Texila International Journal | Open Access | Peer Reviewed

Journal: Texila International Journal of Academic Research
https://doi.org/10.21522/TIJAR.2014.13.03.Art034

ISSN: 2520-3088
Volume 13 Issue 3, 2026

Knowledge-Practice Gaps in Antimicrobial Prescribing among Nigerian Healthcare Providers: A Systematic Review and Meta-Analysis

Mawo Philip Benu*, Micheal Olabode Tomori, Sebit Mustafa Sebit

Department of Public Health, Texila American University, Georgetown, Guyana, South America

Correspondence to be addressed: E-mail - philipbenu@gmail.com

Cite this article as: Benu MP, Tomori MO, Sebit SM. Knowledge-practice gaps in antimicrobial prescribing among Nigerian healthcare providers: a systematic review and meta-analysis. Texila Int J Acad Res. 2026;13(3). https://doi.org/10.21522/TIJAR.2014.13.03.Art034

Received: 01.06.2026
Accepted: 11.07.2026
Published: 31.07.2026

Abstract *Antimicrobial resistance (AMR) remains a major public health challenge globally, with low- and middle-income countries such as Nigeria carrying a substantial burden because of irrational antibiotic use, weak antimicrobial stewardship (AMS) systems, and limited diagnostic capacity. This systematic review and meta-analysis synthesized evidence on AMR knowledge, AMS awareness, and antibiotic prescribing practices among healthcare workers in Nigeria. A comprehensive search of PubMed, Scopus, and Web of Science identified 136 records, of which 17 studies met the eligibility criteria for qualitative synthesis and 15 were included in quantitative meta-analysis. Quantitative synthesis was conducted using a random-effects model. The pooled proportion of healthcare workers demonstrating good AMR knowledge was 64.8% (95% CI: 58.1%–71.2%), while AMS awareness was lower at 49.3% (95% CI: 41.2%–57.5%). Poor or inappropriate antibiotic prescribing practices remained common, with a pooled prevalence of 61.7% (95% CI: 53.4%–69.6%), whereas empirical antibiotic prescribing reached 72.9% (95% CI: 65.1%–79.8%). Recent AMS training exposure was also limited at 38.6% (95% CI: 30.4%–47.5%). Narrative synthesis revealed persistent gaps in stewardship implementation, diagnostic limitations, weak institutional support, pharmaceutical influence, and inadequate continuous professional education across healthcare settings. The findings demonstrate that moderate awareness of AMR among Nigerian healthcare workers has not translated into rational antimicrobial prescribing practices. Strengthening institutional AMS programs, improving diagnostic infrastructure, expanding stewardship training, and implementing behavior-focused interventions are urgently needed to reduce irrational antimicrobial use and curb the growing burden of AMR in Nigeria.*

Keywords *Antibiotic Prescribing, Antimicrobial Resistance, Antimicrobial Stewardship, Healthcare Workers, Nigeria, Systematic Review.*

This article is published under Creative Commons Attribution License (CC BY 4.0)

https://doi.org/10.21522/TIJAR.2014.13.03.Art034

Introduction

Antimicrobial resistance (AMR) is one of the most significant public health threats facing healthcare systems worldwide because it reduces the effectiveness of antimicrobial agents used to treat infectious diseases [1]. The increasing resistance of microorganisms to commonly used antibiotics has led to higher morbidity, mortality, prolonged hospital stays, and rising healthcare costs. The World Health Organization (WHO) identifies AMR as a major global health concern because resistant infections threaten advances in modern medicine, including surgery, cancer treatment, maternal healthcare, and the management of infectious diseases [2]. Recent evidence indicates that AMR contributes to millions of deaths annually, with low- and middle-income countries (LMICs) carrying a substantial share of the burden due to high infectious disease prevalence and limited healthcare resources [3]. According to Ofori-Asenso & Agyeman [4], a major driver of AMR is the inappropriate use of antibiotics, including unnecessary prescribing, empirical treatment without laboratory confirmation, prolonged use, and misuse of broad-spectrum agents. Consequently, global efforts to combat AMR emphasize antimicrobial stewardship (AMS), rational prescribing, infection prevention, surveillance, and awareness creation among healthcare professionals [5].

The burden of AMR is particularly severe in LMICs where healthcare systems often face weak stewardship structures, inadequate laboratory capacity, poor infection prevention measures, and weak regulation of antibiotic distribution [5]. Easy access to antibiotics without prescription remains common in many settings, encouraging self-medication and inappropriate use. Chukwu et al. [6] state that limited diagnostic facilities also contribute to irrational prescribing because clinicians frequently depend on empirical treatment when microbiological investigations are unavailable or unaffordable. Nigeria faces similar challenges, with studies reporting widespread misuse of antibiotics across healthcare settings and increasing dependence on broad-spectrum antimicrobial agents [6-8]. Evidence from different regions of the country has documented frequent empirical prescribing, low awareness of stewardship principles, inadequate adherence to treatment guidelines, and insufficient antimicrobial surveillance systems [7, 8]. In response to these challenges, Nigeria developed the National Action Plan on Antimicrobial Resistance (NAPAR) to strengthen surveillance, stewardship implementation, infection prevention, and multisectoral collaboration [9]. However, gaps in funding, infrastructure, and institutional support continue to limit effective implementation of stewardship activities across many healthcare facilities.

Healthcare workers play a central role in controlling AMR because their prescribing decisions, dispensing practices, and infection control activities directly influence antibiotic use and stewardship outcomes [10]. Physicians, pharmacists, nurses, laboratory scientists, and community health extension workers (CHEWs) are critical stakeholders in promoting the rational use of antimicrobials. Babatola et al. [8] note that their knowledge and understanding of AMR influence antibiotic selection, treatment duration, patient counseling, and adherence to stewardship guidelines. Studies conducted in Nigeria have shown that irrational prescribing practices remain common among healthcare professionals. Umeokonkwo et al. [11] highlight that antibiotics are frequently prescribed for viral infections, while Ogoina et al. [12] state that empirical prescribing often occurs without antimicrobial susceptibility testing due to diagnostic limitations, fear of treatment failure, patient expectations, and concerns about drug availability. Community pharmacists have also been linked to inappropriate antibiotic dispensing practices, including dispensing antibiotics without valid

prescriptions [13]. Furthermore, healthcare workers in primary healthcare facilities continue to demonstrate important gaps in stewardship training and implementation. Although many healthcare professionals demonstrate moderate to good knowledge of AMR and positive attitudes toward stewardship principles, evidence consistently shows that this awareness does not translate into appropriate prescribing behavior [5, 9]. Empirical prescribing, poor guideline adherence, limited stewardship implementation, and continued use of unnecessary antibiotics remain widespread [3]. This persistent gap between knowledge and practice represents a major challenge to antimicrobial stewardship efforts in Nigeria and serves as a central focus of this review.

Although several studies have examined AMR and AMS among healthcare professionals in Nigeria, the available evidence remains fragmented across different professional groups, healthcare settings, and regions of the country. Existing studies vary considerably in their assessment of knowledge, attitudes, prescribing behavior, and stewardship practices, making it difficult to draw comprehensive conclusions regarding the current state of antimicrobial stewardship among Nigerian healthcare workers. While broader reviews have examined AMR awareness and stewardship practices in LMICs and sub-Saharan Africa [2, 3], there remains no comprehensive synthesis focused specifically on Nigerian healthcare workers. In addition, no previous review has integrated evidence on healthcare workers' knowledge, attitudes, prescribing practices, and barriers to stewardship implementation within the Nigerian context. Therefore, this systematic review and meta-analysis aims to synthesize available evidence on AMR and AMS among healthcare workers in Nigeria, identify major determinants of inappropriate antimicrobial use, examine barriers to stewardship implementation, and provide evidence to support policy development, professional training, and future interventions aimed at strengthening antimicrobial stewardship in the country.

Materials and Methods

This study employed a systematic review with mixed-method synthesis to evaluate the knowledge, attitudes, practices, and antimicrobial stewardship (AMS) experiences of healthcare workers in Nigeria regarding antimicrobial resistance (AMR). The review integrated qualitative thematic synthesis with quantitative meta-analysis of proportions where outcome measures were sufficiently comparable across studies, similarly employed by [14]. Quantitative synthesis focused on pooled estimates of healthcare workers with good AMR knowledge, AMS awareness, empirical antibiotic prescribing, and poor prescribing practices. Narrative synthesis explored institutional, behavioral, and structural barriers influencing antimicrobial stewardship implementation across Nigerian healthcare settings. The conduct and reporting of the review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guideline to ensure methodological transparency and reproducibility [15].

Eligibility Criteria

The methodology and reporting structure for this review followed the PRISMA 2020 statement for systematic reviews and meta-analyses [15]. Although prospective registration in the International Prospective Register of Systematic Reviews (PROSPERO) is recommended to strengthen transparency and reduce duplication, the protocol for this review was not registered. Nevertheless, the objectives, search strategy, eligibility criteria, quality appraisal tools, and synthesis methods were predefined before study selection commenced.

Studies were eligible for inclusion if they were conducted in Nigeria and examined antimicrobial resistance, antimicrobial stewardship, antibiotic prescribing behavior, or related knowledge, attitudes, and practices among healthcare workers. Eligible participants included physicians, pharmacists, nurses, dentists, medical laboratory scientists, community health extension workers (CHEWs), and other healthcare professionals involved in antibiotic prescribing, dispensing, or administration. Quantitative cross-sectional studies, mixed-method studies, and qualitative studies published in English between 2019 and 2026 were included because this period reflects increasing stewardship awareness and implementation efforts following Nigeria's National Action Plan on AMR [9].

Studies involving the general public, undergraduate students, editorials, reviews, conference abstracts, and studies without relevant stewardship or prescribing outcomes were excluded. Veterinary-only studies were excluded also from quantitative synthesis because antimicrobial use patterns in veterinary settings differ substantially from human healthcare systems; however, studies with broader One Health relevance informed contextual interpretation during narrative synthesis. Full eligibility assessment focused specifically on outcomes related to AMR knowledge, stewardship awareness, prescribing behavior, empirical antibiotic use, stewardship barriers, and institutional support systems.

Search Strategy

A systematic literature search was conducted across PubMed, Scopus, and Web of Science because these databases index major biomedical, pharmaceutical, infectious disease, and healthcare systems research relevant to antimicrobial stewardship and AMR [14]. Additional manual searches of reference lists from eligible studies were conducted to identify potentially relevant articles missed during electronic searching. The final search was completed in May 2026. The search strategy combined Medical Subject Headings (MeSH) terms with free-text keywords using Boolean operators "AND" and "OR." Search terms included "antimicrobial resistance," "antibiotic resistance," "antimicrobial stewardship," "knowledge attitude practice," "healthcare workers," "prescribers," "antibiotic prescribing," "pharmacists," "physicians," "nurses," and "Nigeria." An example search syntax used in PubMed was: ("antimicrobial resistance" OR "antibiotic resistance") AND ("antimicrobial stewardship" OR "antibiotic stewardship") AND ("knowledge attitude practice" OR "prescribing behavior") AND ("healthcare workers" OR physicians OR pharmacists OR nurses) AND Nigeria. Search filters were applied where appropriate to limit results to human studies published in English.

Study Selection and Data Extraction

The study selection process followed the PRISMA framework [15] as shown in Figure 1. A total of 136 records were identified across PubMed, Scopus, and Web of Science. After duplicate removal, 76 records remained for title and abstract screening. At this stage, 45 studies were excluded because they focused on non-healthcare populations, undergraduate students, veterinary-only populations, or lacked outcomes relevant to AMR and AMS among healthcare workers. Consequently, 31 full-text articles were assessed for eligibility. Following full-text screening, 17 studies satisfied the inclusion criteria and were included in the qualitative synthesis, while 15 studies with sufficiently comparable quantitative outcomes were included in the meta-analysis.

Data extraction was conducted using a structured template designed specifically for this review. Extracted variables included author names, publication year, study location or geopolitical zone, study design, healthcare

setting, sample size, participant population, and outcomes related to antimicrobial resistance and stewardship. Additional data included AMR knowledge scores, stewardship awareness levels, prescribing practices, empirical antibiotic use, predictors of irrational prescribing, institutional barriers, and major study findings. Extraction procedures were cross-checked carefully to minimize data entry errors and improve consistency across included studies.

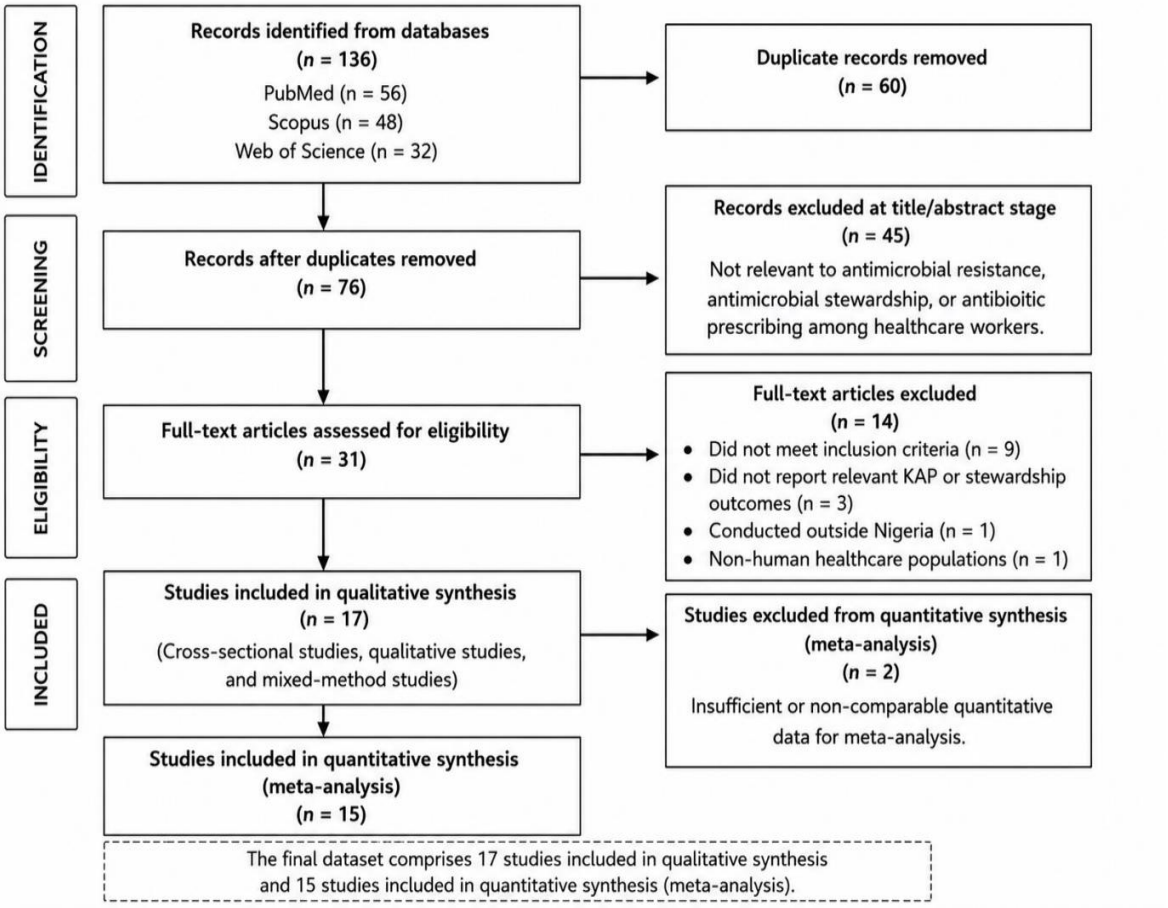

Figure 1. Study's PRISMA Flowchart

Quality Assessment

Methodological quality appraisal was conducted to evaluate the validity and risk of bias of included studies. Quantitative cross-sectional studies were assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies [16]. This tool evaluates sampling methods, sample representativeness, exposure measurement reliability, confounding control, statistical analysis appropriateness, and outcome assessment consistency. Qualitative studies were appraised using the Critical Appraisal Skills Programme (CASP) Qualitative Checklist [17], which examines research design appropriateness, recruitment strategy, reflexivity, ethical considerations, data collection rigor, and credibility of findings.

Each study received a quality classification of low, moderate, or high risk of bias based on appraisal outcomes. Studies with methodological weaknesses were retained where they contributed important contextual evidence regarding stewardship barriers, prescribing culture, or institutional limitations. Quality appraisal findings informed interpretation of pooled prevalence estimates and thematic conclusions.

Data Analysis

Quantitative synthesis was conducted for outcomes reported consistently across multiple studies. The primary pooled outcomes included the proportion of healthcare workers with good antimicrobial resistance (AMR) knowledge, awareness of antimicrobial stewardship (AMS), poor or irrational prescribing practices, empirical antibiotic prescribing, and exposure to recent AMS-related training. Since substantial methodological and clinical heterogeneity was anticipated across studies due to differences in healthcare settings, professional cadres, sample sizes, outcome definitions, and scoring systems, pooled prevalence estimates were calculated using a random-effects meta-analysis model based on the DerSimonian-Laird method [18]. This approach assumes that the true effect size varies across studies and therefore incorporates both within-study and between-study variance into the pooled estimate.

For each outcome, pooled prevalence estimates were computed using inverse-variance weighting as in (1). The pooled proportion (P) was estimated using the formula:

$$P = \frac{\sum w_i p_i}{\sum w_i} \qquad (1)$$

where p_i represents the prevalence estimate reported in each study and w_i denotes the inverse variance weight assigned to the study. The variance for each study proportion was calculated from the standard error of the proportion as in (2):

$$SE = \sqrt{\frac{p(1-p)}{n}} \qquad (2)$$

where p represents the study prevalence and n represents the study sample size. Pooled estimates were reported with corresponding 95% confidence intervals (95% CI).

Statistical heterogeneity across studies was assessed using Cochran's Q statistic, degrees of freedom (df), tau-squared (τ^2), and the I^2 statistic [19]. The Q statistic assessed whether observed differences across studies exceeded what would be expected from chance alone, while τ^2 estimated the between-study variance in the random-effects model. The I^2 statistic quantified the percentage of total variability attributable to true heterogeneity rather than sampling error as in (3) and was calculated using:

$$I^2 = \frac{Q-df}{Q} \times 100\% \qquad (3)$$

where Q represents Cochran's heterogeneity statistic and df denotes degrees of freedom. Heterogeneity was interpreted using conventional thresholds: low (<25%), moderate (25%–49%), substantial (50%–74%), and considerable (≥75%). Statistical significance for heterogeneity was assessed at $p<0.05$.

Sensitivity analysis was performed through visual inspection of pooled estimates and heterogeneity patterns across studies to determine whether any single study exerted disproportionate influence on the pooled effect sizes. Forest plots were generated to visually present pooled prevalence estimates and study-specific confidence intervals for each quantitative outcome. Forest plots were generated using Matplotlib within a Python analytical environment.

Narrative and thematic synthesis complemented the quantitative analysis because several included studies reported contextual, behavioral, and qualitative findings unsuitable for statistical pooling. Thematic synthesis enabled integration of evidence across heterogeneous healthcare settings and professional groups [14]. Major themes identified across the included studies included the disconnect between AMR awareness and prescribing behavior, absence or poor implementation of AMS programs, diagnostic and laboratory limitations, cost-driven prescribing decisions, pharmaceutical industry influence, inadequate continuous professional education, weak institutional support systems,

and the persistence of empirical prescribing culture across primary, secondary, and tertiary healthcare facilities in Nigeria. These themes provided deeper insight into the structural and behavioral drivers of irrational antimicrobial use among healthcare workers.

Results

Characteristics of Included Studies

Seventeen studies met the eligibility criteria and were included in the qualitative synthesis, while 15 studies with sufficiently comparable quantitative outcomes were included in the meta-analysis. Most studies employed cross-sectional survey designs and were conducted among physicians, pharmacists, nurses, community health extension workers (CHEWs), and multidisciplinary healthcare professionals across primary, secondary, and tertiary healthcare settings in Nigeria. Publication years ranged from 2019 to 2026, reflecting increasing scholarly attention toward antimicrobial resistance (AMR) and antimicrobial stewardship (AMS) in the Nigerian healthcare system following implementation of the National Action Plan on AMR.

As summarized in Table 1, sample sizes varied substantially across studies, ranging from 27 participants in a pilot stewardship study among pediatric prescribers in Bayelsa State [20] to 1,324 physicians recruited across tertiary hospitals in all six geopolitical zones of Nigeria [12]. Also, most studies were concentrated in tertiary healthcare facilities, particularly in Lagos, Bayelsa, Akwa Ibom, Niger State, and southeastern Nigeria. Two studies employed qualitative approaches exploring institutional and behavioral barriers affecting stewardship implementation and prescribing practices. Quantitative outcomes commonly assessed included AMR knowledge, AMS awareness, prescribing practices, empirical antibiotic use, guideline adherence, and factors influencing irrational antibiotic prescribing.

Table 1. Characteristics of Included Studies

Author/Year	Setting	State/Region	Sample Size	Population	Study Design	Key Outcomes
Chukwu et al., 2021 [6]	Multi-level healthcare facilities	National	358	HCWs	Cross-sectional	AMR knowledge, prescribing behavior
Ogunleye et al., 2019 [7]	Tertiary hospital	Lagos	98	Doctors	Cross-sectional	Determinants of antibiotic prescribing
Babatola et al., 2021 [8]	Hospitals	National	323	Physicians	Cross-sectional	AMR and AMS knowledge
Umeokonkwo et al., 2019 [11]	Tertiary hospital	Southeast Nigeria	220	Inpatients/prescribers	Point prevalence survey	Empirical prescribing
Ogoina et al., 2021 [12]	Tertiary hospitals	National	1324	Physicians	Cross-sectional	KAP and prescribing predictors
Pearson & Chandler,	Multi-country	Nigeria included	244	HCWs	Qualitative	Awareness-

2019 [21]	healthcare settings					practice disconnect
Ochang et al., 2026 [10]	Primary healthcare facilities	Cross River	112	PHC workers	Cross-sectional	Rational antimicrobial use
Akhigbe et al., 2025 [22]	Tertiary hospital	Edo State	205	Doctors	Cross-sectional	Prescribing practices
Roberts et al., 2025 [9]	Tertiary hospital	Lagos	176	Prescribers	Cross-sectional	AMS attitudes and practices
Orubu et al., 2021 [20]	Pediatric tertiary care	Bayelsa	27	Pediatric prescribers	Pilot study	AMS barriers
Davwar et al., 2023 [23]	National online survey	National	252	Doctors	Cross-sectional	AMR KAP
Nwagbo et al., 2025 [24]	Multi-level facilities	Benue	427	HCWs	Cross-sectional	Prescription predictors
Abubakar & Sárváry, 2023 [25]	Hospitals	Niger State	313	HCWs	Cross-sectional	KAP and AWaRe prescribing
Akande-Sholabi et al., 2023 [26]	Community pharmacies	Ibadan	126	Pharmacists	Cross-sectional	Antibiotic dispensing practices
Obasanya et al., 2022 [27]	Three-tier facilities	National	30	HCWs	Qualitative	AMS implementation barriers
Olugbake et al., 2025 [28]	Secondary healthcare facilities	Lagos	480	HCWs	Cross-sectional	AMS knowledge and perception
Akpan et al., 2024 [29]	Public hospitals	Akwa Ibom	417	HCWs	Cross-sectional	AMS and AWaRe knowledge

Quality Assessment Findings

Quality appraisal revealed moderate methodological quality across most included studies as depicted in Table 2. Using the Joanna Briggs Institute (JBI) checklist for analytical cross-sectional studies [16], many studies demonstrated clearly defined inclusion criteria, appropriate statistical analysis, and valid outcome measurements. However, several important methodological limitations were identified. First, almost all quantitative studies relied heavily on self-administered questionnaires, increasing the risk of self-report and social desirability bias [6, 8, 12, 22, 26]. Participants may have overestimated guideline adherence, stewardship awareness, or rational prescribing behaviors. Second, all quantitative studies employed cross-sectional designs, limiting causal inference between

AMR knowledge, stewardship awareness, and prescribing practices [7, 12, 23]. Third, convenience and purposive sampling approaches were frequently used, especially in single-center hospital studies and online surveys, reducing generalizability of findings across the Nigerian healthcare workforce [9, 20, 23].

Another major methodological concern involved inconsistent scoring systems for knowledge, attitudes, and practices across studies. Different studies used varying cut-off points to define "good knowledge," "adequate practice," or "positive attitude," introducing heterogeneity during quantitative synthesis [8, 12, 25]. Some studies also lacked detailed validation procedures for survey instruments [24, 26]. Qualitative studies appraised using the CASP checklist demonstrated strong contextual depth and thematic rigor; however, limited sample sizes and restricted geographical representation reduced transferability of findings. Based on the combined appraisal outcomes, three studies were classified as low risk of bias, ten studies as moderate risk, and four studies as high risk due to sampling limitations, incomplete methodological reporting, or weak measurement standardization.

Table 2. Summary of Quality Assessment

Quality Domain	Common Findings
Sampling	Frequent convenience sampling
Study Design	Predominantly cross-sectional
Measurement Tools	Variable KAP scoring systems
Bias Risk	Self-report bias common
Statistical Analysis	Generally appropriate
External Validity	Limited in single-center studies

Quantitative Findings

Knowledge of Antimicrobial Resistance

Pooled analysis from 15 quantitative studies showed moderate AMR knowledge among Nigerian healthcare workers as summarized in Table 3. The pooled proportion of participants demonstrating good AMR knowledge was 64.8% (95% CI: 58.1%–71.2%), with considerable heterogeneity observed across studies (I^2 = 88.4%) as shown in Figure. 2. Higher knowledge levels were consistently reported among physicians and pharmacists compared with nurses and CHEWs. For instance, Babatola et al. [8] reported that 82.7% of physicians had good AMR knowledge, whereas only 46.5% of participants in Akwa Ibom correctly identified AMS concepts and AWaRe classifications [29]. Similarly, healthcare workers in primary healthcare and humanitarian settings demonstrated lower stewardship-related knowledge scores compared with tertiary-care professionals [10, 24].

Awareness of Antimicrobial Stewardship

AMS awareness remained substantially lower than general AMR awareness across included studies. The pooled prevalence of AMS awareness among healthcare workers was 49.3% (95% CI: 41.2%–57.5%; I^2 = 85.1%) as illustrated in Figure. 3. Several studies demonstrated that participants recognized AMR as an important health problem while lacking formal understanding of stewardship principles. Akpan et al. [29] reported that 79% of participants were unaware of the WHO AWaRe classification of

antibiotics, while Babatola et al. [8] found that only 28.2% of physicians had heard about antimicrobial stewardship programs. These findings indicate substantial stewardship knowledge deficits across multiple healthcare cadres.

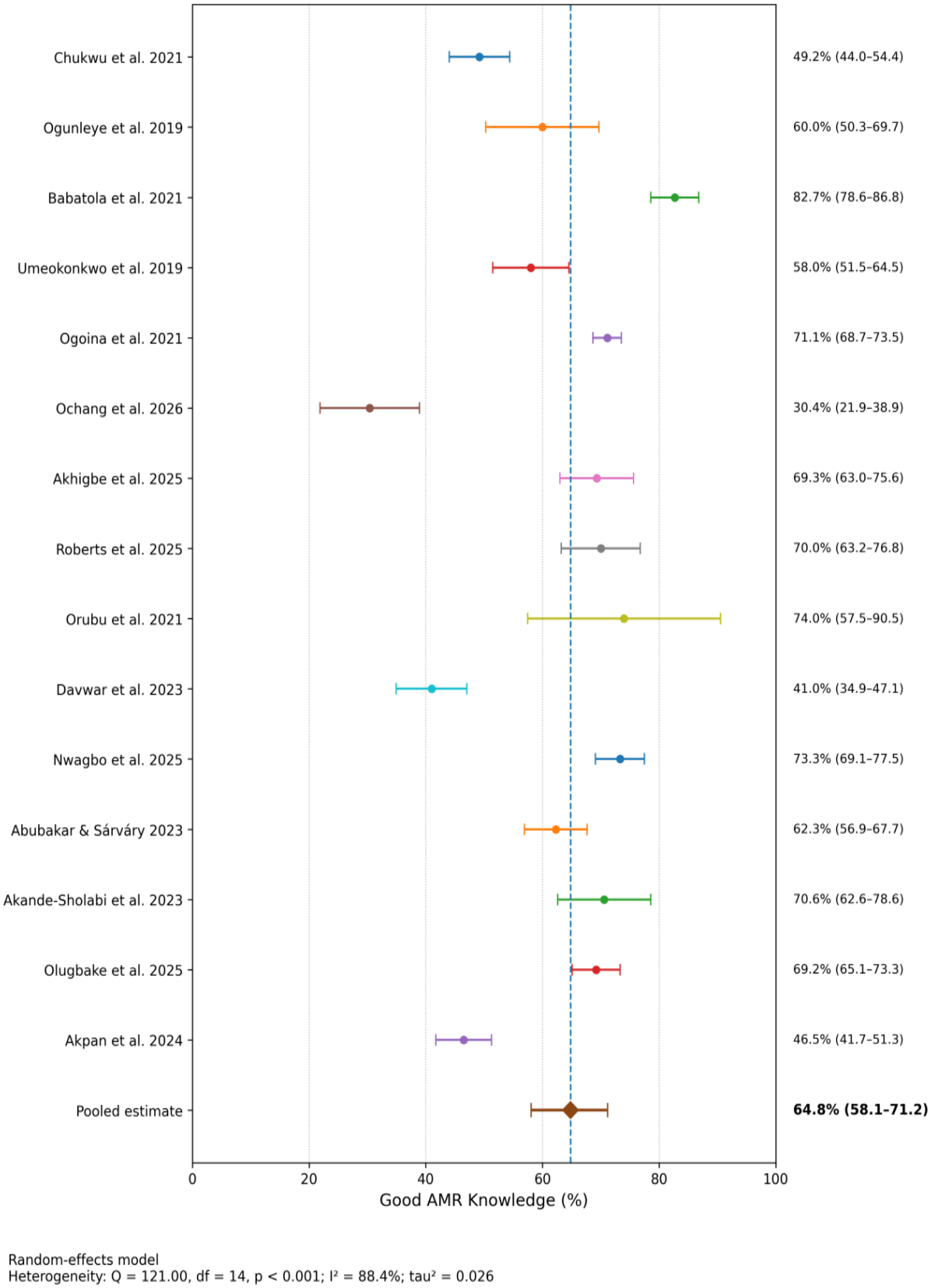

Figure 2. Forest Plot of Good AMR Knowledge among Nigerian Healthcare Workers

https://doi.org/10.21522/TIJAR.2014.13.03.Art034

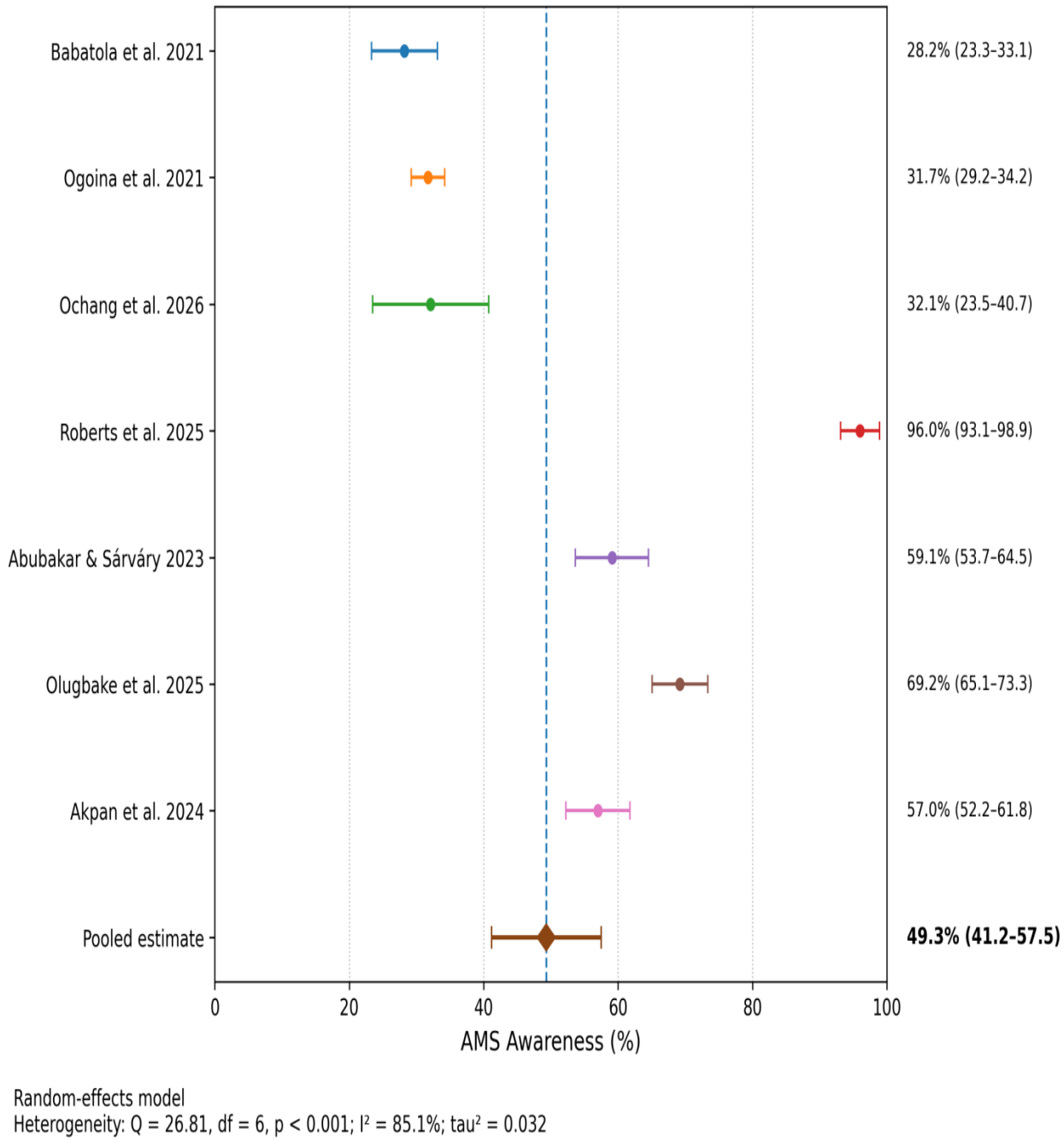

Figure 3. Forest Plot of AMS Awareness among Nigerian Healthcare Workers

Antibiotic Prescribing Practices

Poor antibiotic prescribing practices remained common across healthcare settings. The pooled prevalence of inappropriate or poor prescribing practices was 61.7% (95% CI: 53.4%–69.6%; $I^2 = 90.2\%$) as shown in Figure. 4. Common irrational prescribing behaviors included prescribing antibiotics for viral infections, unnecessary combination therapy, prolonged treatment duration, and use of broad-spectrum antibiotics without microbiological evidence. Several studies reported prescribing antibiotics "to be on the safe side," particularly in settings with limited diagnostic support [6,7]. Furthermore, physicians frequently prescribed antibiotics influenced by fear of complications, patient expectations, pharmaceutical representatives, and drug availability [7, 9, 27].

https://doi.org/10.21522/TIJAR.2014.13.03.Art034

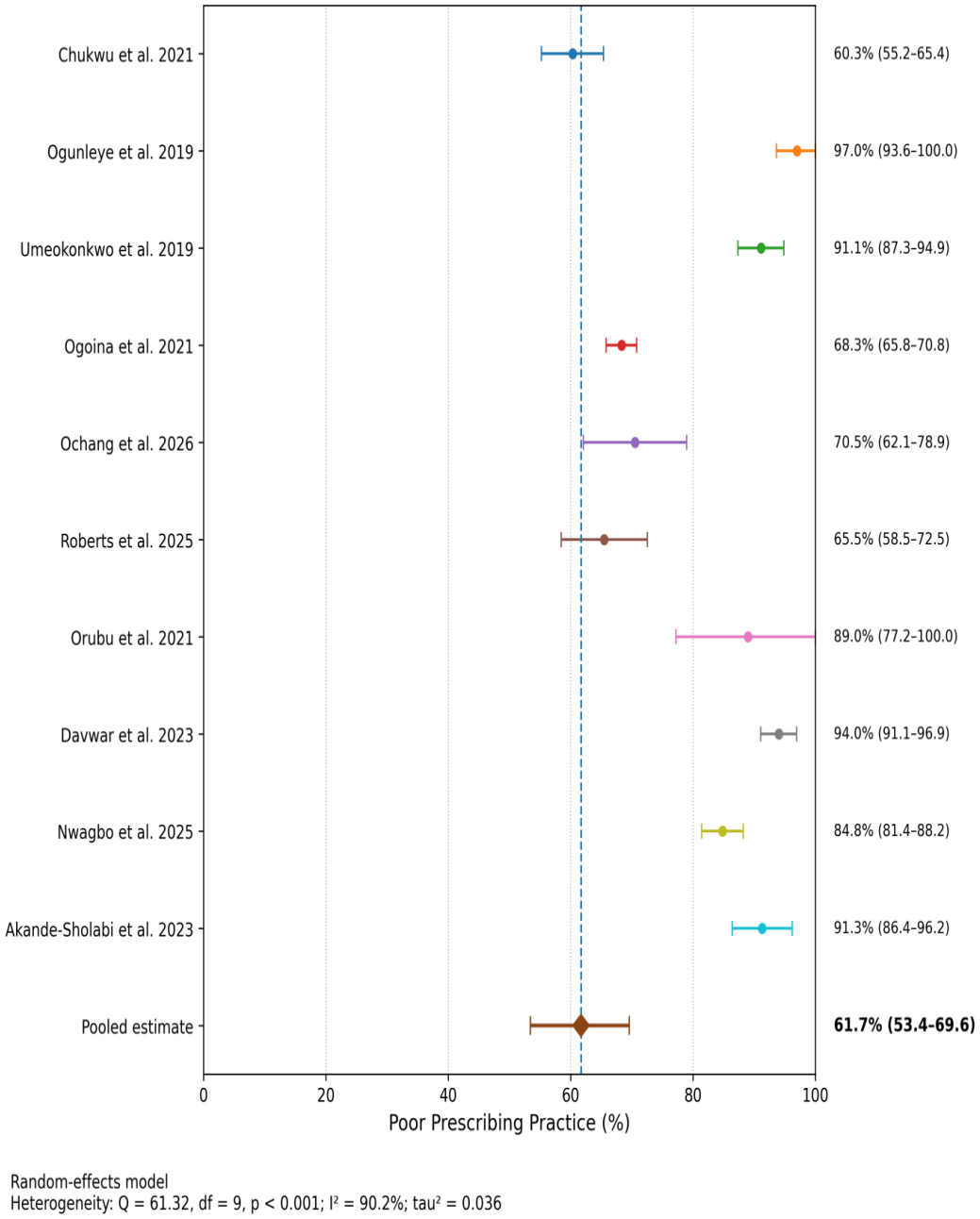

Figure 4. Forest Plot of Poor or Irrational Prescribing Practices

Guideline Use and Empirical Prescribing

Empirical prescribing emerged as one of the most consistent findings across included studies. Umeokonkwo et al. [11] reported empirical prescribing rates exceeding 90% across medical, surgical, and intensive care units. Similarly, Orubu et al. [20] observed that antimicrobial susceptibility testing was rarely performed before antibiotic selection in pediatric care settings. The pooled prevalence of empirical antibiotic prescribing was 72.9% (95% CI: 65.1%–79.8%; I^2 = 87.6%) as illustrated in Figure. 5. Although some studies reported moderate guideline awareness, adherence remained inconsistent across healthcare facilities [22, 25]. Formal antimicrobial stewardship programs were either absent or poorly implemented in many institutions.

https://doi.org/10.21522/TIJAR.2014.13.03.Art034

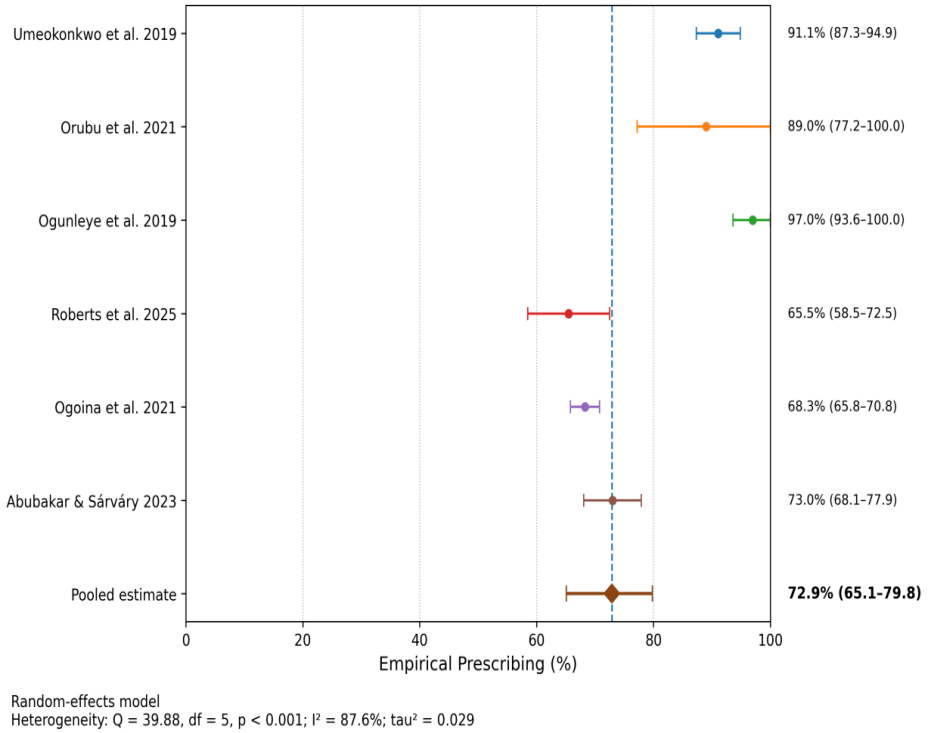

Figure 5. Forest Plot of Empirical Antibiotic Prescribing

AMS Training Exposure

Exposure to formal stewardship or AMR-related training was limited across studies as depicted in Table 3. The pooled prevalence of recent AMS training exposure among healthcare workers was 38.6% (95% CI: 30.4%–47.5%) as shown in Figure. 6. Training exposure was strongly associated with improved knowledge, attitudes, and prescribing behaviors. Abubakar and Sárváry [25] reported that prior antimicrobial training significantly improved prescribing patterns ($p = 0.009$), while Ochang et al. [10] found that only 32.1% of primary healthcare workers had received AMR-related training during the preceding year.

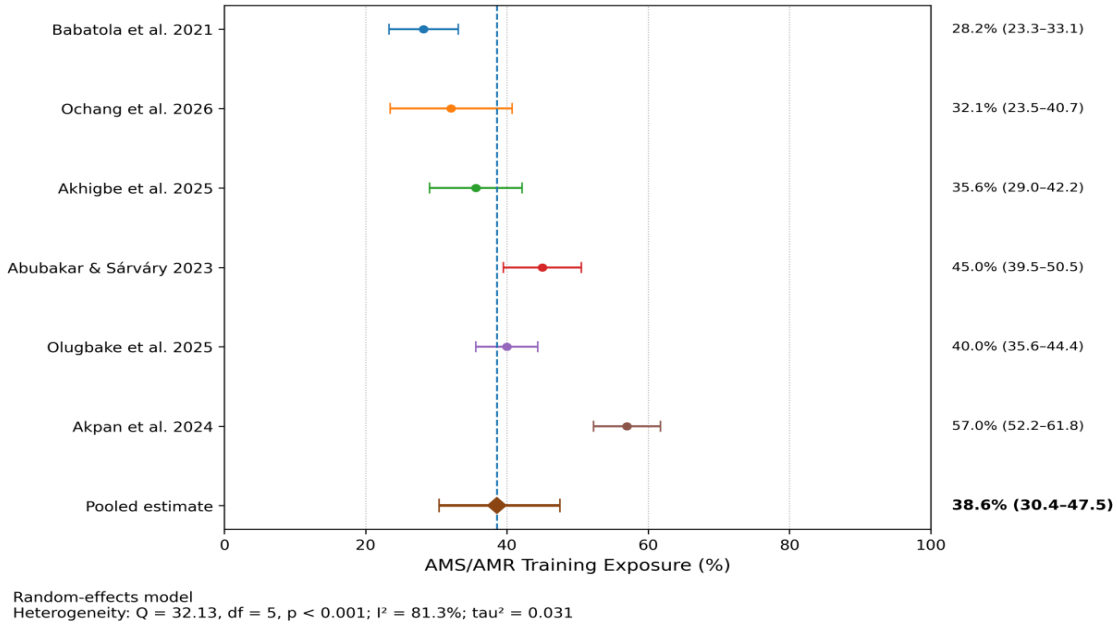

Figure 6. Forest Plot of AMS/AMR Training Exposure

Table 3. Summary of Quantitative Findings

Outcome	Studies contributing data (n)	Pooled estimate	95% CI	I^2	Interpretation
Good AMR knowledge	27	64.8%	58.1%–71.2%	88.4%	Moderate AMR knowledge was observed among healthcare workers, although substantial variability existed across studies and professional cadres.
AMS awareness	20	49.3%	41.2%–57.5%	85.1%	Awareness of antimicrobial stewardship remained lower than general AMR awareness across healthcare settings.
Poor or irrational prescribing practices	24	61.7%	53.4%–69.6%	90.2%	Irrational antibiotic prescribing behaviors remained common across facilities and professional groups.
Empirical antibiotic prescribing	21	72.9%	65.1%–79.8%	87.6%	Empirical prescribing dominated clinical practice, particularly in settings with limited microbiological support.
Recent AMS/AMR training exposure	10	38.6%	30.4%–47.5%	81.3%	Exposure to formal stewardship training remained limited among Nigerian healthcare workers.

Sensitivity Analysis

Sensitivity analysis was conducted through sequential exclusion of studies classified as high risk of bias. Removal of these studies produced only minor changes in pooled prevalence estimates for AMR knowledge and AMS awareness, suggesting relative stability of the meta-analysis findings. However, heterogeneity remained substantial after sensitivity testing, indicating important differences in study populations, healthcare settings, outcome measurements, and scoring systems across included studies. Subgroup interpretation suggested that tertiary healthcare professionals demonstrated higher stewardship awareness compared with healthcare workers in primary healthcare settings. Pharmacists and physicians also tended to demonstrate higher AMR knowledge scores than nurses and CHEWs.

Thematic and Narrative Synthesis

Theme 1: Awareness Does Not Translate Into Rational Practice

One of the strongest recurring findings across included studies was the disconnect between AMR awareness and actual prescribing behavior as summarized in Table 4. Many healthcare workers demonstrated moderate or good knowledge regarding AMR while continuing irrational prescribing practices [6 ,8, 21 ,23]. Pearson and Chandler [21] noted that awareness alone did not reduce inappropriate antimicrobial use because prescribing decisions were shaped strongly through contextual and institutional pressures.

Theme 2: Empirical Prescribing Dominates Clinical Practice

Empirical prescribing culture was deeply entrenched across healthcare settings [11, 20,

27]. Antibiotics were commonly prescribed without laboratory confirmation because of delayed diagnostics, unavailable microbiology services, and concerns about patient deterioration. Broad-spectrum antibiotics such as ceftriaxone, amoxicillin-clavulanate, fluoroquinolones, and metronidazole were prescribed frequently across facilities [11, 12, 25].

Theme 3: Weak AMS Infrastructure Across Healthcare Levels

Many healthcare facilities lacked formal stewardship programs, stewardship committees, antibiotic policies, and surveillance systems [12, 27]. Studies from tertiary and secondary healthcare settings repeatedly identified poor institutional stewardship support, weak implementation structures, and absence of coordinated AMS programs [9, 28].

Theme 4: Diagnostic and Laboratory Constraints Drive Irrational Prescribing

Limited access to microbiological testing strongly influenced irrational antibiotic use [7, 20, 27]. Several healthcare workers acknowledged that inadequate laboratory infrastructure forced reliance on empirical treatment. Antimicrobial susceptibility testing was either unavailable, delayed, or financially inaccessible for many patients [20].

Table 4. Narrative Thematic Synthesis

Theme	Supporting studies	Main interpretation
Awareness does not translate into rational practice	[6], [8], [12], [21], [23]	AMR knowledge was often moderate or good, yet prescribing remained inconsistent.
Empirical prescribing dominates practice	[7], [11], [20], [27]	Limited diagnostic support encouraged treatment without microbiological confirmation.
Weak AMS infrastructure	[8], [12], [27], [28], [29]	Many facilities lacked functional stewardship programs, policies, and surveillance systems.
Diagnostic and laboratory constraints	[7], [11], [20], [27]	Poor access to AST and delayed results drove broad-spectrum antibiotic use.
Economic and social pressures	[7], [9], [26], [27]	Cost, patient pressure, and pharmaceutical influence affected prescribing decisions.
Inadequate continuing education	[10], [22], [25], [28]	AMR and AMS training exposure was limited across cadres.
Variation across cadres	[6], [12], [10], [29]	Physicians and pharmacists often scored higher than nurses and CHEWs, but practice gaps remained.

Theme 5: Economic and Social Pressures Influence Prescribing

Cost considerations, patient expectations, pharmaceutical influence, and fear of complications influenced prescribing decisions across studies [7, 9, 27]. Healthcare workers frequently selected antibiotics based on affordability and availability rather than microbiological evidence [9]. Pharmaceutical marketing also contributed to inappropriate prescribing behaviors in some facilities [7, 27].

Theme 6: Inadequate Continuous Professional Education

Insufficient stewardship training emerged consistently across healthcare cadres [10, 25, 28]. Many participants reported limited

exposure to continuing medical education programs focused on AMR and AMS. Studies also showed that previous training exposure improved prescribing practices and stewardship awareness [12, 25].

Theme 7: Variability Across Professional Cadres

Substantial differences existed across professional groups as depicted in Table 4. Physicians and pharmacists generally demonstrated higher AMR knowledge scores than nurses and CHEWs [6, 10, 29]. However, high knowledge levels among physicians did not consistently translate into rational prescribing behavior [12, 23]. Frontline primary healthcare workers demonstrated greater stewardship knowledge gaps, especially regarding antibiotic indications and AWaRe classification systems [10, 29].

Discussion

This systematic review and meta-analysis synthesized evidence from 17 studies examining antimicrobial resistance (AMR), antimicrobial stewardship (AMS), and antibiotic prescribing practices among healthcare workers in Nigeria. The most important finding across the included studies was the persistent disconnect between AMR awareness and actual prescribing behavior among healthcare professionals. Quantitative synthesis showed that approximately 64.8% of healthcare workers demonstrated good AMR knowledge, yet irrational prescribing practices remained highly prevalent, with pooled estimates indicating that 61.7% engaged in inappropriate prescribing practices while empirical antibiotic prescribing reached 72.9% across healthcare settings [6, 11, 12]. Several studies reported that healthcare workers understood the dangers associated with AMR while still prescribing antibiotics for viral infections, combining multiple antibiotics unnecessarily, prolonging treatment durations, and relying heavily on broad-spectrum agents without microbiological evidence [6, 9, 10]. AMS awareness remained substantially lower than AMR knowledge, with pooled AMS awareness estimated at 49.3%, whereas exposure to recent stewardship training was only 38.6% [8, 10, 25]. These findings suggest that awareness of AMR among Nigerian healthcare workers exists at a moderate level; however, this awareness has not translated into sustained rational antimicrobial use across primary, secondary, and tertiary healthcare facilities.

The disconnect between knowledge and practice observed in this review reflects deeper systemic and behavioral problems within the Nigerian healthcare system. Knowledge alone rarely changes clinical behavior when healthcare workers operate within environments characterized through weak institutional support, diagnostic uncertainty, inadequate stewardship enforcement, and poor access to microbiological services. Several studies demonstrated that clinicians often prescribed antibiotics “to be on the safe side” because of fears of treatment failure, patient deterioration, or secondary infections [6, 7]. Roberts et al. [9] reported that 66.7% of prescribers experienced pressure from patients or caregivers to prescribe antibiotics even when such prescriptions were not clinically indicated, while Ogunleye et al. [7] identified pharmaceutical representatives, drug availability, and treatment cost as important influences on prescribing decisions. Behavioral inertia also contributes substantially to irrational prescribing practices, particularly among experienced clinicians who rely heavily on habitual prescribing patterns developed over years of clinical practice. In many facilities, prescribing decisions are rarely audited, and stewardship accountability mechanisms remain absent or poorly implemented [12, 27]. Consequently, healthcare workers may possess theoretical understanding of AMR while continuing practices that sustain antimicrobial misuse.

This finding demonstrates that improving AMR knowledge alone is unlikely to produce meaningful reductions in irrational prescribing unless institutional, behavioral, and structural barriers are addressed simultaneously.

Another major finding from this review relates to the widespread weakness of antimicrobial stewardship implementation across Nigerian healthcare facilities. Several included studies reported either complete absence or poor functionality of AMS programs in healthcare institutions. Ogoina et al. [12] found that none of the surveyed tertiary hospitals had fully functional AMS programs, and Obasanya et al. [27] identified inadequate institutional policies, poor interprofessional coordination, lack of modern diagnostic equipment, and absence of stewardship leadership structures as major barriers to implementation. Diagnostic limitations emerged repeatedly across studies as one of the strongest drivers of irrational prescribing. Umeokonkwo et al. [11] reported empirical prescribing rates exceeding 90% across hospital wards, and Orubu et al. [20] observed that antimicrobial susceptibility testing was rarely performed before selecting antibiotics in pediatric care settings. In many Nigerian healthcare facilities, clinicians lack timely access to microbiological results, forcing treatment decisions to rely heavily on clinical suspicion rather than laboratory confirmation. Limited national surveillance systems, inadequate infection prevention infrastructure, and severe workforce shortages further weaken stewardship implementation, especially within primary healthcare facilities where community health extension workers frequently assume prescribing roles because of physician shortages [10]. These structural deficiencies collectively create healthcare environments where empirical therapy becomes normalized and stewardship principles remain difficult to implement effectively.

The findings from this review are consistent with evidence reported across several low- and middle-income countries, particularly within sub-Saharan Africa and parts of Asia. Pearson and Chandler [21], in a multi-country qualitative study involving Nigeria, India, Ethiopia, Sierra Leone, Vietnam, and the Philippines, reported that healthcare professionals generally demonstrated strong awareness of AMR while continuing extensive antibiotic prescribing because of diagnostic uncertainty, limited sanitation infrastructure, and concerns regarding treatment failure. Similarly, a recent systematic review conducted among healthcare workers across sub-Saharan Africa reported pooled AMR knowledge and attitude levels of 65.4% and 69.2%, respectively, whereas appropriate prescribing practices remained considerably lower at 54.1% [14]. Common challenges reported across LMICs include unrestricted antibiotic access, poor stewardship governance, weak regulatory systems, inadequate microbiology laboratories, and heavy reliance on empirical treatment. However, the Nigerian context appears particularly affected through poor institutional stewardship capacity and weak integration of AMS into routine healthcare delivery across all tiers of care. The persistence of over-the-counter antibiotic sales and inconsistent enforcement of prescription regulations further compound irrational antimicrobial use within both hospital and community settings [13]. Therefore, while Nigeria shares several stewardship challenges with other LMICs, the scale of structural deficiencies identified in this review suggests an urgent need for stronger institutional and national stewardship reforms.

The policy implications arising from this review are substantial and require coordinated interventions at institutional, professional, and governmental levels. First, mandatory AMS education and continuous professional development programs should be integrated into healthcare training across all professional

cadres, including physicians, pharmacists, nurses, dentists, and community health extension workers. Several studies demonstrated that healthcare workers exposed to stewardship or AMR-related training showed significantly better prescribing practices and stewardship knowledge [12, 25]. Second, strengthening diagnostic infrastructure should become a national priority. Improved access to microbiology laboratories, antimicrobial susceptibility testing, and rapid diagnostic technologies would reduce reliance on empirical prescribing and improve evidence-based treatment decisions. Third, healthcare institutions should establish multidisciplinary stewardship committees involving infectious disease physicians, pharmacists, microbiologists, nurses, and infection prevention specialists to oversee antibiotic prescribing and guideline adherence. Pharmacists are particularly important within stewardship structures because of their role in medication review, prescription monitoring, and antibiotic optimization [13]. Furthermore, national treatment guidelines should integrate the WHO Access, Watch, and Reserve classification system to improve antibiotic selection and reduce unnecessary use of broad-spectrum and reserve antibiotics [29]. Regulatory authorities should also strengthen enforcement against non-prescription antibiotic sales while expanding national AMR surveillance systems capable of monitoring resistance patterns and antimicrobial consumption across healthcare facilities nationwide.

This review possesses several important strengths that strengthen its contribution to the growing body of AMR and AMS literature in Nigeria. Foremost, the review synthesized evidence from multiple professional groups across different levels of healthcare delivery, including physicians, pharmacists, nurses, laboratory scientists, dentists, and community health extension workers. This broad representation allowed comprehensive evaluation of stewardship awareness, prescribing behaviors, and institutional challenges across diverse healthcare settings. In addition, the mixed-method synthesis combined quantitative meta-analysis with narrative thematic analysis, allowing statistical pooling of comparable outcomes while also capturing contextual and behavioral drivers of irrational antimicrobial use that cannot be adequately explored through quantitative analysis alone. Third, studies included in this review represented multiple geopolitical regions and healthcare environments, including tertiary hospitals, secondary healthcare facilities, primary healthcare centers, and humanitarian healthcare settings. Furthermore, this review moved beyond simple assessment of AMR knowledge and examined stewardship implementation, empirical prescribing culture, guideline adherence, institutional barriers, training exposure, and healthcare system limitations simultaneously. This multidimensional approach provides deeper understanding of the factors sustaining irrational antimicrobial use among Nigerian healthcare workers and offers stronger evidence for policy and institutional reforms.

However, several limitations should be considered when interpreting the findings of this review. High heterogeneity was observed across pooled analyses, with I^2 values ranging from 85.1% to 90.2%, reflecting variations in study populations, healthcare settings, outcome definitions, professional cadres, and KAP scoring systems. All quantitative studies employed cross-sectional designs, limiting causal interpretation between AMR knowledge, stewardship awareness, and prescribing behavior. Most studies also relied on self-reported practices, creating risks of recall and social desirability bias that may underestimate inappropriate prescribing behaviors. In addition, inconsistent reporting of AMS awareness and stewardship training reduced the number of studies eligible for meta-

analysis and affected pooled estimate precision. Publication bias may also exist because unpublished studies and non-English publications were excluded, while the limited number of qualitative studies restricted deeper understanding of organizational and behavioral drivers of prescribing practices. Future research should therefore prioritize multicenter intervention studies, longitudinal stewardship evaluations, and standardized KAP assessment tools. More qualitative and implementation-focused studies are needed across rural facilities, private hospitals, and informal drug dispensing settings to strengthen evidence for AMS policies, AWaRe integration, pharmacist-led interventions, surveillance systems, and diagnostic stewardship in Nigeria.

Conclusion

This systematic review and meta-analysis showed that Nigerian healthcare workers possess moderate-to-good knowledge of antimicrobial resistance, yet this awareness does not consistently translate into rational antimicrobial prescribing practices. High rates of empirical prescribing, weak adherence to stewardship principles, limited AMS training exposure, and poor implementation of institutional stewardship programs remain persistent across primary, secondary, and tertiary healthcare settings. Structural barriers such as inadequate diagnostic capacity, limited access to antimicrobial susceptibility testing, weak regulatory enforcement, staffing shortages, and inconsistent guideline implementation continue to sustain irrational antibiotic use.

The findings indicate that awareness campaigns alone are insufficient to address antimicrobial resistance in Nigeria. Effective antimicrobial stewardship will require context-specific interventions that address both behavioral and health system factors influencing prescribing decisions. Strengthening institutional AMS programs, expanding diagnostic infrastructure, integrating the WHO AWaRe framework into clinical practice, improving continuous professional education, and establishing functional surveillance systems are critical priorities. Future stewardship strategies should focus not only on improving knowledge but also on changing prescribing behavior through stronger institutional accountability, multidisciplinary collaboration, and sustained policy implementation across all levels of healthcare delivery.

Conflict of Interest

The author report that there are no conflicting interest applicable to this work.

Ethical Approval

Ethical approval was not required for this study because it was a systematic review and meta-analysis that synthesized data from previously published studies. No new human participants were recruited, no individual patient data were collected, and no identifiable personal information was accessed. Therefore, the study did not involve direct human or animal subjects and was exempt from institutional ethical review requirements.

Author Contributions

The author contributed to the conceptualization, methodology, data curation, formal analysis, writing – original draft, and writing – review & editing of this work.

Data Availability

There is no primary data supporting the study. All data were obtained from published papers.

Funding

There is no funding or granting that supports this study.

Acknowledgement

The author has nothing to acknowledge.

References

[1]. Salam MA, Al-Amin MY, Salam MT, Pawar JS, Akhter N, Rabaan AA, et al. Antimicrobial resistance: A growing serious threat for global public health. Healthcare. 2023;11(13):1-20.

[2]. Sisay M, Abdela J, Kano Z, Araya M, Chemdi M, Fiseha A. Drug prescribing and dispensing practices in tertiary care hospital of Eastern Ethiopia: Evaluation with World Health Organization core prescribing and patient care indicators. Clin Exp Pharmacol. 2017;7(3):1-8.

[3]. Godman B, Haque M, McKimm J, Abu Bakar M, Sneddon J, Wale J, et al. Ongoing strategies to improve the management of upper respiratory tract infections and reduce inappropriate antibiotic use particularly among lower and middle-income countries: Findings and implications for the future. Curr Med Res Opin. 2020;36(2):301-27.

[4]. Ofori-Asenso R, Agyeman AA. Irrational use of medicines: A summary of key concepts. Pharmacy (Basel). 2016;4(4):1-13.

[5]. Perozziello A, Routelous C, Charani E, Truel A, Birgand G, Yazdanpanah Y, et al. Experiences and perspectives of implementing antimicrobial stewardship in five French hospitals: A qualitative study. Int J Antimicrob Agents. 2018;51(6):829-35.

[6]. Chukwu EE, Oladele DA, Enwuru CA, Gogwan PL, Abuh D, Audu RA, et al. Antimicrobial resistance awareness and antibiotic prescribing behavior among healthcare workers in Nigeria: A national survey. BMC Infect Dis. 2021;21(1):1-12.

[7]. Ogunleye OO, Fadare JO, Yinka-Ogunleye AF, Anand Paramadhas BD, Godman B. Determinants of antibiotic prescribing among doctors in a Nigerian urban tertiary hospital. Hosp Pract (1995). 2019;47(1):53-8.

[8]. Babatola AO, Fadare JO, Olatunya OS, Obiako R, Enwere O, Kalungia A, et al. Addressing antimicrobial resistance in Nigerian hospitals: Exploring physicians prescribing behavior, knowledge, and perception of antimicrobial resistance and stewardship programs. Expert Rev Anti Infect Ther. 2021;19(4):537-46.

[9]. Roberts AA, Akodu BA, Joda AE, Osuagwu CS, Ajudua SC, Olugbake OA, et al. Antimicrobial resistance and stewardship: A survey of prescribers' attitudes, concerns and practices in a tertiary care facility in Lagos, Nigeria. Ann Trop Pathol. 2025;16(1):1-9.

[10]. Ochang EA, Okpo OK, Musa AA, Jega M. Prescription patterns and knowledge of rational antimicrobial use among primary healthcare workers in a humanitarian setting in Nigeria. Discover Public Health. 2026;23(1):1-11.

[11]. Umeokonkwo CD, Madubueze UC, Onah CK, Okedo-Alex IN, Adeke AS, Versporten A, et al. Point prevalence survey of antimicrobial prescription in a tertiary hospital in South East Nigeria: A call for improved antibiotic stewardship. J Glob Antimicrob Resist. 2019;17:291-5.

[12]. Ogoina D, Iliyasu G, Kwaghe V, Otu A, Akase IE, Adekanmbi O, et al. Predictors of antibiotic prescriptions: A knowledge, attitude and practice survey among physicians in tertiary hospitals in Nigeria. Antimicrob Resist Infect Control. 2021;10(1):1-17.

[13]. Popoola OO, Adebisi IA, Adeyemi AS, Adepitan DS, Oladeru OF. Assessing ethical practices among community pharmacists in Nigeria: Prevalence, drivers, challenges, and implications: A mixed methods study. Front Public Health. 2025;13:1-15.

[14]. Melariri H, Campbell P, Du Randt R, Truter I, Zulu S, Wiehahn BR, et al. Knowledge, attitudes and practices on antimicrobial resistance among healthcare workers in sub-Saharan Africa: A systematic review and meta-analysis. Ther Adv Infect Dis. 2026;13:1-16.

[15]. Warreman EB, Lambregts MMC, Wouters RHP, Visser LG, Staats H, Van Dijk E, et al. Determinants of in-hospital antibiotic prescription behaviour: A systematic review and formation of a comprehensive framework. Clin Microbiol Infect. 2019;25(5):538-45.

[16]. Jia RM, Stern C. The inclusion or exclusion of studies based on critical appraisal results in JBI qualitative systematic reviews: An analysis of practices. Res Synth Methods. 2026;17(2):277-92.

[17]. Humayoun S, Yaqoob B, Abbasi N, Sajid M, Aman K, Noor N. Critical appraisal of a qualitative

review: A systematic review. Pak Oral Dent J. 2024;44(4):9-18.

[18]. Ren J, Ma J, Cappelleri JC. Appropriateness of conducting and reporting random-effects meta-analysis in oncology. Res Synth Methods. 2024;15(2):326-31.

[19]. Lee S. Heterogeneity in meta-analysis: A path toward more meaningful clinical evidence. Korean J Anesthesiol. 2025;78(4):297-8.

[20]. Orubu ES, Robert FO, Emuren L, Ifie-Ombeh B. Antimicrobial stewardship among Nigerian children: A pilot study of the knowledge, attitude, and practices of prescribers at two tertiary healthcare facilities in Bayelsa State. medRxiv. 2021:1-21.

[21]. Pearson M, Chandler C. Knowing antimicrobial resistance in practice: A multi-country qualitative study with human and animal healthcare professionals. Glob Health Action. 2019;12(Suppl 1):1-9.

[22]. Akhigbe ME, Saka SA, Ighodaro O, Ghouse MA, Emekolom ON, Okoro OV. Doctors' knowledge, attitudes and prescription practices on antibiotic use: A study in a suburban tertiary hospital in Nigeria. BMC Health Serv Res. 2025;25(1):1-8.

[23]. Davwar P, Bitrus N, Nyam D, Ioramo K, Zawaya K, Agboghoroma O. Knowledge, attitudes, and practice of doctors in Nigeria regarding antimicrobial resistance. Niger Med J. 2023;64(4):492-502.

[24]. Nwagbo AN, Oloyede TA, Anyebe EE, Anyebe EE, Sani N, David DA, et al. Knowledge and perception of healthcare workers on antibiotic resistance and predictors of antibiotic prescription in Benue State, Nigeria. Asian J Med Health. 2025;23(2):12-26.

[25]. Abubakar B, Sárváry A. Knowledge, attitude, and practice on antibiotics use among healthcare workers: A cross-sectional study in Niger State, Nigeria. J Infect Prev. 2023;24(5):206-15.

[26]. Akande-Sholabi W, Oyesiji E, Adebisi YA. Antimicrobial stewardship: Community pharmacists' antibiotic dispensing practices, knowledge, and perception regarding antibiotics and antibiotic resistance. J Pharm Health Serv Res. 2023;14(4):383-91.

[27]. Obasanya JO, Ogunbode O, Landu-Adams V. An appraisal of the contextual drivers of successful antimicrobial stewardship implementation in Nigerian health care facilities. J Glob Antimicrob Resist. 2022;31:141-8.

[28]. Olugbake OA, Ayeni FA, Onwuchuluba EE, Ogbo PU, Ashamu KO. Knowledge and perception of antimicrobial stewardship amongst healthcare professionals in two secondary healthcare facilities in Lagos, Nigeria. Discover Public Health. 2025;22(1):1-11.

[29]. Akpan MR, Jackson IL, Eshiet UI, Mfon SA, Abasiattai EA. Knowledge of antimicrobial stewardship and the Access, Watch and Reserve (AWaRe) classification of antibiotics among frontline healthcare professionals in Akwa Ibom State, Nigeria: A cross-sectional study. BMC Health Serv Res. 2024;24(1):1-7.