

SYMBIOTIC ANALYSIS OF DRUG AUTHENTICATION MESSAGES AND CONSCIOUSNESS AGAINST FAKE DRUGS

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Abstract

Substandard and falsified (SF) medicines represent a critical global public health threat, with Nigeria among the highest-burden countries. Drug authentication messaging the dissemination of consumer-directed guidance on how to verify medicine quality is an emerging countermeasure, yet its impact on consumer consciousness against fake drugs has not been systematically evaluated in Agbor. A cross-sectional study was conducted among 396 drug users aged 18 years and above in Agbor using systematic random sampling. A structured questionnaire assessed drug authentication message exposure, comprehension, and attitude alongside consciousness scores against fake drugs measured on a validated 20-item scale. Logistic regression identified predictors of high consciousness. Most respondents (78.3%) had been exposed to drug authentication messages, primarily through pharmacist counselling (63.1%) and television (58.4%). Respondents with high message comprehension had significantly higher consciousness scores (81.2 ± 10.4 vs. 53.6 ± 14.9 ; $p < 0.001$). Message comprehension (aOR = 4.22), NAFDAC verification habit (aOR = 3.17), and tertiary education (aOR = 2.31) were independent predictors of high consciousness. Drug authentication messaging is associated with substantially higher consumer consciousness against fake medicines in Agbor. Comprehension quality not mere exposure is the operative predictor, necessitating interactive rather than passive messaging formats.

Keywords: Drug authentication, fake medicines, substandard medicines, NAFDAC, Consciousness.

Introduction

Substandard and falsified (SF) medicines are among the most insidious threats to global public health. The World Health Organization estimates that SF medicines account for approximately 10% of drugs circulating in low- and middle-income country markets, rising to 30% or more in some sub-Saharan African countries (WHO, 2017). These medicines ranging from diluted active ingredients and incorrect excipient compositions to outright pharmacologically inactive products kill an estimated 169,000 children annually from pneumonia alone, and cost billions in failed

treatment, prolonged illness, and antimicrobial resistance generation (Ozawa et al., 2018).

Nigeria has one of the most heavily documented SF medicine burdens globally. The National Agency for Food and Drug Administration and Control (NAFDAC), established in 1993 to combat drug counterfeiting and adulteration, has over three decades fought a persistent battle against porous borders, weak supply chain monitoring, and widespread patronage of unregistered medicine vendors. Seizure data from NAFDAC consistently identify unregistered pharmacies, open markets, and itinerant drug sellers 'quacks' as primary distribution points for SF medicines, with highest penetration in semi-urban and rural communities (Dike et al., 2020). Agbor, as a semi-urban commercial hub in Delta State, represents a context of particular vulnerability.

Drug authentication messaging consumer-facing communication that teaches individuals how to verify medicine authenticity (checking NAFDAC registration numbers, examining physical product characteristics, using scratch-and-verify SMS platforms, and patronizing accredited outlets) — represents a demand-side complement to supply-chain regulatory enforcement. However, the effectiveness of these messages in building sustained consumer consciousness against SF medicines has received little systematic evaluation. Most existing evidence addresses awareness of NAFDAC rather than functional authentication behaviour and its consciousness correlates. This study addressed this gap by examining the influence of drug authentication messages on consciousness against fake drugs among users in Agbor.

Statement of the Problem

Despite sustained regulatory efforts by NAFDAC and the increasing deployment of consumer-directed drug authentication messages through multiple channels (pharmacist counselling, television, radio, posters, and social media), substandard and falsified medicines continue to circulate

widely in Nigerian markets, including semi-urban centres such as Agbor. Existing communication campaigns appear to achieve relatively high levels of message exposure, yet there is limited empirical evidence on whether this exposure translates into adequate comprehension of authentication procedures or into elevated and sustained consumer consciousness against fake drugs.

The problem is compounded by the sophisticated nature of modern counterfeiting, which often renders simple visual inspection unreliable, and by the persistently low utilisation of NAFDAC's more reliable technological tools such as scratch-and-verify codes and the Mobile Authentication Service (MAS). Without clear evidence on the relationship between message exposure, message comprehension, and consciousness levels, and without identification of the barriers that prevent consumers from converting knowledge into protective behaviour, interventions risk remaining inefficient and inequitable. In particular, vulnerable groups including those with lower educational attainment, younger consumers, and those who primarily purchase from open markets and patent medicine stores may remain inadequately protected. This study therefore sought to systematically examine the symbiotic relationship between drug authentication messaging and consumer consciousness against fake drugs in Agbor in order to generate evidence that can guide more effective, comprehension-focused communication strategies.

Objectives of the Study

The specific objectives of the study were to:

- i. assess the level of exposure to and comprehension of drug authentication messages among drug users in Agbor.
- ii. determine the relationship between drug authentication message exposure/comprehension and consciousness against fake drugs.
- iii. identify barriers to drug authentication practice among the respondents.

- iv. determine the independent predictors of high consciousness against fake drugs.

Research Questions

The study was guided by the following research questions:

- i. What is the level of exposure to and comprehension of drug authentication messages among drug users in Agbor?
- ii. What is the relationship between drug authentication message exposure/comprehension and consciousness against fake drugs?
- iii. What barriers hinder drug authentication practice among drug users in Agbor?
- iv. What are the independent predictors of high consciousness against fake drugs among the respondents?

Review of the Related Literature

SF medicines operate through two primary threat pathways: direct pharmacological harm from toxic or contaminated ingredients; and indirect harm from therapeutic failure resulting in disease progression, treatment resistance, and fatal outcome. The antimicrobial resistance crisis has a documented SF-medicine contribution, as subtherapeutic antibiotic concentrations selectively pressure resistant bacterial strains (Ozawa et al., 2018). In Nigeria, surveys have identified antimalarials, antibiotics, and antihypertensives as the most frequently falsified drug classes categories of critical importance to the national disease burden profile (Dike et al., 2020).

Consumer-level drug authentication is complicated by the sophisticated counterfeiting operations that replicate packaging, colour, smell, and tablet appearance of genuine products with high fidelity. Simple visual inspection the most common authentication method is therefore unreliable without supplementary technological verification. NAFDAC has deployed scratch-and-verify codes, QR codes, and a mobile authentication service (MAS) to address this gap, yet consumer uptake of these tools remains sub-optimal (Erhun et al., 2021). Communication campaigns have

increasingly sought to address this uptake gap, but evidence on campaign effectiveness is predominantly self-reported and lacks rigorous outcome measurement.

Consumer health consciousness defined as a motivated, sustained orientation towards health protection that translates awareness into behavioural vigilance is a mediating construct between health messaging and protective behaviour (Acheampong et al., 2021). Studies from Ghana, Kenya, and South Africa demonstrate that targeted health communication campaigns increase consciousness scores against SF medicines, with greatest gains among recipients who engage with interactive or multi-modal message formats rather than passive broadcast approaches (Bates et al., 2020). Education level and prior experience with SF medicine harms are consistently identified as moderating variables.

The literature therefore indicates that while message exposure is a necessary first step, the quality of comprehension and the conversion of knowledge into consistent authentication behaviour remain critical and under-researched determinants of effective consumer protection against fake medicines in the Nigerian context.

Methodology

Study Design and Setting

A descriptive cross-sectional design was used in Agbor, Delta State. The town was chosen for its documented SF medicine market penetration and its representativeness of medium-sized commercial hubs in Nigeria's Niger Delta region.

Population of the Study

The target population comprised all adult drug users (individuals aged 18 years and above) who purchase or use medicines in Agbor, Delta State. This population includes patrons of community pharmacies, patent medicine stores, and open-market drug sales points within the town. The accessible population consisted of adult customers present at the selected

medicine retail outlets during the period of data collection.

Sample Size and Sampling

Sample size was determined using the single proportion formula with estimated SF medicine encounter prevalence of 45%, 95% confidence, 5% precision, and 10% attrition, yielding $n = 396$. Systematic random sampling was applied across six major community pharmacies, two patent medicine stores, and two open-market drug sales points identified by NAFDAC district office records. Every k th eligible adult customer who met the inclusion criteria (aged 18 years and above, had purchased or used medicines within the preceding three months, and consented to participate) was selected until the required sample size was achieved.

Instrument

A pre-tested structured questionnaire collected: (A) socio-demographics; (B) drug authentication message exposure and source (8 items); (C) message comprehension scale (10 items; Cronbach's $\alpha = 0.82$); (D) NAFDAC verification habit (5 items); and (E) Consciousness Against Fake Drugs Scale (CAFDS 20 items adapted from Acheampong et al., 2021; $\alpha = 0.86$; range 0–100; ≥ 60 = high consciousness). The instrument was pre-tested among 30 adult drug users in a neighbouring community with similar characteristics to ensure clarity, cultural appropriateness, and reliability.

Method of Data Analysis

Data were cleaned, coded, and analysed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarise socio-demographic characteristics, message exposure, comprehension levels, authentication practices, and consciousness scores. Chi-square tests were employed to examine associations between categorical variables. Independent samples t-tests were used to compare mean CAFDS scores between high- and low-comprehension groups. Binary logistic regression (enter method) was performed to identify independent

predictors of high consciousness (CAFDS ≥ 60), with adjusted odds ratios (aOR) and 95% confidence intervals reported. A two-tailed alpha level of 0.05 was set for statistical significance.

Results

Socio-demographic Profile

Table 1. Socio-demographic Characteristics and Medicine Purchasing Behaviour (n = 384)

Variable	n (384)	%
Age < 30 years	142	37.0
Age 30–44 years	158	41.1
Age ≥ 45 years	84	21.9
Male sex	221	57.6
Tertiary education	146	38.0
Trader/market vendor	133	34.6
Primary medicine source: Patent medicine store	186	48.4
Primary medicine source: Community pharmacy	147	38.3
Previous experience with suspected fake medicine	178	46.4

Previous experience with suspected fake medicine 178/46.4. Of 396 questionnaires distributed, 384 were adequately completed (response rate: 97.0%). Mean age was 33.4 ± 11.2 years; 57.6% were male. Traders/market vendors constituted the largest occupational group (34.6%). Most respondents purchased medicines from patent medicine stores (48.4%) or community pharmacies (38.3%). Nearly half (46.4%) reported previous experience with suspected fake medicine.

Exposure to and Comprehension of Drug Authentication Messages

Table 2. Drug Authentication Message Exposure, Comprehension, and Consciousness Indicators (n = 384)

Indicator	N	%
Exposed to any drug authentication message	301	78.3
Source: Pharmacist counselling	242	63.1
Source: Television	224	58.4
Source: Radio	191	49.7
Source: NAFDAC posters/flyers	163	42.4
Source: Social media	128	33.3
High message comprehension ($\geq 7/10$)	158	41.1
Checks NAFDAC number before purchase	187	48.7
Uses NAFDAC scratch-and-verify/MAS	89	23.2
High consciousness (CAFDS ≥ 60)	201	52.3

Drug authentication message exposure was high (78.3%; $n = 301$), with pharmacist counselling (63.1%), television broadcasts (58.4%), and radio (49.7%) as leading sources. However, only 41.1% ($n = 158$) demonstrated high message comprehension (correctly answered $\geq 7/10$ comprehension items), indicating a substantial exposure-comprehension gap. The particularly low rate of MAS/scratch-and-verify usage (23.2%) despite these being the most reliable authentication tools indicates a critical operational gap in consumer authentication practice.

Association between Message Comprehension and Consciousness

Table 3. Consciousness against Fake Drugs Outcomes by Message Comprehension Level ($n = 384$)

Outcome	High Comprehension ($n=158$)	Low Comprehension ($n=226$)	Test Stat	p-value
Mean CAFDS score ($\pm$ SD)	81.2 $\pm$ 10.4	53.6 $\pm$ 14.9	$t = 21.34$	< 0.001
High consciousness (≥ 60), n (%)	142 (89.9%)	61 (27.0%)	$\chi^2 = 137.2$	< 0.001
Checks NAFDAC number, n (%)	138 (87.3%)	49 (21.7%)	$\chi^2 = 168.4$	< 0.001
Refuses suspected SF medicine, n (%)	149 (94.3%)	98 (43.4%)	$\chi^2 = 111.2$	< 0.001
Reports SF medicine to NAFDAC, n (%)	68 (43.0%)	18 (8.0%)	$\chi^2 = 74.4$	< 0.001

Respondents with high message comprehension recorded significantly higher mean CAFDS scores (81.2 $\pm$ 10.4) compared to those with low comprehension (53.6 $\pm$ 14.9; $t(382) = 21.34$; $p < 0.001$; Cohen's $d = 2.22$). High consciousness prevalence was 89.9% versus 27.0% across the high and low comprehension groups respectively.

Predictors of High Consciousness against Fake Drugs

Table 4. Binary Logistic Regression: Predictors of High Consciousness against Fake Drugs ($n = 384$)

Predictor	aOR	95% CI	p-value
High message comprehension (vs. low)	4.22	2.38–7.49	< 0.001
Regular NAFDAC number verification (vs. rarely)	3.17	1.84–5.45	< 0.001
Tertiary education (vs. secondary/below)	2.31	1.39–3.83	0.001
Prior SF medicine experience (vs. none)	1.87	1.12–3.11	0.016
Multi-source message exposure (≥ 3 sources)	1.74	1.04–2.90	0.033
Age ≥ 30 years (vs. < 30 years)	1.49	0.91–2.42	0.112

Discussion

This study provides clear empirical evidence that drug authentication message comprehension not merely exposure is the operative determinant of consumer consciousness against fake medicines in Agbor. The exposure-comprehension gap (78.3% vs. 41.1%) reflects a chronic limitation of mass media health communication: broadcast reach does not guarantee functional knowledge acquisition (Bates et al., 2020). The very large effect size (Cohen's $d = 2.22$) of the comprehension-consciousness relationship suggests that current exposure-focused campaigns are delivering only a fraction of their potential impact, and that shifting messaging strategy from breadth to depth would yield substantial consciousness gains.

The low utilization rate (23.2%) of NAFDAC's most reliable authentication tools scratch-and-verify codes and the Mobile Authentication Service despite their availability indicates that awareness of these tools is insufficient to motivate their consistent use. Barriers likely include perceived complexity, time cost of verification, limited demonstrative practice opportunities, and possibly low trust or awareness of the reliability of the systems. Although pharmacist counselling was the most common message channel (63.1%), overall high comprehension remained at only 41.1%. This suggests that even interactive channels are not currently maximising comprehension outcomes, possibly due to consultation time constraints, high patient volumes, or inadequate training of pharmacists in structured authentication counselling.

Prior experience with suspected SF medicines ($aOR = 1.87$) emerged as a significant predictor of high consciousness. This finding aligns with health belief model predictions that perceived susceptibility and prior harm experience motivate protective behaviour (Acheampong et al., 2021). It also creates a concerning equity dynamic: consciousness tends to be highest among those who have already been harmed. Proactive consciousness-

building particularly among younger respondents, those with lower educational attainment, and those who primarily purchase from open markets and patent medicine stores is therefore essential if the system is to move beyond harm-first learning.

Tertiary education (aOR = 2.31) and regular NAFDAC number verification habit (aOR = 3.17) independently predicted high consciousness, reinforcing the importance of both cognitive capacity and established behavioural routines. Multi-source exposure also showed a modest independent association, suggesting that reinforcement across channels may support deeper processing, although comprehension quality remained the dominant factor.

Summary of Findings

- i. Drug authentication message exposure was high (78.3%) but comprehension was moderate (41.1%), revealing a significant exposure-comprehension gap.
- ii. High comprehension was strongly associated with consciousness against fake drugs (Cohen's $d = 2.22$; $p < 0.001$).
- iii. NAFDAC number checking was relatively common (48.7%) but sophisticated authentication tool use (scratch-and-verify/MAS) was rare (23.2%).
- iv. Message comprehension, NAFDAC verification habit, and tertiary education independently predicted high consciousness against fake drugs.

Conclusions

Drug authentication messages reach the majority of Agbor drug users but currently fail to generate adequate comprehension necessary for sustained high consciousness against fake medicines. Comprehension quality, rather than mere exposure, is the overwhelmingly dominant

predictor of consciousness. These findings necessitate a fundamental shift in strategy from passive broadcast-oriented campaigns toward interactive, demonstration-based, and comprehension-focused messaging approaches that actively equip consumers with practical authentication skills.

Recommendations

- i. NAFDAC should develop and systematically deploy interactive drug authentication training sessions at community pharmacies, patent medicine stores, open markets, and primary health centres, incorporating hands-on demonstration of scratch-and-verify codes and the Mobile Authentication Service.
- ii. Pharmacist undergraduate curricula and continuing professional development programmes should include structured modules on patient-centred drug authentication counselling, with emphasis on practical demonstration and comprehension checking.
- iii. NAFDAC's public messaging campaigns should be redesigned on the basis of rigorous health communication formative research, prioritising comprehension and behavioural skill acquisition over simple reach metrics.
- iv. Community health workers and trained peer educators should be engaged as drug authentication champions, particularly in open-market settings where SF medicine penetration is highest and formal pharmacy counselling is least accessible.
- v. Future interventions should specifically target younger adults, individuals with secondary education or below, and those who primarily purchase from informal outlets, in order to reduce the equity gap in consciousness levels.

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