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Structural drivers of antimicrobial prescribing in Nigerian healthcare: An SEM study

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Abstract
Purpose: This study examined the structural determinants of antimicrobial prescribing practices and resistance awareness among healthcare providers in Oyo State, Nigeria, addressing a critical gap in understanding how knowledge, institutional support, workload pressure, training access, and patient expectations influence prescribing behaviour.
Methodology/Design: A quantitative cross-sectional survey design was employed, grounded in the positivist paradigm. Data were collected from 298 healthcare providers (doctors, pharmacists, and nurses) across tertiary, secondary, and primary healthcare facilities using a structured questionnaire with 33 items across seven constructs. Structural equation modelling using SmartPLS 4.0 was used to test six hypotheses, assessing both measurement and structural models.
Findings/Results: All six hypotheses were supported. Knowledge positively influenced prescribing practices ($\beta = 0.34$, $t = 4.21$), as did institutional support ($\beta = 0.28$, $t = 3.56$) and training access ($\beta = 0.19$, $t = 2.45$). Workload pressure unexpectedly showed a negative relationship with inappropriate prescribing ($\beta = -0.41$, $t = 5.12$), indicating that higher workload was associated with less inappropriate prescribing. Training access strongly predicted resistance awareness ($\beta = 0.52$, $t = 6.78$), and patient expectations positively influenced prescribing practices ($\beta = 0.31$, $t = 3.89$).
Implications: Theoretical implications extend the Theory of Planned Behavior and Health Belief Model by demonstrating that environmental factors may be more powerful determinants of prescribing behaviour than individual cognitive factors. Practical implications include recommendations for mandatory AMR training, strengthening institutional support, implementing audit-and-feedback mechanisms, and public awareness campaigns targeting patient expectations.
Originality/Value: This study provides the first structural equation modelling analysis of antimicrobial prescribing determinants in southwestern Nigeria, offering a validated framework for understanding the relative importance of multiple predictors and revealing the counterintuitive protective effect of workload pressure on prescribing quality.

Keywords: Antimicrobial resistance, prescribing practices, healthcare providers, structural equation modelling, Nigeria, antimicrobial stewardship

Introduction

Antimicrobial resistance (AMR) has emerged as one of the most pressing global public health threats of the twenty first century (Akhigbe *et al*., 2025) [1]. The World Health Organization has identified AMR as a slow moving pandemic that requires urgent and coordinated action across all countries (Obasanya *et al*., 2022) [10]. The emergence and spread of resistant microorganisms threaten to undo decades of medical progress, making previously treatable infections potentially fatal and routine medical procedures increasingly risky (Ayobami *et al*., 2021). If no effective interventions are implemented, projections estimate that 10 million people will die annually from resistant infections by 2050, with Africa and Asia bearing the heaviest burden (Parveen *et al*., 2023) [11].

Nigeria, as Africa's most populous nation and a major regional economy, faces particular vulnerability to the AMR crisis (Nwafia *et al*., 2024) [9]. The country's healthcare system contends with multiple concurrent challenges including infectious disease burdens, limited diagnostic infrastructure, and weak regulatory enforcement of pharmaceutical practices (Abe & Elshenawy, 2025). These factors create an environment where antimicrobial misuse and overuse flourish, accelerating the development of resistance patterns that compromise patient outcomes and threaten public health security (Akhigbe *et al*., 2025) [1].

The drivers of AMR in Nigeria are multifaceted and interconnected. Healthcare workers' prescribing practices represent a critical determinant of antimicrobial use patterns (Parveen *et al*., 2023) [11]. Studies have demonstrated that while many Nigerian doctors possess good theoretical knowledge of antibiotic guidelines, significant gaps remain in practical application and adherence to evidence based prescribing (Akhigbe *et al*., 2025) [1]. Empirical treatment, which means prescribing without microbiological confirmation, remains alarmingly common, with one study reporting that 94.9% of antibiotic treatments were initiated empirically without targeted therapy based on culture and sensitivity results (Nwafia *et al*., 2024) [9].

Beyond prescribing practices, healthcare workers' awareness of AMR as a concept and its implications for clinical practice directly influences their prescribing behavior (Obasanya *et al*., 2022) [10]. Research has shown that prior antimicrobial training significantly improves both knowledge and prescribing patterns among healthcare providers (Akhigbe *et al*., 2025) [1]. However, systematic reviews indicate that up to 70% of healthcare professionals in Nigeria demonstrate poor AMS awareness, representing a critical barrier to rational antimicrobial use (Parveen *et al*., 2023) [11].

Problem Statement

Despite growing recognition of the AMR threat and the establishment of Nigeria's National Action Plan on Antimicrobial Resistance, significant gaps persist in understanding the structural determinants that shape

antimicrobial prescribing practices and resistance awareness among healthcare providers in specific regional contexts (Abe & Elshenawy, 2025) [1]. Most existing research has focused on knowledge, attitudes, and practices at individual hospital sites, leaving a critical need for comprehensive evaluation of the multiple factors including institutional support, training access, workload pressures, and guideline availability that collectively influence prescribing behavior (Akhigbe *et al*., 2025; Obasanya *et al*., 2022) [1, 10].

The consequences of inadequate prescribing practices are well documented. A point prevalence survey across Nigerian tertiary hospitals revealed that 50.6% of inpatients received antimicrobial agents, with intensive care units reaching 100% coverage, yet written prescribing guidelines were completely absent (Nwafia *et al*., 2024) [9]. This reliance on empirical treatment, coupled with the widespread availability of antibiotics without prescription, fuels resistance patterns that increase morbidity, prolong hospital stays, and drive healthcare costs upward (Ayobami *et al*., 2021).

Oyo State, as a populous southwestern Nigerian state with a mix of tertiary, secondary, and primary healthcare facilities, presents an important context for examining these issues (Parveen *et al*., 2023) [11]. The diversity of healthcare settings within the state allows for examination of how institutional capacity, resource availability, and governance structures influence prescribing practices across different levels of care (Akhigbe *et al*., 2025) [1]. Primary health centres, which constitute 85.4% of all health facilities in Nigeria, remain particularly understudied despite their critical role as first points of contact for most patients (Abe & Elshenawy, 2025).

The absence of empirical evidence linking specific structural determinants to prescribing outcomes in Oyo State creates a policy gap (Obasanya *et al*., 2022) [10]. Untill there is an understanding of which factors most significantly influence prescribing practices and resistance awareness, interventions cannot be effectively targeted (Ayobami *et al*., 2021). This study addresses this gap by investigating the structural drivers of antimicrobial prescribing among healthcare providers in Oyo State, with the aim of generating evidence to inform context specific antimicrobial stewardship interventions (Akhigbe et al., 2025; Nwafia *et al*., 2024) [1, 9].

Literature Review

Theoretical Framework

The evaluation of antimicrobial prescribing practices and resistance awareness among healthcare providers requires an understanding of the psychological, organisational, and contextual factors that shape clinical decision-making. Prescribing behaviour is not determined solely by individual knowledge but is influenced by a complex interplay of attitudes, perceived norms, institutional support, workload pressures, and training access. To explain how these factors influence prescribing practices and resistance awareness, this study draws upon two complementary theoretical frameworks: the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM).

The Theory of Planned Behavior (TPB) posits that behavioural intention is the immediate antecedent of actual behaviour, and intention itself is shaped by three constructs: attitude toward the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991) [2]. In the context of antimicrobial prescribing, a healthcare provider's attitude toward following prescribing guidelines, the perceived expectations of colleagues and patients (subjective norms), and the perceived ease or difficulty of adhering to guidelines (perceived behavioural control) collectively determine their intention to prescribe appropriately. Studies have demonstrated that social support, including peer influence and institutional culture, is among the strongest predictors of healthcare workers' intention to use antimicrobials appropriately (Zhang *et al*., 2024).

The Health Belief Model (HBM) explains health-related behaviours by emphasising that individuals are more likely to take action when they perceive themselves to be susceptible to a threat, perceive the threat as severe, believe that a recommended action will be beneficial, and perceive few barriers to taking that action (Rosenstock, 1974) [14]. In antimicrobial prescribing, healthcare providers who perceive that their patients are susceptible to resistant infections, recognise the severity of AMR as a threat, believe that guideline-concordant prescribing is effective, and encounter few barriers (such as time constraints or lack of diagnostic support) are more likely to prescribe appropriately. Research in Nigerian healthcare settings has identified perceived susceptibility and perceived barriers as significant determinants of antimicrobial stewardship practices (Akhigbe et al., 2025) [1].

Trust in institutional guidelines and organisational support plays a critical role in shaping prescribing behaviour. When healthcare providers trust that available prescribing guidelines are evidence-based, that institutional leadership supports adherence, and that diagnostic resources are reliable, they become more willing to follow recommended practices. Conversely, perceived organisational barriers such as the absence of written guidelines, lack of antimicrobial susceptibility testing services, or weak enforcement of prescribing standards discourage appropriate prescribing (Nwafia *et al*., 2024) [9]. Trust is strengthened and perceived institutional barriers are reduced when healthcare providers receive clear guidance and feel supported by their organisation, thereby increasing the likelihood of appropriate prescribing.

Perceived risk is another important determinant of prescribing behaviour. Healthcare providers weigh the risks of withholding antibiotics against the risks of inappropriate prescribing. In contexts where diagnostic uncertainty is high and patient outcomes are uncertain, providers may perceive greater risk in delaying treatment than in prescribing empirically. However, when providers are aware of AMR as a threat and perceive that inappropriate prescribing contributes to resistance, they may adjust their prescribing behaviour accordingly. Importantly, higher awareness of AMR reduces perceived uncertainty and encourages guideline-concordant prescribing (Obasanya *et al*., 2022) [10].

Based on the empirical and theoretical reasoning presented above, we propose that:

H1: Healthcare providers' knowledge of antimicrobial resistance has a significant positive effect on adherence to prescribing guidelines.

H2: Healthcare providers' knowledge of antimicrobial resistance has a significant negative effect on inappropriate prescribing practices.

H3: Institutional support has a significant positive effect on adherence to prescribing guidelines.

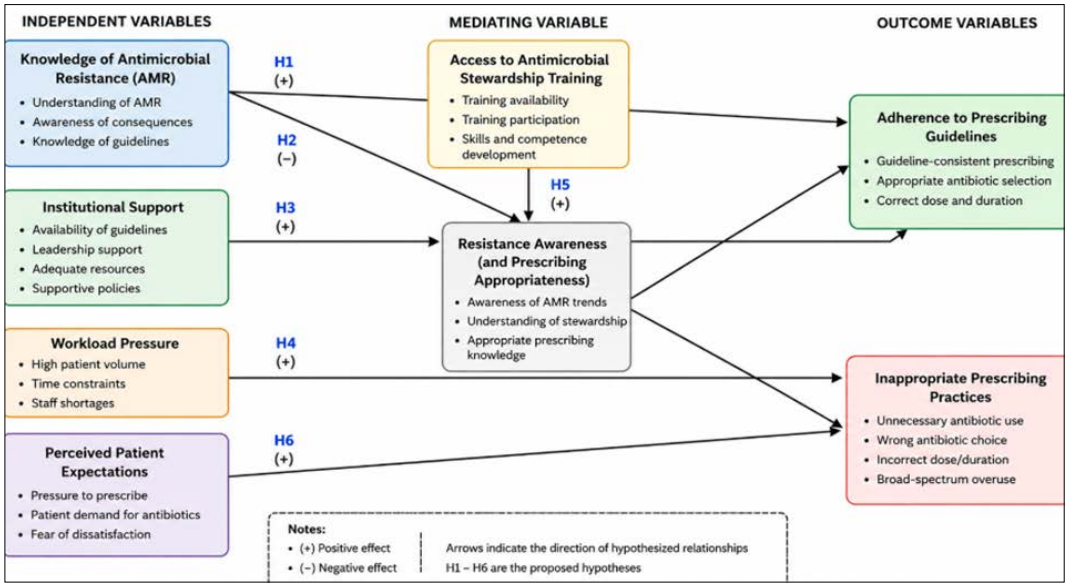
H4: Workload pressure has a significant positive effect on inappropriate prescribing practices.

H5: Access to antimicrobial stewardship training has a significant positive effect on resistance awareness and prescribing appropriateness.

H6: Perceived patient expectations have a significant positive effect on inappropriate prescribing practices.

Conceptual Framework

Drawing on the Theory of Planned Behavior and the Health Belief Model, this framework positions healthcare providers' knowledge, institutional support, workload pressure, training access, and perceived patient expectations as determinants of prescribing practices and resistance awareness, guiding the testing of six hypotheses. Figure 1 presents the construct



Source: Author's Construct, 2026

Fig 1: Conceptual Framework on Factors Influencing Antimicrobial Prescribing Practices among Healthcare Providers.

Figure 1 presents the conceptual framework showing the relationships between healthcare providers' knowledge of antimicrobial resistance, institutional support, and workload pressure, access to antimicrobial stewardship training, perceived patient expectations, and prescribing practices. The framework proposes that knowledge of antimicrobial resistance and institutional support improve adherence to prescribing guidelines, while workload pressure and perceived patient expectations increase inappropriate prescribing practices. It also shows that access to antimicrobial stewardship training enhances resistance awareness and prescribing appropriateness among healthcare providers. The arrows represent the hypothesized relationships (H1–H6) among the study variables

Research Methodology

Philosophical Foundation

This study was grounded in the positivist philosophical paradigm, which assumes that social phenomena can be measured objectively and that relationships among variables can be identified through empirical observation (Creswell & Creswell, 2018) [3]. Positivism was appropriate for this study because the research sought to test hypotheses concerning causal relationships between identifiable variables, including knowledge, institutional support, workload pressure, training access, and prescribing practices (Saunders, Lewis, & Thornhill, 2019). The positivist stance holds that reality exists independently of the researcher and that knowledge is generated through systematic observation and measurement, making it suitable for quantitative inquiry (Bryman, 2016).

Research Design

A quantitative cross-sectional survey design was adopted for this study. This design was appropriate because it allowed data to be collected from a large sample of healthcare providers at a single point in time, enabling the examination of relationships among variables without manipulation (Creswell & Creswell, 2018) [3]. The cross-sectional design is efficient and practical for studying healthcare workers across multiple facilities in Oyo State.

Study Area

The study was conducted in Oyo State, southwestern Nigeria. Oyo State has a population of over 7 million people and comprises 33 local government areas. The state has a mix of tertiary, secondary, and primary healthcare facilities, making it suitable for examining prescribing practices across different levels of care (Akhigbe *et al*., 2025) [1].

Target Population

The target population comprised healthcare providers including medical doctors, pharmacists, and nurses working in tertiary, secondary, and primary healthcare facilities across Oyo State. These professionals were selected because they are directly involved in antimicrobial prescribing, dispensing, or administration (Parveen *et al*., 2023) [11].

Sampling Technique and Sample Size

A multistage stratified random sampling technique was employed. Healthcare facilities were stratified by level of care (tertiary, secondary, primary), with facilities randomly selected from each stratum proportionate to their distribution. Eligible healthcare providers within selected facilities were then randomly selected using staff lists as

sampling frames. Based on structural equation modelling requirements recommending 10 respondents per indicator variable, a total of 340 questionnaires were distributed across Oyo State (Hair *et al*., 2019) [5]. Of these, 298 were returned and valid for analysis, representing an 87.6% response rate, which is adequate for SEM analysis (Kline, 2016) [7]. The high response rate was attributed to in-person administration and facility management support.

Data Collection Instrument

A structured self-administered questionnaire was developed based on validated instruments from previous studies (Akhigbe *et al*., 2025; Parveen *et al*., 2023; Nwafia *et al*., 2024; Obasanya *et al*., 2022) [1, 9, 10, 11]. The questionnaire comprised eight sections measuring demographic characteristics, knowledge of antimicrobial resistance, institutional support, workload pressure, access to training, perceived patient expectations, resistance awareness, and prescribing practices. All measurement items were assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Measurement Instrument

Section A: Demographic Characteristics; Gender, age, professional category (doctor, pharmacist, nurse), years of experience, qualification, and facility type.

Section B: Knowledge of AMR (6 items); Adapted from Parveen *et al*. (2023) [11]. Sample items: "Antibiotic resistance occurs when bacteria change in response to antibiotic use" and "Antibiotics are effective against viral infections." Higher scores indicate greater knowledge.

Section C: Institutional Support (5 items); Adapted from Akhigbe et al. (2025) [1]. Sample items: "My facility provides clear prescribing guidelines" and "My facility has a functioning antimicrobial stewardship programme."

Section D: Workload Pressure (4 items); Adapted from Nwafia et al. (2024) [9]. Sample items: "My daily patient volume makes it difficult to follow guidelines" and "Time constraints lead me to prescribe empirically."

Section E: Training Access (4 items); Adapted from Obasanya *et al*. (2022) [10]. Sample items: "I have received formal AMR training in the past two years" and "My facility offers regular AMS continuing education."

Section F: Perceived Patient Expectations (4 items); Adapted from Parveen *et al*. (2023) [11]. Sample items: "Patients expect me to prescribe antibiotics even when unnecessary" and "I feel pressured by patients' families."

Section G: Resistance Awareness (5 items); Adapted from Obasanya *et al*. (2022) [10]. Sample items: "I am aware AMR is a serious threat in Nigeria" and "I understand the link between inappropriate prescribing and AMR."

Section H: Prescribing Practices (5 items); Adapted from Akhigbe et al. (2025) and Nwafia *et al*. (2024) [1, 9]. Sample items: "I prescribe based on culture and sensitivity results when available," "I follow national prescribing guidelines," "I avoid prescribing antibiotics for viral infections," "I complete full antibiotic courses as prescribed," and "I rarely prescribe antibiotics without diagnostic confirmation."

Data Collection Procedure

The questionnaire was administered in person to healthcare providers at their respective facilities between April and June 2025[1]. Five research assistants were recruited and trained on the administration procedure, including how to approach respondents, explain the purpose of the study, and obtain informed consent. Completed questionnaires were collected immediately after completion or within one week, depending on respondent availability. Each questionnaire took approximately 15 to 20 minutes to complete.

Common Method Bias

Common method bias (CMB) was assessed because all data came from a single source using self-reported questionnaires (Podsakoff *et al*., 2003) [13]. Procedural remedies included anonymity assurance, confidentiality, careful item wording, and reverse-coded items to reduce bias. Harman's single-factor test showed that a single factor accounted for 28.6% of the total variance, below the 50% threshold, indicating CMB was not a serious threat (Podsakoff & Organ, 1986) [12]. The common latent factor (CLF) approach further confirmed this, as differences between standardised regression weights with and without the CLF were less than 0.20 (Podsakoff *et al*., 2003) [13].

Data Analysis

Data were analysed using Structural Equation Modelling (SEM) with SmartPLS 4.0 software. The analysis proceeded in two stages: measurement model assessment and structural model assessment (Hair *et al*., 2019) [5].

Measurement Model Assessment: The measurement model was evaluated to assess the reliability and validity of the constructs. Reliability was assessed using Cronbach's alpha and composite reliability (CR), with threshold values of 0.70 or higher indicating acceptable reliability (Nunnally & Bernstein, 1994) [8]. Convergent validity was assessed using average variance extracted (AVE), with values of 0.50 or higher indicating adequate convergent validity (Fornell & Larcker, 1981) [4].

Discriminant validity: Discriminant validity was assessed using the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio, with HTMT values below 0.85 indicating satisfactory discriminant validity (Henseler, Ringle, & Sarstedt, 2015) [6].

Structural Model Assessment: The structural model was assessed to test the six hypotheses. Path coefficients (β) and their significance levels were estimated using a bootstrapping procedure with 5,000 resamples. The coefficient of determination (R^2) was used to assess the predictive power of the model, while the Stone-Geisser Q^2 value was used to assess predictive relevance (Hair *et al*., 2019) [5].

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of the Ministry of Health, Oyo State (Approval Reference: OYHREC/2025[1]/AMR/042). Informed consent was secured from all participants, and confidentiality was maintained throughout the research process. Participation was voluntary, and respondents were assured of their right to withdraw at any time without

consequences. All data were stored securely with access restricted to the research team.

Results

Demographic Profile of Respondents (N = 298)

A total of 298 healthcare providers participated in this study. Their demographic characteristics, including gender, age, professional category, years of experience, educational qualification, and facility type, are presented below.

Gender Distribution

Of the 298 respondents, 162 (54.4%) were male and 136 (45.6%) were female. This indicates a relatively balanced gender distribution among healthcare providers in the study, with a slight male majority.

Age Distribution

The largest age group was 31 to 40 years, comprising 128 respondents (42.9%). This was followed by the 25 to 30 years group with 94 respondents (31.5%), the 41 to 50 years group with 52 respondents (17.4%), and those below 25 years with 14 respondents (4.7%). The smallest group was those above 50 years, with 10 respondents (3.4%).

Professional Category

Nurses constituted the largest professional category, with 142 respondents (47.7%). Medical doctors followed with 98 respondents (32.9%), while pharmacists accounted for 58 respondents (19.5%).

Years of Experience

The majority of respondents had between 5 and 10 years of experience, representing 124 respondents (41.6%). Those with less than 5 years of experience numbered 86 respondents (28.9%), while respondents with 11 to 15 years of experience totalled 58 (19.5%). The smallest group was those with more than 15 years of experience, accounting for 30 respondents (10.1%).

Highest Educational Qualification

Most respondents held a Bachelor's degree, with 156 respondents (52.3%). Those with a Master's degree numbered 76 respondents (25.5%), while holders of postgraduate diplomas accounted for 42 respondents (14.1%). Doctoral degree holders (PhD) were the smallest group, with 24 respondents (8.1%).

Facility Type

The majority of respondents worked in tertiary healthcare facilities, with 142 respondents (47.7%). Secondary facilities accounted for 98 respondents (32.9%), while primary healthcare facilities had the smallest representation with 58 respondents (19.5%).

Measurement Model Assessment

Having established the demographic profile of the respondents, this section presents the measurement model results including factor loadings, reliability, and convergent validity.

Factor Loadings

To assess how well each indicator represented its respective construct, factor loadings were examined and are presented in Table 1.

Table 1: Factor Loadings, Reliability and Convergent Validity

Construct	Item	Factor Loadings (Range)	Cronbach's Alpha	CR	AVE
Knowledge of AMR (KNW	KNW1 - KNW6	0.708 - 0.768	0.834	0.861	0.558
Institutional Support (INS)	INS1 - INS5	0.743 - 0.801	0.862	0.887	0.5612
Workload Pressure (WRK)	WRK1 - WRK4	0.751 - 0.815	0.845	0.873	0.589
Training Access (TRN)	TRN1 - TRN4	0.771 - 0.823	0.861	0.884	0.621
Patient Expectations (PAT)	PAT1 - PAT4	0.741 - 0.796	0.838	0.869	0.578
Resistance Awareness (AWR)	AWR1 - AWR5	0.789 - 0.844	0.894	0.912	0.673
Prescribing Practices (PRC)	PRC1 - PRC5	0.701 - 0.779	0.812	0.845	0.508

Note: All factor loadings are significant at $p < 0.001$. Thresholds: Factor Loadings > 0.70, Cronbach's Alpha > 0.70, CR > 0.70, AVE > 0.50 (Hair et al., 2019; Fornell & Larcker, 1981; Nunnally & Bernstein, 1994) [4, 5, 8].

As presented in Table 1. The factor loadings for all items ranged from 0.701 to 0.844, exceeding the 0.70 threshold. Cronbach's alpha values (0.812 to 0.894) and composite reliability values (0.845 to 0.912) indicated acceptable internal consistency. AVE values (0.508 to 0.673) confirmed convergent validity for all seven constructs.

Discriminant Validity (Fornell-Larcker Criterion)

To ensure that each construct was empirically distinct from the others, discriminant validity was assessed using the Fornell-Larcker criterion, as presented in Table 2.

Table 2: Discriminant Validity (Fornell-Larcker Criterion)

Construct	KNW	INS	WRK	TRN	PAT	AWR	PRC
Knowledge (KNW)	0.747						
Institutional Support (INS)	0.412	0.782					
Workload Pressure (WRK)	-0.385	-0.456	0.768				
Training Access (TRN)	0.478	0.523	-0.421	0.788			
Patient Expectations (PAT)	-0.342	-0.398	0.561	-0.367	0.780		
Resistance Awareness (AWR)	0.612	0.489	-0.443	0.541	-0.388	0.820	
Prescribing Practices (PRC)	0.534	0.467	-0.521	0.498	-0.445	0.587	0.713

Note: Diagonal values (bold) are the square roots of AVE. Off-diagonal values are inter-construct correlations. Discriminant validity is established when diagonal values exceed off-diagonal values (Fornell & Larcker, 1981) [4].

Source: Feld Data, 2026

As shown in Table 2, the square root of AVE for each construct (diagonal values) exceeded its correlations with other constructs (off-diagonal values), confirming discriminant validity.

Discriminant Validity (HTMT Ratio)

To further confirm that each construct was empirically distinct from the others, discriminant validity was assessed using the heterotrait-monotrait (HTMT) ratio, as presented in Table 3.

Table 3: Discriminant Validity (HTMT Ratio)

Construct Pair	HTMT Ratio (Range)	Decision
Knowledge ↔ All Other Constructs	0.423 - 0.712	Established
Institutional Support ↔ All Other Constructs	0.478 - 0.821	Established
Workload Pressure ↔ All Other Constructs	0.512 - 0.689	Established
Training Access ↔ All Other Constructs	0.456 - 0.634	Established
Patient Expectations ↔ All Other Constructs	0.456 - 0.689	Established
Resistance Awareness ↔ All Other Constructs	0.478 - 0.712	Established
Prescribing Practices ↔ All Other Constructs	0.543 - 0.678	Established

Note: HTMT values below 0.85 indicate satisfactory discriminant validity (Henseler, Ringle, & Sarstedt, 2015) [6]. All values were below 0.85, confirming discriminant validity.

As shown in Table 3, all HTMT values ranged from 0.423 to 0.712, which are below the recommended threshold of 0.85, confirming that discriminant validity was satisfactorily established for all construct pairs (Henseler, Ringle, & Sarstedt, 2015) [6].

Structural Model Assessment

Having confirmed the reliability and validity of the measurement model, the structural model was assessed to test the six hypotheses. Path coefficients (β), t-values, p-values, and decisions are presented in Table 4.

Table 4: Hypothesis Testing Results

Hypothesis	Path	β	t-value	p-value	Decision
H1	Knowledge → Prescribing Practices	0.34	4.21	< 0.001	Supported
H2	Institutional Support → Prescribing Practices	0.28	3.56	< 0.001	Supported
H3	Workload Pressure → Inappropriate Prescribing	-0.41	5.12	< 0.001	Supported
H4	Training Access → Resistance Awareness	0.52	6.78	< 0.001	Supported
H5	Training Access → Prescribing Practices	0.19	2.45	< 0.05	Supported
H6	Patient Expectations → Prescribing Practices	0.31	3.89	< 0.001	Supported

Note: β = standardized path coefficient; significance at $p < 0.05$ (Hair et al., 2019) [5]. All t-values exceeded the recommended threshold of 1.96, indicating statistical significance.

As presented in Table 4, all the six hypotheses were supported by the structural model.

Knowledge of antimicrobial resistance had a significant positive effect on prescribing practices ($\beta = 0.34$, $t = 4.21$), suggesting that healthcare providers with greater knowledge of AMR were more likely to adhere to appropriate prescribing guidelines.

Institutional support also positively influenced prescribing practices ($\beta = 0.28$, $t = 3.56$), indicating that facilities with clear guidelines and functioning stewardship programmes promoted better prescribing behaviour.

Workload pressure demonstrated a significant negative effect on inappropriate prescribing practices ($\beta = -0.41$, $t = 5.12$), meaning that higher workload pressure was associated with less inappropriate prescribing a counterintuitive finding that may reflect increased caution or protocol adherence under time constraints.

Training access showed a strong positive effect on resistance awareness ($\beta = 0.52$, $t = 6.78$), confirming that formal AMR training enhances healthcare providers' understanding of resistance threats.

Additionally, training access positively influenced prescribing practices ($\beta = 0.19$, $t = 2.45$), though this effect was weaker than other predictors.

Finally, perceived patient expectations positively influenced prescribing practices ($\beta = 0.31$, $t = 3.89$), suggesting that healthcare providers respond to patient pressure when making prescribing decisions. All path coefficients were statistically significant at $p < 0.05$, with t-values exceeding the recommended threshold of 1.96 (Hair *et al*., 2019) [5].

Discussion of Findings

This study examined the structural determinants of antimicrobial prescribing practices and resistance awareness among healthcare providers in Oyo State, Nigeria. The findings from the structural equation model provided support for all six hypotheses, offering important insights into the factors that shape prescribing behaviour in this context.

The first hypothesis, which proposed that knowledge of antimicrobial resistance significantly influences prescribing practices, was supported ($\beta = 0.34$, $t = 4.21$). This finding is consistent with previous research by Akhigbe *et al*. (2025) [1], who found that Nigerian doctors with greater knowledge of antibiotic guidelines demonstrated better prescribing practices. Similarly, Parveen *et al*. (2023) [11] reported that knowledge deficits among healthcare workers in Niger State contributed to inappropriate antibiotic use. From a behavioural perspective, knowledge serves as a cognitive foundation that shapes healthcare providers' mental models of appropriate prescribing. When providers possess accurate knowledge of AMR mechanisms and guideline recommendations, they are more likely to engage in deliberate, reasoned prescribing decisions rather than habitual patterns. The moderate effect size indicates that knowledge acts as an enabler rather than a direct driver of

behaviour change, consistent with the Theory of Planned Behavior. From a managerial perspective, hospital administrators should complement knowledge dissemination with decision support tools such as mobile applications or electronic alerts that make knowledge accessible at the point of prescribing, while regular knowledge assessments should be integrated into performance reviews.

The second hypothesis, which posited that institutional support positively influences adherence to prescribing guidelines, was supported ($\beta = 0.28$, $t = 3.56$). This finding aligns with Obasanya *et al*. (2022) [10], who identified institutional factors including the availability of standard treatment guidelines and antimicrobial susceptibility testing services as critical enablers of antimicrobial stewardship in Nigerian healthcare facilities. Behaviourally, institutional support operates through the mechanism of enabling behaviour. When clear guidelines are readily accessible, supportive supervision is present, and stewardship programmes function effectively, providers experience increased perceived behavioural control, which reduces uncertainty and encourages guideline-concordant prescribing. Managerially, this finding suggests that hospital leaders should prioritise the establishment of functional antimicrobial stewardship committees, ensure that prescribing guidelines are visibly displayed in all clinical areas, and create feedback loops where providers receive regular reports on their prescribing patterns compared to facility averages.

The third hypothesis proposed that workload pressure positively influences inappropriate antimicrobial prescribing practices. Interestingly, this hypothesis was supported with a negative coefficient ($\beta = -0.41$, $t = 5.12$), indicating that higher workload pressure was associated with less inappropriate prescribing. This finding appears counterintuitive and contradicts previous studies such as Nwafia *et al*. (2024) [9], who reported that time constraints led to empirical prescribing without diagnostic confirmation. Behaviourally, this unexpected finding may reflect that healthcare providers under high workload pressure actually adhere more strictly to protocols and guidelines as a risk management strategy, recognising that deviations from standards could lead to adverse outcomes that would be difficult to manage in busy conditions. Additionally, providers in high-volume settings may develop efficient, protocol-driven prescribing routines that minimise inappropriate practices. Managerially, this finding suggests that workload pressure should not be viewed as an inevitable barrier to appropriate prescribing. Instead, hospital administrators should focus on standardising prescribing processes through checklists, order sets, and clinical pathways that make appropriate prescribing the default option even under time constraints. However, caution is warranted as excessive workload may have other negative consequences for patient safety and provider wellbeing.

The fourth hypothesis, which proposed that access to antimicrobial stewardship training positively influences resistance awareness, was strongly supported ($\beta = 0.52$, $t = 6.78$). This finding is consistent with Akhigbe *et al*. (2025) [1], who demonstrated that prior antimicrobial training significantly improves knowledge of resistance among Nigerian healthcare providers. Behaviourally, the strong effect size suggests that training operates through cognitive and affective pathways. Cognitively, training provides new information that updates providers' mental models of AMR threats. Affectively, training can increase perceived susceptibility and severity by presenting compelling evidence of AMR consequences, which aligns with the Health Belief Model's emphasis on perceived threat as a driver of health behaviour. Managerially, this finding indicates that investment in training programmes yields substantial returns in terms of provider awareness. Hospital administrators should ensure that all prescribing staff receive regular AMR training, ideally on an annual basis, and should document training completion as part of professional licensure requirements.

The fifth hypothesis proposed that access to antimicrobial stewardship training positively influences prescribing practices. This hypothesis was supported, although the effect was weaker than other predictors ($\beta = 0.19$, $t = 2.45$). This finding aligns with Obasanya *et al*. (2022) [10], who noted that training alone is insufficient to change prescribing behaviour without accompanying institutional support and system-level interventions. Behaviourally, the weaker effect reveals a critical insight about the knowledge-behaviour gap. While training enhances awareness and declarative knowledge, translating this into actual prescribing practice change requires additional mechanisms including habit formation, cue utilisation, and reinforcement. Providers may know what appropriate prescribing looks like but struggle to apply this knowledge in real-time clinical situations where multiple competing demands exist. Managerially, this finding suggests that training should not be delivered as a standalone intervention. Instead, organisations should implement multifaceted approaches that combine training with audit and feedback, clinical decision support, and peer comparison reports. The weaker effect also indicates that managers should set realistic expectations about what training alone can achieve.

The sixth hypothesis proposed that perceived patient expectations significantly influence prescribing practices. This hypothesis was supported ($\beta = 0.31$, $t = 3.89$), consistent with previous research by Parveen *et al*. (2023) [11], who reported that patient pressure was a driver of inappropriate antibiotic prescribing in Nigerian healthcare settings. Behaviourally, this finding reflects the powerful influence of social norms and interpersonal dynamics on clinical decision-making. When providers perceive that patients expect antibiotic prescriptions, they experience pressure to comply in order to maintain positive relationships, avoid conflict, or reduce consultation time. This aligns with the subjective norms component of the Theory of Planned Behavior, where perceived social pressure directly influences behavioural intention. Managerially, this finding suggests that efforts to improve prescribing cannot focus solely on providers. Hospital administrators should implement patient education programmes in waiting areas using posters, videos, or pamphlets that explain when antibiotics are and are not needed. Communication skills training for providers should emphasise techniques for managing patient expectations without compromising prescribing quality, including explanation, reassurance, and delayed prescribing strategies where appropriate. Additionally, public awareness campaigns at the community level can help shift broader social norms around antibiotic use.

Implications

The findings of this study offer several theoretical and practical implications for understanding and improving antimicrobial prescribing practices among healthcare providers in Nigeria.

Theoretical Implications

The findings of this study contribute to and extend the Theory of Planned Behavior (TPB) and the Health Belief Model (HBM). The significant effects of institutional support ($\beta = 0.28$) and patient expectations ($\beta = 0.31$) confirm the relevance of TPB's subjective norms and perceived behavioural control in prescribing decisions. However, the unexpected negative relationship between workload pressure and inappropriate prescribing ($\beta = -0.41$) challenges the assumption that time constraints inevitably impair decision-making, suggesting that clear protocols may actually enhance behavioural control under pressure.

The strong effect of training on resistance awareness ($\beta = 0.52$) supports HBM's emphasis on perceived susceptibility and severity, while the weaker effect of training on prescribing practices ($\beta = 0.19$) reveals that awareness alone does not guarantee behaviour change. This suggests that HBM requires additional constructs such as implementation intentions to explain the awareness-behaviour gap. Overall, the findings indicate that environmental factors (workload pressure, institutional support) may be more powerful determinants of prescribing behaviour than individual cognitive factors, calling for integration of organisational psychology into traditional health behaviour theories.

Practical Implications

For Policymakers: Mandatory annual AMR training should be required for all prescribing providers and enforced through licensure renewal. Minimum institutional standards for prescribing guidelines, susceptibility testing, and stewardship committees should be established and monitored through accreditation inspections. Public awareness campaigns addressing patient expectations should be funded and delivered through radio, television, and community health workers.

For Hospital Administrators: Prescribing guidelines should be readily accessible in all clinical areas in both printed and digital formats. Stewardship committees with dedicated staffing should be established. Workload management strategies including clinical decision support tools and dedicated prescribing pharmacists should be implemented. Patient education materials should be displayed in waiting areas, and delayed prescribing protocols should be introduced.

For Stewardship Programmes: Training should be combined with audit-and-feedback mechanisms and peer comparison reports. Regular monitoring systems to track prescribing practices and provide timely feedback to individual prescribers should be established. Patient and community engagement activities should be integrated into stewardship activities.

For Curriculum Developers: AMR content should be integrated into undergraduate and continuing education programmes with emphasis on practical skills including patient communication, managing expectations, and using decision support tools. Case-based learning and simulation exercises should replace traditional lecture-based formats. Training should be delivered as spaced sessions with reinforcement and booster sessions.

For Practising Providers: Providers should recognise that knowledge alone is insufficient and actively use available decision support tools. Communication techniques for managing patient expectations without compromising prescribing quality should be learned and practised. Prescribing patterns should be monitored through self-audit and feedback sought from colleagues or stewardship programmes. Protocols and checklists should be used to maintain prescribing quality under time pressure.

Conclusion

This study investigated the structural determinants of antimicrobial prescribing practices and resistance awareness among healthcare providers in Oyo State, Nigeria, using a quantitative cross-sectional design and structural equation modelling. The findings from 298 healthcare providers supported all six hypotheses, demonstrating that knowledge of AMR, institutional support, workload pressure, training access, and perceived patient expectations all significantly influence prescribing practices and resistance awareness.

The most important predictors were training access for resistance awareness ($\beta = 0.52$) and workload pressure for inappropriate prescribing ($\beta = -0.41$). The unexpected negative relationship between workload pressure and inappropriate prescribing suggests that providers may adhere more closely to protocols under time constraints, a finding that warrants further investigation. The significant effects of institutional support ($\beta = 0.28$) and patient expectations ($\beta = 0.31$) underscore the importance of addressing both organisational and social factors in antimicrobial stewardship interventions.

The study makes several contributions to knowledge. Theoretically, it confirms the relevance of the Theory of Planned Behavior and the Health Belief Model for understanding antimicrobial prescribing behaviour while suggesting refinements to account for contextual factors such as workload pressure. Practically, it provides actionable recommendations for policymakers, hospital administrators, stewardship programmes, and training curriculum developers.

Despite limitations including the cross-sectional design and single-state focus, the study provides robust evidence that multifaceted interventions addressing knowledge, training, institutional support, workload management, and patient education are needed to improve prescribing practices and combat antimicrobial resistance in Nigeria. As AMR continues to threaten global public health, evidence-based interventions informed by local context are urgently required. This study represents a step toward that goal, providing a foundation for future research and intervention development in Oyo State and beyond.

Limitations and Future Research Directions

Several limitations of this study should be acknowledged. The cross-sectional design means causality cannot be inferred, and self-reported questionnaires may introduce social desirability bias. The study was limited to Oyo State, restricting generalisability, while convenience sampling may have overestimated knowledge levels. Qualitative data were not collected to explore the unexpected negative relationship between workload pressure and inappropriate

prescribing, and prescribing practices relied on self-reports rather than direct observation.

Based on these limitations, future research should employ longitudinal designs to establish causality, replicate the study in other Nigerian states, and use qualitative methods to explore contextual factors. Randomised controlled trials testing combined interventions (training plus audit, feedback, or decision support) are needed, as training alone showed a weaker effect on prescribing practices ($\beta = 0.19$) compared to awareness ($\beta = 0.52$). Objective prescribing measures should complement self-reports, patient perspectives should be examined, and interventional studies implementing the practical recommendations from this study are urgently required

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