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Research article

Knowledge and practices regarding antibiotic use among small-scale poultry farmers in Enugu State, Nigeria

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ABSTRACT

This study examined the knowledge and practices regarding antibiotic use among small-scale poultry farmers in Enugu State, Nigeria. A multistage sampling technique was employed to select 88 poultry farmers. The interview schedule was used for data collection. Respondents' indices of knowledge of antibiotic use (KABU), antibiotic resistance (KABR) and antibiotic use practices (PABU) were determined. Binary logistic regression was performed to ascertain the effect of socio-demographics of respondents, knowledge of antibiotic use and knowledge of antibiotic resistance on the likelihood that farmers use antibiotics inappropriately. All poultry farmers studied used antibiotics for growth promotion, disease prevention, and treatment. The mean index of KABU was 0.54 with 48 % of the respondents having good KABU while the mean index of KABR was 0.65 and 70.5 % of the farmers had good KABR. The farmers' mean index of PABU was 0.47 and 83 % of them used antibiotics inappropriately. Farmers with good KABU (OR = 4.2; 95% CI = 1.030–17.222) and KABR (OR = 4.5; 95% CI = 1.258–15.791) were more likely to misuse antibiotics than those with poor knowledge. Antibiotics are routinely, and on many occasions inappropriately, used in small-scale poultry production in Enugu State, Nigeria. Antibiotics are valuable agents whose efficacy can only be preserved if they are handled with care. Training small-scale farmers will allow them to improve their knowledge and practices regarding antibiotic use.

1. Introduction

As witnessed in many low and medium-income countries (LMICs), socioeconomic development and population growth have resulted in increased demands for animal protein [1, 2]. The poultry sector contributes about 9–10% of the agricultural domestic products of the Nigerian economy [3]. To meet the rising demand for animal protein, intensive livestock farming associated with regular, heavy and unregulated use of clinically-relevant antimicrobials in suboptimal doses as growth promoters, prophylactics, and metaphylaxis, has become indispensable [1, 2, 4, 5, 6]. Inappropriate antibiotic use practice potentially increases selection pressure on bacteria leading to the development of antimicrobial resistance [7, 8]. Misuse of antibiotics in animal production also contributes to the accumulation of the antibiotic in the animal tissues with its attendant food safety or public health concerns [9].

The majority of poultry production activities in LMICs are undertaken at small-scale levels [10] and provide investment opportunities and additional income for families. Since a greater proportion of poultry production activities in LMICs are small-scale in nature, identification of knowledge and practices regarding antibiotic use among this category of farmers will enable veterinary extension agents to design and disseminate appropriate educational messages with the view of assisting them to engage in best antibiotics use practices thereby slowing the development of antibiotic-resistant bacteria as well as provision of safe poultry products to the public. Thus, this study was conducted to ascertain the knowledge and practices regarding antibiotic use among small-scale poultry farmers in Enugu State, Nigeria.

2. Materials and methods

2.1. Study area and sampling

A cross-sectional study of small-scale poultry farms in Enugu State, Nigeria, was conducted for three months (April–June) in 2019. The state was purposefully chosen because small-scale poultry farming is one of the most important livelihood strategies of the inhabitants of the state. All

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poultry farms with 50–200 chickens constituted the population for the study. A multistage sampling procedure and random sampling technique were employed in selecting respondents. In the first stage, two agricultural zones were randomly selected from the six agricultural zones in the state. In the second stage, two blocks were also randomly chosen from each of the selected agricultural zones, giving a total of four blocks. In the third stage, two circles were selected from each block resulting in a total of eight circles. In the fourth stage, eleven small-scale poultry farms (50–200 chickens) were selected through the snowballing sampling technique in which an identified small-scale farmer leads the researcher to another similar farmer in each circle. Thus, a total of 88 poultry farms were selected for the study. On each selected farm, the owner or designated worker was requested to participate in the study. Oral informed consent to participate in the study was obtained from each respondent.

2.2. Data collection

The study was approved by the ethical committee of the University of Nigeria, Nsukka. Informed consent was obtained from each participant before he/she was interviewed. Consequently, all participants gave their consent to the study. The instrument developed for data collection was validated by two agricultural extension academic staff specializing in rural sociology, and a veterinarian specializing in Veterinary Microbiology with an interest in antibiotic use and resistance. The validated instrument was pretested in a non-study circle for clarity. Data was collected using a structured interview schedule which contained relevant questions on socio-demographic characteristics of respondents, antibiotic use characteristics of the respondents, knowledge of antibiotic use (KABU) and antibiotic resistance (KABR) and practices of antibiotic use (PABU).

To determine the KABU, the respondents were asked to provide answers to 15 statements bordering on the appropriate and inappropriate use of antibiotics. The KABR was assessed by requesting the respondents to provide answers to another set of 15 statements on antibiotic resistance while responses to another set of 15 statements on practices relating to antibiotic use were used to determine the PABU. In all cases, a correct response was scored one point while an incorrect one scored zero.

2.3. Data management and analysis

The data were entered into a Microsoft Excel worksheet. Socio-demographic and antibiotic use characteristics and the KABU, KABR and PABU of the respondents were determined using descriptive statistics. The KABU index for each respondent was determined by summing the scores of the 15 statements and dividing them by 15. The KABR and PABU indices were similarly calculated. A respondent with a KABU or KABR index of 0.6 and above was regarded as having good knowledge of antibiotic use or antibiotic resistance. A respondent with a PABU index of 0.6 and above was considered to be using antibiotics appropriately. A binary logistic regression was performed to ascertain the effects of age, sex, farming experience, years spent in school, knowledge of antibiotic use and knowledge of antibiotic resistance (as independent variables) on the likelihood that farmers use antibiotics inappropriately (dependent variable). Good knowledge of antibiotic use or antibiotic resistance and appropriate practices of antibiotic use were coded "1" while poor knowledge and inappropriate use practices were coded "0". All analyses were done using SPSS version 23 and at a 5% level of probability.

3. Results

3.1. Socioeconomic characteristics of small-scale poultry farmers in Enugu State

The personal characteristics of the respondents are presented in Table 1. Females constituted 67% of the respondents. The age of the respondents ranged from 22-70 years with a mean of 36.8 years and the majority (65.9%) were below 40 years. The majority (75%) of the farmers was married; farming was reported as the primary occupation for 47.7% of the respondents. The number of years spent in school as indicated by the respondents ranged from 0-20 years with a mean of 6.8 years, with 35% having spent 7–12 years.

Table 1. Socioeconomic characteristics of small-scale poultry farmers in Enugu State, Nigeria.

Variables	Frequency (%)
Personal characteristics	
Sex	
Male	29 (33.0)
Female	59 (67.0)
Age (years)	
below 30	22 (25.0)
30–39	36 (40.9)
40–49	19 (21.6)
50–59	7 (8.0)
60–69	3 (3.4)
above 69	1 (1.1)
Marital status	
Single	21 (23.9)
Married	66 (75.0)
Widowed	1 (1.1)
Years spent in school	
0–6	22 (25.0)
7–12	31 (35.2)
Above 12	17 (19.3)
Primary occupation	
Crop farming	42 (47.7)
Trading	36 (40.9)
Civil service	6 (6.8)
Artisanship	4 (4.5)
Farming experience (years)	
1–5	42 (47.7)
6–10	38 (43.2)
11–15	5 (5.7)
16–20	3 (3.4)

*Multiple responses.. Source: Field survey, 2019.

3.2. Antibiotics use characteristics of small-scale poultry farmers in Enugu State

All respondents (100%) used antibiotics in their poultry farms for growth promotion, disease prevention and treatment. Over 77% of the respondents indicated that their choice of antibiotic was guided by personal experience in using a particular antibiotic, cost of the antibiotic and ease of administering the antibiotic. However, the selection of antibiotics by 63.6% of the farmers was based on the recommendation from veterinary experts. It is worthy of note that only 2.3% of the respondents relied on the results of culture and sensitivity testing for selecting their antibiotics (see Table 2).

The respondents reported they obtained information on the appropriate use of antibiotics from a variety of sources. Drug sellers and other poultry farmers were stated by 98.9% and 81.8% of the respondents, respectively, to be their sources of information on antibiotics. Internet or extension provided information on antibiotic use to 18.2% of the respondents while less than 10% obtained such information through mobile phones, training, handbills and electronic/print media.

Table 2. Antibiotic use characteristics of small-scale poultry farmers in Enugu State, Nigeria.

Variable	Frequency (%)
Antibiotics farm use	
Yes	88 (100.0)
Source of prescription(n = 88)*	
Self	55 (62.5)
Veterinarian	27 (30.7)
Poultry farmers	5 (5.7)
Reasons for antibiotic use (n = 88)*	
Growth promotion	87 (98.9)
Disease prevention	87 (98.9)
Treatment	87 (98.9)
Antiseptics	8 (9.1)
Criteria for choice of antibiotics (n = 88)*	
Personal experience using particular antibiotics	84 (95.5)
Cost of antibiotics	78 (88.6)
Ease of administration	68 (77.3)
Perceived ability to correctly administer certain antibiotics	59 (67.0)
Preference for specific antibiotics	58 (65.9)
Recommendations from veterinary experts	56 (63.6)
Withdrawal period consideration	49 (55.7)
Result of culturing and sensitivity testing	2 (2.3)
Farmers' sources of information on antibiotics (n = 88)*	
Drug sellers	87 (98.9)
Other farmers	72 (81.8)
Friends and relatives	60 (68.2)
Trader association	21 (23.9)
Age group association	18 (20.5)
Extension agents	16 (18.2)
Internet	16 (18.2)
Mobile phones	7 (8.0)
Training	6 (6.8)
Fliers/handbills	5 (5.7)
Television	4 (4.5)
Radio	2 (2.3)
Newspaper	1 (1.1)
Interest to deepen knowledge of antibiotics	
Yes	82 (93.2)
No	6 (6.8)
Training preference(n = 82)*	
Seminar/workshop	41 (46.6)
Classroom training	41 (46.6)
Farm visits	5 (5.7)
Group meeting	3 (3.4)
Online training	2 (2.3)

* Multiple responses. Source: Field survey, 2019.

The majority (93.2%) of respondents were interested in deepening their knowledge on antibiotics use; with about 47% of them willing to receive training through seminars/workshops or physical classes.

3.3. Classes of antibiotics used in small-scale poultry farms in Enugu State

The respondents reported they use antibiotics belonging to seven classes/subclasses of antibiotics (Table 3). Tetracyclines were reported to be used either often (53.4%) or always (46.6%) while penicillins (59.1%), aminoglycosides (53.4%) and macrolides (51.1%) were often used in the farms. Respondents indicated that ionophores (61.4%), cephalosporins (54.5%) and polypeptides (52.3%) were never used in their farms; however, 3.4%, 4.5% and 5.7%, respectively, reported that these agents were always used. Although 40.9% of respondents never used fluoroquinolones on their farms, 39.8% and 9.1%, respectively, reported that they often and always use them.

Table 3. Classes and frequency of antibiotics used in small-scale poultry farms in Enugu State.

Antibiotics used	Frequency (%) of use			
	Never	Rarely	Often	Always
Tetracyclines e.g. chlortetracycline and oxytetracycline	0 (0.0)	0 (0.0)	47 (53.4)	41 (46.6)
Macrolides e.g. erythromycin, tylosin	14 (15.9)	0(0.0)	45 (51.1)	29 (33.0)
Aminoglycosides e.g. gentamicin, neomycin, streptomycin	14 (15.9)	3 (3.4)	47 (53.4)	24 (27.3)
Penicillin e.g. amoxicillin	15 (17.0)	8 (9.1)	52 (59.1)	13 (14.8)
Fluroquinolones e.g. enrofloxacin, flumequine	36 (40.9)	9 (10.2)	35 (39.8)	8 (9.1)
Cephalosporins e.g. cefotaxime	48 (54.5)	16 (18.2)	20 (22.7)	4 (4.5)
Polypeptides e.g. bacitracin	46 (52.3)	18 (20.5)	19 (21.6)	5 (5.7)
Ionophores e.g. monensin	54 (61.4)	28 (31.8)	3 (3.4)	3 (3.4)

3.4. Knowledge of the use of antibiotics by farmers in Enugu State

The respondents' knowledge indices in respect of the fifteen statements on the use of antibiotics ranged from 0.27-0.80 with a mean of 0.54. About 48% of the respondents had good knowledge (KABU index $\geq$0.6) of antibiotic use. Percentage responses to the knowledge statements are presented in Table 4. Responses depicting incorrect knowledge of the use of antibiotics were reported by a majority of the respondents in 8 (53.3%) of the 15 statements. All (100%) of the farmers correctly agreed that antibiotics can cure bacterial infections and that treated birds can recover quickly if treatment is initiated as soon as the bacterial infection is diagnosed while nearly 91% correctly agreed that it is proper to follow instructions when administering antibiotics. However, about 80, 81, 82 and 86% incorrectly agreed, respectively, that it is proper to obtain a prescription for use of antibiotics from another farmer, good to administer antibiotics before the emergence of signs of disease, administer antibiotics without a veterinary prescription and appropriate to discontinue use of antibiotic as soon as the health conditions of the birds improve. About 59% of the respondents incorrectly disagreed that it is proper to perform culture and sensitivity testing before antibiotic administration.

3.5. Knowledge of antibiotic resistance

The respondents' indices on the fifteen statements about knowledge of antibiotic resistance ranged from 0.33-0.87 with a mean of 0.65. Good knowledge of antibiotic resistance (KABR index $\geq$0.6) was found in 70.5% of the respondents. Percentage responses to the KABR statements are presented in Table 5. Responses indicating correct knowledge of antibiotic resistance were reported by the majority of respondents in 12 (80%) of the 15 statements. A vast majority (95.5%) of the respondents incorrectly agreed that antibiotic resistance occurs when the bird becomes resistant to antibiotics. The respondents correctly agreed that indiscriminate use of antibiotics can lead to the emergence of resistance (96.6%) and antibiotic resistance could result in poor clinical response to antibiotic treatment (88.6%). The respondents also correctly reported that resistance could lead to increased mortality and health care cost (84.1%) and that antibiotic resistance is an important and serious health issue (83%). However, 94.3% of the farmers incorrectly disagreed with the need to perform culture and sensitivity testing when an infection is not responding to treatment while 51.1% also incorrectly disagreed that antibiotic resistance is a problem worldwide.

Table 4. Knowledge of small-scale poultry farmers about the use of antibiotics.

Statements about the use of antibiotics	Response, n (%)		
	Agree	Disagree	Correct
Antibiotics cure bacterial infection(s)	88 (100.0)	0 (0.0)	88 (100.0)
Infected birds can recover quickly if treatment is initiated on time	88 (100.0)	0 (0.0)	88 (100.0)
It is advisable to use antibiotics for growth promotion	57 (64.8)	31 (35.2)	31 (35.2)
Excessive use of antibiotics makes them ineffective	70 (79.5)	18 (20.5)	70 (79.5)
Excessive use of antibiotics can result in side effects	69 (78.4)	19 (21.6)	69 (78.4)
It is proper to administer antibiotics without a veterinary prescription	72 (81.8)	16 (18.2)	16 (18.2)
It is proper to obtain a prescription for the use of antibiotics from another farmer	70 (79.5)	18 (20.5)	18 (20.5)
It is proper to follow instructions given to administer antibiotics	80 (90.9)	8 (9.1)	80 (90.9)
It is appropriate to complete the full course of antibiotics prescribed even when birds have recovered	66 (75.0)	34 (25.0)	66 (75.0)
It is proper to perform culture and sensitivity testing before giving antibiotics	36 (40.9)	52 (59.1)	36 (40.9)
Improper use of antibiotics can cause secondary infection by killing good bacteria in animals	49 (55.7)	39 (44.3)	49 (55.7)
Appropriate administration of antibiotics to birds may shorten the duration of bacterial diseases	34 (38.6)	54 (61.4)	34 (38.6)
It is good to administer antibiotics before signs of the disease emerge	71 (80.7)	17 (19.3)	17 (19.3)
Stop administering antibiotics as soon as the birds get better	77 (87.5)	11 (12.5)	11 (12.5)
It is better to use broad-spectrum antibiotics than narrow-spectrum ones	66 (75.0)	22 (25.0)	22 (25.0)

Source: Field survey, 2019.

3.6. Antibiotics use practices

Indices of antibiotic use practices ranged from 0.13-0.73 with a mean of 0.47. Only 17% of the respondents were found to use antibiotics appropriately (PABU index $\geq$0.6) on their farms. Percentage responses to the PABU statements are presented in Table 6. Responses indicating incorrect practices regarding antibiotic use were reported by a majority of the respondents in 7 (46.7%) of the 15 statements. Nearly 91% of the respondents reported that they use antibiotics to improve the quantity and quality of the poultry products while 86.4% discontinue antibiotic administration as soon as the signs of disease stop. Other incorrect antibiotic use practices reported by the farmers include administration of antibiotics in all disease cases (84.1%), storage of leftover antibiotics to be used in the event of other illnesses (80.7 %) and excessive administration of antibiotics (75%). However, the majority of the farmers disagreed with incorrect practices such as not observing the expiration date of antibiotics (88.6%), buying antibiotics without a prescription (75%) and using antibiotics without consulting a veterinarian (67%). About 85% of the farmers agreed to the correct practice of administering antibiotics following the prescription on the label while 75% agreed that they purchase these drugs from a veterinary drug store or pharmacy based on prescription.

The logistic regression model on the effects of age, sex, farming experience, years spent in school, knowledge of antibiotic use and knowledge of antibiotic resistance on the likelihood that farmers misuse antibiotics was statistically significant ($\chi 2(df = 6) = 15.185$, $p = 0.019$). The model explained 25.9% (Nagelkerke R2) of the variance in antibiotic use practices and correctly classified 81.8% of the practices. Farmers with good knowledge of antibiotic use were significantly (OR = 4.211; $p = 0.045$) more likely to misuse antibiotics than those with poor knowledge (Table 7). Similarly, those with good knowledge of antibiotic resistance were significantly (OR = 4.527; $p = 0.018$) more likely to misuse antibiotics than those with poor knowledge.

Table 5. Knowledge of small-scale poultry farmers on antibiotics resistance.

Knowledge of antibiotics resistance	Response, n (%)		
	Agree	Disagree	Correct
Antibiotic resistance occurs when the bird becomes resistant to antibiotics	84 (95.5)	4 (4.5)	4 (4.5)
Indiscriminate and imprudent use of antibacterial can lead to the emergence of resistance	85 (96.6)	3 (3.4)	85 (96.6)
Antibiotic resistance results in poor clinical response to antibiotic treatment	78 (88.6)	10 (11.4)	78 (88.6)
Infections caused by resistant bacteria can be very difficult to treat	72 (81.8)	16 (18.2)	72 (81.8)
It is necessary to perform culture and susceptibility testing when the infection is not responding to antibiotic treatment	5 (5.7)	83 (94.3)	5 (5.7)
Antibacterial resistance is a problem worldwide	43 (48.9)	45 (51.1)	43 (48.9)
Inappropriate use of antibiotics prevents antibacterial resistance	18 (20.5)	70 (79.5)	70 (79.5)
Efficient use of antibiotics could lead to antibacterial resistance	18 (20.5)	70 (79.5)	70 (79.5)
Antibacterial resistance can lead to increased mortality and health care cost	74 (84.1)	14 (15.9)	74 (84.1)
If taken too often or unnecessarily the antibiotics are less likely to work in the future	65 (73.9)	28 (26.1)	65 (73.9)
The use of antibiotics in poultry does not cause antibiotic resistance that could affect humans	38 (43.2)	50 (56.8)	50 (56.8)
Antibiotic resistance is an issue that could affect me and my family	55 (62.5)	33 (37.5)	55 (62.5)
Overuse and misuse of antibiotics in animals do not cause antibiotic resistance in human bacteria because the antibiotics that are used to treat animals are different from those used to treat humans	33 (37.5)	55 (62.5)	55 (62.5)
Antibiotic resistance does not constitute a problem for the effective treatment of diseased poultry birds	25 (28.4)	63 (71.6)	63 (71.6)
Antibiotic resistance is an important and serious health issue	73 (83.0)	15 (17)	73 (83.0)

Source: Field survey, 2019.

Table 6. Antibiotics use practices of small-scale poultry farmers in Enugu State.

Statements on antibiotic use practices	Response, n (%)		
	Agree	Disagree	Correct
I stop using antibiotics whenever signs of disease stop	76 (86.4)	12 (13.6)	12 (13.6)
I give a lot of antibiotics to my birds	66 (75.0)	22 (25.0)	22 (25.0)
I usually keep antibiotics and use them later for other illnesses	71 (80.7)	17 (19.3)	17 (19.3)
I use antibiotics for low feed intake	55 (62.5)	33 (37.5)	33 (37.5)
I use antibiotics without consulting a veterinarian	29 (33.0)	59 (67.0)	59 (67.0)
I stop administering antibiotics to the birds before completing the course of treatment	43 (48.9)	45 (51.1)	45 (51.1)
I prefer to get antibiotics from other farmers without having to see a veterinarian	34 (38.6)	54 (61.4)	54 (61.4)
I buy and encourage buying antibiotics without prescription	22 (25.0)	66 (75.0)	66 (75.0)
I do not look at the expiry date of the antibiotics before using it	10 (11.4)	78 (88.6)	78 (88.6)
I administer antibiotics according to the prescription on the label	75 (85.2)	13 (14.5)	75 (85.2)
I buy antibiotics from the veterinarydrugshop/pharmacy based on prescription	66 (75.0)	22 (25.0)	66 (75.0)
I use leftover antibiotics in an event of repeated illness	63 (71.6)	25 (28.4)	25 (28.4)
I give antibiotics to birds for all types of illnesses	74 (84.1)	14 (15.9)	14 (15.9)
I use antibiotics to improve the quantity and quality of poultry products	80 (90.9)	8 (9.1)	8 (9.1)
I do not treat the entire flock by mass application of the antibiotics to the entire flock in drinking water	44 (50.0)	44 (50.0)	44 (50.0)

Source: Field survey, 2019.

4. Discussion

This study examined antibiotic use, antibiotic resistance and practices regarding antibiotic use among small-scale poultry farmers in Enugu State, Nigeria. The findings show that all the 88 poultry farmers in the study have used antibiotics on their farms at various times within the preceding year. The majority of the farmers used these agents based on self-prescription. Thus, the use of antibiotics in poultry farming is a common practice in the study area. It was observed from the result that most (70%) of the farms sampled often or always used antibiotics belonging to the tetracyclines (particularly oxytetracycline and chlortetracycline), macrolides (tylosin and erythromycin), aminoglycosides (gentamicin and neomycin) and penicillins (ampicillin). This observation is similar to that of Galadima et al. [11] in Maiduguri, Northeast Nigeria, in which tetracycline and aminoglycoside were the most popular classes of antibiotics used by poultry farmers. The high rate of usage of these antibiotic agents in poultry production may be attributed to their affordability as well as the fact that a greater proportion of poultry drug formulations in the Nigerian market contain these antibiotic agents.

Drug formulations containing fluoroquinolones (especially ciprofloxacin or flumequine) and cephalosporins (particularly cefotaxime) were often or always used in 48.9 % and 27.2 % of the farms, respectively. These are critically important antimicrobial agents and their use in food animals can select resistant bacteria which may be transmitted to humans through the food chain. Apart from treatment purposes, nearly all the farmers used antibiotics for disease prevention and growth promotion. This finding is similar to those of several previous authors [12, 13, 14, 15]. Although the use of antibiotics at subtherapeutic doses in animal production is reported to improve growth performance [16], such application has also been found to contribute to the emergence of antibiotic-resistant bacteria. However, WHO [17] recommended a complete restriction on the use of all classes of medically important antimicrobials in food-producing animals for growth promotion and disease prevention. Many developed countries have banned the use of antimicrobial agents as growth promoters [18, 19].

Citing growing AMR in Nigeria, the National Agency for Food and Drug Administration and Control (NAFDAC) in 2018 issued a ban on the use of antibiotic additives in animal feed. However, drug formulations containing a cocktail of antimicrobial agents (including medically important antimicrobials) abound in Nigerian markets whereby poultry farmers purchase and routinely administer them to their birds via drinking water for therapeutic and non-therapeutic purposes. Thus, the high rates of resistance to penicillins, tetracyclines, fluoroquinolones and cephalosporins among members of the Enterobacteriaceae were reported in chicken in several studies in Nigeria [20, 21, 22, 23]. could be attributed to excessive use of these agents in poultry production.

The majority of the farmers were engaged in self-prescription while the choice of antibiotics used by over 75 % of the farmers was based on their personal experience, cost and ease of administration of the drugs and about 64 % based on a recommendation from a veterinarian; a finding similar to that of Nsofor et al. [24]. Most of the farmers interviewed believe that there is no need to request the assistance of the veterinarian since they can follow the instructions on the drug label and would only seek a prescription from a veterinarian if the birds are not

Table 7. Factors influencing misuse of antibiotics among small-scale poultry farmers in Enugu State.

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	-0.052	0.037	1.940	1	0.164	0.949	0.882	1.021
Years in School	-0.022	0.057	0.145	1	0.703	0.979	0.875	1.094
Farming Experience	0.097	0.062	2.439	1	0.118	1.102	0.976	1.244
Gender(1)	0.070	0.648	0.012	1	0.915	1.072	0.301	3.819
GKABU(1)	1.438	0.719	4.003	1	0.045	4.211	1.030	17.222
GKABR(1)	1.510	0.637	5.612	1	0.018	4.527	1.298	15.791
Constant	-1.858	1.591	1.363	1	0.243	0.156		

Nagelkerke $R^2 = 25.9\%$.

B = Regression coefficient; S.E. standard error; Exp(B) = exponentiated coefficient = Odds ratio (OR); C.I. = Confidence interval; GKABU = Good knowledge of antibiotic use; GKABR = Good knowledge of antibiotic resistance; YrsSch = Years spent in school; FarmExp = Farming experience.

responding to treatment. In Nigeria, as in many low- and medium-income countries (LMIC), sales of antibiotics are largely unregulated [25, 26]. Both self-prescription and purchase of antibiotics without veterinary prescription promote irrational use of antibiotics and their attendant consequences [27]. To avoid treatment failures and the development of AMR, it is best practice to perform laboratory diagnosis and antimicrobial sensitivity testing (AST) before administration of the antibiotic agent. Unfortunately, in the present study, only 2.3% of the farmers indicated that the choice of antibiotics used depended on the results of the AST. This observation is not surprising given the fact that only one veterinary microbiology diagnostic facility exists in the study area. Additionally, the respondents were small-scale farmers who raised chickens to augment family income and therefore will not be willing to increase production costs. Drug sellers, other farmers and friends were the major sources of information for the farmers on antibiotics; an observation that suggests a weak linkage between veterinarians/veterinary extension services and the small-scale poultry farmers in the study area. Some previous authors have also reported on drug sellers, other farmers and friends as major channels of information dissemination to farmers [14, 24, 28]. For-profit interest, information from drug sellers can be biased in favour of more antibiotics purchases and consequent excessive use in poultry production. In line with the findings of Di Martino et al. [29] and Adebowale et al. [30], poultry farmers in the present study indicated an interest in deepening their knowledge of antibiotics with seminars/workshops and classrooms as the preferred training platforms. Veterinarians and extension agents can therefore use these platforms to interface with the poultry farmers in the provision of accurate and reliable information on antibiotics and their prudent use.

Although 48 and 70.5% of the respondents had good knowledge of antibiotic use and resistance, respectively, 83% of them were still engaged in inappropriate antibiotic use practices. Farmers with good knowledge of antibiotic use and antibiotic resistance were, respectively, 4 and 5 times more likely to misuse antibiotics than those with poor knowledge. This observation is quite surprising as one expects good knowledge to translate into appropriate or best practices. This finding indicates that knowledge did not change the farmers' attitudes towards antibiotic use. Although the farmers were aware that antibiotic misuse was associated with antibiotic resistance, they did not consider it an important problem that could affect human health; a finding similar to that of Carter et al. [31]. The farmers also stated that they were not ready to take any risk of losing their birds, especially during the first week of life, by not administering antibiotics such as tetracycline. Thus, the main concern about the well-being of their chickens most likely contributed to the inappropriate use of antibiotics by the farmers studied.

5. Conclusion

Antibiotics are valuable agents whose efficacy can only be preserved if they are handled with care. Unfortunately, it is clear from the results of this study that antibiotics are routinely used, and on many occasions inappropriately, in small-scale poultry production in Enugu State, Nigeria. Training of small-scale farmers through seminars and workshops will provide them with the opportunity to improve their knowledge and practices regarding antibiotic use. Strengthening the linkage between veterinarians, veterinary extension agents and poultry farmers' association will create ample opportunities for sharing accurate information on the appropriate use of antibiotics in poultry production in the study area.

Declarations

Author contribution statement

Jane M. Chah.; Sandra C. Nwankwo.; Irenonsen O. Uddin; Kennedy F. Chah: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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