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Comparative analysis of the unregulated sale of antimicrobial prescription medication by drug retailers before and during the COVID-19 pandemic in Abuja, Nigeria

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ABSTRACT

Background: The sustained high-level unregulated sale of prescription medicines in developing countries is recognized as a significant factor in the development of drug resistance among pathogenic microorganisms. Apart from the millions of deaths annually that are attributed directly to antimicrobial resistance to commonly prescribed medicines this major global public health problem hinders achieving the United Nations' Sustainable Development Goals by its target of 2030. This study compared the extent of the sale of non-prescribed antimalarial medication and of antibiotics before and during the coronavirus disease (COVID)-19 pandemic in each of the six local government areas within the Federal Capital Territory-Abuja, Nigeria. **Methods:** A structured questionnaire was designed to determine the percentage sales of both antimalarials and antibiotics, without diagnosis or prescription from qualified medical practitioners, over six-month periods between January to June of 2019 and 2020. **Results:** The data showed that all of the 130 community pharmacies and registered chemist stores where questionnaires were completed engaged in non-prescribed sales of both sets of medicine. Moreover, approximately three-quarters of drug retailers recorded increased patronage in the purchase of both classes of antimicrobial during the 2020 survey period that coincided with the first few months of the COVID-19 pandemic. Over successive years this saw an overall rise in over-the-counter sales of antimalarials and antibiotics (each $p < 0.01$). Yet, only Abuja Municipal Area Council and Bwari ($p < 0.0001$ and $p < 0.001$, respectively) recorded significant increases in indiscriminate sales of each medicine. **Conclusion:** In line with the high frequency of self-medication, this report points to the threat of possible emergence and spread of multidrug-resistant bacterial and *Plasmodium* spp. in the Abuja region. These findings highlight the imperative requirement for public health policymakers to implement effective strategies to curb the extensive unregulated sale of prescription drugs in the nation's capital city and likely elsewhere in Nigeria.

Introduction

In recent years, prior to the emergence of Severe Acute Respiratory Syndrome Coronavirus 2

(SARS-CoV-2) infection, serious concern had been raised regarding the increasingly widespread resistance to commonly prescribed medicines (or

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simply, 'drugs') of pathogenic bacteria, such as *Klebsiella pneumoniae*, *Escherichia coli* and *Staphylococcus aureus*, and of the causative agent of malaria, the *Plasmodium* protozoan parasite [1,2]. It was predicted that if internationally coordinated effective measures are not taken against antimicrobial resistance in Africa, by 2050 approximately 10 million lives and US\$100 trillion in economic productivity will be lost per annum [3].

Developing countries like the West African nation of Nigeria suffer an incalculable public health toll from the enduring indiscriminate use of antibiotic medication (or simply, 'antibiotics') [4]. A major contributing factor in the rise of multidrug-resistant (MDR) strains of pathogenic bacteria is the continuing adoption of poor healthcare management procedures. These include inadequate patient education and inappropriate prescription practices as a result of limited and outdated diagnostic microbiology facilities. Other determinants are poor supply chains of antimicrobials in the population, lack of appropriate functioning drug regulatory mechanisms, non-human use of antimicrobials such as in livestock production, and the unavailability of surveillance data [3–5].

Malaria is a potentially life-threatening disease that is transmitted between humans by the bite of infectious female *Anopheles* spp. mosquitoes. According to the World Health Organization (WHO), 229 million confirmed cases of symptomatic infection and 409,000 deaths were reported globally in 2019, of which African countries (mostly in the sub-Saharan region) contributed 93% morbidity and 94% mortality [6]. The Nigerian Federal Ministry of Health follows the malaria diagnosis and treatment guidelines that are recommended by the WHO [7]. This approach aims at achieving effective case management, reducing human-parasite reservoirs, and preventing the emergence and dissemination of *Plasmodium* resistance to antimalarial medicines.

Despite this policy, antimalarial medication (or simply, 'antimalarials') is sold over-the-counter in pharmacies throughout Nigeria without either accurate diagnosis or appropriate prescription from qualified medical practitioners [8]. This unregulated activity has resulted in the emergence of strains of the deadliest of the five human malaria parasites, *P. falciparum*, with reduced susceptibility to the first-line treatment of artemisinin-based combination therapy (ACT) [9,10]. Each ACT is a combination of an artemisinin

derivative and a longer-acting antimalarial that has a different mechanism of action against uncomplicated asexual blood stage malaria. Examples include artemether-lumefantrine and artesunate-amodiaquine.

Before confirmation of the index Coronavirus Disease 2019 (COVID-19) case in Nigeria on February 27, 2020 fear of an infectious disease outbreak that was confirmed later to be a pandemic had already circulated around the most populous country in Africa [11]. Federal Capital Territory (FCT)-Abuja is the administrative division in Nigeria with the second highest incidence of COVID-19 [12]. The ongoing public health threat has overwhelmed an already fragile national healthcare system such that the dilapidated and outdated medical facilities cannot effectively accommodate the growing number of confirmed SARS-CoV-2-infected patients [13,14]. As a result, people with other serious ailments are continually being denied appropriate medical attention. For instance, it was reported that at least three public hospitals in FCT-Abuja refused admission to a cardiovascular patient until he eventually died without assessment [15].

It is noteworthy that the recognized clinical signs and symptoms of SARS-COV-2 infection, such as fever, dry cough, sore throat, headache, fatigue, myalgia, breathlessness, hypoxaemia and acute respiratory disease, share several overlapping features with both bacterial and malarial infections [16,17]. In light of the inadequate provision for molecular diagnostics outside of a select few suitably supplied tertiary care centres misdiagnosis of COVID-19, malaria and MDR bacterial infections is likely to be a common occurrence in both urban and rural communities across Nigeria [16]. Hence, it may be reasonably assumed that the parallel public health management of these deadly infectious diseases will continue to be difficult to achieve.

The excessive pressure placed by the effect of the COVID-19 pandemic on a poor healthcare system has given rise to a situation in which people have chosen not to seek advice from a qualified medical practitioner but instead to engage in self-medication [18]. To this end, the aim of this study was to determine the level of pharmacy sale of non-prescribed antimalarials and antibiotics in FCT-Abuja during the COVID-19 pandemic compared to a similar period 12 months previously. This would reveal the extent of the underlying issue of

indiscriminate medication sales and show the degree to which this has been escalated by the demand for unregulated drugs in the face of COVID-19.

Materials and Methods

Study sites and population

A questionnaire-based survey was conducted in community pharmacies and registered chemist stores (collectively termed 'drug retailers') in the six local government areas that comprise FCT-Abuja, Nigeria; Abaji (ABJ), Kwali (KWL), Gwagwalada (GWA), Kuje (KUJ), Bwari (BWR) and Abuja Municipal Area Council (AMAC) (**Figure 1**). The last national census undertaken in Nigeria was in 2006, since when the population is projected to have risen from 140 million to 206 million. However, according to the most recent population projection of 2016 by the National Population Commission of Nigeria, FCT-Abuja has a total population of 3,564,100. This was broken down as follows: ABJ 148,600; KWL 218,400; GWA 402,000; KUJ 246,400; BWR 581,100; and AMAC 1,967,500 [19]. In 2020, the metropolitan area population of Abuja is estimated to be 3,277,740, up from 2,590,920 in 2016, a rise of 20.95% [20].

Data were collected only from community pharmacies in GWA, KUJ, BWR and AMAC, while data from ABJ and KWL were collected from both community pharmacies and registered chemist stores. This was due to the restricted availability of pharmacies in the two latter local government areas.

Study design

A stratified questionnaire was designed to compare the percentage sales of antimalarials between January to June 2019 and January to June 2020. A similar approach was used in the case of antibiotics. Attached to each questionnaire was a respondent consent form. The map coordinates of all the drug retailers from which data were collected were also recorded using the Global Positioning System (GPS) satellite-based radionavigation application.

Data collection

Information on the sale of antimalarials and antibiotics, without diagnosis and prescription from a qualified medical practitioner, was collected from all the six local government areas in FCT-Abuja. Due to differences in the population and economic activity there are variations in the number of drug retailers present in the local government areas. This resulted in differences in the volume of data collected from each local government area. A total of 130 data sets were collected across ABJ (14),

KWL (7), GWA (15), KUJ (9), BWR (8) and AMAC (77). In each data collection centre, in the first instance the pharmacist was consulted, which happened in most cases. On the few occasions when the pharmacist was unavailable an experienced salesperson was approached. The record of total sales of each of antimalarials and antibiotics between January to June 2019 and for the same six-month period in 2020 was requested. From this information the frequency of sales during each period was calculated.

Data analysis

The data collected from the survey were tabulated and analyzed statistically by Student's *t*-test using the SPSS software package. A *p*-value of ≤ 0.05 was considered statistically significant.

Results

For the 130 drug retailers from which data were collected the survey showed that between January and June 2020 approximately three-quarters of respondents recorded a higher frequency of non-prescription sales for antimalarials (97; 74.6%) and antibiotics (100; 77.0%), respectively, compared to the same period of the immediately previous year (**Figure 2**). Conversely, a combined total of around a quarter of stores reported either a stable or lower purchase frequency for antimalarials (14; 10.8% and 19; 14.6%, respectively) and antibiotics (both 15; 11.5%).

Across the six local government areas of FCT-Abuja there was a 36.1% increase in over-the-counter purchase of antimalarials between 2019 and 2020 (48.03 vs 65.35 mean daily sales per retailer; $p < 0.01$). Similarly, sales of antibiotics rose by 33.8% (47.71 vs 63.83; $p < 0.01$) (**Table 1**). The combined mean sales figures per day for the 130 retailers surveyed of antimalarials and antibiotics in 2019 were almost identical (298.24 vs 298.03; 0.07% difference, $p > 0.05$). The following year there was a greater but still insignificant difference in these values, the purchase of antimalarials slightly outnumbering those of antibiotics (380.78 vs 368.84; 3.1%, $p > 0.05$).

The mean sales figures reported by drug retailers from each of the local government areas showed that the frequency of purchase of non-prescription antimalarials and antibiotics in ABJ, KWL, GWA, BWR and AMAC increased in 2020 compared to 2019 (**Figure 3**). An exception to this trend was observed in KUJ, where a slightly higher purchase level of both medicines was reported in

2019 compared to the following year. However, of the five local government areas in which drug dispensing rose, it was only in BWR ($p < 0.001$) and

AMAC ($p < 0.0001$) that significant increases in sales were recorded (Table 2).

Figure 1. Simplified political map of Federal Capital Territory-Abuja showing the six local government areas (colour-coded according to the key). The approximate site of each drug retailer where a questionnaire was completed is indicated (red dot with road name or other address).

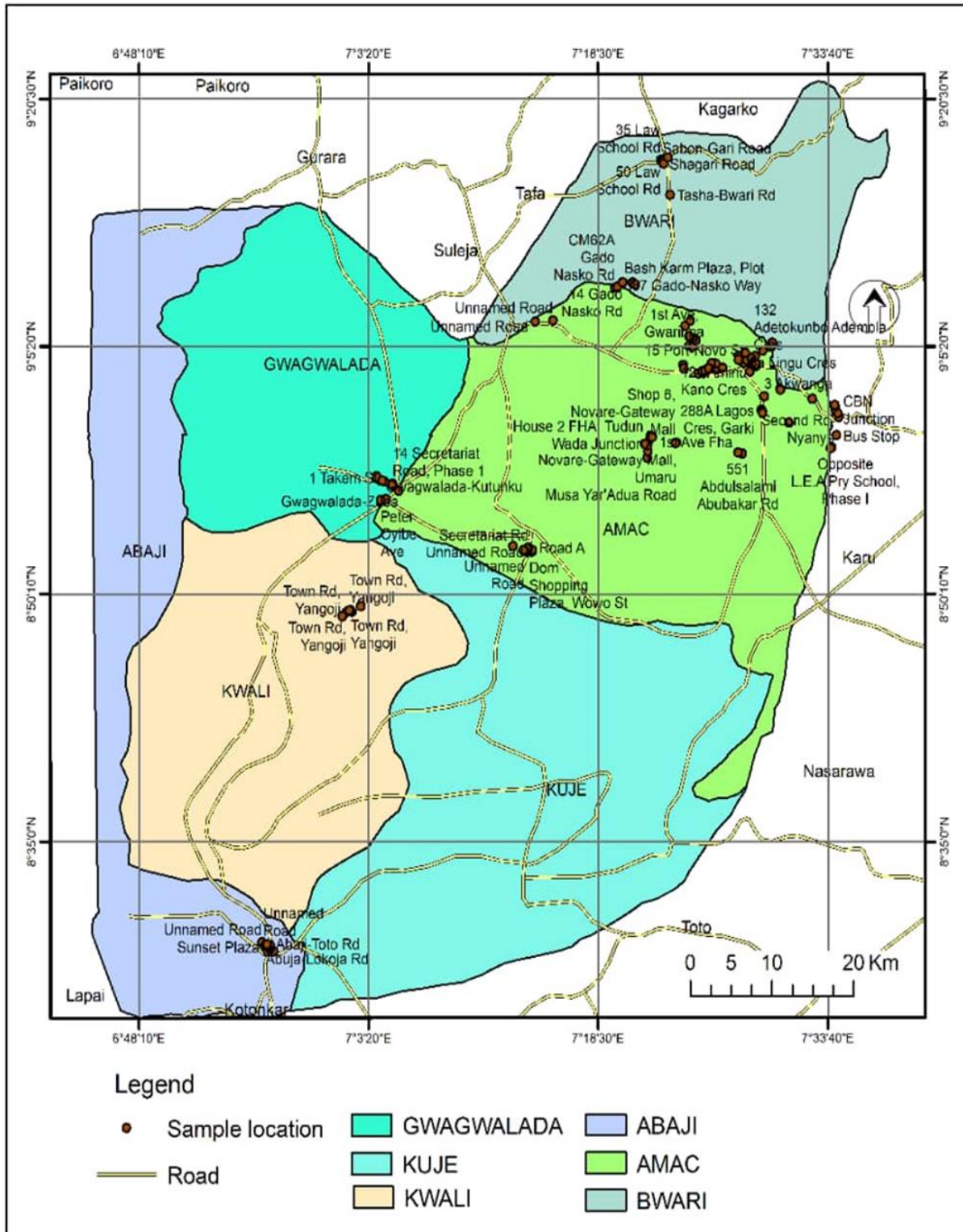


Figure 2. Reported overall frequency of non-prescription sales by drug retailers of antimalarials and antibiotics over a six-month survey period in 2020.

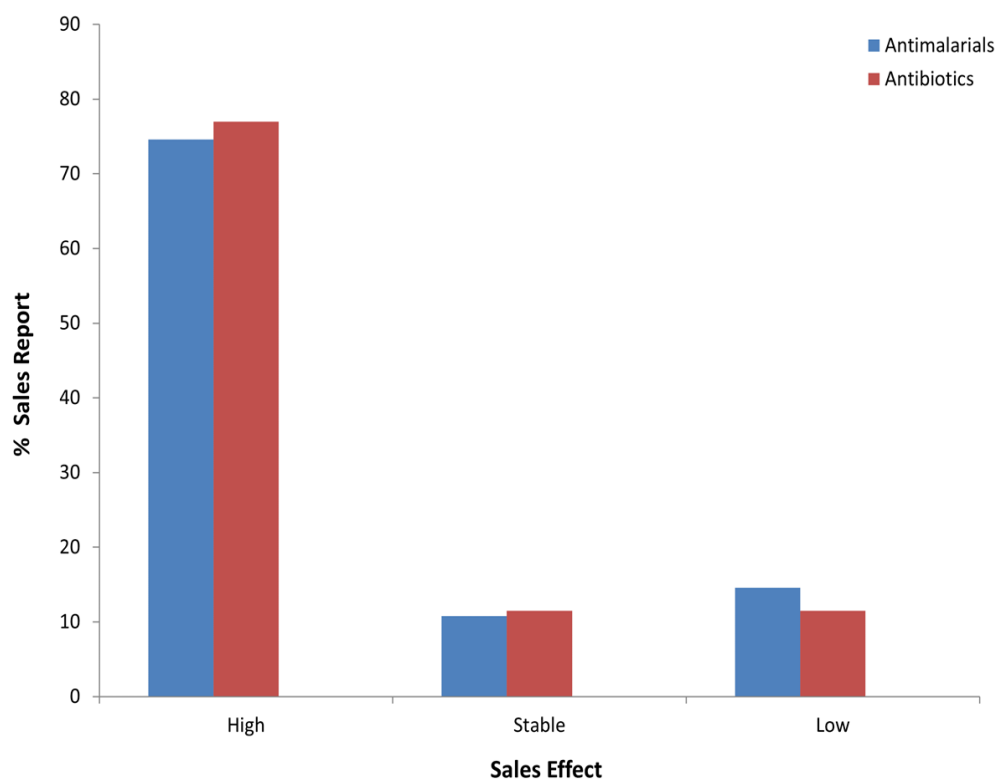


Figure 3. Non-prescription sales by drug retailers of antimalarials and antibiotics in each local government area over similar six-month survey periods in 2019 and 2020.

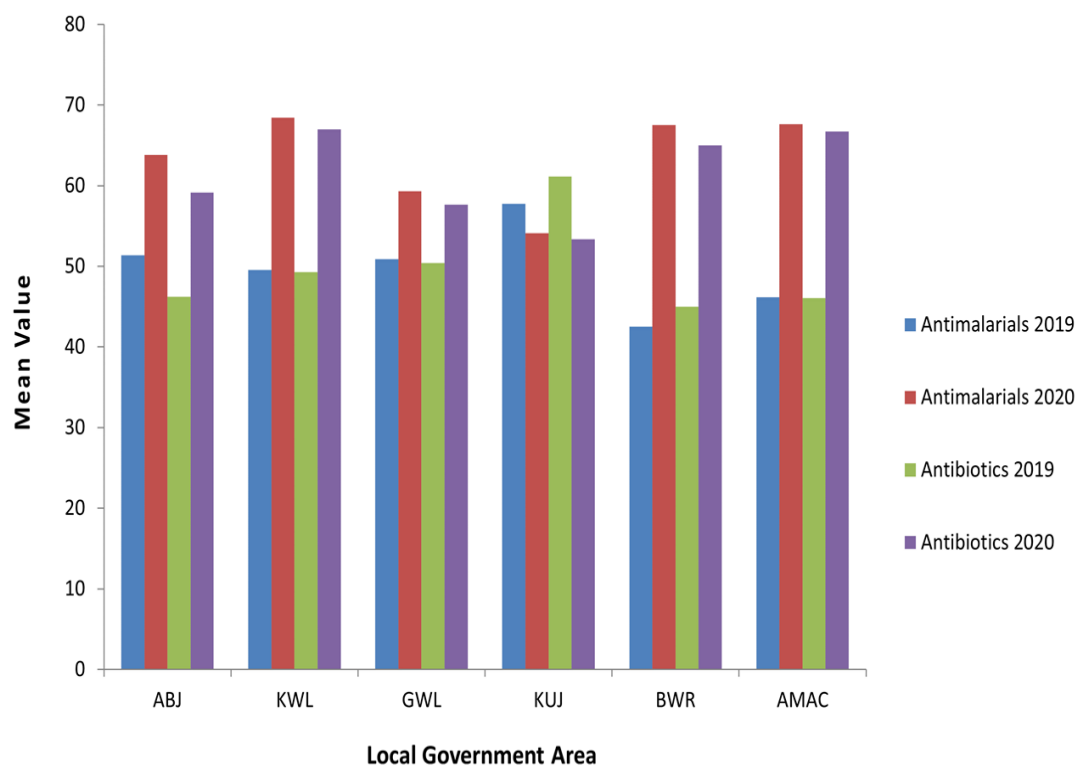


Table 1. Non-prescription sales of antimalarials and antibiotics over similar six-month survey periods in 2019 and 2020.

LGA	Antimalarials			Antibiotics		
	2019	2020	Mean Difference	2019	2020	Mean Difference
ABJ (14)	51.36	63.79	12.43	46.21	59.14	12.93
KWL (7)	49.57	68.43	18.86	49.27	67.00	17.73
GWL (15)	50.87	59.33	8.46	50.40	57.67	7.27
KUJ (9)	57.78	54.11	-3.67	61.11	53.33	-7.78
BWR (8)	42.50	67.50	25.00	45.00	65.00	20.00
AMAC (76)	46.16	67.62	21.46	46.04	66.70	20.66
Mean (129)	48.03	65.35	17.32	47.71	63.83	16.12

Values shown are the mean of item sales figures per day pooled from the total of drug retailers in each local government area, LGA (numbers in parentheses).

Table 2. Student's *t*-test analysis of antimalarials and antibiotics dispensed over similar six-month survey periods before and during the COVID-19 pandemic.

Code for Variable	Variable for Comparison	<i>t</i> -value	df	<i>p</i> -value	Interpretation
AM-ABJ	Jan – June 2019 Jan – June 2020	-1.658	13	0.121	No Significance
AB-ABJ	Jan – June 2019 Jan – June 2020	-1.822	13	0.092	No Significance
AM-KWL	Jan – June 2019 Jan – June 2020	-2.423	6	0.052	No Significance
AB-KWL	Jan – June 2019 Jan – June 2020	-2.225	6	0.068	No Significance
AM-GWA	Jan – June 2019 Jan – June 2020	-1.324	14	0.207	No Significance
AB-GWA	Jan – June 2019 Jan – June 2020	-1.331	14	0.204	No Significance
AM-KUJ	Jan – June 2019 Jan – June 2020	0.484	8	0.641	No Significance
AB-KUJ	Jan – June 2019 Jan – June 2020	0.902	8	0.393	No Significance
AM-BWR	Jan – June 2019 Jan – June 2020	-5.292	7	0.001	Significance
AB-BWR	Jan – June 2019 Jan – June 2020	-5.134	7	0.001	Significance
AM-AMAC	Jan – June 2019 Jan – June 2020	-8.706	76	0.0001	Significance
AB-AMAC	Jan – June 2019 Jan – June 2020	-10.406	76	0.0001	Significance

AM = antimalarials; AB = antibiotics; df = degrees of freedom; Abaji = ABJ; Kwali = KWL; Gwagwalada = GWA; Kuje = KUJ; Bwari = BWR; Abuja Municipal Area Council = AMAC.

Discussion

This study reveals that each one of the community pharmacies and registered chemist stores in every local government area within FCT-Abuja where questionnaires were completed engaged in the sale of both antimalarials and antibiotics without diagnosis or prescription from a qualified medical practitioner (130/130; 100%). The uniformly consistent behaviour was observed irrespective of the timing of the survey, undertaken over the first half of the two consecutive years of 2019 and 2020. This corroborates a previous finding that almost 80% of sicknesses across Nigeria are self-treated with over-the-counter medicines obtained from community pharmacies [21]. A similar report from Nigeria's largest city, Lagos, indicated that 60-90% of people from some communities practiced self-medication [22].

During the first six months of 2020, when the second set of survey data was collected, community transmission of SARS-CoV-2 escalated at an alarming rate in Nigeria [14]. Our findings showed a positive turnover in the sales of antimalarials and antibiotics in Abaji, Kwali, Gwagwalada, Bwari and AMAC local government areas compared to the same reporting period of 2019, prior to the start of the COVID-19 pandemic. The only exception was in Kuje, where a slight decrease in the purchase of both sets of medicine was recorded in 2020. For the entire FCT-Abuja administrative division, comparing 2020 to 2019 77.5% and 75.2% of drug retailers reported increased sales of antimalarials and antibiotics, respectively. This striking upsurge in the purchase of prescription medicines marketed for the treatment of malaria and bacterial infections, both of which occur very commonly in Nigeria [23,24], may be reasonably attributed to the added case burden of the COVID-19 pandemic on the country's notably weak healthcare system. The emergence of SARS-CoV-2 infection has overwhelmed Nigerian public hospitals with cumulative effects ranging from reduced accessibility to medical laboratory services, inadequate clinical care infrastructure to the difficulty in facilitating inter-practice physician consultations [25]. As a consequence, healthcare centres in hard-hit locations have experienced diminished or complete cessation of medical attendance to non-COVID-19 patients [15, 26].

The non-prescription purchase of antimalarials and antibiotics in each year showed a remarkable similarity. For instance, in 2019 the sales

for antimalarials and antibiotics were almost identical at 48.03 and 47.71 items per retailer per day, respectively (**Table 1**). In the same vein, in 2020, closely matched mean figures of 65.35 for antimalarials and 63.83 for antibiotics were recorded. This indicates clearly that the rates at which both classes of drug were dispensed – as an index of the growth in their sales from 2019 to 2020 – followed an equivalent upward trend. Additionally, it provides indirect evidence in support of our opinion aired recently that the consumption of both medicines has become normalized behaviour in the management of malaria infection in sub-Saharan Africa [27].

While the generic term antibiotic was used in this survey it was noted anecdotally that individual respondents discussed in particular increased sales of azithromycin (sometimes referred to under the brand names of zithromax or azithromycin). This medication is commonly used to treat pneumonia, a frequently observed clinical manifestation of severe COVID-19 as well as, for instance, of *K. pneumoniae*, *Streptococcus pneumoniae* and *Haemophilus influenza* infections. This may help to explain, in addition to the main reason of limited testing, why for COVID-19 in Nigeria the number of confirmed cases is far less than the estimated incidence [13,28]. Other antibiotics such as ciprofloxacin and amoxicillin are often taken in combination with antimalarials to treat possible typhoid, caused by *Salmonella enterica* subsp. *enterica*. For antimalarials, artesunate-amodiaquine, sold under the brand name camoquin, was preferentially reported, which aligns with Nigeria following WHO recommendations to support ACT [7].

Of the six FCT-Abuja local government areas where data were collected, only AMAC and Bwari recorded a significant difference ($p < 0.05$) in the sales of antimalarials and antibiotics; in each location this was very marked (**Table 2**). This may be attributed to AMAC and Bwari – adjoining each other to the central-east and north-east of FCT-Abuja – having higher population densities compared to the other four areas [17]. In accord, AMAC was ranked among the local government areas in Nigeria with the highest rate of COVID-19 transmission [29].

Due to certain similarities in the signs and symptoms of clinical presentation of malaria, bacterial infections and COVID-19, together with the low rate and limited testing capacity for SARS-

CoV-2 in Nigeria, it proposed that the pronounced rise in self-medication of both antimalarials and antibiotics in 2020 may be, in some cases, attributed to misinterpretation of the manifestations of COVID-19 as malaria or bacteremia, and vice versa. This provides indirect evidence to support the argument that in Nigeria, and likely elsewhere in sub-Saharan Africa, the number of unsuspected (and thus undiagnosed) cases of COVID-19 far exceeds those confirmed cases that are reported [13,30,31].

Conclusion

This study demonstrates a significant increase in the practice of self-medication in FCT-Abuja, Nigeria, during the COVID-19 pandemic. The surge in sale of antimalarials and antibiotics may be due in large part to a desire to treat undiagnosed signs and symptoms of febrile illness which may or not be due to SARS-CoV-2 infection. Such a reliance on non-prescribed medication is thought to be the result of an overwhelmed healthcare system. Combined with a worrying underlying rise in the indiscriminate use of antimicrobial drugs, the escalation of unregulated pharmaceutical sales during the COVID-19 pandemic may increase selective pressure for the emergence and spread of MDR bacteria and ACT-resistant *Plasmodium* spp. In order to meet the public health challenge of malaria and bacterial infections in Nigeria, as well as to combat COVID-19 effectively, it is imperative for concerned stakeholders to implement strict policies to curb unrestricted access of the general public to both antimalarial and antibiotic medicines.

Author contribution statement

All authors contributed substantially to the development and the writing of this article as indicated. Conception, ROM, DI and AWT-R; study design, ROM, DI, FUS and AWT-R; data collation, ROM, AAB, FUS; data analysis, ROM, AAB, KHO and AWT-R; writing — original draft preparation, ROM, AAB, DI; writing — review and editing critically for important intellectual content, AWT-R. All authors read and approved the final version of the manuscript.

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Ethics statement

This study was approved by the Medical Research and Ethics Committee of Nasarawa State University and conformed with the ethical regulations of the World Medical Association and

the Declaration of Helsinki. Written informed consent was obtained from each survey respondent prior to their completion of the questionnaire.

Competing interest statement

The authors declare no conflicts of interest.

Financial disclosures statement

The authors report no relevant financial or non-financial competing interests.

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