

Knowledge, Attitude, and Practices of Healthcare Workers towards Antimicrobial Resistance in Secondary Healthcare Facilities in South West Nigeria

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Abstract Antimicrobial resistance (AMR) is a critical public health challenge that disproportionately burdens low- and middle-income countries, including Nigeria. Healthcare workers (HCWs) play a pivotal role in both AMR propagation and control. This cross-sectional study assessed AMR knowledge, attitude, and practices (KAP) among 329 HCWs in selected secondary health facilities across six South West Nigerian states. A structured, self-administered questionnaire captured composite AMR knowledge and attitude scores, and key AMR practice behaviours. Chi-square tests and Pearson correlation were applied at $p < 0.05$. Overall, 74.8% of respondents demonstrated adequate AMR knowledge (mean score: 12.86 ± 2.67 ; range: 4–17). Laboratory scientists (13.42 ± 2.43) and pharmacists (13.34 ± 2.16) recorded the highest mean knowledge scores; nurses scored the lowest (12.50 ± 2.76). AMR knowledge adequacy differed significantly by professional designation ($\chi^2 = 9.58$, $p = 0.023$) and state ($\chi^2 = 40.72$, $p < 0.001$). Positive AMR attitude was recorded in 57.1% of respondents (mean score: 50.53 ± 4.15). AMR attitude was significantly associated with professional designation ($\chi^2 = 9.15$, $p = 0.027$). Practice gaps were prominent: 40.4% purchased antibiotics over the counter without a prescription, 73.6% reported stopping antibiotic courses when they felt better, and 73.6% kept leftover antibiotics for future use. Despite adequate knowledge, critical AMR practice deficits persist among South West Nigerian secondary HCWs. Targeted antibiotic stewardship programmes, integrated IPC–AMR training, and strengthened diagnostic infrastructure are urgently needed.

Keywords Attitude, Antimicrobial Resistance, Antibiotic Stewardship, Healthcare Workers, Knowledge, Nigeria, Practices, Secondary Healthcare.

Introduction

Antimicrobial resistance (AMR) has emerged as a defining public health crisis of the 21st century. The World Health Organization (WHO) lists AMR among its top ten global public health threats, with estimates placing AMR-attributable mortality at 4.95 million deaths annually in 2019, including 1.27 million directly attributable deaths [1]. Projections suggest this burden could escalate to 10 million deaths per year by 2050 absent decisive intervention [2]. The toll falls disproportionately on low- and middle-income countries (LMICs), with western sub-Saharan Africa recording the highest AMR-attributable mortality rates globally [1].

In Nigeria, the burden of AMR is incompletely characterised due to limited national surveillance infrastructure and epidemiological data gaps [3]. However, accumulating evidence documents clinically significant AMR, including methicillin-resistant *Staphylococcus aureus* (MRSA) and fluoroquinolone-resistant *Escherichia coli* in South West Nigeria [4, 5]. National estimates suggest 20–50% of antibiotic use is inappropriate, driven by over-the-counter availability without prescription, physician overprescribing, and weak infection prevention and control (IPC) implementation [6, 7].

Healthcare workers (HCWs) are pivotal actors in the AMR response. Their prescribing and dispensing behaviours directly influence selective pressure for resistance development. Their adherence to IPC measures determines the within-facility transmission of resistant organisms. Their own antibiotic use practices—particularly self-medication—reflect and propagate community-level resistance [8]. Yet the knowledge, attitudes, and practices (KAP) of Nigerian HCWs regarding AMR remain incompletely studied, particularly at the secondary healthcare level [9, 10].

Secondary healthcare facilities in South West Nigeria—comprising Lagos, Ogun, Oyo,

Osun, Ondo, and Ekiti states—serve as critical first-level referral nodes, managing conditions most prone to AMR complications, including sepsis, respiratory infections, and post-surgical wound infections [11]. The AMR KAP profile of the secondary HCW workforce is therefore highly consequential for patient safety and AMR containment outcomes.

Understanding HCWs' AMR KAP is also essential for targeted programme design. The WHO Global Action Plan on AMR emphasises optimising antimicrobial use through antibiotic stewardship programmes (ASPs), which include surveillance, HCW education, and behavioural change toward evidence-based prescribing [12]. Nigeria's National AMR Action Plan (NAMAP) aligns with these imperatives, but implementation at sub-national and facility levels remains variable [3].

This study assessed the AMR knowledge, attitude, and practices of HCWs in secondary health facilities across six South West Nigerian states, and identified correlates of adequate AMR knowledge and positive AMR attitude to inform stewardship programme design.

Materials and Methods

Study Design and Setting

A cross-sectional descriptive survey was conducted in selected secondary healthcare facilities across the six South West states of Nigeria: Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo. This design is appropriate for estimating the prevalence and distribution of KAP toward AMR at a single point in time [13]. The six states were purposively selected to ensure geographic representativeness of the South West geopolitical zone.

Study Population and Sampling

All categories of HCWs employed in the selected facilities were eligible, including doctors, nurses, pharmacists, laboratory scientists, laboratory technicians, and pharmacy technicians, provided they had practised at the facility for at least three months.

Proportionate stratified random sampling was applied within each facility to ensure cadre representation. A total of 329 respondents were enrolled: Lagos (n = 207), Ogun (n = 46), and Ekiti, Oyo, Osun, and Ondo (n = 19 each).

Data Collection Instrument

A validated, semi-structured, self-administered questionnaire adapted from comparable AMR and IPC KAP tools [14, 15] was used. The AMR-related sections assessed: (i) AMR knowledge—multi-domain items covering antibiotic classes, mechanisms of resistance, appropriate antibiotic indications, resistance-reducing practices, and information sources; (ii) AMR attitude—a 20-item Likert-scale composite covering prescribing philosophy, stewardship endorsement, community education, and enforcement attitudes; and (iii) AMR practices—covering antibiotic self-use, over-the-counter (OTC) purchasing, treatment completion, antibiotic storage, and facility-level stewardship exposure.

Scoring and Categorisation

Composite AMR knowledge scores were computed by summing binary item scores (1 = correct, 0 = incorrect). Composite AMR attitude scores were computed from Likert-scale responses (Strongly Agree = 4 to Strongly Disagree = 1, with reverse coding for negatively worded items). Knowledge was categorised as 'adequate' ($\geq 70\%$ of maximum) or 'not adequate' ($< 70\%$). Attitude was categorised as 'positive' or 'negative' based on median-split cut-off values.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 25.0. Descriptive statistics—frequencies, proportions, means, and standard deviations—were calculated for all variables. Bivariate associations between categorical variables were assessed using Pearson's chi-square test; associations between composite scores were assessed using Pearson's product-moment correlation coefficient. A two-tailed p-value of < 0.05 was considered statistically significant [16].

Ethical Considerations

The relevant institutional review committee approved the study before it began. We obtained written informed consent from all participants. Participation was entirely voluntary, and anonymity was maintained; no identifying information was included in the dataset. The study followed the Declaration of Helsinki [17].

Results

Sociodemographic Characteristics

A total of 329 HCWs participated (Table 1). The mean age was 38.0 ± 8.8 years (range: 18–62). Females constituted 66.3% (n = 218). Most respondents were married (72.0%) and identified as Christian (73.9%). Nurses formed the largest cadre (56.5%), followed by doctors (28.9%), pharmacists (6.1%), laboratory scientists (4.3%), pharmacy technicians (2.7%), and laboratory technicians (1.5%). Lagos State accounted for 62.9% of respondents. Overall, 278 (84.5%) respondents had ever received AMR training, and 227 (69.0%) had done so within the preceding 12 months.

Table 1. Sociodemographic and Training Profile of Respondents (N = 329)

Variable	n	%
Gender		
Male	111	33.7
Female	218	66.3
Mean Age ± SD (range, years)	38.0 ± 8.8 (18–62)	
Marital Status		

Married	237	72.0
Single	83	25.2
Other	9	2.7
Religion		
Christianity	243	73.9
Islam	86	26.1
Professional Designation		
Nurse	186	56.5
Doctor	95	28.9
Pharmacist	29	8.8
Laboratory Scientist	19	5.8
State of Practice		
Lagos	207	62.9
Ogun	46	14.0
Ekiti	19	5.8
Oyo	19	5.8
Osun	19	5.8
Ondo	19	5.8
AMR Training History		
Ever trained on AMR	278	84.5
AMR training in last 12 months	227	69.0
Ever trained on IPC	313	95.1
IPC training in last 12 months	263	79.9

AMR Encounters in Clinical Practice

Frequency of suspected AMR case encounters was high (Table 2): 82 (24.9%) respondents encountered AMR cases daily, 70 (21.3%) weekly, and 150 (45.6%) monthly;

only 27 (8.2%) reported never encountering such cases. These findings confirm the routine clinical relevance of AMR in secondary care and reinforce the imperative for AMR literacy among secondary facility HCWs [9, 18].

Table 2. Frequency of AMR Case Encounters Reported by Respondents (N = 329)

Frequency of AMR Encounters	n	%
Daily	82	24.9
Weekly	70	21.3
Monthly	150	45.6
Never	27	8.2

AMR Knowledge

Overall, 246 (74.8%) respondents demonstrated adequate AMR knowledge, while 83 (25.2%) did not (Table 3). The mean AMR knowledge score was 12.86 ± 2.67 (range: 4–17). Laboratory scientists had the highest mean score (13.42 ± 2.43), followed by pharmacists (13.34 ± 2.16) and doctors (13.32 ± 2.59); nurses had the lowest mean score (12.50 ± 2.76) and the highest proportion with inadequate knowledge (31.7%). Professional designation was significantly associated with AMR knowledge adequacy ($\chi^2 = 9.58$, $df = 3$, $p = 0.023$).

State of practice was also significantly associated with AMR knowledge adequacy ($\chi^2 = 40.72$, $df = 5$, $p < 0.001$): Ondo State recorded only 15.8% with adequate knowledge, compared with 94.7% in Ekiti, 78.3% in Ogun, and 76.8% in Lagos. On specific knowledge domains, 89.4% correctly identified unnecessary antibiotic use as the single most important contributor to AMR emergence; 96.4% correctly characterised AMR as microorganism insensitivity or immunity to antimicrobial drugs; and 87.5% correctly identified all four bacterial resistance mechanisms [19].

Table 3. AMR Knowledge Adequacy by Professional Designation

Designation	Adequate Knowledge n (%)	Inadequate n (%)	Mean Score (SD)
Doctor	79 (83.2)	16 (16.8)	13.32 (2.59)
Nurse	127 (68.3)	59 (31.7)	12.50 (2.76)
Pharmacist	24 (82.8)	5 (17.2)	13.34 (2.16)
Laboratory Scientist	16 (84.2)	3 (15.8)	13.42 (2.43)
Total	246 (74.8)	83 (25.2)	12.86 (2.67)

$$\chi^2 = 9.58, df = 3, p = 0.023$$

Table 4. AMR Knowledge Adequacy by State of Practice

State	Adequate Knowledge n (%)	Not Adequate n (%)	Total n
Ekiti	18 (94.7)	1 (5.3)	19
Lagos	159 (76.8)	48 (23.2)	207
Ogun	36 (78.3)	10 (21.7)	46
Ondo	3 (15.8)	16 (84.2)	19
Osun	16 (84.2)	3 (15.8)	19
Oyo	14 (73.7)	5 (26.3)	19

$$\chi^2 = 40.72, df = 5, p < 0.001$$

AMR Attitude

The mean AMR attitude score was 50.53 ± 4.15 (range: 34–58). Overall, 188 (57.1%) respondents demonstrated a positive AMR attitude and 141 (42.9%) a negative attitude (Table 5). Professional designation was significantly associated with AMR attitude ($\chi^2 = 9.15$, $df = 3$, $p = 0.027$): pharmacists (72.4%) and laboratory scientists (73.7%) showed the highest positive attitude rates, while

nurses had the lowest (50.5%). On specific items, 98.5% agreed on the need for regular AMR training updates; 97.3% endorsed collaborative stewardship between HCWs and administrators; and 96.7% agreed AMR prevention should be a priority for all HCWs. However, 23.1% agreed it is acceptable to prescribe antibiotics for viral infections, and only 58.7% agreed that prescriptions should be

reserved for confirmed or highly probable bacterial infections [20].

Table 5. AMR Attitude Category by Professional Designation

Designation	Positive Attitude n (%)	Negative Attitude n (%)	Mean Score (SD)
Doctor	59 (62.1)	36 (37.9)	50.8 (3.9)
Nurse	94 (50.5)	92 (49.5)	50.2 (4.2)
Pharmacist	21 (72.4)	8 (27.6)	51.3 (4.0)
Laboratory Scientist	14 (73.7)	5 (26.3)	51.6 (3.7)
Total	188 (57.1)	141 (42.9)	50.53 (4.15)

$$\chi^2 = 9.15, df = 3, p = 0.027$$

AMR Practices

Table 6 presents key AMR practice behaviours. Practice gaps were pronounced: 133 (40.4%) respondents reported purchasing antibiotics OTC without a prescription; 282 (85.7%) reported stopping antibiotic courses when they felt better; and 242 (73.6%) reported keeping leftover antibiotics for future use. These behaviours are individually and collectively drivers of AMR and represent a fundamental knowledge-to-practice translation gap [8, 21].

Regarding facility-level stewardship, 242 (73.6%) respondents reported that their facility

had guidelines for rational antibiotic use, while 37 (11.2%) reported no such guidelines. Isolation precautions for patients with multidrug-resistant organisms were not consistently implemented: only a minority reported always implementing barrier nursing [22]. AMR confidence was relatively high: 69.9% of respondents were confident or very confident in identifying AMR infections based on clinical presentation, and 76.3% based on laboratory findings; however, insufficient laboratory capacity, lack of rapid diagnostic tests, and delays in result reporting were cited as major diagnostic constraints [23].

Table 6. AMR-Related Practice Behaviours Among Respondents (N = 329)

Practice Item	Yes n (%)	No n (%)	Missing n
Purchases antibiotics OTC without a prescription	133 (40.4)	196 (59.6)	0
Stop antibiotics when feeling better	282 (85.7)	47 (14.3)	0
Keeps leftover antibiotics for future use	242 (73.6)	87 (26.4)	0
Completes full antibiotic course	282 (85.7)	47 (14.3)	0
The facility has rational antibiotic use guidelines	242 (73.6)	37 (11.2)	50

Correlates of AMR Knowledge and Attitude

Table 7 presents key bivariate associations. Prior IPC training was significantly associated with adequate AMR knowledge ($\chi^2 = 6.94$, $df = 1$, $p = 0.008$): 76.4% of those with prior IPC training had adequate AMR knowledge, compared with 43.8% among those without. Importantly, prior AMR-specific training was

not significantly associated with adequate AMR knowledge ($\chi^2 = 0.33$, $p = 0.567$), suggesting that training quality and content, rather than frequency, may be more determinative [24]. A weak but statistically significant positive correlation was found between IPC and AMR knowledge scores ($r = 0.146$, $p = 0.008$). Adequate IPC knowledge was significantly associated with

positive AMR attitude ($\chi^2 = 13.21$, $df = 1$, $p < 0.001$) [25].

Table 7. Bivariate Associations with AMR Knowledge and Attitude

Variable	Test Statistic	p-value	Significance
Professional designation vs. AMR knowledge	$\chi^2 = 9.58$, $df = 3$	0.023	Significant
State of practice vs. AMR knowledge	$\chi^2 = 40.72$, $df = 5$	< 0.001	Significant
IPC training (ever) vs. AMR knowledge	$\chi^2 = 6.94$, $df = 1$	0.008	Significant
AMR training (ever) vs. AMR knowledge	$\chi^2 = 0.33$, $df = 1$	0.567	Not significant
Professional designation vs. AMR attitude	$\chi^2 = 9.15$, $df = 3$	0.027	Significant
Adequate IPC knowledge vs. positive AMR attitude	$\chi^2 = 13.21$, $df = 1$	0.0003	Significant
IPC KW score vs. AMR KW score (Pearson r)	$r = 0.146$	0.008	Significant

Discussion

This study provides a multi-state assessment of AMR KAP among secondary HCWs in South West Nigeria, offering evidence directly relevant to national AMR stewardship programme design and implementation.

The finding that 74.8% of respondents demonstrated adequate AMR knowledge is broadly encouraging and compares favourably with reports from comparable LMICs, where AMR knowledge adequacy has ranged from 50–80% [14, 15, 26]. The significantly superior AMR knowledge profile of laboratory scientists (84.2% adequate) and pharmacists (82.8%), relative to nurses (68.3%), is clinically meaningful. Laboratory scientists' routine engagement with culture, sensitivity reporting, and resistance pattern interpretation likely accounts for their higher knowledge scores [23]. The AMR knowledge gap among nurses is particularly concerning, given their dominance in the secondary HCW workforce and their central role in antibiotic administration and IPC adherence [27].

The large and highly significant variation in AMR knowledge adequacy by state ($p < 0.001$)—with Ondo State recording only 15.8% adequate knowledge versus 94.7% in Ekiti—is a striking finding. Possible explanations include differential

implementation of the National AMR Action Plan across states, variation in state-level training programme reach and quality, and differences in facility-level supportive supervision and governance [3, 28]. This finding argues for state-disaggregated AMR surveillance and capacity-building assessments.

Despite generally adequate knowledge, AMR attitude outcomes were more mixed: only 57.1% demonstrated positive attitudes. The significant association between professional designation and AMR attitude ($p = 0.027$), with nurses demonstrating the lowest positive attitude rate (50.5%), parallels the knowledge findings. This knowledge–attitude gap mirrors findings from multiple comparable African settings and likely reflects workload pressure, patient demand for antibiotics, peer prescribing norms, and perceived inadequacy of diagnostic support [29].

The AMR practice findings are the most alarming aspect of this study. Despite relatively adequate knowledge, 40.4% of respondents purchased antibiotics OTC without a prescription, 73.6% stopped antibiotic courses when feeling better, and 73.6% retained leftover antibiotics. These behaviours by HCWs themselves are individually well-established drivers of AMR [8, 21] and signal a

profound knowledge-to-practice translation gap. That HCWs self-medicate with and misuse antibiotics, undermines their credibility as AMR stewardship advocates and suggests that knowledge- or attitude-only interventions may be insufficient without structural reform—including stronger prescribing regulations, professional accountability mechanisms, and accessible diagnostic infrastructure [30].

The finding that IPC training—rather than AMR-specific training—was significantly associated with adequate AMR knowledge ($p = 0.008$) reinforces the evidence for integrated IPC-AMR programme design. It suggests that IPC training platforms may provide a more consistently accessible and quality-assured vehicle for AMR capacity building than standalone AMR training, which may be more variable in content and reach [25]. Leveraging existing IPC training infrastructure to embed AMR stewardship content represents a practical and efficient approach for resource-constrained settings [12].

The high self-reported diagnostic confidence (69.9% and 76.3% clinically and laboratory confident, respectively) should be interpreted carefully in the context of well-documented laboratory capacity limitations in Nigerian secondary facilities. Overconfidence in AMR identification, without confirmatory susceptibility testing, may delay recognition of resistant cases and lead to inappropriate management [23]. Strengthening laboratory capacity for antibiotic susceptibility testing is therefore a critical system-level priority.

This study has several limitations. The cross-sectional design precludes causal inference. Self-reported practice data are subject to social desirability bias and likely overestimate appropriate behaviours. The Lagos-dominated sample (62.9%) may limit generalisability to less urbanised and rural secondary facilities. Future studies should incorporate validated observational assessments, longitudinal designs, and ensure balanced multi-state

sampling to better capture geographic heterogeneity in AMR KAP [13, 16].

Conclusion

Healthcare workers in South West Nigeria's secondary health facilities generally demonstrate adequate AMR knowledge, but this knowledge does not consistently translate into positive AMR attitudes or appropriate antibiotic use practices. Critical practice deficits – OTC antibiotic purchasing, premature treatment discontinuation, and leftover antibiotic retention – persist even among knowledgeable HCWs, signaling a profound knowledge-to-practice gap. Significant knowledge disparities by professional cadre and state underscore the inadequacy of generic national interventions. Integrated IPC-AMR training, targeted nurse-focused educational programmes, enforced prescribing guidelines, and strengthened laboratory diagnostic infrastructure are the foundational pillars of an effective AMR response in this context.

Conflict of Interest

The authors declare no conflict of interest.

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Author Contributions

Peter Idowu Omoniyi: conceptualisation, data collection, formal analysis, and manuscript drafting. George Ikpe, Abiodun Olaiya Paul, Chukwuma Grant Madubuko, Omowumi O Okedare, Golibe Ugochukwu, Shadrach Dimang: supervision, critical review, and editing. All authors approved the final manuscript.

Ethical Approval

The relevant institutional review committee approved this study before data collection. We

obtained written informed consent from all participants. The study adhered to the Declaration of Helsinki.

Data Availability

The dataset supporting the conclusions of this article is available from the corresponding

author on reasonable request, subject to applicable ethical approval conditions.

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