge of mRDT statistically significant (P<0.05). The Post-hocTurkeys' multiple comparison test shows only the differences between the 21-30 age groups &41 years and above (adjusted p value= 0.0053); 31-40 years and 41 years and above (adjusted p-value= 0.0236) were statistically significant. Also, differences between means among the various age groups for the use of mRDT were statistically significant (p<0.05), with posthoc turkeys test showing the differences to be significant only between 18-20 years and 31-40 years (adjusted p-value= 0.0068).

Table 3. Mean percentage scores for Knowledge of mRDT, usage of mRDT, and malaria control practices

	Knowledge of mRDT			Use of mRDT			Malaria Control Practice		
	Mean score	±SEM	Anova/independent T-test P-value	Mean score	±SEM	Anova/independent T-test P-value	mean score	±SEM	Anova/independent T-test P-value
Age of respondents									
18-20 years	88.54	1.635	p=0.04727**	84.54	2.416	p=0.04559	82.03	1.899	p=0.7808
21-30 years	91.31	0.897		80.5	1.219		82.02	1.517	
31-40 years	91.78	1.673		73.41	3.05		80.54	3.508	
41 and above years	83.68	2.843		76.74	2.906		78.95	3.012	
Gender									
Male	90.75	1.227	p=0.175	80.64	1.436	p=0.6081	82.3	1.565	p=0.4501
Female	88.64	0.9817		79.55	1.492		80.67	1.458	
Highest Educational level of respondents									
Attended informal school	90.56	3.719	p=0.3527	85.44	3.656	p=0.1083	80	4.082	p=0.4904
School drop-out	100	0		100	0		100	0	
Primary school	87.44	2.353		77.67	1.988		80.83	2.915	
Diploma	90.15	0.8225		81.19	1.59		82.26	1.279	
Secondary school education	87.51	2.489		75.53	2.895		78.14	3.179	
First degree and above	92.1	1.757		81.13	2.941		82.67	3.554	

Results from table 4 show that factors associated with good knowledge of mRDT are 21-30 years age group (AOR:0.082; p=0.001), primary school level education (AOR:10.9982; p=0.033), while factors associated with good usage of mRDT is 18-20 years age group (AOR:0.36; p=0.033) while factor associated with good malaria control practice are those with a diploma as their highest qualification (AOR:2.208; p=0.019). Knowledge of mRDT was seen to be a predictor of good usage of mRDT (OR:0.197; p=0.033) and good malaria control practices (OR:0.166; p=0.000).

Table 4. Predictors of Good knowledge, usage of mRDTs & good malaria control practices among healthcare workers

Independent variable	Good knowledge of mRDT		Good usage of mRDT		Good malaria control practices	
	AOR; P-Value		AOR; P-Value		AOR; P-Value	
Age of respondents						
18-20 years	0.726;	*p*=0.647	0.36;	*p*=0.033*	0.617;	*p*=0.432
21-30 years	0.082;	*p*=0.001*	0.497;	*p*=0.1	1.132;	*p*=0.811
31-40 years	0.259;	*p*=0.146	1.083;	*p*=0.874	1.776;	*p*=0.349
41 and above years	ref	ref	ref	ref	ref	ref
Gender						
Male	0.435;	*p*=0.147	0.725;	*p*=0.264	0.94;	*p*=860
Female	ref	ref	ref	ref	ref	ref
Highest Educational level of respondents						
Never Attended school	2.166;	*p*=0.558	0.524;	*p*=0.351	2.238;	*p*=0.381
School drop-out	0;	*p*=0.999	0;	*p*-=0.999	0;	*p*=999
Primary school	10.998;	*p*=0.033*	0.935;	*p*=0.896	3.062;	*p*=0.126
Diploma	0.62;	*p*=0.7	1.779;	*p*=0.266	2.208;	*p*=0.019*
Secondary school education	0.865;	*p*=0.069	1.209;	*p*=0.674	5.445;	*p*=0.247
First degree and above	ref	ref	ref	ref	ref	ref
	Good usage of mRDT		Good malaria control practices			
	OR; P-VALUE		OR; P-VALUE			
Good knowledge	0.197;	*p*=0.001*	0.166;	*p*=000*		

AOR: Adjusted odds ratio

IV. Discussion

In this study, we investigated the knowledge of health workers on mRDT, use of mRDT, and demonstration of malaria control practice by health workers in primary health facilities, and our study was able to ascertain these and association between independent variables with mRDT knowledge, mRDT usage and malaria control practices by healthcare workers were determine. The objective of the study was thus achieved. Our study was not conducted in general hospitals, private health facilities, and retail pharmacies because, at the time of the data collection, these settings have not been trained nor supplied with commodities for RDT testing.

Though mRDT is not a gold standard for malaria diagnosis, due to its various limitations[28], studies about knowledge and use of mRDT are still important as it is the dominant malaria test being carried out in the Afro region due to its other advantages withRDTs being used safely and effectively by community health workers, [9-12] though more research is necessary to make a similar conclusions for the use of RDT in the formal health care as well as retail sectors. RDTs have been reported to have a high diagnosticaccuracy across many areas, though their lower specificity oberved in the retail sector needs to be examined.[29]The extent to which the implementation process of mRDT-led, parasite-based diagnosis accommodateit is known that end-user beliefs, attitudes, perceptions, and satisfaction, as well as technology learnability and suitability, influences the level of acceptance and use of mRDTs.[30]In moderate to high transmission setting, compliance to treatment was observed to be higher if children were tested with mRDT compared to children who were not. [31]Acceptability of mRDT was moderate among the majority of health workers .[32]Additionally, diagnostic testing with mRDTs when compared to presumptive treatment of fevers implemented in registered drug shops substantially improved appropriate treatment of malaria with ACT.[33]thus, introducing mRDT reduces overuse of antimalarials.[34]

Our studies have shown that a high proportion of health care workers have good knowledge ofmRDT. This is irrespective of their gender or educational status.This high scorewas similarto a reported study [35]. The mean score for knowledge was thushigher than that reported among health workers in Zamfara State, Nigeria, [22]who reported a mean score for knowledge of mRDT among health care workers as 64.1%. It is also higher than seen in a similar study among the populace in Myanmar.[36]Another study had earlier shown that healthcare workers in PHCs in Akwa-Ibom state Nigeria had a fair knowledge of mRDT.[37]High knowledge by health care workers ofmRDT in our study might have been due to confirmed trainings by the Government and partners that have taken place among these healthcare workersas confirmed by questions asked as part of the study**.** Though our study had a high level of knowledge among healthcare workers, a significant difference in the mean score for knowledge (ANOVA) when41-year-old and above were compared with the 21-30- & 31-40-years age group with $p<0.05$. mean difference in knowledge between gender (Independent T-test) were not statistically significant ($P>0.05$) as well as difference by educational level ($P>0.05$).[36]

Though the mean score for the use of mRDT by the healthcare workers is generally high, a lower proportion demonstrated good usage of mRDT when compared with those that have good knowledge of mRDT. There is a similarity in the usage of mRDT by health care workers between the gender, educational status, and age group ($p>0.05$). with only a significant difference($p<0.05$) seen between the 15-20 years & 31-40 years age group when compared. Some studies reported higher scores for use of mRDT by health workers with as high as 92% [22]and 96%[37]of health workers carrying out mRDTtest correctly. Another study has shown that health workers do not have good knowledge of mRDT usage due to the fact that they have not been trained.[36]A study demonstrated that healthcare worker utilization of mRDT was associated with the health worker and health system-related factors that are potentially modifiable[22]which may require sustaining training of healthcare workers on benefits of using mRDT and provision of free mRDT in health facilities.[22] Another study has shown that mRDTs are generally used well, though compliance with test results is variable, especially inthe formal health care sector,[29] its use remains low with about 85% of health workers reporting satisfaction with the presumptive diagnosis.[32]

Health workers demonstrated good malaria control practices with high scores irrespective of their gender, age group, or educational status. The difference among these variables were all not statistically significant. This might infer the good use of the knowledge of malaria control practices and the availability of the various malaria control materials. A study has shown knowledge of preventive measures of malariato below.[38]but there was, reported high use of malaria control practice with very high percentage using LLINs, environmental means of malaria control, and use of the indoor residual spray.[38]Most health workers were seen to demonstrate good malaria control practice of indoor residual spraying, insecticide-treated nets with no statistically significant difference in mean score seen among the age group, gender, and educational status.[39]

Variables associated with higher odds of knowledge are those that never attended informal school when compared to those with degrees, but it is not statistically significant ($p>0.05$). primary school certificate holders.have significantly higher odds of knowledge for mRDT compared to those with degrees. Higher educational qualifications among these health workers do not indicate a higher knowledge of MRDT. The 21-30 years age group have significantly ($p<0.001$) lower odds of knowledge compared with 41 years and above.While the 18-20 years age group is associated with significantly lower odds for good usage of mRDTcompared to the 41 years and above age group, indicating that increasing age is associated with good usage of mRDT. Those with the national diplomaandthose withSecondary school educationmore likely to demonstrate higher odds for the usage of mRDT, but thevalues are not statistically significant. The study also shows that those with a national diploma are twice more likely to demonstrate good malariacontrol practice than those with a degree. This is statistically significant. A look into the years of service which could have thrown more light could be considered in subsequent studies.

Knowledge of MRDT is associated with significantly lower odds for the use of MRDT and demonstration of good malaria control practice; therefore, for our study, it can be said that knowledge of mRDT does not predict good usagemRDT nor demonstration of good malaria control practice. A study might well explain this as it was shown that intention to use mRDT was influenced positively by health workers having a proper understanding of the aims and expected benefits, the experience of healthcare workers, and the general attitude of healthcare workers.[32]. Another study among the population has shown a negative non-significant correlation between knowledge with the practice of malaria control practice. However, the results were not significant.[35]A chi-square test in another study indicated that a lack of education and non-usage of ITNs were significantly associated with malaria infection.[40]. Basic training and resources are essential but insufficient to maximize the potential of mRDTs in many contexts[41]

Limitations

The study was carried out in metropolitan LGAs with rural LGAs left out, which might make it difficult to generalizefindings across the state. There is the possibility of bias in reporting by healthcare workers having used self-administered questionnaires. Health workers were not categorized into the various professional group, which might give more useful information. Years of experience, which is a very important variable, were not included in the analysis. Our study did not cover the general hospital, private facilities, and pharmacies, which is another limitation.

V. Conclusion

Most Healthcare workers demonstrated a good knowledge of mRDT, with only a fair number demonstrating good usage of MRDT. A good number of health workers are also seen to have demonstrated good malaria control practices.

Recommendations.
Subsequent studies should include other facility types and consideration of facilities in rural areas. Consideration for inclusion of healthcare workers attitudes for subsequent studies will be useful in addition to more demographic variables.

Author's contribution
SSJ & SGI conceptualized the paper, reviewed the data, and analyzed them. SSJ & SGI wrote the draft of the manuscript. SSJ, SGI,DM, ABO & SN interpreted the data and reviewed the manuscript for intellectual content. All authors read and made input to the final draft.

Competing interests
No conflict of interest to report. For this study and publication, no funding was received.

Data availability/data sharing statement
Data is available from the corresponding author upon request

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