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IDENTIFICATION OF FAKE ANTI-MALARIAL DRUGS AMONG LAGOS RESIDENTS**

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ABSTRACT

Introduction: Malaria medications are in high demand, and they have inappropriately become a target for pharmaceutical counterfeiting. Mobile Authentication Services (MAS) are used to identify fake drugs and confirm the authenticity of products. The objective of this study is to identify factors influencing the use of MAS in the identification of fake antimalarial drugs.

Methods: This was a descriptive cross-sectional study of 350 people. Respondents were chosen using the multistage sampling method and the research instrument was a semi-structured interviewer-administered pre-tested questionnaire. Data was analyzed using SPSS software version 23, with the level of significance set at 5%.

Results: The study found that 38.6% of respondents were of aged 38 years and above, 76% were females, 67.4% were of the Yoruba ethnic group, 72% were married, 35.1% had a tertiary education, and 55.1% were traders. Only 41% and 43.1%, respectively, were aware of the anti-fake and substandard antimalarial drug campaigns and the use of mobile authentication services in identifying fake and substandard antimalarial

drugs. Less than half of respondents (41%) had good knowledge of the mode of operation and benefits of the services, and just 20% were currently using the services. Religion, education, occupation, residential area and knowledge were determinants of current utilization ($P < 0.05$).

Conclusion: Consumers in Lagos State are unaware of the use of MAS to detect counterfeit anti-malarial drugs. Health promotion programs are essential to promote its usage, most especially among those with low levels of education.

Keywords: Anti-malarial drugs; fake and substandard; Mobile Authentication Services.

INTRODUCTION

Malaria has been recognized as a serious health problem since ancient times.¹ This makes malaria medications to be in high demand, and they have unfortunately become a target for pharmaceutical counterfeiting. Chloroquine was the preferred drug of choice for malaria therapy two decades ago, but its effectiveness was reduced by the emergence of malaria parasite resistance.² The last decade saw the introduction of newer and more potent Artemisinin-Based Combination Therapy (ACT). Access to "safe, effective,

quality, and affordable essential medicines" has been included as Goal No. 3.8 in the United Nations Sustainable Development Goals, but the threat of substandard and counterfeit medicines makes this appear unattainable anytime soon.^{3,4} Substandard and counterfeit medicines are a major public health threat and its defined as products that are deliberately and fraudulently produced and/or mislabeled for identity and/or source to appear to be a genuine product.⁵

Almost all medicines are counterfeited, but antimalarials, particularly artemisinin derivatives, are especially vulnerable, with disastrous consequences in terms of endangering patients' health and resulting in unnecessary morbidity and mortality.^{5,6,7,8} Treatment failure, disabilities and loss of confidence in healthcare are not unexcepted from the consequences.⁹ While quantifying the scope of the problem is difficult, research has estimated that counterfeit drugs for pneumonia and malaria kill approximately 250,000 children each year.¹⁰ Furthermore, it is estimated that 116,000 people die each year in Sub-Saharan Africa as a result of counterfeit malaria drugs.¹¹ In other words, fraudulent drugs are responsible for more than a quarter of all malaria deaths.¹² Although the estimated prevalence of substandard and falsified medicines appears to have decreased in Nigeria over the years, from 67% in 2001 to 5% in 2012, the country is still reported to have one of the highest incidences in Sub-Saharan Africa.¹³

To combat the counterfeiting of medicines, the Mobile Authentication Service (MAS) is one of the technological measures introduced by the National Agency for Food and Drug Administration and Control (NAFDAC).^{14,15} The Mobile Authentication Service (MAS) is an attempt to turn the mobile phone, which is presumably in the hands of the majority of Nigerians, into a weapon for waging the country's war on fake and substandard pharmaceutical products.¹⁶ MAS verifies the authenticity of pharmaceutical product sources and supply chains, preventing counterfeiters from infiltrating.¹⁷ It helps customers to authenticate their medications at the point of

purchase, as one of several approaches to the eradication of fake/substandard pharmaceuticals. The SMS is free, and buyers or consumers are not required to pay any fees to use this facility via their mobile phones at the point of purchase, nor are they required to register to access this service. Nigeria is the first country where MAS has been widely used for pharmaceutical security.¹⁸ Although MAS does not provide information about these medicines' biopharmaceutical properties, it confirms the authenticity of the product source and supply chain, preventing counterfeiters from infiltrating.¹⁷ If used correctly, this advantage can be very beneficial for artemisinin-combination therapy medicines.

However, despite strong policies and substantial resources committed to the design, development, and implementation of the Mobile Authentication device to help eradicate counterfeit drugs, many Nigerians are not taking advantage of the services. This makes the country to keep facing overwhelming drug counterfeit problems.¹⁹ According to empirical evidence, the vast majority of drug buyers/consumers do not bother to check whether the drugs they purchase have an authentication scratch-off panel, while those who buy drugs with an authentication scratch-off panel do not bother to scratch and authenticate the drugs before payment.^{15,20} According to studies, perceived reliability and awareness, access to appropriate phone technology, and good network services required to run the MAS scheme are some of the factors that can influence MAS usage among the general public.^{1,12} This study was therefore designed to assess the level of awareness, extent of utilization and degree of acceptance of MAS among residents of Lagos State. The study will also make suggestions and recommendations on the general public's current use of MAS.

METHODS

Study Area

This research was conducted in Lagos State, which is located in Nigeria's South Western

geopolitical zone. Lagos State is arguably the country's most economically important state, with the largest urban area, a major financial center, and the fifth largest economy in Africa if it were a country. The state is loosely classified into two geographical areas, the Island and the Mainland and it has 16 LGAs.

Study Design and Population

This was a descriptive cross-sectional study carried out among consumers who purchased antimalarial drugs in pharmacy/patent medicine store outlets in Lagos. Only consumers within the age range 15-49 years coming to buy antimalaria drugs in registered Pharmaceutical outlets were included in the study while consumers of drugs that were less than 15 years of age and those who purchase drugs outside antimalarial drugs were excluded.

Sample Size and Sampling Technique

The estimated sample size of the study was 350, determined using Leslie Fisher's formula. $N = Z^2 pq / d^2$ where z is the standard normal deviation at a 95% confidence interval (1.96), N is the sample size, and p is the previously estimated proportion of clients using MAS (26.1%).¹⁷ q is $1-p$ while d is the error margin which is 0.05. We arrived at a sample size of 296 which was increased to 325 with the addition of 10% non-response. However, respondents were given a total of 350 questionnaires.

A multistage sampling technique was used to select respondents. 10 outlets were chosen from the list of all registered Community pharmacies/Patent medicine vendors/Hospital Pharmacy outlets in Lagos state. The desired sample size was then selected using stratified random sampling with a proportional allocation of respondents from the selected outlets. This was done by dividing the number of attendees in each outlet by the total number of attendees across the 10 selected outlets and multiplying this by the sample size. Thereafter, the respondents were selected by systematic sampling, (with the sampling fraction determined based on the suggestion of

attendees in the selected outlet and the number of respondents to be selected). The first respondent was selected by simple random technique and subsequent respondents were selected using sampling fraction.

Instruments of the study

Pretested, semi-structured questionnaires were used to measure the awareness and previous usage of MAS as an instrument for detecting fake antimalarial drugs. This was developed based on the review of the previous literature. The questionnaire was made up of questions on socio-demographic status, awareness of MAS in detecting fake antimalarial drugs, and previous usage of MAS in detecting fake antimalarial drugs. The questionnaires were pretested among consumers in Egbedore LGA, Osun State (outside the study area).

Data Analysis

Variable measurement

The outcome/dependent variable is the usage of MAS with options of yes or no. Independent variables include sociodemographic statuses such as age, sex, religion, ethnicity, marital status, level of education, occupation, and residential area. In addition, knowledge of the benefits of usage of MAS and the dangers of not using MAS categorized into good or poor knowledge depending on whether score was above or below the mean score.

The questionnaires were sorted, and the data obtained were entered into the computer. This was analyzed using Statistical Package for Social Sciences (SPSS) version 23. Descriptive statistics using mean and standard deviation were used for continuous variables while categorical variables such as age, sex, religion, ethnicity, marital status, level of education, occupation, residential area, awareness, and knowledge questions were described using a frequency distribution table. Cross-tabulation was done between the dependent variable (usage of MAS) and independent variables (socio-demographic status and categorized knowledge) using chi-square as the choice of

test statistics. The level of significance is set with a p-value less than 0.05. The strength of the association between these two variables was assessed using crude and adjusted Odds ratio with a 95% confidence interval.

Ethical consideration

The letter of permission to conduct the study was obtained from the Ethical committee, College of Health Sciences, Osun State University. In addition, permission was also taken from the Chairman of the Patent Medicine Vendor as well as the Community Pharmacy Association in Lagos State before carrying out the study. Verbal consent was obtained from each respondent after explaining the objectives of the study to them.

RESULTS

Respondents whose age was greater than 38 years constituted the highest proportion (38.6%); two-thirds of the respondents were male and Yoruba (64.6% and 67.4% respectively). Most of the respondents practice Christianity (76%) while 72% were married. Respondents with secondary education have the highest proportion (30.6%), trading is the occupation of more than half of them (55.1%) while almost all the respondents (91.7%) were residents of the urban area (Table 1).

More than half of the respondents were not aware of the campaign against fake and substandard antimalarial drugs nor were they aware of mobile authentication services for identifying fake and substandard antimalarial drugs (57.7%, 56.9% respectively). Television was the source of information for 12.3% of those that were aware of fake and substandard antimalarial drugs and 21.7% of those that were aware of mobile authentication services (Table 2). The benefits of using MAS and the dangers that can arise from not using it are unknown to two-thirds of the respondents (Table 3). Therefore, as shown by the summarized knowledge in Figure 1, more than half of the respondents have poor knowledge of Mobile Authentication Services (59%). Most of the

respondents (77.5%) have never used mobile authentication services before in the identification of fake antimalarial and 80% are not using it currently. The reason for non-usage in half of the respondents (50.3%) was because they don't know how to use it. Mobile network issues were the most perceived constraints to non-usage of the services among the respondents as indicated in Table 4.

Table 1: Socio-demographic characteristics (N 350)

Variable	Frequency
Age	
18-27years	87(24.9%)
28-37years	128(36.5%)
≥ 38years	135(38.6%)
Gender	
Male	226(64.6%)
Female	124(35.4%)
Ethnicity	
Yoruba	236(67.4%)
Igbo	99(28.3%)
Hausa	15(4.3%)
Religion	
Christianity	266(76.0%)
Islamic	80(22.9%)
Traditional	4 (1.1%)
Marital Status	
Married	252(72.0%)
Single	94(26.9%)
Widower	4(1.1%)
Level of education	
None	40(11.4%)
Primary	80(22.9%)
Secondary	107(30.6%)
Tertiary	123(35.1%)
Occupation	
Trading	193(55.1%)
Artisan	76(21.7%)
Civil servant	14(4.0%)
Professionals	65(18.6%)
Student	2(0.6%)
Residential area	
Rural	29(8.3%)
Urban	321(91.7%)

Table 2: Consumers' level of awareness of Mobile Authentication Services (MAS) in identifying fake and substandard antimalarial drugs

Variable	Frequency
Are you aware of the campaign against fake and substandard antimalarial drugs	
Yes	148(42.3%)
If yes, what is your source of information	
Social media	20(5.7%)
Radio	36(10.3%)
Television	43(12.3%)
Internet	9(2.6%)
Friends	9(2.6%)
Colleague	2(0.6%)
Seminar and advert	2(0.6%)
I don't know	8(2.3%)
Newspaper	10(2.9%)
I don't know	8(2.3%)
Not Applicable	202(57.7%)
Are you aware of mobile authentication services in identifying fake and substandard antimalarial drugs	
Yes	151(43.1%)
No	199(56.9%)
If yes, what is your source of information	
Friend	22(6.3%)
Television	76(21.7%)
Radio	34(9.7%)
Newspaper	18(5.1%)
I don't know	2(0.6%)
Found on the pack of the drug	1(0.3%)
Not Applicable	197(56.3%)

There is an association between socio-demographic status (religion and residential area) and current usage of mobile authentication services with a p-value of <0.001 for religion, educational level, and occupation and a p-value of 0.042 for residential area (Table 5). Furthermore, a statistically significant association exists between the knowledge of respondents on mobile authentication services and their utilization of the service ($p < 0.001$). Respondents with poor knowledge are 166 times less likely to use mobile authentication services compared to those with good

knowledge ($P < 0.05$, AOR-0.006, 95% CI 0.001-0.048) (Table 6)

DISCUSSION

This study investigated consumer awareness and described respondents' use of mobile authentication services in identifying counterfeit and substandard anti-malarial drugs as well as factors influencing the usage of MAS. Findings from the study revealed that there is low level of awareness of the NAFDAC Mobile Authentication Service (MAS) as well as the benefits of using MAS for identifying fake and substandard anti-malarial drugs and dangers of not using the device which is similar to the findings of studies conducted among consumers in Southeast Nigeria by Chinedu-okeke and Wogu, Omaka-amari, Ugwu, Ugwuoke, & Agu.^{1,21} This is in contrast to another study conducted in the same region of the country where the level of awareness was above average.⁹

Further analysis of findings showed that majority of respondents in this study's population do not know how to use the mobile authentication service, and the most perceived constraints to non-usage of the MAS among those who do are network failure and ignorance of how to effectively use the device. It was evident in a previous study that people's inability to obtain efficient phone technology and poor network services contributed to the MAS scheme's inability to reduce or eliminate fake/counterfeit drug production, distribution, and consumption.¹ Therefore, the issue of technical support needs to be addressed. MAS being a tool that relies on technology, there is a need to collaborate with telecommunication providers, not only for free MAS messaging but also to ensure that network challenges are minimized to the greatest extent possible.

Furthermore, the overall knowledge of the respondents demonstrates that more than half of the respondents are unfamiliar with the services. As a result, this can be concluded to be a dominant factor contributing to poor

Table 3: Knowledge of Benefits of using Mobile Authentication Services and its dangers

Variable	Frequency
Benefits of using Mobile Authentication Services	
It is convenient	17(4.9%)
It is easy to identify fake and substandard drugs	77(22.0%)
It is genuine	17(4.9%)
It aids to promote health and prevent danger	12(3.4%)
To safe life	6(1.7%)
I don't know	221(63.1%)
Dangers of not using Mobile Authentication Services	
Fake substandard drugs cannot be detected	11(3.1%)
Risk of consuming fake and substandard drugs	43(12.3%)
Risk of loss of life	38(10.9%)
It encourages an increase in fake drugs production	15(4.3%)
Results in health complication	25(7.1%)
I don't know	218(62.3%)

Table 4: Ever users and current users of Mobile Authentication services among respondents

Variable	Frequency
Have you ever used NAFDAC mobile authentication services before in the identification of fake antimalarial drugs	
Yes	79(22.5%)
No	271(77.5%)
Are you currently using the NAFDAC mobile authentication services in the identification of fake antimalarial drugs	
Yes	70(20%)
No	280(80%)
Reason for non-usage of the mobile authentication services	
No time to use it	66(18.9%)
The service is not effective	36(10.3%)
I don't know how to use	176(50.3%)
A reliable source of drug purchase	4(1.1%)
Not Applicable	68 (19.4%)
Perceived Constraints to non-usage of mobile authentication services among respondents	
Mobile Network issues	58(16.6%)
Ignorance on part of users	42(12%)
Language barrier	34(9.7%)
Delay of message alert	34(9.7%)
Time constrains	44(12.6%)
Ignorance	54(15.4%)
I don't know	84 (24.0%)

Table 5: Association between socio-demographic status, knowledge, and usage of MAS

Variable	Yes (%)	No (%)	χ^2	Df	P-value
Age (in categories)					
18-27years	12(13.8)	75(86.2)	3.78	2	0.151
28-37years	25(19.5)	103(80.5)			
Greater than 38	33(24.4)	102(75.6)			
Sex					
Male	48(21.2)	178(78.8)	0.61	1	0.434
Female	22(17.7)	102(82.3)			
Ethnicity					
Yoruba	52(22.0)	184(78)	3.15	2	0.207
Igbo	14(14.1)	85(85.9)			
Hausa	4(26.7)	11(73.3)			
Religion					
Christianity	53(19.9)	213(80.1)	1.08	2	0.001
Islam	17(21.2)	63(78.8)			
Traditional	0(0)	4(100)			
Marital Status					
Married	56(22.2)	196(77.8)	3.31	2	0.191
Single	14(14.9)	80(85.1)			
Widower	0(0)	4(100)			
Education Level					
None	1(2.5)	39(97.5)	69.15	3	0.001
Primary	4(5)	76(95)			
Secondary	11(10.3)	96(89.7)			
Tertiary	54(43.9)	69(56.1)			
Occupation					
Trading	18(9.3)	175(90.7)	41.66	4	0.001
Artisan	18(23.7)	58(76.3)			
Professional	29(44.6)	36(55.4)			
Civil servant	5(35.7)	9(64.3)			
Student	0(0)	2(100)			
Residential Area					
Rural	10(34.5)	19(65.5)	4.15	1	0.042
Urban	60(18.7)	261(81.3)			
Good knowledge	69(46)	81(54)	1.11	1	0.001
Poor knowledge	1(0.5)	199(99.5)			

Table 6: Predictors of current usage of Mobile Authentication Services

Variable	P value	OR (95% CI)	P value	AOR(95% CI)
Occupation				
Professionals	<0.01	4.93(2.79-6.69)	0.43	1.3(0.67-2.51)
Education				
Educated	0.018	11.16(1.51-82.75)	0.32	0.32(0.03-3.02)
Categorized knowledge				
Poor knowledge	<0.01	0.005(0.001-0.39)	< 0.01	0.006(0.001-0.048)
Good knowledge				

service utilization. The extent of utilization was greatest among those with the highest level of education and lowest among those who had no formal education, this is consistent with the findings of Justine & Ilomuanya who discovered that respondents with tertiary education had the highest level of awareness and utilization of MAS (85%).¹⁷

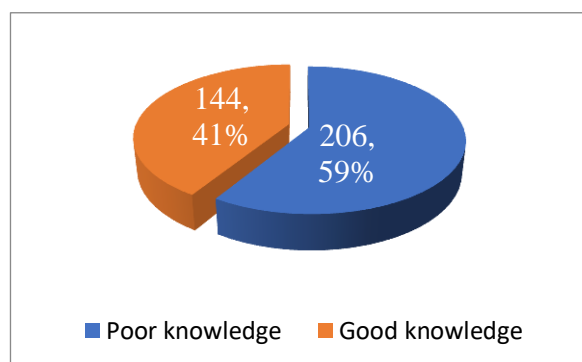


Figure 1: Summarized knowledge of the use of mobile authentication service (MAS) in identifying fake and substandard antimalarial drugs

Furthermore, findings from the bivariate analysis observed a statistically significant association between the usage of mobile authentication services and some socio-demographic status of the respondents. Even though the level of utilization is low among the respondents, Christians, respondents with tertiary education, civil servant, and respondents in rural areas utilize the service more than their counterparts. This could be an indication that the service's communication, either in terms of content or channels used, is being withheld from a segment of society; another study conducted in Nigeria gave a similar view.¹⁷ These findings concur with the findings of other studies that stated that low population mobilization, and inadequate network services are part of the factors that result in low awareness and service utilization among the respondents.^{9,21} This was further evidenced in this study by the statistically significant relationship between knowledge of mobile authentication services and current usage of the services as respondents with

poor knowledge were 166 times less likely to utilize MAS devices compared to their counterparts.

As mentioned in another study, awareness of the services alone is not enough to increase the usage of MAS by the populace.¹⁶ Therefore, findings from this study recommends that appropriate health education and public sensitization be implemented using Information, Education and Communication techniques such as newspapers, magazines, broadcast radio, and television to educate the public on the usage of the mobile authentication service as well as the benefits of using the device. Also, there is a need to implement practical approaches such as NAFDAC's continuous collaboration with mobile network providers for free MAS messages and minimizing network challenges, as well as continuous involvement of consumers in pharmaceutical outlets in mobilization campaigns and as ambassadors in disseminating information within the community on MAS services. This will encourage the populace to adopt and use MAS technology in order to eliminate, if not completely eradicate, fake and counterfeit drugs in Nigeria.

The limitation of this study is that it is a cross-sectional study and cannot be used to analyze respondent's behavioral change over time.

CONCLUSION

This paper evaluated level of awareness and factors influencing usage of MAS among Lagos residents. This paper concludes that less than half of the respondents had good knowledge of mode of operation, benefits, timing of mobile authentication services and dangers of not using mobile authentication services in identifying fake antimalarial drugs, and an association was established between knowledge and service utilization.

As a result, while service utilization is low, education is critical to increasing the use of mobile authentication services. Other factors

discovered to influence service utilization include religion, level of education, occupation, and area of residents. Therefore, increasing the utilization of MAS requires continuous awareness creation and Health promotion programs on MAS, mode of operation, benefits of usage across population regardless of individual's socio-demographic characteristics most especially among those with low levels of education.

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