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ORIGINAL RESEARCH

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Evaluation of Counterfeit Antimalarial Drug Awareness and Knowledge Among Pharmacy Attendants in Nairobi County, Kenya

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ABSTRACT

Malaria presents a significant health challenge in sub-Saharan Africa, leading to an increased demand for antimalarial drugs. However, the global prevalence of counterfeit drugs, estimated at 10%, jeopardizes treatment efficacy, resulting in an annual economic loss of $75 billion. In Kenya, the accessibility of antimalarials, particularly through pharmacies, exacerbates this issue. This study sought to address knowledge gaps on counterfeit antimalarials among pharmacy attendants in Nairobi County. Utilizing a cross-sectional descriptive survey, the research evaluated awareness levels of counterfeit antimalarial drugs among pharmacy attendants. The study involved five subsections, focusing on pharmacy professionals engaged in antimalarial sales, with a sample size of 251 determined using Cochran's formula. Data collection methods included questionnaires, and observation checklist. Instrument validity was ensured through a pre-test analysis, and reliability was assessed via training and a test-retest approach. Data analysis, performed using Microsoft Excel and SPSS, incorporates ANOVA at a 95% significance level. Surveying 251 pharmacy attendants in Nairobi revealed a slightly higher distribution of males (52.2%) than females (47.8%), primarily aged 18-24 (51%), holding TVET qualifications (60.2%), with an average work experience of four years (30.7%). Community pharmacies dominated (61.8%), and pharmaceutical technologists constitute the most prevalent professionals (29.5%). Artemether-Lumefantrine is the preferred antimalarial (36.7%). Concerning awareness of counterfeit drugs, 39.8% rely on the Pharmacy and Poisons Board, with 72.9% knowledgeable about counterfeit antimalarial effects. The study identifies correlations between knowledge levels and the color and odor of antimalarial drugs. The regression model (R^2=0.093, F (3, 247) =8.422, p<0.001) signifies the predictive efficacy of drug characteristics on knowledge, with color and odor emerging as robust predictors. Despite commendable knowledge, there exists a perception gap among pharmacy attendants regarding counterfeit antimalarial drug campaigns and awareness training. Addressing this gap is crucial to preventing an increased distribution of counterfeit drugs in the sector.

Keywords: *Antimalarials, Pharmacy Attendants, Counterfeit Drugs, Awareness Level, Knowledge Level*

INTRODUCTION

Malaria remains a significant global health challenge, particularly in sub-Saharan Africa, where approximately 92% of all malaria cases and 93% of malaria-related deaths occur (World Health Organization [WHO], 2023). The burden of this mosquito-borne disease has led to an increased demand for antimalarial drugs in endemic regions. However, the availability of counterfeit antimalarial drugs poses a critical threat to malaria control efforts, compromising the efficacy of treatment and exacerbating the public health impact. Recent reports suggest a rising prevalence of counterfeit drugs in the pharmaceutical market, with antimalarials being one of the most targeted categories (Ziavrou et al., 2022; Evans et al., 2019). The World Health Organization estimates that up to 10% of drugs available in low and middle-income countries are counterfeit, leading to an annual economic loss of approximately $75 billion globally (WHO, 2018). In Kenya, the situation is exacerbated by the widespread availability and accessibility of antimalarial drugs (Girma et al., 2022) through various retail outlets, including pharmacies, where a significant proportion of the population seeks treatment.

This study focused on assessing the awareness and knowledge of counterfeit antimalarial drugs among pharmacy attendants within Nairobi, the capital city of Kenya. Pharmacy attendants play a crucial role in the healthcare system as frontline providers of medications, making their awareness and understanding of counterfeit drugs pivotal in ensuring the delivery of safe and effective antimalarial treatments (Adigwe, 2023). The proliferation of counterfeit antimalarial drugs poses multifaceted challenges. Firstly, it jeopardizes patient health by exposing individuals to substandard or ineffective medications, leading to treatment failure and the development of drug-resistant strains of malaria parasites (Plowe, 2022). Secondly, the economic impact on individuals and healthcare systems is substantial, as patients invest in medications that provide little or no therapeutic benefit. Thirdly, the rise of counterfeit drugs erodes public trust in healthcare systems, undermining efforts to promote and sustain effective malaria control programs. Despite the gravity of the issue, there is a paucity of research focusing on the awareness and knowledge of counterfeit antimalarial drugs among pharmacy attendants in the Kenyan context. This study aims to bridge this gap by systematically investigating the current state of awareness and knowledge among pharmacy attendants in the capital city.

METHODOLOGY

Study Design

This study employed a cross-sectional descriptive survey according to Aggarwal & Ranganathan (2019). This design involves the description of data and testing the hypothesis. The researcher chose the design because data was to be gathered through observation and use of a questionnaire to give a snapshot of current status.

Study Location

This study was conducted in Nairobi City County located between 1.3107° S, 36.8250° E. Being a low malaria region, the location of the study was selected depending on socio-economic status and poverty levels and malarial disease treatment culture. This resulted in conducting of the survey in five sub-sections, indicated as Kayole, Kibra, Makadara, Kasarani and Nairobi CBD.

Target Population

Target population for this study comprised pharmacy attendants authorized to sell, or those who assist in selling of antimalarial drugs within pharmacy outlets in Nairobi county. This included pharmacists, pharmaceutical technologists, clinical officers, and biomedical scientists etc.

Sample Size Determination

A sample size is the proportion of the entire population that is studied. Due to time constraints, the whole sampling area cannot be studied and therefore, a sample size is to be determined to give a smaller portion that can be easily studied to represent the larger size (Bujang & Baharun, (2016). Therefore, the sample size of this study was determined using the Cochran's formula, which is represented as;

The Cochran formula:

$n= (Z^2 \times pq)/e^2$

Where:

- e is the desired level of precision (i.e., the margin of error) (0.5),
- p is the (estimated) proportion of the population which has the attribute in question,
- q is 1 – p.

The z-value is found in a Z table (1.96)

Therefore, $n=Z^2 \times p\ (1-p)/e^2$

Therefore, based on previous study by Chemiati (2020) carried out in Nairobi on counterfeit drugs, a sample size of 329 was used, which had P= 79.4% counterfeit drugs. Therefore, using the P=79.4% as the proportion, n will be.

$$n = \frac{1.96^2 \times 0.794(1-0.794)}{0.05^2}$$

$$n = 251$$

Sampling Techniques

Sampling process involved the presentation of questionnaires to the pharmacy attendants in the selected region. Research assistants were trained on sample collection and how to guide the respondents on filling the form without influencing their decisions.

Research Instrumentation

Primary data was collected by use of observation and questionnaires, which have semi-structured questions, where the respondents were required to fill the questionnaire. Questions relating to sociodemographic distribution and antimalarial drugs demand and consumption were featured in the study. The raw data was processed using Microsoft Excel (2019) software and coded.

Validity and Reliability of Research Instruments

Validation of the research instrument was affirmed by use of a well-structured questionnaire. A pre-test study was conducted to check on the questionnaire's precision so that the received feedback was accurate and true. Reliability was guaranteed through research assistants training of the tools and test- retest approach was used to assess reliability of questions using Pearson's product moment correlation coefficient.

Pilot study

Pilot study in this case involved a survey in two regions of Nairobi City County, where the questionnaires was presented to the respondents and evaluated for any uncertainties or discrepancies that will impact the main study. Random samples will be collected for validity purposes.

Data Collection Procedures

The sampling team were trained on the sampling criteria and the checklist given to collect samples accordingly. The well-structured questionnaires were given to the pharmaceutical professionals, in every 3rd pharmaceutical retail to address the knowledge of antimalarial consumption in the region and their knowledge on counterfeit drugs. Measurement of knowledge was done using Likert scale, where respondents who selected all the identification features for antimalarials were awarded a scale of 1 (Very knowledgeable), those who selected only 3-4 features were awarded a scale of 2 (Knowledgeable) while those who identified only 1 feature and those who did not identify any at all were awarded a scale of 3 (Not knowledgeable).

Data Analysis Techniques

This involved the process of transforming, cleaning, interpreting and presentation of raw data into most useful information that can be well understood. The data collected were processed using Microsoft Excel (2019) and coded. The coded data were then processed using the SPSS statistical tool, where the probability, correlation, regression and variance was analyzed using ANOVA. The data collected were analyzed under a significance level of 95% or p-value of 0.05.

Ethical Considerations

Permission to conduct this study was obtained from the school of public health, Kenyatta University. Ethical approval was sought from the Kenyatta University ethics review committee. Permission to collect data was also obtained from the National Commission for Technology and Innovation (NACOSTI). Participation in this study was entirely voluntary. Information pertaining to what the research entails was made provided for all participants prior to data collection. Informed consent was then obtained from the participants. Collected data was stored in a password protected device accessible only by the lead researcher.

RESULTS

Subject Demographics

There was a slight difference in gender distribution of male (52.2%) and female (47.8%). Most of the pharmacy attendants had age distribution of 15-24% while others were distributed at 25-34 (26.7%), 35-44 (9.2%), 45-54 (2.4%), 55-64 (8.4%) and above 65% (2.4%). Most of them were TVET graduates (60.2%), University (28.7%) and high school certificate holders (11.2%). Furthermore, most of the pharmacy attendants had a work experience of 4 years (30.7%). Others had 1 Year (14.7%), 2 Years (20.3%), 3 years (13.5%), 5 years (16.7%) and over 5 years (4%). In the study, most of the pharmacy categories involved were 61.8% community pharmacy, 20.3% hospital pharmacy while 17.9% were clinical pharmacy. In addition, most of the attendants were pharmaceutical technologists (29.5), clinical medicine (24.3%), business related professions (15.9%), secondary school leavers (10.4%), Bachelors of pharmacy (9.6%), and clinical laboratory sciences (2.8%).

Table 1:

Sociodemographic Distribution of Pharmacy Attendants in Nairobi City County

Gender	Frequency (n=251)	Percent (%)
Male	131	52.2
Female	120	47.8
Age Distribution		
18-24	128	51.0
25-34	67	26.7
35-44	23	9.2
45-54	6	2.4
55-64	21	8.4
65	6	2.4
Education Level		
High School	28	11.2
TVET	151	60.2
University	72	28.7
Work Experience		
1 Year	37	14.7
2 Years	51	20.3
3 Years	34	13.5
4 Years	77	30.7
5 Years	42	16.7
> 5 years	10	4.0
Pharmacy Category		
Hospital Pharmacy	51	20.3
Clinical Pharmacy	45	17.9
Community Pharmacy	155	61.8
Profession		
Biomedical Science	19	7.6
Business Related	40	15.9
Secondary Education	26	10.4
Clinical Medicine	61	24.3
Clinical Laboratory Sciences	7	2.8
Pharmaceutical Technologist	74	29.5
Bachelors of Pharmacy	24	9.6

Characteristics of Antimalarials Sold in Nairobi

The respondents also indicated that the available antimalarial brands in Nairobi City County are Malarone (3.2%), Coartem /Artemether Limefantrin (33.1%), Fansidar (24.7%), Malarone paedriatic (7.6%), Plaquenil (4.8%), Lariam (6.8%), Qualaquin (4.8%), Aralen phosphate (2.4%), Aralen (4.8%), Doryx (3.2% and Monodox (4.8%). However, the most preferred antimalarial drugs in Nairobi City County is Artemether Lumefantrine (36.7%), Doxycycline (23.5%), Mefloquine Hydrochloride (12.0%), Hydrochloroquine (9.2%), Pyrimethamine (4.0%), Atovaquone-proguanil (4.0%), Quinine (3.6%), Chloroquine (2.4%), Artemisinin Combination Therapy (ACT) (2.4%), and Sulfadoxine-pyrimethamine (SP) (2.4%).

Table 2:

Brands and Preferences of Antimalarials Sold in Nairobi

Antimalarial Brands Available	Frequency	Percent (%)
Malarone (atovaquone/ proguanil)	8	3.2
Coartem (Artemether/ Lumefantrine)	83	33.1
Fansidar (Pyrimethamine/ sulfadoxine)	62	24.7
"Malarone Paedriatic (atovaquone/proguanil) "	19	7.6
Plaquenil (Hydroxychloroquine)	12	4.8
"Lariam (Mefloquine) "	17	6.8
"Qualaquin (quinine) "	12	4.8
Aralen Phosphate (Chloroquine)	6	2.4
Aralen (Chloroquine)	12	4.8
Doryx (Doxycycline)	8	3.2
Monodox (Doxycycline)	12	4.8
Most Preferred Antimalarial Drugs		
Atovaquone-proguanil	10	4.0
Doxycycline	59	23.5
Mefloquine hydrochloride	30	12.0
Quinine	9	3.6
Hydroxychloroquine	23	9.2
Artemether Lumefantrine (AL)	92	36.7
Chloroquine	6	2.4
Artemisinin Combination Therapy (ACT)	6	2.4
Sulfadoxine-pyrimethamine (SP)	6	2.4
Pyrimethamine	10	4.0

Awareness of Pharmacy Attendants on Counterfeit Antimalarial Drugs

From the study, 39.8% of the participants cited pharmacy and poisons board as their source of information concerning counterfeit antimalarial drugs. Others cited social media (19.1%), Newspapers and magazines (19.1%), Healthcare facility (12.4)

and peer to peer (9.6%). However, based on their opinion on whom should be given awareness on counterfeit antimalarial drugs, many cited public (35.9%), pharmacists (31.9%), Pharmaceutical companies (19.1%), medical physicians (6.0%), Government (5.6%) and to everyone (1.6%). Based on the opinion on how to improve the counterfeit antimalarial awareness, 23.5% cited billboards, social media (24.3%), Television (16.3%), radio stations (12.4%), newspapers (8.4%), workshops (4.8%), leaflets (4.4%), peer to peer (2.4%) and all methods (3.6%). Furthermore, the respondents stated that responsibility for counterfeit campaign should be given to the public health (Ministry of health) (27.1%), pharmacists (21.9%), media (15.5%), pharmaceutical companies (14.3%), medical practitioners (13.1%), while others cited to all (8%).

In addition, 72.9% of the participants were knowledgeable about the effects of counterfeit antimalarial drugs, 21.5% were very knowledgeable while 5.6% were not knowledgeable based on their responses. The participants were also evaluated on their ability to identify features of counterfeit antimalarial drugs, where 29.5% were familiar with packaging materials, expiry dates and label/ legitimacy, 27.1% were familiar with size, shape and color, 17.9% were familiar with odor, color and shape, 10.0% were familiar with shape, size and color while 15.5% were familiar with all the identification features. The participants also cited that the regulatory authority visit their retails regularly (44.6%), once a year (26.3%), twice a year (22.3%) and others cited no visitation (6.8%). However, 46.6% think that the regulatory authority is moderately efficient in their function, 35.1% think that they are less efficient while 18.3% think that they are highly efficient in their function.

Table 3:

Sources of Information of Counterfeit Antimalarial Drugs, Counterfeit Awareness, Responsibility On Counterfeit Campaign, Knowledge of Its Effects and Distinguishing Features

What is Your Source of Information on Counterfeits Antimalarial Drugs?	Frequency (n=251)	Percent (%)
Pharmacy and Poisons board	100	39.8
Healthcare Facility	31	12.4
Social Media	48	19.1
Newspapers and magazines	48	19.1
Peer to peer	24	9.6
In Your Opinion, Who Should be Given Awareness on Counterfeit Antimalarial Drugs?		
Pharmacist	80	31.9
Public	90	35.9
Pharmaceutical Company	48	19.1
Government	14	5.6
Medical Physicians	15	6.0
All of the Above	4	1.6
In your opinion, how can awareness on Counterfeits Antimalarials be improved?		
Social Media	61	24.3
Newspapers	21	8.4
Television	41	16.3
Billboards	59	23.5
Leaflets	11	4.4
Peer to Peer	6	2.4
Workshops	12	4.8
Radio stations	31	12.4
All of the above	9	3.6
In your opinion, who should be responsible for counterfeit antimalarials campaign?		
Public Health (Ministry of Health)	68	27.1
Pharmacists	55	21.9

Pharmaceutical Companies	36	14.3
Media	39	15.5
Medical Practitioners	33	13.1
All of the Above	20	8.0
How knowledgeable are you on the effects of counterfeit drugs in the population?		
Not Knowledgeable	14	5.6
Knowledgeable	183	72.9
Very Knowledgeable	54	21.5
What Antimalarial Distinguishing features are you familiar with?		
Packaging Material, Expiry dates, Label/Legitimacy	74	29.5
Size, Shape, color, Odor	68	27.1
Color	45	17.9
Shape	25	10.0
All of the above	39	15.5

Correlation Between Knowledge Level and Medicine Factors and Education Level of Pharmacy Attendants

i. Color of the Antimalarial Drugs

Chi-Square test of independence was done to determine the relationship between color of counterfeit antimalarial drugs and knowledge. The test was computed at 0.05 alpha. The X^2-test results were statistically significant, X^2 (1, N=251) =30.500, P<0.001. Continuous correction test (1, N=251) = 28.926, p<.001indicates that the variables are normally distributed. On the other hand, the Fisher's exact test (1, N=251), p=<.001 indicates a significant relationship between level of knowledge and color of antimalarial drugs. The likelihood ratio (1, N=251) = 48.450, p=<.001 significantly supports alternate hypothesis, therefore, there is a significant relationship between the two variables. Linear by linear association (1, N=251) = 30.460, p=<.001 indicates a linear relationship between knowledge and color of the antimalarial drugs.

Table 4:

Relationship Between Color of Antimalarial Drug and Knowledge Level of Pharmacy Attendants on Counterfeit Antimalarials

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	30.500[a]	1	.000		
Continuity Correction[b]	28.926	1	.000		
Likelihood Ratio	48.450	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	30.460	1	.000		
N of Valid Cases	753				

a. *0 cells (0.0%) have expected count less than 5. The minimum expected count is 19.12.*

b. *Computed only for a 2x2 table*

ii. Shape of Antimalarial Drugs

Chi-Square test of independence to determine the relationship between shape of counterfeit antimalarial drugs and knowledge at 0.05 alpha was also performed. The X^2-test results were statistically not significant, X^2 (1, N=251) =0.905, P=0.341. Continuous correction test (1, N=251) = 0.749, p<0.387 indicates that the variables are not normally distributed. The Fisher's exact test (1, N=251), p=0.344, indicates no significant relationship between level of knowledge and shape of antimalarial drugs. The likelihood ratio (1, N=251) = 0.898, p=0.343 significantly supports null hypothesis, therefore, there is no significant relationship between the two

variables. Linear by linear association (1, N=251) = 0.904, p=0.342 indicates no linear relationship between knowledge and shape of the antimalarial drugs.

Table 5:

Relationship Between Shape of Antimalarial Drug and Knowledge Level of Pharmacy Attendants on Counterfeit Antimalarials

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.905[a]	1	.341		
Continuity Correction[b]	.749	1	.387		
Likelihood Ratio	.898	1	.343		
Fisher's Exact Test				.344	.193
Linear-by-Linear Association	.904	1	.342		
N of Valid Cases	753				

a. *0 cells (0.0%) have expected count less than 5. The minimum expected count is 69.48.*

b. *Computed only for a 2x2 table*

iii. Odor of Antimalarial Drugs

Similarly, Chi-Square test of independence to determine the relationship between odor of counterfeit antimalarial drugs and knowledge was performed at 0.05 alpha. The X^2-test results were statistically significant, X^2 (1, N=251) =41.300, P<0.001. Continuous correction test (1, N=251) = 39.862, p<.001indicates that the variables are normally distributed. The Fisher's exact test (1, N=251), p=<.001 indicates a significant relationship between level of knowledge and odor of antimalarial drugs. The likelihood ratio (1, N=251) = 53.620, p=<.001 significantly supports alternate hypothesis, therefore, there is a significant relationship between the two variables. Linear by linear association (1, N=251) = 41.245, p=<.001 indicates a linear relationship between knowledge and odor of the antimalarial drugs.

Table 6:

Relationship Between Odor of Antimalarial Drug and Knowledge Level of Pharmacy Attendants on Counterfeit Antimalarials

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	41.300[a]	1	.000		
Continuity Correction[b]	39.862	1	.000		
Likelihood Ratio	53.620	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	41.245	1	.000		
N of Valid Cases	753				

a. *0 cells (0.0%) have expected count less than 5. The minimum expected count is 33.47.*

b. *Computed only for a 2x2 table*

Multiple Linear Regression was used to test if the participant's ability to identify Color, Shape and Odor of the antimalarial drugs predict their knowledge of antimalarial drugs weighted by age distribution. The fitted regression model was knowledge 0.622. However, the overall regression was statistically

significant (R^2=0.093, F (3, 247) = 8.422, P<0.001). This means that, all the variables (color, shape and odor) of the antimalarial drugs are excellent predictors of knowledge.

Table 7:

Prediction of Knowledge Level Based on Participants' Ability to Identify Drug Characteristics Weighted by Age Distribution

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.305[a]	.093	.082	.602

a. Predictors: (Constant), Color, Shape, Odor

Table 8:

Analysis of Variance

ANOVA[a,b]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.147	3	3.049	8.422	.000[c]
	Residual	89.416	247	.362		
	Total	98.562	250			

a. *Dependent Variable: knowledgeable;* ***b.*** *Weighted Least Squares Regression - Weighted by Age Distribution;* ***c.*** *Predictors: (Constant), Color, Shape, Odor*

DISCUSSION

This study aimed at examining awareness and knowledge levels of pharmacy attendants regarding counterfeit antimalarial drugs in the bustling urban setting of Nairobi City County. Malaria remains a significant health concern in Kenya, and the integrity of antimalarial drugs is paramount for effective treatment and prevention. Given the pivotal role that pharmacy attendants play in the healthcare system, as the first 'handlers' of patient within the community setting, this investigation holds implications for the quality of pharmaceutical care and patient outcomes. This research looked at demographic characteristics, antimalarial brands, awareness sources, distinguishing features, and factors influencing knowledge levels of pharmacy attendants at different pharmacy outlets within Nairobi city. A total of 251 participants were recruited and gave feedback corresponding to a 100% response rate.

The gender distribution, with 52.2% males and 47.8% females, reflects a relatively balanced representation. This finding aligns with existing literature that often reports a gender balance or slight variations in the distribution of healthcare workers (Elsa, 2022). The predominant age group of 18-24 years (51.0%) may imply a youthful workforce, and while this aligns with the general trend of young professionals entering the healthcare sector (Okoroafor et al., 2022), it also raises considerations for the potential impact of limited experience on their ability to recognize and combat counterfeit drugs (Adigwe et al., 2022). However, the prevalence of pharmacy attendants with 4 years of work experience (30.7%) is noteworthy, potentially indicating a balance between experienced professionals and those entering the field. The educational background, with 60.2% being TVET graduates, underscores the diverse educational pathways within the pharmacy workforce. Notably, the pharmaceutical technologists (29.5%) were the dominant group. This diversity might contribute to a range of skills and perspectives but could also pose challenges in standardizing knowledge levels, considering that regulations require every pharmacy outlet to be run by a pharmacist (Ilardo & Speciale, 2020). The distribution across pharmacy categories, with 61.8% in community pharmacy, highlights the critical role these settings play in the distribution of antimalarial drugs. The prevalence of community pharmacies is consistent with the recognized role of community-based healthcare in addressing public health challenges, particularly in resource-limited settings (Goode et al., 2019). This resonates with the literature emphasizing the importance of community pharmacies in ensuring accessibility to essential medications.

In terms of characteristics and preferences of

antimalarial drugs sold by pharmacy outlets in Nairobi, Coartem (Artemether/Lumefantrine) emerges as the most prevalent antimalarial brand, constituting 33.1% of the surveyed drugs, reflecting its widespread use in the region. This aligns with global trends, as Coartem is recommended by the World Health Organization as a first-line treatment for uncomplicated malaria (WHO, 2024). Artemether Lumefantrine (AL) follows closely as the most preferred antimalarial drug (36.7%), further emphasizing the significance of artemisinin-based combination therapies (ACTs) in malaria treatment. The preference for AL resonates with studies emphasizing its efficacy, safety, and tolerability, reinforcing its status as a key antimalarial drug (Abamecha et al., 2021). The popularity of Doxycycline (23.5%) and Mefloquine Hydrochloride (12.0%) aligns with their roles in prophylaxis, catering to travelers and individuals with specific medical conditions (Gaillard et al., 2015; Ohrt, 1997). However, the relatively low usage of Chloroquine (2.4%) and Sulfadoxine-pyrimethamine (SP) (2.4%) aligns with global efforts to phase out these drugs due to resistance concerns (Roux et al., 2021).

The majority of participants (72.9%) claimed to be knowledgeable about the effects of counterfeit antimalarial drugs while only 21.5% stated that they were very knowledgeable. This, they deemed so by examining specific features of antimalarial medicine, with packaging materials, expiry dates, and label/legitimacy being the most commonly recognized features (29.5%). This highlights the significance of packaging in distinguishing genuine from counterfeit drugs as posited by Salim et al. (2021). This study found that the Pharmacy and Poisons Board emerge as the most common source of information about counterfeit antimalarial drugs (39.8%), followed by social media (19.1%), newspapers/magazines (19.1%), healthcare facilities (12.4%), and peer-to-peer interactions (9.6%). The prominence of social media as a source suggests the increasing impact of digital platforms on health-related awareness. This corresponds with the trend observed in contemporary literature where online sources are gaining significance in health education Ghahramani et al., 2022). Similarly, reliance on the Pharmacy and Poisons Board aligns with the notion that regulatory bodies play a crucial role in disseminating information. However, participants express varying opinions on the efficiency of regulatory authorities, with 46.6% considering them moderately efficient.

Additionally, participants express their opinions on who should be targeted for awareness campaigns, with the majority favoring the public (35.9%), pharmacists (31.9%), and pharmaceutical companies (19.1%). The emphasis on public awareness aligns with the understanding that the general population should be well-informed to identify counterfeit drugs. The call for pharmacist awareness acknowledges their pivotal role in ensuring drug safety. However, the relatively lower emphasis on medical physicians calls for a more inclusive campaign approach. Regarding improving awareness, participants suggest various methods, with social media (24.3%) and billboards (23.5%) being the most popular choices. The preference for social media resonates with contemporary literature, emphasizing the effectiveness of online platforms in health communication Ghahramani et al., 2022). The recommendation for billboards is noteworthy, as it taps into visual communication, potentially reaching a broader audience. In terms of who should be responsible for counterfeit campaign, participants suggested that the responsibility be given to public health (Ministry of Health) (27.1%), followed by pharmacists (21.9%) and pharmaceutical companies (14.3%).

This study further explored correlation between the knowledge level of pharmacy attendants and various factors related to antimalarial drugs, such as color, shape, odor, and education level. There was significant relationship between color of antimalarial drugs and the knowledge of pharmacy attendants. Similarly, there was a significant relationship between odor of antimalarial drugs and the knowledge of pharmacy attendants. Color and odor identification aligns with other studies emphasizing the importance of sensory cues in identifying counterfeit drugs (Wertheimer, 2008). Contrary to color, the study finds no significant relationship between the shape of antimalarial drugs and the knowledge of pharmacy attendants.

CONCLUSION

In conclusion, analysis of pharmacy attendants in Nairobi City County revealed a balanced gender distribution, predominantly consisting of individuals aged 18-24 years. Notably, a diverse educational background was observed, with a significant proportion having Technical and Vocational Education and Training (TVET) qualifications. Regarding antimalarial drug characteristics, the study highlighted the dominance of Coartem and Artemether Lumefantrine, aligning with global trends favoring artemisinin-based combination therapies (ACTs). Conversely, the low usage of Chloroquine and Sulfadoxine-pyrimethamine reflected adherence to global efforts combating drug resistance. In terms of awareness sources, participants predominantly relied on the Pharmacy and Poisons Board and social media for information on counterfeit antimalarial drugs. Further, there was a recognized need for targeted awareness campaigns, particularly focusing on the public, pharmacists, and pharmaceutical companies. The study indicated a substantial level of knowledge among participants about counterfeit antimalarial drugs, with packaging materials, expiry dates, and label/legitimacy being the most recognized features. The correlation analysis established a significant relationship between participants' knowledge and the color and odor of antimalarial drugs, highlighting the importance of sensory cues in identifying counterfeit medications.

RECOMMENDATIONS

This study recommends:

1. Tailored Educational Programs: Develop and implement tailored educational programs for pharmacy attendants that focus on enhancing their knowledge about counterfeit antimalarial drugs, emphasizing the recognition of key features and the importance of adhering to regulatory requirements.
2. Regulatory Measures and Pharmacist Presence: Address the prevalence of pharmaceutical technologists in pharmacy outlets by enforcing regulatory measures that ensure the presence of a qualified pharmacist in each pharmacy.
3. Targeted Awareness Campaigns: Design targeted awareness campaigns utilizing various channels, including social media, billboards, and workshops. These campaigns should prioritize the public, pharmacists, and pharmaceutical companies, aligning with participants' suggestions.

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