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Antimicrobial Resistance and Stewardship Perceptions Among Poultry Stakeholders in Abeokuta, Nigeria: A Cross-Sectional Survey

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ABSTRACT
Antimicrobial resistance (AMR) threatens poultry production, food safety and public health. This cross-sectional survey evaluated poultry stakeholders' attitudes toward AMR and perceptions of antimicrobial stewardship in Abeokuta, Nigeria. Of 120 questionnaires returned, 113 and 111 complete questionnaires were analyzed descriptively and in multivariable regression, respectively. Seven stewardship-supportive statements (D2-D8), each scored from 1 (strongly disagree) to 5 (strongly agree), were averaged to form a perception scale; no items required reverse coding. Agreement proportions and 95% Wilson confidence intervals (CIs) were computed, and scale reliability was evaluated using Cronbach's alpha and associations with age, sex, tertiary education, poultry experience and farm size were investigated using multiple linear regression with HC3 robust standard errors. The mean age of respondents was 34.1 years (SD 8.2), 54.9% were female, and 60.2% had a tertiary education. Agreement was high that antimicrobial overuse contributes to AMR (78.8%; 95% CI 70.3-85.3), improper use contributes to multidrug resistance (87.6%; 95% CI 80.3-92.5), self-prescription should be discouraged (86.7%; 95% CI 79.2-91.8), and training farmers in non-antibiotic disease prevention is a priority (92.0%; 95% CI 85.6-95.8). The scale had acceptable internal consistency (alpha = 0.711; mean = 4.12/5, SD = 0.58). Each 10-year increase in age was associated with a 0.211-point lower score (beta = -0.211; 95% CI -0.388 to -0.034), while tertiary education was associated with 0.247-point higher score (beta = 0.247; 95% CI 0.011-0.483). These results reflect perceptions of stewardship, not actual antimicrobial-use patterns. Veterinary support, vaccination, biosecurity, diagnostics and farmer education could thus be considered intervention priorities.

Keywords: Antimicrobial Resistance, Antimicrobial Stewardship, Poultry, Perceptions, Farmers

INTRODUCTION

Antimicrobial resistance (AMR) is a significant challenge to human and animal health and to the sustainability of food-production systems. Poultry production is particularly relevant as antimicrobials can be used for treatment, prevention and production use, and there may be access to veterinary oversight and diagnostic services that are not equal. Superfluous and unwarranted exposure may create selection pressure for resistant organisms and diminish the effectiveness of valuable medicines in the future. Prudent antimicrobial use is therefore a key pillar of stewardship, alongside vaccination, hygiene, biosecurity, diagnostics, professional veterinary care, and good husbandry in food animals (World Health Organization, 2017; World Organization for Animal Health, 2024). Research conducted in Nigeria has also highlighted resistance among bacterial isolates and the continuing search for alternative antimicrobial agents (Ofesi *et al*., 2025).

Knowledge and practice are not always aligned, as evidenced by poultry production. The systematic review and meta-analysis showed high study heterogeneity and varied stakeholder knowledge and practices regarding antimicrobial use, with persistent use for prevention and growth promotion in some settings and veterinary advice not always being a determining factor in antibiotic treatment decisions (Al Sattar *et al*., 2023). Similar patterns of access and use of antimicrobials have been reported in Nigerian studies. A national survey in 12 states revealed the use of critically important antimicrobials for growth promotion and prophylaxis, and the non-compliance of some producers with antimicrobial withdrawal periods (Njoga *et al*., 2021).

A survey of commercial farms in Plateau and Oyo States also found easy access to antimicrobials and self-directed use by some farmers (Ndahi *et al*., 2023).

Awareness among Farmers is also not uniform in Nigeria. Yakubu *et al*. (2024) found a high level of knowledge about the use of antimicrobials and that irrational use can contribute to the development of antimicrobial resistance among 247 commercial poultry farmers in the north-western part of Nigeria, and that educational qualification was significantly associated with knowledge and attitudes. In contrast, important gaps in knowledge, attitudes and risk perception were observed in broiler farmers in Oyo State (Oloso *et al*., 2022). Even in Enugu State, there is coexistence of high AMR knowledge with inappropriate use among small-scale farmers (Chah *et al*., 2022), and studies have continued to reveal risky

practices and gaps in AMR awareness across 200 poultry farms in Enugu, Nigeria (Ezeh *et al*., 2024; Ejikeugwu *et al*., 2025).

These findings underscore the need to distinguish awareness, perceptions and actual behaviour. Producers may endorse stewardship principles yet continue to use antimicrobials because of disease pressure, cost, convenience, established production routines or limited access to timely professional support. Studies in Cameroon and Ghana similarly reported gaps between AMR awareness and farmers' antimicrobial-use practices (Moffo *et al*., 2020; Hackman *et al*., 2025). A composite stewardship-perception scale can complement separate knowledge, attitude and practice measures by summarizing respondents' endorsement of key stewardship principles. Examining its internal consistency and associations with demographic and production characteristics is a necessary preliminary step before broader validation.

Evidence on antimicrobial resistance (AMR) and stewardship perceptions in Abeokuta remains limited, as does evidence that clearly differentiates between perceptions and reported or observed antimicrobial-use practices among poultry stakeholders. This study was conducted to fill this void by measuring the level of awareness and stewardship perception of poultry stakeholders in Abeokuta, Nigeria and for the development of locally suitable interventions for stewardship.

MATERIALS AND METHODS

Study Design, Study Participants and Data Cleaning

A cross-sectional questionnaire survey of the poultry stakeholders in Abeokuta, Ogun state, Nigeria was carried out. A total of 150 questionnaires were sent out, and 120 questionnaires were returned (80.0%). The returned questionnaires were coded and entered into Microsoft Excel. Seven questionnaires were excluded due to missing information for the primary analyses, and 113 questionnaires were used for descriptive and scale analyses. All the model variables were complete cases (n = 111) used in multivariable regression.

Farms were classified by flock size as small-scale (<500 birds), medium-scale (500–5,000 birds) or large-scale (>5,000 birds).

Questionnaire Design

The questionnaire was created by reviewing the literature and antimicrobial stewardship guidance. The draft instrument was piloted with experts in agricultural extension, veterinary medicine and public health to evaluate the relevance of the items, their clarity and content coverage. It was then pre-tested with 10 poultry stakeholders in FUNAAB. Feedback on the pre-test was utilized to improve the wording, sequence and clarity of the questions. The main survey was not conducted on participants who took part in the pretest.

Sampling Technique and Participant Recruitment

The data were gathered from January to July 2025. Abeokuta poultry farms and poultry farmers' associations were sampled using purposive sampling. The adult population (18 years old and above) who directly participated in poultry production, poultry health, and antimicrobial use or farm-management activities in Abeokuta were the eligible participants considered for the study.

People who did not participate in poultry-related activities or who did not return a complete questionnaire were eliminated. The survey used self-administered questionnaires, with trained research assistants available to clarify questions without influencing participants' responses.

Measures and Scale Construction

Age, sex, education, poultry experience, farm scale and poultry type were noted in the questionnaire. Participants rated the perception items on a 5-point Likert scale: 1 = very strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = very strongly agree. The norm of using antibiotics for disease prevention was perceived as a practice (item D1) and is therefore reported separately. The 6 items in the composite perception scale were: antimicrobial overuse contributes to AMR; antimicrobial resistance in poultry can affect human health; farmers should be educated about antimicrobial misuse; self-prescription should be discouraged; antibiotics are becoming less effective because of resistance; and improper antimicrobial use contributes to multidrug resistance; and farmers should be trained in non-antibiotic disease-prevention practices. No reverse coding was required because all items were positively worded. The scale score is the mean of the seven item scores; higher scores represent greater endorsement of antimicrobial-stewardship principles.

Statistical Analysis

Means, standard deviations, medians and ranges were summarized for continuous variables and frequencies and percentages for categorical variables. A proportion was reported for each perception statement with a 95% Wilson confidence interval (CI) of the agreement rate (agree or strongly agree). Cronbach's alpha was used to determine the internal consistency of the D2-D8 scale. A multiple linear regression model with prespecified variables (age, sex, tertiary education, poultry experience and farm scale) and HC3 heteroskedasticity-robust standard errors was used to examine the effect of these variables on the perception score. Complete cases were used for the regression (n = 111). A p-value of < 0.05 was used as a measure of statistical significance; effect estimates, confidence intervals, and more than just p-values were emphasized.

RESULTS AND DISCUSSION

Respondent Characteristics

The final analysis of the questionnaire included 113 respondents. The mean age was 34.1 ± 8.2 years, the median age was 32 years, and the range was 21-60 years. Females made up 54.9% of the respondents, and males 43.4%. Most respondents were tertiary educated (60.2%), with secondary education (24.8%) next. Most of them were experienced in poultry farming for one and five years (89.4%). Small-scale farms were the dominant group, with 65.5% of the respondents; medium-scale farms had 32.7%, while large-scale farms had the least at 1.8%. Broiler production was the most prevalent poultry enterprise in the area (39.8%), followed by layer production (30.1%) and mixed poultry production (19.5%), with local poultry production the least common at 10.6% (Table 1).

Table 1: Sociodemographic and Production Characteristics of Respondents (n = 113)

Characteristic	Category/Statistic	Result n (%)
Age (years)	Mean ± SD	34.1 ± 8.2
	Median	32
	Range	21-60
Sex	Male	49 (43.4)
	Female	62 (54.9)
	Not indicated	2 (1.8)
Education	No formal education	12 (10.6)
	Primary education	5 (4.4)
	Secondary education	28 (24.8)
	Tertiary education	68 (60.2)
Poultry experience	<1 year	3 (2.7)
	1-5 years	101 (89.4)
	6-10 years	9 (8.0)
Farm scale	Small	74 (65.5)
	Medium	37 (32.7)
	Large	2 (1.8)
Poultry type	Broilers	45 (39.8)
	Layers	34 (30.1)
	Local	12 (10.6)
	Mixed	22 (19.5)

AMR and Stewardship Perceptions

Overall, respondents strongly agreed with statements supporting stewardship. The majority agreed that antimicrobial overuse is a factor that leads to AMR (78.8%; 95% CI: 70.3-85.3), that self-prescription should be discouraged (86.7%; 95% CI: 79.2-91.8) and that improper use of antimicrobials leads to multidrug resistance (MDR) (87.6%; 95% CI: 80.3-92.5) and that farmer training should be promoted in non-antimicrobial methods of preventing diseases (92.0%; 95% CI: 85.6-95.8). Also, 89.4% agreed that antibiotics are often used to prevent diseases (95% CI: 82.4-93.8). This reflects respondents' perceptions of common practice and does not represent the percentage of respondents who use antibiotics preventively (Table 2).

Table 2: Respondents' Perceptions of Antimicrobial Resistance (AMR) and Antimicrobial Stewardship (n = 113)

Statement	n/N (%)	95% CI
Antibiotics are frequently used for disease prevention	101(89.4)	82.4 - 93.8
Overuse of antimicrobials contributes to AMR	89(78.8)	70.3 - 85.3
Antimicrobial resistance in poultry can affect human health	81(71.7)	62.8 - 79.2
Farmers should be educated about antimicrobial misuse	101(89.4)	82.4 - 93.8
Self-prescription of antimicrobials should be discouraged	98(86.7)	79.2 - 91.8
Antibiotics are becoming less effective because of resistance	95(84.1)	76.2 - 89.7
Improper antimicrobial use contributes to multidrug resistance	99(87.6)	80.3 - 92.5
Farmers should be trained in non-antibiotic disease-prevention practices	104(92.0)	85.6 - 95.8

Key: n/N = Number of Respondents Who Agreed or Strongly Agreed/Total Number of Respondents; CI = Confidence Interval

Scale Reliability and Multivariable Analysis

The multiple linear regression included 111 complete cases and explained 8.5% of the variation in antimicrobial-stewardship perception scores (R^2 = 0.085; adjusted R2 = 0.041). The model was statistically significant based on the HC3 robust overall test, F(5, 105) = 2.44, p = 0.039. Each 10-year increase in age was associated with a 0.211-point reduction in perception score (adjusted β=-0.211; 95% CI: -0.388 to -0.034; p=0.020), whereas tertiary education was associated with a 0.247-point increase (adjusted β=0.247; 95% CI: 0.011 to 0.483; p=0.040). Sex, poultry experience and farm size were not significantly associated with perception scores (Table 3).

Table 3: Multivariable Linear Regression Analysis of Factors Associated with Antimicrobial Stewardship Perception Scores

Predictor	Adjusted coefficient (β)	95% CI	*p*-value
Age, per 10-year increase	-0.211	-0.388 to -0.034	**0.020**
Female vs male	-0.135	-0.346 to 0.076	0.211
Tertiary education	0.247	0.011 to 0.483	**0.040**
Poultry experience, years	0.031	-0.031 to 0.094	0.323
Medium/large farm vs small farm	-0.111	-0.344 to 0.122	0.350

Key: beta (β) = Adjusted Regression Coefficient; CI = Confidence Interval. Statistical Significance was Set at p < 0.05. Male Sex and Small Farm Size were the Reference Categories. Model n = 111; R-Squared = 0.085; Adjusted R-squared = 0.041; Robust Overall Model test p = 0.039

Discussion

The overall perception profile suggests a stewardship-friendly attitude of poultry farmers in the study area of Abeokuta. The highest accolade was for training in non-antibiotic disease prevention, the encouragement of not prescribing antibiotics and awareness of the importance of avoiding the inappropriate use of antimicrobials in the emergence of MDR. The D2-D8 items also provided a relatively stable scale (alpha = 0.711), allowing them to be used as a preliminary summary of perceptions of stewardship. Although the internal consistency is sufficient to establish construct validity, it is not enough to ensure that this is a fully validated universal instrument, and the scale should be treated as a study-specific instrument (Tavakol & Dennick, 2011; Boateng *et al*., 2018).

Recent evidence from northwestern Nigeria shows that commercial poultry farmers have substantial knowledge of antimicrobial use and AMR (Yakubu *et al*., 2024), which aligns with the favourable perception pattern in this study. However, it contrasts with the findings by Oloso *et al*. (2022) in Oyo State, where broiler farmers exhibited significant gaps in knowledge and risk perception, while the more recent study in Enugu found that many broiler farms had limited knowledge of AMR and a high frequency of antibiotic use among the farmers (Ejikeugwu *et al*., 2025). They also listed practices in Nsukka city that could contribute to AMR, as done by Ezeh *et al*. (2024). These differences highlight the need for AMR awareness and antimicrobial-use practices to be context-specific, and results of one poultry production system should not be assumed to apply to another (Oloso *et al*., 2022; Yakubu *et al*., 2024; Ejikeugwu *et al*., 2025).

One key suggestion is that positive perceptions do not necessarily mean wise use of antimicrobials; rather, they are enabling factors. Although small-scale poultry farmers in Enugu State had reasonable knowledge of antibiotic use and resistance, they still used antibiotics inappropriately, as Chah et al. (2022) noted. Njoga *et al*. (2021) reported prophylactic and growth-promoting use of CIAMs and poor adherence to withdrawal periods at the national level, while Ndahi *et al*. (2023) found that some commercial poultry farmers had easy access to antimicrobials and used them at their discretion. Limited training was associated with low knowledge of AMR and inappropriate practices outside Nigeria: in Cameroon, some poultry farmers self-medicated birds despite awareness of public-health concerns (Moffo *et al*., 2020) and in Accra, many poultry farmers self-medicated their birds despite the public-health concerns of AMR (Hackman *et al*., 2025). Therefore, the current perception results should not be interpreted as an indication of current proper use of antimicrobials in the study population.

Strong stewardship perceptions were independently related to education. Respondents with tertiary education scored about 0.25 points higher than respondents without tertiary education. This direction is similar to what Yakubu *et al*. (2024) observed between educational qualification and AMR knowledge and attitudes, and to the Cameroon study by Moffo *et al*. (2020), which found an association between education and improved knowledge and risk perception of AMR. However, formal education should not replace prudent behaviour. Despite this, the study by Chah *et al*. (2022) in Enugu has demonstrated that knowledge does not necessarily imply the non-use of antimicrobials for routine purposes, and there is a need for practical extension messages, access to professional advice and viable alternatives to routine antimicrobial use.

A slight negative correlation was found with age, with a 1-decade increase associated with a 0.21-point decrease in the perception score (after adjustment). The cross-sectional design cannot rule out the possibility that ageing actually does not affect the poor stewardship orientation. The association could instead reflect differences in training exposure, information sources, or production routines that develop over time across cohorts. The findings are not comparable, but older poultry farmers in Accra were more likely to self-medicate with antimicrobials, suggesting that differences in established treatment behaviour by age group need to be explored. Communication for stewardship should, therefore, be accessible to all age groups and communicated in several different ways rather than relying on the assumption that one and the same educational approach will be effective for all producers.

However, none of the sex, poultry experience, or farm size variables was independently related to the perception score in this sample. So, these null findings are informative and indicate that variation in production or demographic characteristics is not a significant factor in the variation observed. The model explained little variation ($R^2 = 0.085$), meaning most variation is not explained by the model. Various factors that are not available for reproducible modelling in the provided data set, like the availability of veterinary services, information sources, previous losses, availability and price of medicines, trust in the drug sellers, perceived economic risk, and access to extension services, may be closer determinants of stewardship perceptions and behaviour.

Potential interventions should extend beyond awareness campaigns. The World Health Organization (2017) states that medically important antimicrobials should be used sparingly in food-producing animals, and the World Organization for Animal Health (2024) emphasizes the need for veterinary oversight, diagnostics, vaccination, biosecurity, hygiene, and responsible use and distribution of antimicrobials, as well as sound husbandry. The current One Health AMR action plan in Nigeria also emphasizes cross-sectoral action between humans, animals, food and the environment (Federal Ministries of Agriculture and Food Security, Environment, & Health and Social Welfare, 2024). From a practical point of view, the level of support given to farmer education and non-antibiotic control of diseases, in this study, offers a good starting point for the development of programmes that include the provision of training, affordable veterinary consultation, vaccination, better farm hygiene and biosecurity, laboratory assistance, farm records, and better stewardship of antimicrobials sold.

This study has several strengths, including reporting proportions with confidence intervals, assessing reliability before interpreting the composite score, and using HC3 robust standard errors. However, recruitment via poultry farms and farmers' associations could have introduced selection bias and reduced representativeness. The data on the cross-section are self-reported and self-explanatory, and there may be recall and social-desirability bias. The results may not apply to poultry stakeholders beyond Abeokuta. Moreover, the perception scale was not externally validated, and the regression accounted for only 8.5% of the variance in scores, or 4.1% after controlling for other factors (Mokkink *et al*. 2024). Longitudinal and intervention studies should be conducted to determine whether alterations in stewardship perceptions are associated with measurable alterations in antimicrobial purchasing, antimicrobial prescribing, treatment records and antimicrobial disease prevention practices.

CONCLUSION

Overall, poultry stakeholders in Abeokuta had positive attitudes toward antimicrobial resistance and stewardship. Perception scores showed a small negative association with age and a strong positive association with tertiary education. These results reflect perceptions of stewardship and do not reflect actual antimicrobial use practices. Potential priorities for locally appropriate stewardship interventions include veterinary support, vaccination, biosecurity, diagnostic services and farmer education.

ETHICAL APPROVAL AND INFORMED CONSENT

The Research and Ethics Committee of the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta, gave ethical clearance (FUNAAB/COLVET/CREC/2023/01/01).

Participation was anonymous and voluntary. Informed consent was sought from the respondents, and participants could withdraw from the survey at any time in line with the stipulations of the World Medical Association Declaration of Helsinki Ethical Principles (2014).

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CONFLICT OF INTEREST STATEMENT

There is no conflict of interest.

DATA AVAILABILITY

The data used in this study are available upon reasonable request from the corresponding author. The data cannot be made publicly available because they include information collected from human participants and are subject to institutional and ethical requirements for data sharing.

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