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Physician perspectives on antimicrobial resistance and stewardship in Nigeria's private healthcare sector: a cross-sectional survey study

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Abstract

Background

Antimicrobial resistance (AMR) is a major global health threat driven in part by inappropriate antimicrobial use. In Nigeria, limited diagnostic capacity and inconsistent training in antimicrobial stewardship contribute to suboptimal prescribing practices, particularly in the private sector, which delivers most healthcare services. This study explored private-sector physicians' knowledge, attitudes, prescribing behaviours, and training experiences related to AMR and antimicrobial stewardship.

Methods

We conducted a cross-sectional survey of licensed physicians randomly selected from private healthcare facilities in Lagos State and the Federal Capital Territory (FCT). Data were collected through a self-administered web-based questionnaire and analysed descriptively. Findings were interpreted using the Consolidated Framework for Implementation Research.

Results

Of 172 physicians invited, 153 participated. While 70.6% reported awareness of AMR and 87.6% correctly defined it, only half had received formal training in appropriate antimicrobial use. Despite this, attitudes toward stewardship were highly positive, with 98.7% expressing interest in further training. Reported barriers included limited diagnostic capacity, regulatory gaps, and financial constraints.

Conclusion

Private-sector physicians in Nigeria demonstrate awareness of AMR and strong interest in stewardship, but important training gaps and structural barriers persist. Integrating accessible, context-specific stewardship education into continuing professional development may support improved prescribing practices in private healthcare settings.

Background

Antimicrobial resistance (AMR) is a growing global health crisis, directly responsible for an estimated 1.27 million deaths annually and contributing to almost five million additional annual deaths worldwide. [1] In response, the World Health Organization (WHO) launched the Global Action Plan on AMR in 2015, urging Member States to develop national strategies focused on surveillance, regulation of antimicrobial use, and public education.[1]

A decade later, AMR remains a major global challenge particularly in low- and middle-income countries (LMICs), where infectious disease burden, weak health systems, and limited access to diagnostics contribute to excessive and often inappropriate antimicrobial use.[2] While high-income countries have made greater progress with respect to antimicrobial stewardship programs, LMICs continue to face challenges due to fractured and under-resourced implementation efforts.[3]

In Sub-Saharan Africa, resistance rates are rising constantly, [4] yet stewardship policies remain scarce and inconsistently applied.[4,5] Stewardship interventions are often ineffective when they fail to account for prescribers' day to day clinical realities, including resource constraints and patient expectations.[6] Evidence suggests that successful stewardship initiatives must be context-specific, locally adapted, and supported over time, with implementation strategies that align with local organizational and health-system realities.[7] However, systemic barriers, such as shortages of trained personnel, limited financing, inadequate political commitment, and competing health priorities, have hindered stewardship implementation across LMICs.[8] Even when healthcare providers are aware of AMR, inappropriate prescribing remains common, especially in settings with limited medical resources and strong patient pressure.[9]

Nigeria faces a particularly severe AMR crisis, driven by widespread antimicrobial misuse, limited diagnostic and surveillance infrastructure, and weak regulatory oversight.[10,11] Although the country first adopted a national action plan for AMR in 2017, subsequently revised in 2024, its implementation has been uneven, particularly in the private sector, which accounts for over 60% of healthcare delivery.[12] Private healthcare facilities often lack formal stewardship programs and operate in a context of unregulated antibiotic sales and inadequate enforcement of prescription regulations.[13]Recent studies estimated that over 70% of antimicrobials prescribed in Nigerian hospitals are issued without adherence to clinical guidelines or adequate supervision.[14] While national AMR strategies exist, their reach remains limited at the primary and secondary care levels, and particularly weak within the private sector.[15]

Despite their central role in healthcare delivery, private-sector providers have been largely overlooked in Nigeria's AMR response. Research and policy efforts have predominantly focused on public-sector and tertiary-care institutions, with limited attention to stewardship implementation in private healthcare settings.[16] As a result, there is limited evidence on how physicians in the private sector perceive AMR, make prescribing decisions, and navigate the organizational and system-level factors that influence antimicrobial stewardship implementation. Better understanding these factors is essential for designing contextually appropriate stewardship strategies in mixed health systems.

This study addresses this critical gap by exploring private-sector physicians' perspectives on AMR and stewardship in Nigeria. We conducted a survey of physicians practicing in private healthcare facilities in two Nigerian states (Federal Capital Territory [FCT] and Lagos) to: 1) assess their knowledge and attitudes toward AMR and antibiotic prescribing, and 2) examine factors that may influence the implementation of antimicrobial stewardship initiatives in private healthcare settings. By examining

stewardship readiness through the lens of implementation science, this study aims to identify individual, organizational, and system-level determinants that may facilitate or hinder stewardship efforts. Evidence from the private sector can inform stewardship policy, professional regulation, service delivery strategies, and capacity-strengthening initiatives in Nigeria and other LMICs where private providers play a substantial role in healthcare delivery.

Methods

Study design and setting

We conducted a cross-sectional survey among physicians working in private healthcare facilities in Nigeria. We followed the Consensus-based Checklist for Reporting Survey Studies (CROSS Checklist) (See Supplementary File 1).

Data were collected between 4 September and 2 December 2024 from 75 facilities located in 17 Local Government Areas (LGAs, i.e., administrative divisions covering approximately half a million people each) across two states: the Federal Capital Territory (FCT, Abuja) and Lagos State.

In Lagos State, 12 out of 37 LGAs were conveniently selected to capture a mixture of urban, suburban, and rural settings, with contextual variation in healthcare delivery environments. Within these LGAs, 27 private healthcare facilities selected by random sampling were distributed as follows: Eti-Osa (5), Ibeju-Lekki (1), Ojodu Local Council Development Area (1), Ojokoro Local Council Development Area (1), Ikeja (2), Ikorodu (2), Kosofe (3), Surulere (3), Ojo (3), Ajeromi-Ifelodun (1), Alimosho (3), and Ifako-Ijaiye (2).

In the FCT, 48 private healthcare facilities were randomly sampled from five of the six LGAs: Abuja Municipal Area Council (AMAC) (22), Gwagwalada (13), Bwari (6), Kuje (6), and Kwali (1). The sixth LGA, Abaji, was excluded due to lack of geographical accessibility.

Study population and recruitment

Eligible participants were licensed physicians currently practicing exclusively in private-sector healthcare facilities, including clinics and hospitals, within the selected LGAs.

A sampling frame of private healthcare facilities was compiled in collaboration with the Institute of Human Virology Nigeria (IHVN), using data from the Health Facility Monitoring and Accreditation Agency (HEFAMAA) in Lagos State and the Private Health Establishments Registration and Monitoring Committee (PHERMC) in the FCT.

Physicians affiliated with selected facilities were invited to participate via phone or email by the IHVN team. Invitations included a link to the electronic consent form and survey questionnaire. Participants who completed the survey confirmed submission by sending a screenshot of the completion message. A modest incentive was provided to cover mobile data costs (needed to complete the web-based survey)

and compensate for time. Compensation was issued only after cross-verification between study teams to ensure completion.

Sample size

This study is part of a broader feasibility assessment in preparation of an intervention study. As such, we aimed to recruit approximately 150 participants to ensure reasonable diversity in facility types and geographic locations. To account for potential non-response, a slightly higher number of potentially eligible individuals (n = 172) were invited to participate.

Data collection

Data were collected using a self-administered, web-based questionnaire distributed via SurveyMonkey® (Momentive Inc., San Mateo, CA, USA). The survey included a mix of multiple-choice, yes/no, Likert-scale, and open-ended questions exploring participants' basic demographics, knowledge of AMR, antibiotic prescribing behaviours, prior exposure to antimicrobial stewardship-related training, and perceptions of the relevance, feasibility, and acceptability of a tailored stewardship program. The survey was designed to take approximately 15–20 minutes to complete and measures were taken to prevent multiple submissions. The full questionnaire is provided in Supplementary File 2.

Data analysis

Descriptive statistics (frequencies and percentages) were used to summarize survey responses. For key outcomes, such as AMR awareness, familiarity with stewardship, and willingness to participate in training, 95% confidence intervals (CIs) were calculated using the Wilson score method for binomial proportions.

To support interpretation and systematically identify factors relevant to future stewardship interventions, we used the updated Consolidated Framework for Implementation Research (CFIR) [17] as an analytic framework to examine individual-, organizational-, and system-level influences on antimicrobial stewardship implementation (Fig. 1). Survey findings were mapped to the five CFIR domains as follows: (1) Individuals involved (e.g., physicians' knowledge and awareness of AMR and stewardship, attitudes towards antibiotic prescribing, history of stewardship-related training, and prescribing decision-making patterns); (2) Innovation (e.g., perceived effectiveness and relevance of stewardship, willingness to participate in training, and preferences regarding training delivery formats); (3) Inner setting (characteristics of the practice environment, including years of clinical experience, facility type, direct dispensing practices, and perceived barriers to implementation); (4) Outer setting (external influences such as regulations, existing policies, and patient expectations or demands); and (5) Implementation process (perceived steps needed for successful implementation, such as readiness to engage with professional associations and other entities).

Analyses were conducted in Stata version 18 (Stata Corp LLC, College Station, TX, USA) and data visualizations were created using Tableau Desktop (version 2025.2.3; Tableau Software, Seattle, WA, USA).

Ethics Approval

Ethical approval was obtained from the University of Ottawa's Health Sciences and Science Research Ethics Board (approval n. H-06-24-10154), the Federal Capital Territory Health Research Ethics Committee (FHREC; approval n. FHREC/2024/01/138/13-06-24), and the Lagos State Health Research Ethics Committee (LSHREC; approval n. LSHREC/2024/00012). All participants provided informed consent to participate as well as possible publication before initiating the survey. All participants remained anonymous and possible identification details were removed.

Results

A total of 153 private-sector physicians completed the survey, representing an 88.9% response rate from 172 invited participants. Respondents were almost evenly distributed between the FCT (49.7%) and Lagos States (50.3%). Most participants were male (72.6%, 111/153), aged between 30 and 39 years (52.3%, 80/153), and held a medical degree without additional specialization (89.5%, 137/153) (Table 1). Based on the CFIR framework described earlier, findings are presented according to the five core domains: (i) individuals involved, (ii) innovation, (iii) inner setting, (iv) outer setting, and (v) implementation process.

Table 1
Sociodemographic characteristics of the participants.

Characteristics	Overall (N = 153)	
	n	%
Sex		
Male	111	72.5
Female	42	27.5
Age group (years)		
20–29	45	29.4
30–39	80	52.3
40–49	18	11.8
50 and above	10	6.5
Educational level		
MD/MBBS Degree	137	89.5
Clinical Specialty Diploma	10	6.5
Doctoral Degree	5	3.3
Prefer not to answer	1	0.7
Geographic area of practice		
FCT Abuja State	76	49.7
Lagos State	77	50.3

FCT, Federal Capital Territory; MBBS, Bachelor of Medicine, Bachelor of Surgery; MD, Medical Degree.

Individuals involved

Of 153 participants, 70.6% (108/153; 95% CI: 62.8–77.3) reported having knowledge of AMR, and 87.6% (134/153) correctly identified its definition as “the condition which occurs when bacteria, viruses, fungi, and parasites no longer respond to antimicrobial medicines”. However, 12.4% (19/153) selected an incorrect definition (Table 2). Similarly, 70.6% (108/153) reported being familiar with the concept of antimicrobial stewardship, while 29.4% (45/153) had never heard of it.

Table 2
Knowledge and awareness of antimicrobial resistance and stewardship among survey participants.

Characteristics	Overall (N = 153)	
	n	% (95% CI)
Knowledge about AMR		
Yes	108	70.6 (62.8–77.3)
No	45	29.4 (22.7–37.2)
Definition of AMR		
Occurs when bacteria, viruses, fungi, and parasites no longer respond to antimicrobial medicines.	134	87.6 (0.8–0.92)
Occurs only when antimicrobials are prescribed indiscriminately by primary healthcare providers or dispensed without a prescription by pharmacists and patent medicine vendors.	19	12.4 (0.08–0.19)
Occurs when germs like bacteria and fungi require the addition of antiviral and antifungal agents to work.	0	-
Familiar with the concept of antimicrobial stewardship		
Yes	108	70.6 (62.8–77.3)
No	45	29.4 (22.7–37.2)
Attended any form of training on antimicrobial prescribing and use		
Yes	75	49.0 (41.1–57.0)
No	78	51.0 (43.0-58.9)
AMR, Antimicrobial resistance.		

About half of the participants (78/153) reported never having attended any training related to antimicrobial prescribing and use. Among those, three-quarters attributed it to lack of awareness about available opportunities as the primary reason. Other barriers included limited accessibility to courses

(7.7%, 6/78) and time constraints (5.1%, 4/78). Notably, no participant cited cost or lack of interest as reasons for non-participation (See Supplementary Table S1).

Awareness of the scope and impact of AMR was high (Fig. 2). Nearly all respondents (98.7%, 151/153) agreed that AMR is a problem in Nigeria, while 86.9% (133/153) recognized it as a growing global health threat. A similar proportion (86.9%, 133/153) perceived AMR as relevant to their clinical practice, and 96.1% (147/153) agreed that it complicates treatment of bacterial infections in their country. Most participants (75.8%, 116/153) disagreed with the statement that antimicrobials should be prescribed without concern due to their life-saving nature, while 13.7% (21/153) were neutral and 9.8% (15/153) agreed (Fig. 2).

Regarding antimicrobial prescribing practices, 71.2% (109/153) reported relying on clinical and/or laboratory test results to guide antimicrobial prescribing, while 11.8% (18/153) disagreed, and 17.0% (26/153) were neutral (Fig. 3). Yet almost half (49.0%, 75/153) admitted prescribing antimicrobials when uncertain about a diagnosis, to minimize clinical risk. Although 60.8% (93/153) disagreed with prescribing antimicrobials before performing diagnostic tests to save patients time or money, 18.3% (28/153) agreed with the practice. Only 5.9% (9/153) reported prescribing based on patient requests, while 87.6% (134/153) disagreed. Nonetheless, 70.6% (108/153) stated they often rely on clinical and symptomatic indicators even in the absence of laboratory confirmation (Fig. 3).

Innovation: relevance and willingness of uptake

An overwhelming majority (98.7%, 151/153) expressed willingness to participate in stewardship training. Confidence in stewardship program effectiveness was high: 64.7% (99/153) reported being “very confident” that stewardship programs would improve antimicrobial use, and 29.4% (45/153) expressed moderate confidence. Only 5.2% (8/153) were neutral, and none indicated lack of confidence (See supplementary Figure S1).

Inner setting: experience level, facility types, direct dispensing practices, and barriers to implementation

In terms of professional experience, 41.2% (63/153) had been licensed for over five years, and nearly half (47.7%, 73/153) had worked in the private sector for 1–3 years (Table 3). Most participants (64.7%, 99/153) were employed in for-profit private hospitals or clinics, followed by facilities run by non-governmental organizations (16.9%, 26/153) and faith-based clinics or hospitals (9.8%, 15/153). Most participants (61.4%, 94/153) were primarily involved in outpatient care, while 30.7% (47/153) provided inpatient care, and around 7.2% reported other service types, including home visits.

Table 3
Experience, practice and facility types of participants

Characteristics	Overall (N = 153)	
	n	% (95% CI)
Time licensed as HCP in Nigeria		
Less than 1 year	4	2.6 (1.0-6.8)
1–3 years	53	34.6 (27.5–42.6)
4–5 years	33	21.6 (15.7–28.9)
More than 5 years	63	41.2 (33.6–49.2)
Time practiced as HCP in private sector		
Less than 1 year	11	7.2 (4.0-12.6)
1–3 years	73	47.7 (39.9–55.7)
4–5 years	24	15.7 (10.7–22.4)
More than 5 years	45	29.4 (22.7–37.2)
Type of healthcare facility		
Private Clinic/Hospital (Profit Organization)	99	64.7 (56.8–71.9)
Private Clinic/Hospital (NGO-Non-Faith-Based)	26	17 (11.8–23.9)
Faith Based Private Clinic/Hospital (NGO)	15	9.8 (6.0-15.7)
Self-Owned Private Clinic/Hospital	12	7.8 (4.5–13.4)
Others	1	0.7 (0.1–4.6)
Type of care involved		
Outpatient care	94	61.4 (53.4–68.9)
Inpatient care	47	30.7 (23.9–38.5)
Home visits	1	0.7 (0.1–4.6)
Other (please specify)	11	7.2 (4.0-12.6)

HCP, Healthcare practitioner; NGO, Non-governmental organization.

Reported prescribing frequency was high: 61.4% (94/153) indicated prescribing antimicrobials daily, and 28.8% (44/153) a few times per week (See Supplementary Table S2). Only one respondent reported never prescribing antimicrobials. Dispensation practices (i.e., provision of antimicrobials directly to the patient, without writing a prescription) varied: 58.2% (89/153) reported never dispensing antimicrobials

directly to patients, while 32.0% (49/153) did so occasionally. A small proportion reported dispensing “often” 4.6%, (7/153) or “very often” 5.2% (8/153).

Factors reported as influencing antimicrobial choice included clinical severity (80.4%, 123/153) and infection site/type (73.2%, 112/153). Economic and access issues were also mentioned: 58.8% (90/153) considered patient costs, and nearly half considered local drug availability (See supplementary Figure S2).

Participants identified several potential barriers to stewardship implementation (Fig. 4). The most frequently cited were infrastructure deficiencies and insufficient diagnostic capacity (60.1%, 92/153), lack of regulatory oversight (43.8%, 67/153), and financial pressures (41.8%, 64/153).

Outer setting and implementation process: external influences and steps needed for intervention success

Almost all participants (97.4%, 149/153) agreed that improved physician training and education are essential for supporting antimicrobial stewardship. Additionally, 76.5% (117/153) supported offering continuing education credits or professional development incentives, and 79.7% (122/153) endorsed greater collaboration between healthcare facilities to share best practices (See supplementary Figure S2). When asked which organizations and regulatory bodies should be involved in a stewardship program, participants primarily recommended the Nigerian Medical Association (89.5%, 137/153), followed by the Pharmacy Council of Nigeria (84.3%, 129/153). Punitive enforcement approaches were least favored, with only 13.7% (21/153) supporting involvement of law enforcement agencies.

Discussion

This study offers insights into the knowledge, attitudes, prescribing behaviours, and contextual factors related to antimicrobial resistance and stewardship among physicians in private healthcare facilities in two Nigerian states. Framed as an evaluation of antimicrobial stewardship readiness in everyday clinical practice, it highlights how prescribing behaviours are shaped by diagnostic constraints, regulatory environments, and organizational realities within private healthcare settings. Our findings reveal both opportunities and persistent challenges for implementing stewardship programs in this context. By using the CFIR to guide interpretation, we identify multi-level influences on prescribing practices and stewardship readiness, ranging from individual clinician perceptions to broader systemic and organizational constraints. From a health services perspective, these findings highlight how governance gaps and regulatory environments shape antimicrobial prescribing practices in private healthcare settings.

Awareness of AMR among participants was relatively high, with most respondents familiar with the concept and able to correctly identify it. This finding is consistent with previous studies in LMICs that have reported growing awareness of AMR among healthcare providers.[8,18] Interestingly, our study did

not identify patient demand as a major driver of antimicrobial prescribing: over 87% of participants disagreed with the notion that they prescribe antimicrobials solely based on patient requests. This contrasts with findings from a national survey in Nigeria, which reported that patient influence was a significant factor in prescribing decisions.[18] Our results align more closely with recent research suggesting that prescribing behaviours are shaped primarily by clinical judgment and systemic constraints rather than patient pressure.[19]

Our findings indicate that private practitioners in Nigeria are highly willing to participate in stewardship training and confident in the potential of such programs to improve prescribing practices, despite limited prior exposure to formal training opportunities. Rather than resisting stewardship efforts, participants expressed a desire for structured opportunities to engage professionally and enhance their skills, provided that these initiatives are accessible, contextually appropriate, and compatible with their daily practice realities. From a health system perspective, integrating antimicrobial stewardship training into continuing professional development pathways represents a key policy lever to support quality improvement and strengthen stewardship implementation in private healthcare settings. This aligns with evidence from both high-income and LMICs, which highlights the importance of tailoring stewardship interventions to the specific needs and resources of local healthcare systems.[19,20] These findings reinforce the central role of education and professional training as key mechanisms for supporting behaviour change and improving antimicrobial prescribing practices.

In our study, nearly two-thirds of participants expressed confidence in the effectiveness of stewardship programs, suggesting strong readiness for structured interventions. However, evidence from a recent review of stewardship efforts in LMICs emphasizes that the success of such programs depends not only on provider willingness but also on thoughtful design, particularly simplicity, adaptability, and perceived relevance to local clinical realities.[21]

Facility-level factors, practice settings, and broader systemic limitations play a critical role in shaping antimicrobial prescribing in Nigeria's private healthcare sector. In our study, more than half of respondents were relatively new to working in the private sector. While this may reflect a younger cohort of practitioners, we cannot infer whether this influences stewardship awareness or prescribing quality. Previous research has shown that prescribing behaviours are influenced by multiple factors, such as postgraduate qualification, years of clinical experience, sources and methods of updating knowledge, type of practice setting (inpatient versus outpatient), and clinical presentation (e.g., presence of fever).[22]

Notably, nearly one-third of participants reported directly dispensing antibiotics to patients, thus bypassing formal prescription channels and regulatory oversight. This practice, which has also been documented in other settings,[23] undermines stewardship efforts and reflects broader issues of weak enforcement and limited accountability. In terms of prescribing decisions, the most frequently cited influences were illness severity (80.4%) and infection site or type (73.2%), rather than patient demand, suggesting that clinical judgement remains the dominant driver. However, over half of participants indicated that patient costs and local drug availability affected their choices, highlighting how structural

and economic constraints often compel prescribers to make suboptimal yet potentially pragmatic decisions. Similar patterns have been observed in other resource-limited settings, where stockouts and affordability issues significantly shape antimicrobial prescribing behaviours.[24]

Inadequate infrastructure and diagnostic capacity were identified by 60.1% of participants as major barriers to stewardship implementation. This finding reflects a broader trend in LMIC private-sector facilities, where routine microbiological testing is often unavailable or prohibitively slow, and rapid diagnostic tools are rarely accessible. Even when laboratory services exist, turnaround times for antibiotic susceptibility test results are typically long, limiting their practical utility for clinical decision-making. Global reviews of stewardship programs in resource-limited settings [25,26] have emphasized that these inner-setting challenges cannot be addressed solely through provider education; they require targeted system-level investments and tailored implementation support to create an enabling environment for effective stewardship.

Our study suggests that successful implementation of antimicrobial stewardship in Nigeria's private sector requires more than individual provider readiness. Coordination across multiple levels, professional engagement, and regulatory alignment are critical. This is consistent with evidence from other LMICs showing that provider-focused education particularly when linked to license renewal or professional accreditation can significantly improve stewardship practices.[27] Notably, nearly 80% of participants endorsed inter-facility collaboration as a promising strategy for scaling stewardship in a context-sensitive manner. A recent study in Nigeria’s public healthcare sector similarly highlighted the need for context-specific decision-support tools to improve prescribing practices in primary healthcare, consistent with the gaps identified in our findings.[28]

Participants strongly favored stewardship programs led by or offered in close collaboration with trusted professional bodies such as the Nigerian Medical Association and the Pharmacy Council of Nigeria. This preference aligns with global experience, where professional and regulatory institutions with clinical credibility tend to gain greater trust from healthcare practitioners and are more effective in integrating stewardship policies compared to law enforcement agencies.[29] Only a small proportion of participants (13.7%) supported the involvement of the police, reflecting a general rejection of punitive or coercive enforcement in favour of collaborative, trust-based regulatory approaches.

Despite strong support for stewardship initiatives, participants highlighted persistent structural challenges that could undermine program effectiveness. These include inadequate regulatory inspections, financial pressures linked to drug dispensing, and limited diagnostic infrastructure. Addressing these foundational system-level weaknesses is essential for sustainability. Similar barriers have been documented in recent qualitative studies in Nigeria, which found that while private practitioners supported stewardship in principle, implementation was hindered by poor oversight, fragile supply chains, and commercial incentives.[30]

Our results suggest that implementing stewardship in Nigeria's private sector will require more than provider-focused interventions. System-level support is necessary, particularly investments in diagnostic capacity, clearer regulatory frameworks, and alignment of professional development with practical incentives. To ensure strategies are contextually relevant, perceived as legitimate, and widely adopted, they should be co-designed with providers, professional associations, and regulatory bodies. Such approaches should explicitly incorporate educational design principles to ensure that training interventions are effective, accessible, and responsive to providers' practice environments.

This study provides valuable insights into the potential acceptability and uptake willingness of antimicrobial stewardship initiatives in Nigeria's private healthcare sector, a critical yet often overlooked contributor to appropriate antimicrobial use. By applying the CFIR, we systematically examined multilevel factors that may influence stewardship implementation, offering practical guidance for designing and scaling interventions. By generating evidence from the private sector, this study contributes to more inclusive and context-sensitive stewardship planning in Nigeria and other LMICs, where private healthcare plays a dominant but under-researched role.

This study has several strengths, including a high response rate and a focus on the private healthcare sector, a critical but understudied component of Nigeria's health system. However, several limitations should be acknowledged. First, the study was conducted in selected areas of only two Nigerian states and was intended to produce nationally representative estimates. In Lagos state, LGAs were purposively selected to capture diverse healthcare contexts before facilities were randomly sampled within those areas. Consequently, the findings may be subject to selection bias and should not be generalized to all private-sector physicians in Nigeria. Nevertheless, the inclusion of facilities across urban, peri-urban, and rural settings in both Lagos and the Federal Capital Territory allowed us to capture a range of private healthcare environments and prescribing contexts. Second, participation was voluntary and based on self-reported survey responses, creating the possibility of response and social desirability bias, particularly for questions related to prescribing practices and stewardship behaviours. Finally, although the sample size was modest, the response rate was high (88.9%), reducing concerns regarding non-response bias and providing valuable insight into an understudied segment of the Nigerian healthcare system.

Future research should prioritize the design and pilot testing of context-specific stewardship interventions to assess their impact and acceptability among private-sector physicians and other healthcare professionals. Longitudinal studies would be valuable to evaluate behavioral changes and system-level integration of stewardship practices over time.

Conclusions

Private-sector physicians in Nigeria show awareness of AMR and high willingness to engage in stewardship initiatives. However, several persistent systemic barriers hinder consistent stewardship practices. It is encouraging that participants expressed strong support for training-based incentives,

inter-facility collaboration, and leadership from professional and regulatory bodies promising starting points for stewardship program design. This study provides foundational evidence to inform health system and policy responses aimed at advancing stewardship in Nigeria's underregulated private healthcare sector by identifying key contextual drivers and challenges. To successfully integrate stewardship into routine private care, coordinated efforts among key interest holders will be essential, with a focus on strengthening capacity through accessible, context-specific education and professional training, and leveraging trusted professional networks to ensure relevance, uptake, and sustainability.

Declarations

Authors' Contributions

SPND led project coordination, performed data management, statistical analysis and data synthesis, and drafted the manuscript. NM contributed to developing the data collection tools and supported project coordination as well as data analysis and synthesis. BU and NE contributed to conceptualizing the study and developing data collection tools and carried out participant recruitment and tracking of survey completion. CL contributed to developing the analysis plan and supported analysis. AM contributed to developing data collection tools and survey completion tracking. MT contributed to refining the data analysis plan and reporting of findings. CO contributed to conceptualize the study and developing data collection tools. GS conceptualized the study, was responsible for funding acquisition, oversaw the study design and implementation, and provided critical input during manuscript review and editing. All authors contributed to manuscript review and editing until finalization. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work.

Availability of data and materials

The data supporting the findings of this study will be made publicly available in the University of Ottawa's Borealis data repository upon acceptance.

Competing Interests

The authors declare no competing interests.

Declaration of generative AI and AI-assisted technologies in the writing process

While preparing this manuscript, the author used Microsoft Copilot to reduce word count and improve clarity. The authors reviewed all the content of this work ensuring accuracy and integrity. The authors take full responsibility for the manuscript.

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Figures

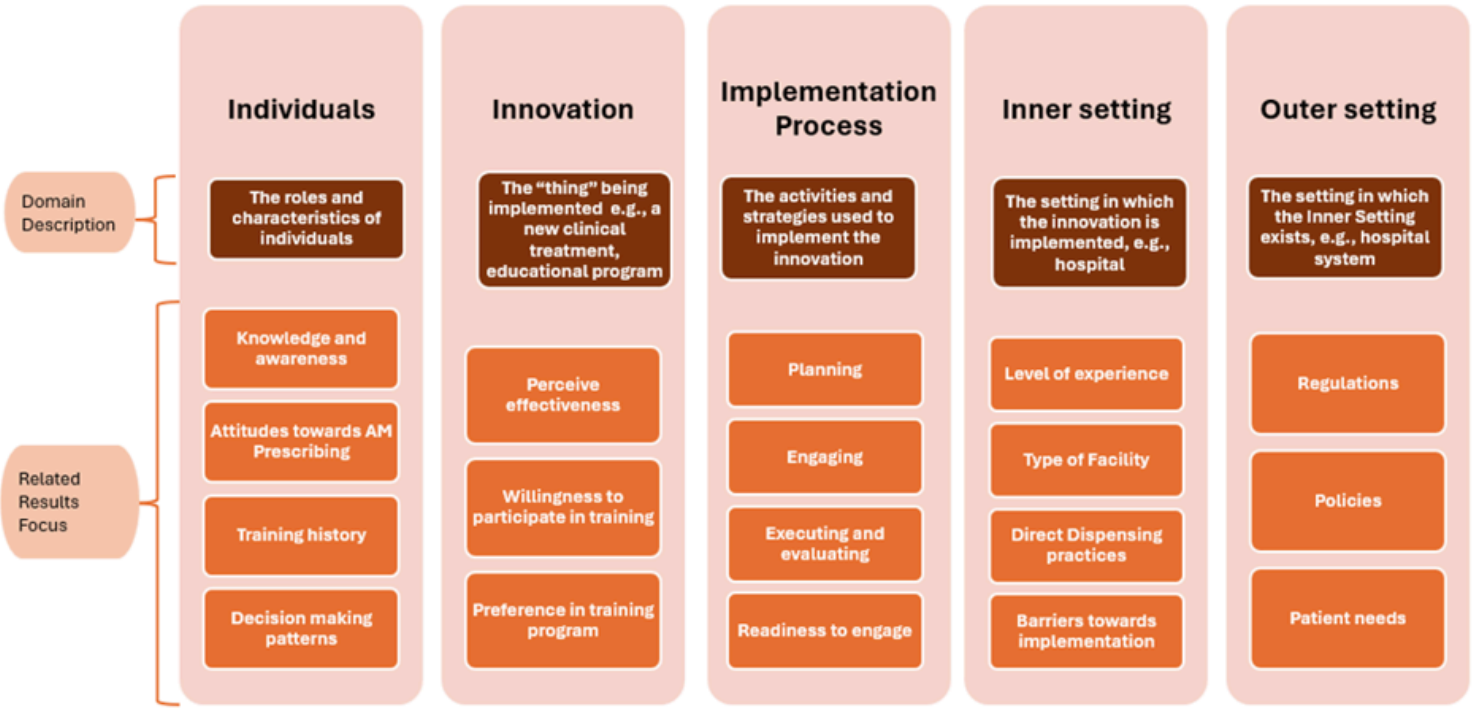
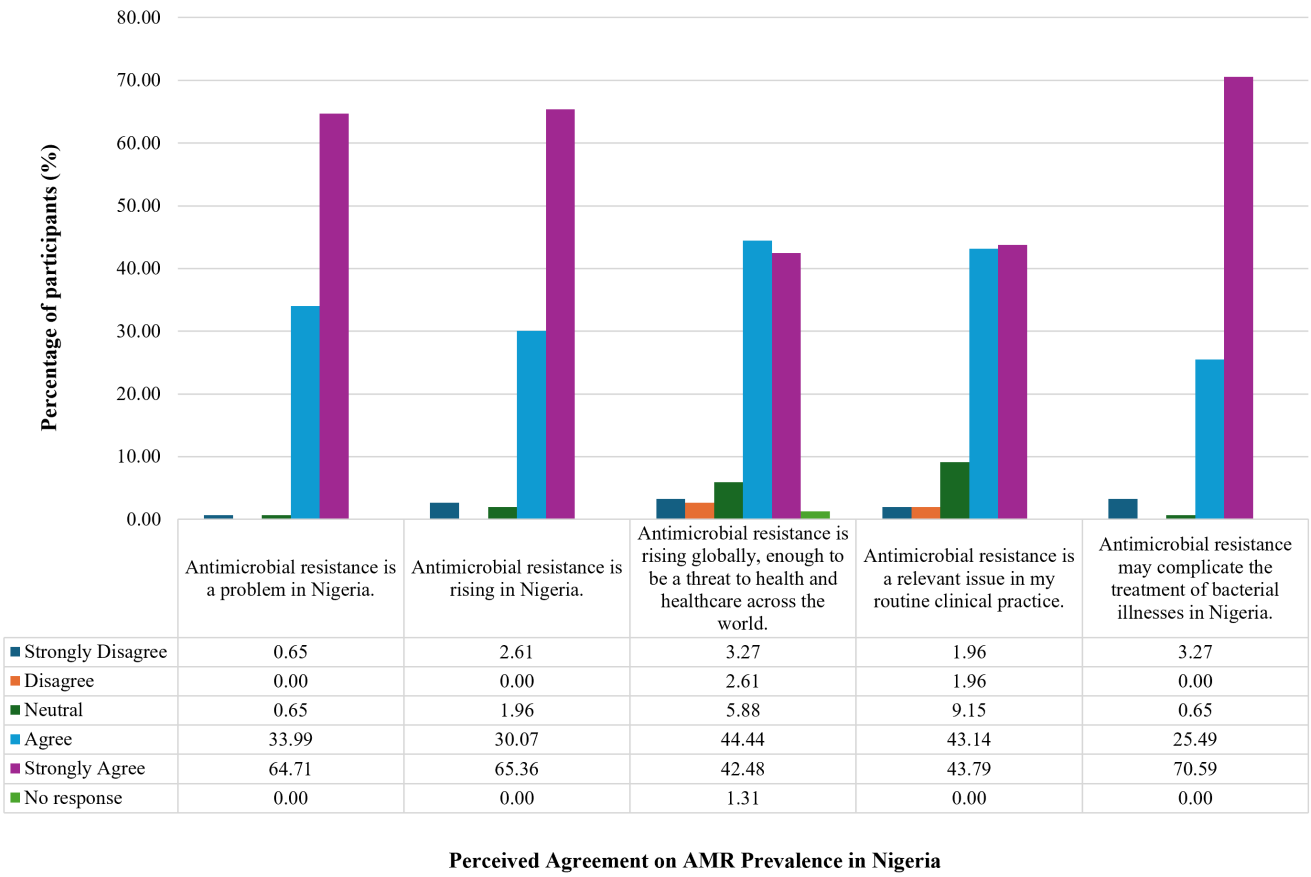


Figure 1

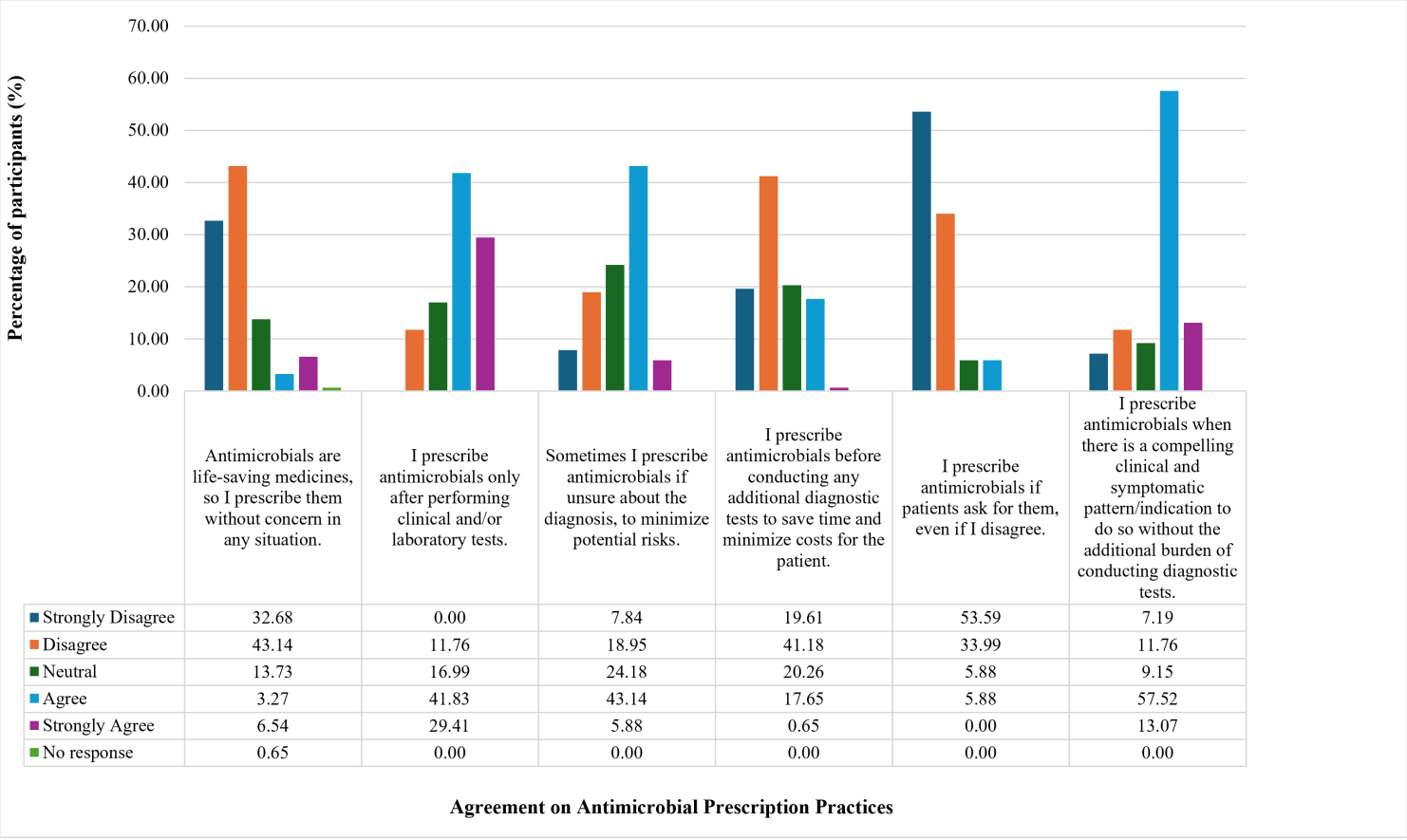
Application of the Consolidated Framework for Implementation Research (CFIR) to survey responses from physicians practicing in private healthcare facilities



	Antimicrobial resistance is a problem in Nigeria.	Antimicrobial resistance is rising in Nigeria.	Antimicrobial resistance is rising globally, enough to be a threat to health and healthcare across the world.	Antimicrobial resistance is a relevant issue in my routine clinical practice.	Antimicrobial resistance may complicate the treatment of bacterial illnesses in Nigeria.
Strongly Disagree	0.65	2.61	3.27	1.96	3.27
Disagree	0.00	0.00	2.61	1.96	0.00
Neutral	0.65	1.96	5.88	9.15	0.65
Agree	33.99	30.07	44.44	43.14	25.49
Strongly Agree	64.71	65.36	42.48	43.79	70.59
No response	0.00	0.00	1.31	0.00	0.00

Figure 2

Perceived burden of antimicrobial resistance in Nigeria (N=153).



	Antimicrobials are life-saving medicines, so I prescribe them without concern in any situation.	I prescribe antimicrobials only after performing clinical and/or laboratory tests.	Sometimes I prescribe antimicrobials if unsure about the diagnosis, to minimize potential risks.	I prescribe antimicrobials before conducting any additional diagnostic tests to save time and minimize costs for the patient.	I prescribe antimicrobials if patients ask for them, even if I disagree.	I prescribe antimicrobials when there is a compelling clinical and symptomatic pattern/indication to do so without the additional burden of conducting diagnostic tests.
Strongly Disagree	32.68	0.00	7.84	19.61	53.59	7.19
Disagree	43.14	11.76	18.95	41.18	33.99	11.76
Neutral	13.73	16.99	24.18	20.26	5.88	9.15
Agree	3.27	41.83	43.14	17.65	5.88	57.52
Strongly Agree	6.54	29.41	5.88	0.65	0.00	13.07
No response	0.65	0.00	0.00	0.00	0.00	0.00

Figure 3

Self-reported prescribing practices of antimicrobials in the private sector (N=153).

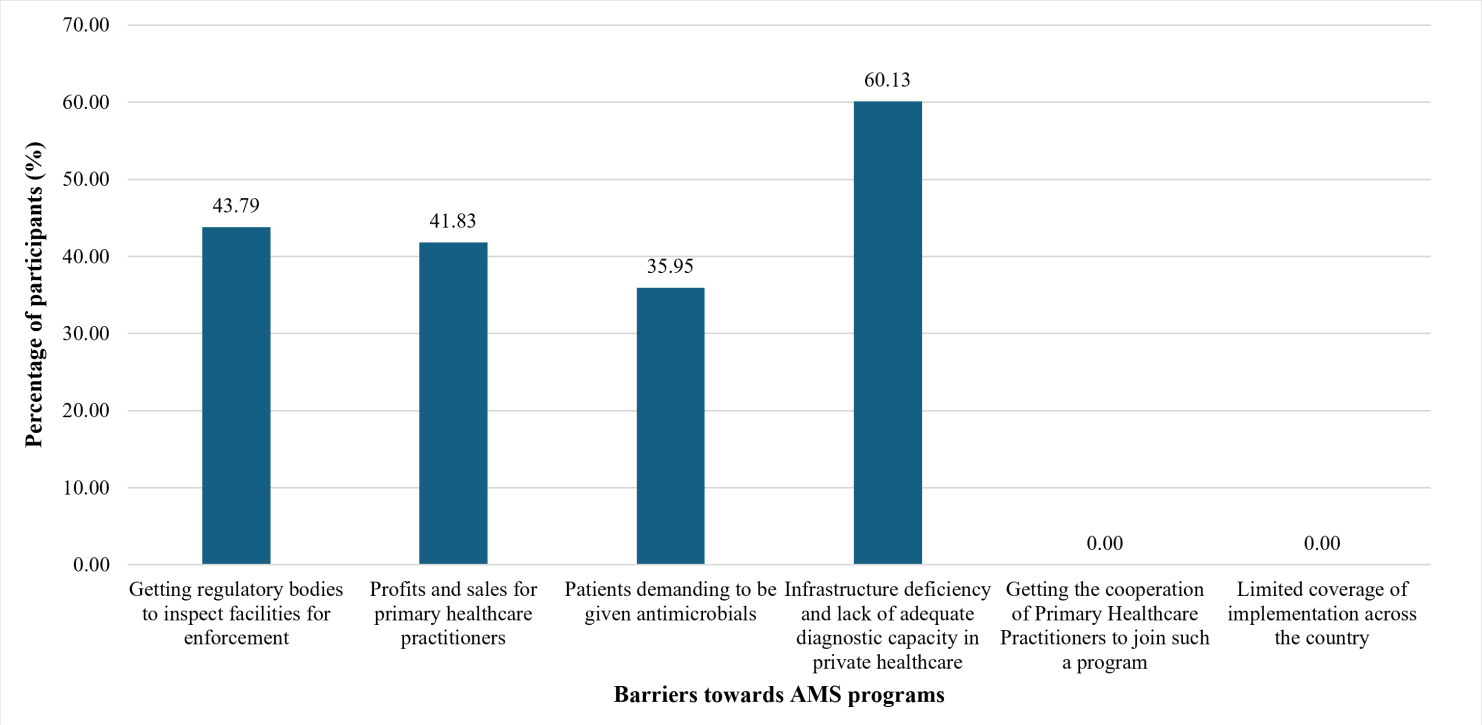


Figure 4

Systemic challenges to antimicrobial stewardship initiatives among survey participants (N=153).

Supplementary Files

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- SupplementaryMaterials.docx