Counterfeit drugs and public health: a global examination of the impact, challenges, and solutions in low- and middle-income countries

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ABSTRACT

Counterfeit drugs remain a significant public health concern in Nigeria, undermining treatment outcomes and consumer trust. This study investigates the prevalence, patterns, and detection practices of counterfeit drug sales in Uyo Metropolis, Nigeria. A cross-sectional survey design was adopted, targeting 200 drug outlets across pharmacies, drugstores, and informal sellers. One respondent—pharmacist or sales personnel was selected per outlet via convenience sampling. Data collection involved structured questionnaires (assessing knowledge, practices, and experiences) and analysis of six-month sales records to identify trends in counterfeit drug sales. Observational visits were also conducted in 50 outlets to assess physical security measures and inventory practices. Quantitative data were analyzed using SPSS (Version 20) with descriptive statistics and chi-square tests, while qualitative data were analyzed thematically. Approximately 75% of pharmacists-sales person reported encountering counterfeit drugs within the past year, with antimalarials, antibiotics, and pain relievers being the most affected. Only 45% could confidently identify counterfeit drugs unaided, while 30% had received formal training. About 60% relied on visual inspection for detection. Consumers were moderately aware of counterfeit drugs (68%), but only 40% knew how to verify them. Sales data revealed that 12% of drugs sold were flagged as counterfeit. Consumer behavior indicated that 45% prioritized price over brand, and 60% were willing to pay a premium for verified medications. Observational assessments revealed limited use of advanced detection tools. The widespread presence of counterfeit drugs and limited detection capacity underscore the need for strengthened regulation, pharmacist training, and consumer education to enhance pharmaceutical safety in Uyo

Keywords: Counterfeit drugs, Pharmaceutical services, Community pharmacy services, Drug monitoring, Cross-sectional studies

Introduction

The sale of counterfeit drugs remains a significant challenge in many parts of the world, particularly in developing countries [1]. Counterfeit medicines are defined as drugs that are deliberately misrepresented in terms of identity or source, including products that may contain incorrect or harmful ingredients. The World Health Organization (WHO) has highlighted counterfeit drugs as a global public health threat, contributing to adverse treatment outcomes, resistance to treatment, and the loss of consumer trust in the health system [2]. In countries like Nigeria, the prevalence of counterfeit drugs is alarmingly high, despite various regulatory efforts. Uyo Metropolis, a rapidly growing urban area in Akwa Ibom State, Nigeria, is no exception to this growing concern [3].

Nigeria has been identified as one of the countries most affected by the trade in counterfeit drugs due to weak regulatory enforcement, inadequate healthcare infrastructure, and a lack of public awareness [3]. Studies have shown that counterfeit medications are often sold through formal (pharmacies, licensed drugstores) and informal channels (street vendors, unregistered outlets), further complicating efforts to curb their distribution [4]. The sale of counterfeit drugs in Uyo Metropolis is particularly worrisome because of the presence of both urban and peri-urban populations, where the accessibility and affordability of legitimate drugs are major concerns.

In addition to the direct health risks posed by counterfeit drugs, the socio-economic impact of these illicit sales is profound. Counterfeit medicines contribute to the erosion of confidence in the healthcare system, exacerbate the burden on healthcare facilities, and lead to a loss in revenue for legitimate pharmaceutical businesses [6]. These challenges are often compounded by the lack of adequate training for pharmacists and sales personnel, who may unknowingly contribute to the sale of counterfeit drugs. Furthermore, counterfeit drug networks operate with sophisticated methods of deception, including the use of fake packaging, falsified certificates of authenticity, and illegal distribution practices [7].

The regulatory framework designed to combat counterfeit drug sales in Nigeria, including agencies such as the National Agency for Food and Drug Administration and Control (NAFDAC), has made significant strides in curbing the problem [8]. However, the widespread nature of counterfeit drug sales in many Nigerian cities suggests that enforcement remains insufficient. There is a pressing need to explore the extent of counterfeit drug sales in Uyo Metropolis specifically, to assess the current state of regulatory practices, and to determine the factors that contribute to the proliferation of counterfeit medicines in the area.

and sales patterns of counterfeit drugs in Uyo Metropolis. It will also evaluate the knowledge, attitudes, and practices of pharmacists and drug vendors regarding counterfeit drugs, and assess the effectiveness of existing measures to combat counterfeit drug sales [4]. Through this research, the study seeks to provide a clearer picture of the scope of the problem and offer evidence-based recommendations for improving regulatory efforts, public awareness, and consumer safety.

Methods

Research design

This study employed a cross-sectional survey design to investigate the prevalence and patterns of counterfeit drug sales in Uyo Metropolis. The cross-sectional design allows for the collection of data at a single point in time, providing a snapshot of counterfeit drug sales across a variety of pharmacyoutlets in the area.

Study area

The research was conducted in Uyo Metropolis, the capital of Akwa Ibom State in Nigeria. Uyo Metropolis has a growing population and a significant number of formal and informal drug outlets. The study targeted community pharmacies, general drugstores, and informal drug outlets across the metropolis.

Study population

The study targeted 200 drug outlets within Uyo Metropolis, which includes: pharmacies (both independent and chain pharmacies), general drugstores that sell over-the-counter medications, and unregistered or informal drug outlets (e.g., open markets, street vendors). In each of the 200 outlets, the survey targeted pharmacists, pharmacy technicians, and other sales personnel who handle the dispensation of medications and have a direct role in the procurement and sales of drugs.

The study specifically focused on the sale of prescription drugs, over-the-counter medications, and common medications (e.g., pain relievers, antimalarials, antibiotics, and antihypertensives) that are commonly counterfeited. A stratified random sampling technique was employed to select the 200 drug outlets. A random selection was then performed within each stratum to ensure that the sample was representative of all types of drug outlets in Uyo Metropolis.

Sampling of participants

For each selected drug outlet, a convenience sampling method was used to select one respondent—the pharmacist or the sales personnel in charge of drug distribution. The total number of respondents was 200 individuals.

Data collection methods

The research was billed for 6months from April to October 2025. The data collection process involved

analysis. A set of two separate structured questionnaires were developed—one for pharmacists and sales personnel (QA), and the other for the analysis of drug sales data (QB).

This questionnaire QA assessed the knowledge, practices, andexperiences of the personnel regarding counterfeit drug detection and prevention. Key areas included knowledge of counterfeit drug characteristics, experience with counterfeit drugs in their outlets, detection methods used (visual inspection, packaging checks, etc.), awareness of regulations and anti-counterfeit measures, and training on counterfeit drug detection. Questionnaire QB focused on understanding the purchasing patterns of consumers and whether counterfeit drugs were being sold in the outlet. Data points included the frequency of counterfeit drugs encountered in sales, types of drugs most commonly suspected to be counterfeit, and methods by consumers to verify drug authenticity.

Finally,a sales record review was conducted to examine the sales patterns and identify suspicious transactions related to counterfeit drugs. Pharmacies and drug outlets were asked to provide anonymized sales data for the past 6 months, including: (a) drug names and brands flagged as counterfeit, (b) the quantity of suspected counterfeit drugs sold, (c) types of drugs most frequently involved in counterfeit transactions, and (d) frequency of consumer complaints about counterfeit drugs.

The researcher analyzed these records to identify trends in the sale of suspiciousor non-standard drugs, helping to triangulate the findings from the questionnaires.

Site visits and observations

A sample of 50 drug outlets was assessed to observe the physical presence of security measures likeholograms, QR codes, or tamper-evident packaging. These visits also allowed the observance and assessment ofinventory management practices and how counterfeit drugs might be identified or segregated in real time.

Data analysis

The data analyses were conducted as follows:

Quantitative Data Analysis

Data from the questionnaires and sales records were entered into statistical software SPSS (Version 20, IBM). The following analyses were performed.

Descriptive statistics (frequencies, percentages, and means) were calculated to determine the prevalence of counterfeit drugs, the types of counterfeit drugs encountered, and the sales patterns.Cross-tabulationidentifies relationships between pharmacy characteristics (e.g., size, type, trainings) and the occurrence of counterfeit drug sales.The chi-square test assesses the associations between variables such as the knowledge of pharmacists, sales outlet type, and

Qualitative data Analysis

Thematic analysis was conducted on the open-ended responses from the questionnaires and any observational data from site visits. Themes such as counterfeit drug characteristics,consumer behavior, detection methods, and regulatory knowledge were identified and analyzed.

Ethical considerations

All participants (pharmacists and sales personnel) were informed about the study's purpose and the voluntary nature of their participation. Written consent was obtained before data collection. The privacy and confidentiality of the respondents was maintained. Personal and outlet identifiers were removed or anonymized in the final dataset.

Ethical approval

The study obtained approval from the University ethical committee (the Institutional Review Board (IRB) of the University of Uyo) to ensure compliance with ethical standards in research involving human participants.

Data availability

Sales records from some outlets may not be available or complete, which could impact the reliability of sales data.

Results

Demographic profile of respondents

Of the 100 pharmacists surveyed, 60% were male, and 40% were female (Table 1). The majority (65%) of pharmacists were aged between 30-45 years, followed by 25% aged 46-60 years, and 10% under 30 years. A significant proportion of pharmacists (70%) had been practicing for more than 5 years, while 15% had between 2-5 years of experience, and 15% had less than 2 years. Most pharmacists (90%) bagged a Bachelor's degree in Pharmacy, while 10% had higher qualifications (MSc, PharmD or PhD.).

Similarly, of the 200 consumers surveyed, 55% were female, and 45% were male. The majority of consumers (50%) were aged 25-40 years, followed by 35% aged 41-60 years, and 15% under 25 years. Most consumers (60%) had at least a secondary school education, 30% had a tertiary education, and 10% had a primary school education or less. Most consumers (50%) were in the middle-income bracket, 30% were in the low-income group, and 20% were in the high-income group (Table 2).

Prevalence of counterfeit drugs in Uyo metropolis

Pharmacists' perspective

Pharmacists (75%) reported encountering counterfeit drugs in their pharmacies within the past year. However, only 45% stated they could identify counterfeit drugs with confidence without external assistance. The drugs most commonly reported as

counterfeit included antimalarials (30%), antibiotics (25%), pain relievers (20%), and antihypertensives (15%). Vitamins and cough syrups were also mentioned, but to a lesser extent (10%).

Pharmacists (60%) indicated they used visual inspection (e.g., checking holograms, and packaging) to detect counterfeit drugs, while 25% used rapid diagnostic tests (RDTs) or spectrometric devices. Only 15% indicated they had access to a pharmaceutical-grade counterfeit detection technology (e.g., scanners or databases for drug verification) (Figure 1).

Consumers (68%) reported being aware of counterfeit drugs, but only 40% knew how to identify counterfeit drugs during purchase. Common methods by consumers to verify authenticity included checking for visible security features like holograms (50%) and asking pharmacists for verification (30%) (Figure 2).

Approximately 20% of consumers reported having unknowingly purchased counterfeit drugs. The most frequently counterfeited medications identified by consumers included antimalarials, antibiotics, and painkillers. Of these, 50% of consumers who reported purchasing counterfeit drugs experienced ineffectiveness or adverse side effects, while 20% experienced health complications related to toxic ingredients. The sourcing of medications by consumers is detailed in Figure 3.

Pharmacists' knowledge and practices on counterfeit drug detection revealed that only 30% of pharmacists reported they received formal training or professional development on detecting counterfeit drugs while 70% stated they learned through self-study or informal training within their pharmacy networks.

Most pharmacists (80%) reported they follow measures to secure the supply chain by purchasing drugs only from authorized distributors. However, 15% admitted purchasing drugs from unverified sources due to cost concerns, and 5% indicated they were unsure about their sources.

Regarding regulatory compliance, 85% of pharmacists were aware of national regulations relating to counterfeit drugs, but only 60% complied consistently with drug verification procedures (e.g., cross-checking batches against regulatory databases). 40% admitted they did not always check for counterfeit drugs due to time constraints or lack of resources.

The frequency of counterfeit drug sales showed that sales records had 12% of all drug sales in the last 6 months flagged as potentially counterfeit. This was based on visual identification, customer complaints, or testing results from local laboratory tests.

The top counterfeit drugs identified included antimalarial drugs (35%), antibiotics (28%), analgesics (18%), and other medications (19%). Pharmacists encounter with counterfeit medicines is summarized in Figure 4.

Pharmacies reported financial losses from counterfeit drugs, with an estimated 8% reduction in overall sales revenue due to returns and unsold stock of potentially counterfeit drugs.

Consumer behaviour towards counterfeit drugs revealed that 45% of consumers indicated that they prioritize price over brand when purchasing medications, and only 35% consistently purchased medications from trusted or well-known pharmacies, while 20% frequented discounted or unbranded drugstores for cost-saving reasons.

Regarding willingness to pay for verification, 60% of consumers expressed willingness to pay a small premium for medications with guaranteed authenticity, such as those with QR codes, holograms, or other anti-counterfeiting measures. However, 40% indicated that price was more important than security features, particularly in lower-income groups.

The observational findings regarding security features revealed that 55% of pharmacies have visible security measures such as holograms, tamper-evident seals, or QR codes on high-risk medications. However, only 30% had advanced counterfeit detection tools like scanners, and fewer than 10% used mobile verification platforms for real-time checking.

In 5% of pharmacies, tampered packaging was identified in a random inspection, suggesting a need for greater vigilance in securing drug stocks.

Table 1: Demographics of Pharmacists respondents in the study

Characteristics	Frequency
Gender	
Male	60
Female	40
Age of respondents (years)	
Under 30	10
30 – 45	53
46-60	25
61 and above	12
Education level	
Bachelor of Pharmacy	63
Masters or PostgraduateDiploma	25
Doctor of Philosophy	12
Years of practice	
Less than 5	55
Greater than 5 but less than 10	15
Greater than 10	30

Table 2: Demographics of consumers' respondents in the study

Characteristics	Frequency	Percentage
Gender		
Male	90	45
Female	110	55
Age of respondents (years)		
Under 25	30	15
25 – 40	80	40
41-60	70	35
61 and above	20	10
Education level		
No formal education	36	18
Primary school	20	10
Secondary school	84	42
Tertiary	60	30

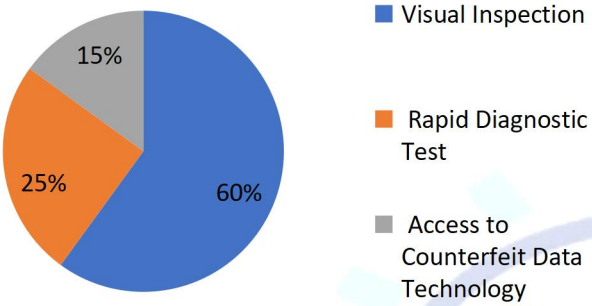

Figure 1: Protocols of Pharmacists respondents for detecting counterfeit drugs

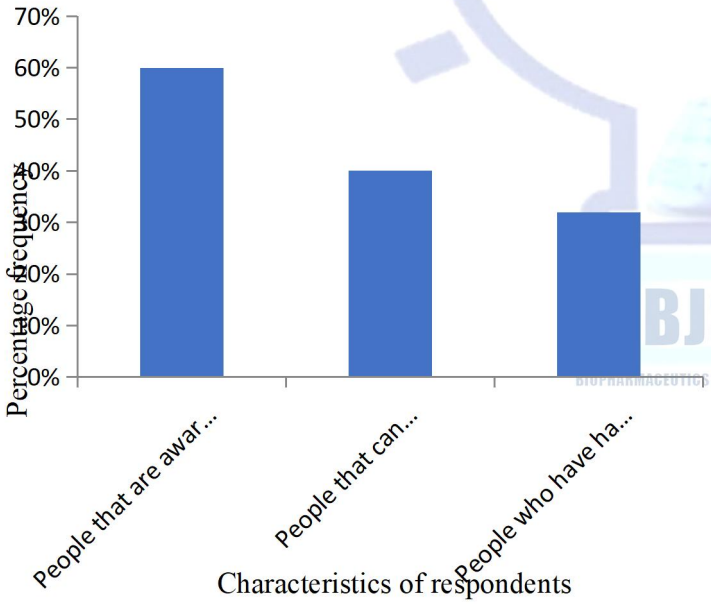

Figure 2: Consumers and their disposition to counterfeit drugs

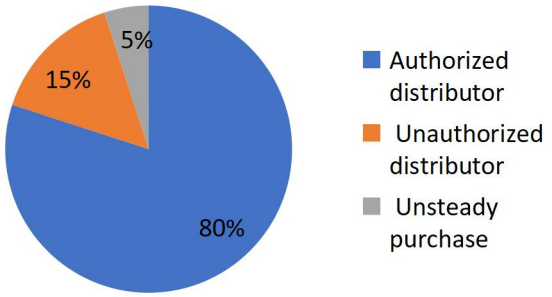

Figure 3: Consumers sourcing of medications

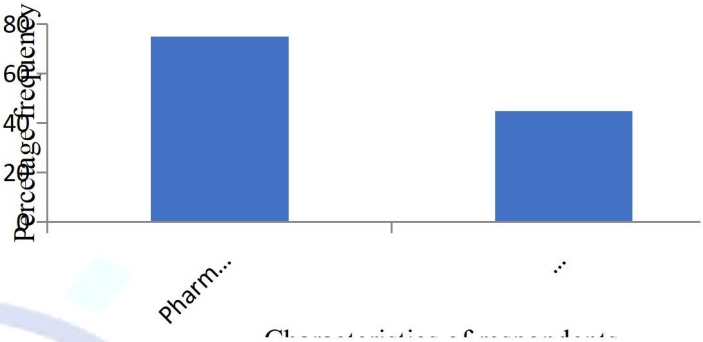

Figure 4: Pharmacists' encounter and self-assessed confidence in spotting out counterfeit drugs

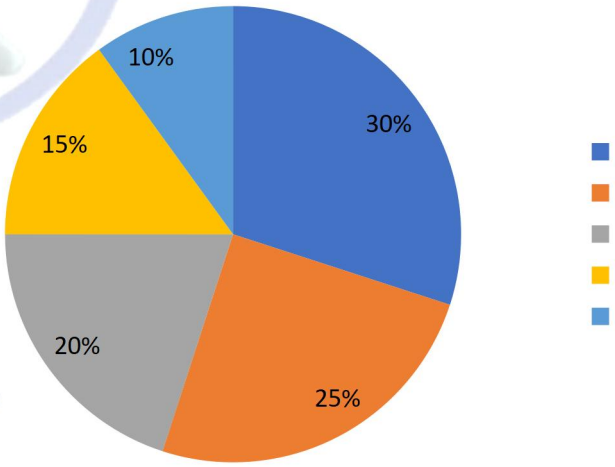

Figure 5: Pharmacists perceived distribution of spotted counterfeit medications

Discussion

.The issue of counterfeit drugs is a critical concern for both public health and economic stability in developing countries like Nigeria. This study aimed to investigate the prevalence and patterns of counterfeit drug sales in Uyo Metropolis, with a focus on the knowledge, attitudes, and practices of pharmacists and sales personnel, as well as the regulatory environment. The findings revealed alarming trends in the sale of counterfeit drugs, which have serious implications for patient safety, healthcare quality, and economic stability [9].

systems. These guidelines are essential in promoting patient safety, optimizing medication therapy, and ensuring the efficient operation of pharmacy services [39].

The key areas covered by the ASHP guidelines are briefly examined in this review.

Medication safety and error prevention

ASHP guidelines emphasize the importance of a culture of safety in health systems, focusing on reducing medication errors through error reporting systems to track and address medication-related incidents, standardized protocols for medication preparation, dispensing, and administration to minimize the risk of human error, the use of technology, such as computerized physician order entry (CPOE), barcode scanning, and automated dispensing cabinets (ADC), all geared towards enhancing accuracy in medication use [41].

Pharmacist's role in patient care

The guidelines highlight the expanding role of pharmacists in direct patient care. The key recommendations include pharmacist-led patient education on medication usage, side effects, and adherence, pharmacists' participation in multidisciplinary teams, providing expertise in pharmacotherapy management, drug interactions, and monitoring, pharmacists' involvement in clinical decision-making, especially in complex drug regimens like those involving oncology, pediatrics, and critical care, sterile and non-sterile compounding [42]. The guidelines provide and spell out specific protocols for aseptic techniques in sterile compounding (e.g., chemotherapy, parenteral nutrition) and non-sterile compounding (e.g., creams, ointments). The guidelines focus on maintaining clean and controlled environments for compounding, following Good Manufacturing Practices (GMP) for sterile and non-sterile products, and ensuring appropriate storage and labeling of compounded products to avoid contamination and misuse [43].

Pharmaceutical care in special populations

ASHP guidelines also emphasize personalized pharmaceutical care for specific populations, such as in paediatrics addressing the unique pharmacokinetic and pharmacodynamic considerations in children, geriatrics: focusing on polypharmacy, drug-drug interactions, and adjusting medications for age-related physiological changes, in pregnancy and lactation ensuring that drug therapies are safe for expectant or breastfeeding mothers [44].

Pharmacy staffing and resource allocation

The guidelines offer recommendations for adequate staffing levels, training, and professional development to ensure that health-system pharmacists are equipped to handle complex and evolving demands. This includes ensuring sufficient pharmacists per patient ratio to maintain high-quality care, alongside continuous education and certification programs to keep up with advancements in pharmacotherapy and emerging drug therapies [45].

Drug shortages and medication management

ASHP guidelines provide strategies for dealing with drug shortages, a common issue in healthcare settings, which can compromise patient care. Suggested measures include alternative therapy options for patients during shortages, collaborating with manufacturers and distributors to manage and mitigate shortages, and developing inventory management strategies to maintain an uninterrupted supply of essential drugs [46].

Quality Assurance and continuous improvement

The guidelines advocate for ongoing quality improvement programs within pharmacy departments, with focus on regular audits of medication usage and dispensing practices, using data to inform and improve clinical pharmacy services, and engaging in benchmarking with other institutions to identify best practices and opportunities for improvement [47].

Ethical and legal considerations

ASHP guidelines stress the importance of pharmacists practicing within the legal and ethical framework of the profession. This includes ensuring patient confidentiality and handling personal health information appropriately, adhering to federal and state regulations governing the distribution and use of controlled substances, and providing ethical guidance in situations where drug therapy may be controversial or where patient autonomy in conflict with clinical recommendations [48].

Pharmacovigilance and drug monitoring

Monitoring drug safety post-market is a key component of ASHP's guidelines. Pharmacists are encouraged to: Participate in pharmacovigilance programs, collecting data on adverse drug reactions (ADRs) and reporting them to regulatory bodies like the FDA, Monitor drug efficacy through therapeutic drug monitoring (TDM), ensuring that patients are receiving optimal doses for their conditions [49].

Pharmacy practice training and curricular

There are over twenty schools of pharmacy in Nigeria with different nomenclature for the department where pharmacy practice and training in pharmaceutical care are offered. The variation in the nomenclature is a sign of the focus of training and emphasis area. This explains why there are lapses and the problems confronting the concept of standardized practice [50].

The National Universities Commission Benchmark is merely to guide in developing the courses to instruct students who wants to study to become pharmacists. A professional guideline that emphasizes a standardized

practice is therefore required to give a one-product service delivery across the various practice setting. Currently, we have a system approach to schools that treats subjects as objects. As Aristotle says "education is a political issue", other interests have taken the content of the curriculum government determined curriculum spells out what schools should be doing and how they should be doing it. A standardized curriculum is the idea that all schools nationwide set the curriculum that they teach to their students so each one will be on the same level as the other [51].

Challenges to the effective discharge of PC

The barriers to establishing a direct relationship with the patient during pharmaceutical care are multi-faceted. The patient's need and desired outcome can only be established sometimes with the impute of the family members, caregivers, and other members of the healthcare team. In some community settings, pharmacists do not have access to hospital records for continuity of care. The data for monitoring of medication therapy need to be available with an understanding within organizations (formal and informal). A standardized protocol therefore needs to be in place. This may be from community practice to hospital and vice-versa [52].

It is ideal to have a comprehensive database for all patients. The health system's policies and procedures, therefore, should aim at a standardized method of storage and retrieval of patient information for a consistent and informed practice [53].

The system of recording patient-specific data has been found to vary widely depending on the practitioners' preferences and practices setting. A standardized protocol for adding information to the patient's health record should be established for continuity-of-care. Information on patient's health records is meant to be accessed from different professionals. The system operating now does not allow coordinated access to a comprehensive view for a full discharge of responsibility. After all, the healthcare concept is a wholesome focus [55].

Conclusion

The ASHP guidelines aim to support health-system pharmacists in delivering the highest standard of patient care by focusing on safety, efficiency, and quality. Through these comprehensive guidelines, ASHP provides a roadmap for integrating pharmacists into patient care teams, enhancing the use of medications, and improving overall healthcare outcomes. The guidelines also advocate for a proactive approach to emerging challenges, such as drug shortages and counterfeit drugs, helping to ensure that patients receive safe, effective, and timely care.

Ethical Consideration

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request. All data supporting the findings of this study have been included within the article and its supplementary materials, where applicable.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Compliance with ethical guidelines

This study was conducted in accordance with ethical standards as outlined in the Declaration of Helsinki and/or relevant institutional and national research committee guidelines. Ethical approval was obtained from the appropriate institutional review board, and informed consent was obtained from all individual participants included in the study.

Authors' contributions

All authors contributed significantly to the conception, design, execution, and/or interpretation of the research. Author SOA was responsible for the conceptualization, methodology, data collection, Author JIA handled data analysis and interpretation, and Author AEA contributed to the drafting and revising of the manuscript. All authors reviewed and approved the final version of the manuscript.

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