

Knowledge, attitudes and practices regarding antibiotic use in chicken farming in a rural area of Viet Nam, 2023–2024

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Objective: Antibiotic misuse in animal husbandry contributes to antimicrobial resistance, a major public health concern. This study assessed the knowledge, attitudes and practices (KAPs) regarding antibiotic use in chicken farming among residents of a rural community in northern Viet Nam.

Methods: A cross-sectional study combining quantitative and qualitative methods was conducted from October 2023 to August 2024, comprising a survey of 264 chicken farmers and 20 in-depth interviews.

Results: Overall, 211 (79.9%) respondents had incomplete knowledge about antibiotic use, 161 (61.0%) exhibited attitudes that could potentially contribute to inappropriate antibiotic use, and 217 (82.2%) reported unsafe practices related to antibiotic use. In multivariable logistic regression analysis, annual household income, farming method, farming system, educational attainment, poultry disease experience and chicken feeding practices were independently associated with one or more KAP outcomes.

Discussion: Inappropriate antibiotic use was common among farmers. Community-based training, improved veterinary support and stronger regulations are needed to promote rational antibiotic use and reduce the risks of antimicrobial resistance.

Antibiotics have transformed the treatment of bacterial infections in humans and animals. However, their misuse in animal husbandry has accelerated antimicrobial resistance (AMR), which threatens public health and food safety.¹ AMR occurs when bacteria become resistant to antibiotics, making infections more difficult to treat and increasing the risk of disease transmission, severe illness and mortality.²

Globally, livestock account for a significant portion of antibiotic use, with poultry farming being a major contributor.^{3,4} In Viet Nam, antibiotics are widely used in small-scale chicken farming, where veterinary supervision is often limited. Many farmers administer antibiotics without professional guidance, increasing the risk of inappropriate use and development of AMR.⁵ Misuse is

driven by easy access to antibiotics, economic pressures and limited awareness of proper use.

Previous studies have shown that farmers often lack knowledge about antibiotic indications, dosages and withdrawal periods.^{6–14} Misconceptions are common, such as the beliefs that antibiotics should be used for all diseases and that higher doses improve recovery. Understanding the knowledge, attitudes and practices (KAPs) of chicken farmers is therefore essential for designing effective interventions.

This study aims to assess KAPs regarding antibiotic use in chicken farming in a rural community in northern Viet Nam, and to identify key factors associated with inappropriate use.

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METHODS

Study site

This study was conducted in Lau Thuong Commune, Thai Nguyen Province, Viet Nam, a rural mountainous area where small-scale poultry farming is a major source of livelihood. Chickens are typically raised in free-range or semi-intensive systems using traditional practices. Veterinary drugs are frequently purchased informally without professional guidance, and access to veterinary services is limited.¹⁴ These conditions reflect settings where unregulated antibiotic use contributes to AMR.

Study design and population

A cross-sectional mixed-methods study was conducted from October 2023 to August 2024 among chicken farmers aged ≥ 18 years who were involved in chicken management and decision-making about antibiotic use.

Sampling methods

Stratified random sampling was applied to ensure representation across demographic groups, village clusters and farm-scale categories within the commune. A list of eligible chicken farms was obtained from the local veterinary authority, which maintains records of livestock-keeping households for vaccination and disease management purposes. The list was updated before sampling and was considered to include all active chicken farms in the study area.

Farms were stratified by village and farm size (≤ 50 , 51–1000, >1000 chickens). The number of farmers selected from each village was proportional to the total number of eligible households in that village. Within each stratum, systematic random sampling was used to select participants from the official list. Sample size was calculated using the formula:

$$n = \frac{Z^2 \cdot \frac{\alpha}{1-\alpha} \cdot P \times (1-P)}{d^2},$$

where n is the minimum sample size; $Z = 1.96$ (95% confidence level, with $\alpha = 0.05$); P is the estimated prevalence; and d is the desired margin of error (set at 5%). Based on Pham-Duc et al., the estimated prevalence of incomplete knowledge, attitudes that could contribute to inappropriate antibiotic use, and poor practices was

0.80, 0.86 and 0.87, respectively.² These values yielded minimum required sample sizes of 246, 185 and 174, respectively. To ensure adequate representation, the largest value (246) was selected and adjusted for a 5% non-response rate. The sample size was calculated as:

$$n_{\text{adjusted}} = \frac{246}{1 - 0.05} \approx 259.$$

In total, 264 farmers were invited from a list of 580 eligible chicken farms to respond to the structured questionnaire.

For the qualitative component, 20 in-depth interviews were conducted using purposive sampling.

Data collection tools

Quantitative data were collected using a structured questionnaire adapted from validated KAP surveys on antibiotic use in Viet Nam.^{2,8,12} The questionnaire consisted of four sections: (i) demographic information (15 items), and (ii) knowledge (15 items), (iii) attitudes (12 items) and (iv) practices (18 items) related to antibiotic use (Supplementary Material). The questionnaire was pre-tested with 20 farmers outside the study area to ensure clarity, cultural relevance and reliability. Although internal consistency was not formally assessed, the questionnaire was adapted from previously validated tools.^{2,4} Correct responses are provided in **Supplementary Tables 1–3**.

Qualitative data were collected through semi-structured interviews focusing on each participant's perceptions, decision-making processes and barriers to appropriate antibiotic use. The interview guide was adapted from previous studies.^{15,16} Interviews were conducted in Vietnamese, audio-recorded with participant consent, transcribed verbatim and anonymized.

Each interview lasted 30–40 minutes and was conducted by a main interviewer with one or two note-takers. Participants were purposively selected to ensure diversity in farm size, farming experience and antibiotic use practices.

For the quantitative analysis, correct knowledge responses were scored as 1 and incorrect or unknown responses as 0. Attitude and practice items (Likert scale or multiple choice) were coded as 1 if appropriate or 0 if inappropriate or incorrect based on recommended

guidelines and prior studies.^{2,4} Domain scores were summed and converted to percentages of the maximum possible score. A threshold of $\geq 75\%$ was used to classify adequate knowledge, appropriate attitudes and appropriate practices, as has been used in previous research,² corresponding to scores of ≥ 11 , ≥ 9 and ≥ 14 , respectively. Missing responses were rare and were coded as incorrect to avoid overestimation.

Data management and quality control

Data were collected by trained researchers following standardized procedures. Completed questionnaires were checked daily for completeness and accuracy and double-entered into a secure Excel database (Microsoft Corporation, Redmond, WA, USA). Qualitative transcripts were cross-checked against audio recordings to ensure fidelity. All data were stored securely, and confidentiality was strictly maintained.

Data analysis

Quantitative data were analysed using SPSS (version 28.0). Descriptive statistics summarized demographic characteristics and KAP outcomes. Univariate analyses (χ^2 test or Fisher's exact test, as appropriate) were performed to identify factors associated with KAPs regarding antibiotic use. Variables with $P \leq 0.05$ in univariate analysis, together with variables considered theoretically relevant based on previous studies, were included in multivariable logistic regression models. Knowledge and attitudes were additionally retained in the practice model because of their epidemiological relevance in the KAP framework. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated. Statistical significance was set at $P < 0.05$.

Qualitative data were analysed thematically using NVivo software.^{17,18} Transcripts were coded inductively, and emerging codes were grouped into categories and overarching themes to capture farmers' perceptions and decision-making related to antibiotic use.

RESULTS

Participant characteristics

All 264 selected farmers provided informed consent before the interview, resulting in a 100%

response rate. Of the respondents, 141 (53.4%) were male. Most participants were aged >35 years (224, 84.8%), and 135 (51.1%) belonged to the Kinh ethnic group, while 129 (48.9%) were from ethnic minorities. The majority had secondary education (181, 68.6%), and 191 (72.3%) reported household income below the local average. Poultry farming was the main income source for 154 (58.3%) participants, and 179 (67.8%) had more than 10 years of farming experience (Table 1).

Altogether, 203 (76.9%) farmers reported their chickens had experienced diseases in the past 12 months, and 164 (62.1%) reported having only irregular access to veterinary services. Most households practised mixed farming (230, 87.1%) and raised chickens mainly for meat (112, 42.4%) or eggs (102, 38.6%) (data not shown). Semi-free-range or combined systems were common, and 116 (43.9%) used household food waste as feed (data not shown).

Knowledge, attitudes and practices

Knowledge

Overall, 178 (67.4%) farmers had heard of antibiotics, but only 24 (9.1%) had received formal training in their use (Table 2). Most respondents knew that antibiotics treat bacterial infections (205, 77.7%) and should be used by prescription or under professional guidance (225, 85.2%). In addition, 203 (76.9%) respondents were aware that inappropriate use, such as incorrect dosing, misuse and failure to follow professional guidance, could result in financial losses for farmers. These losses may arise from unnecessary expenditure on antibiotics, reduced treatment effectiveness due to inappropriate use, and additional costs associated with treating diseases linked to AMR. Furthermore, 162 (61.4%) acknowledged that the misuse of antibiotics in animals may reduce their effectiveness in humans.

Several misconceptions were also identified. Approximately half of respondents (134, 50.8%) believed that antibiotics could treat all animal diseases, while 120 (45.5%) considered antibiotics to be appropriate for promoting animal growth. Furthermore, 105 (39.8%) believed that antibiotics have no side-effects. Misunderstandings regarding appropriate treatment practices were also common, with 147 (55.7%) indicating that the dosage and frequency of antibiotics

Table 1. Characteristics of study respondents, Lau Thuong Commune, Viet Nam (N = 264)

Characteristics	No. (%)
Sex	
Male	141 (53.4)
Female	123 (46.6)
Age group (years)	
≤35	40 (15.2)
36–54	115 (43.6)
≥55	109 (41.2)
Ethnic group	
Kinh	135 (51.1)
Other minorities (Cao Lan, Dao, Keo, Muong, Nung, San Diu, Tay, Thai)	129 (48.9)
Educational attainment	
Primary school or below	51 (19.3)
Secondary school	181 (68.6)
Tertiary education	32 (12.1)
Annual household income	
Below local average	191 (72.3)
Above local average	73 (27.7)
Primary source of income	
Poultry farming	154 (58.3)
Other	110 (41.7)
Farming experience	
≤10 years	85 (32.2)
>10 years	179 (67.8)
Experience with poultry diseases	
Within past 12 months	203 (76.9)
More than 12 months ago	61 (23.1)
Access to veterinary services	
Regular (obtain veterinary consultation whenever needed)	100 (37.9)
Irregular (only occasional or no access to professional veterinary services)	164 (62.1)

should be increased if chickens do not improve, and 155 (58.7%) reporting that antibiotics could be stopped once chickens appear to recover. Taken together, 211 (79.9%) respondents demonstrated incomplete knowledge regarding appropriate antibiotic use (data not shown).

Interviews suggested that some farmers perceived antibiotic use as unavoidable in chicken production. For example, one participant stated that it is impossible to raise chickens without using antibiotics (**Supplementary**

Table 4). This perception may encourage widespread reliance on antibiotics observed in the survey.

Attitudes

In general, attitudes towards antibiotic use were mixed (**Table 3**). Of the 264 participants, 161 (61.0%) had at least one incorrect response in the attitude questionnaire, indicating attitudes that could potentially contribute to inappropriate antibiotic use (data not shown).

Table 2. Knowledge of chicken farmers regarding antibiotic use in chicken production, Lau Thuong Commune, Viet Nam (N = 264)

Knowledge statement	No. (%) responses	
	Yes	No
General awareness and exposure to training		
Heard of/aware of antibiotics	178 (67.4)	86 (32.6)
Participated in training on antibiotic use	24 (9.1)	240 (90.9)
	Correct	Incorrect
Knowledge regarding purposes and principles of antibiotic use		
Antibiotics can treat all animal diseases.	130 (49.2)	134 (50.8)
Antibiotics can be used to treat bacterial infections.	205 (77.7)	59 (22.3)
Antibiotics should be used for disease prevention in chicken farming.	65 (24.6)	199 (75.4)
Antibiotics should be used to promote animal growth.	144 (54.5)	120 (45.5)
Antibiotics have no side-effects.	159 (60.2)	105 (39.8)
Antibiotics should be used according to prescription or professional guidance.	225 (85.2)	39 (14.8)
Antibiotics can be used based on personal experience; veterinary advice is only needed when animals are severely ill.	118 (44.7)	146 (55.3)
The dosage and frequency of antibiotics should be increased if chickens do not improve.	117 (44.3)	147 (55.7)
Antibiotics can be stopped once chickens appear to recover.	109 (41.3)	155 (58.7)
Inappropriate antibiotic use is associated with financial loss for farmers.	203 (76.9)	61 (23.1)
Misuse of antibiotics in animals may reduce antibiotic effectiveness in humans.	162 (61.4)	102 (38.6)

Most farmers recognized the importance of antibiotics for treating diseases in livestock production, with 209 (79.2%) agreeing or strongly agreeing that antibiotic treatment is important in animal husbandry. Similarly, 223 (84.5%) agreed or strongly agreed that antibiotic use in chickens requires consultation with a veterinarian or animal health worker, and 230 (87.1%) agreed or strongly agreed that a veterinary prescription is required when using antibiotics.

However, several misconceptions were identified. More than half of the respondents (170, 64.4%) believed that antibiotics can treat all diseases in animals, and 164 (62.1%) agreed or strongly agreed that antibiotics are necessary to improve livestock productivity. In addition, 156 (59.1%) believed that antibiotics should be changed immediately if chickens do not improve, while 129 (48.9%) considered it acceptable to increase antibiotic dosage arbitrarily to accelerate recovery.

Despite these misconceptions, awareness of withdrawal periods before slaughter was relatively high, with 236 (89.4%) agreeing that antibiotics should be

stopped before selling chickens for slaughter. Collectively, 161 (61.0%) exhibited attitudes that could potentially contribute to inappropriate antibiotic use (data not shown).

Preventive use of antibiotics and other medications was frequently reported during interviews. Some farmers routinely administered vaccines and antibiotics, and used disinfectants as part of disease prevention, while others reported frequent use of antibiotics and disinfectants even in the absence of confirmed illness. The use of human medicines for treating livestock was also noted (**Supplementary Table 4**). These findings indicate a widespread reliance on preventive medication, self-prescription and non-veterinary treatment sources, consistent with the quantitative results showing frequent inappropriate antibiotic practices.

Practices

Antibiotics were most commonly used when chickens were diagnosed with disease (184, 69.7%) or showed abnormal clinical signs (160, 60.6%) (**Table 4**).

Table 3. Attitudes of chicken farmers towards antibiotic use in chicken production, Lau Thuong Commune, Viet Nam (N = 264)

Statement	No. (%) participants				
	Strongly disagree	Disagree	Neutral/no opinion	Agree	Strongly agree
Antibiotics help prevent and treat diseases in humans and animals.	16 (6.0)	41 (15.6)	23 (8.7)	150 (56.8)	34 (12.9)
Antibiotics can treat all diseases in animals/livestock.	8 (3.0)	53 (20.1)	33 (12.5)	137 (51.9)	33 (12.5)
Antibiotics are necessary to improve livestock productivity.	11 (4.1)	55 (20.8)	34 (12.9)	124 (47.0)	40 (15.2)
Antibiotic use is important for treating diseases in livestock production.	9 (3.4)	24 (9.1)	22 (8.3)	156 (59.1)	53 (20.1)
Antibiotic use is important for promoting growth in livestock.	19 (7.2)	90 (34.1)	29 (11.0)	84 (31.8)	42 (15.9)
It is necessary to change the type of antibiotic immediately if the animal does not improve.	16 (6.0)	68 (25.8)	24 (9.1)	127 (48.1)	29 (11.0)
To help chickens recover faster, antibiotic dosage can be increased arbitrarily.	24 (9.1)	87 (32.9)	24 (9.1)	108 (40.9)	21 (8.0)
When antibiotics are used correctly, there is little risk of antibiotic resistance.	6 (2.3)	21 (8.0)	26 (9.8)	161 (61.0)	50 (18.9)
Antibiotic use in chickens requires consultation with a veterinarian or animal health worker.	2 (0.8)	18 (6.8)	21 (8.0)	126 (47.7)	97 (36.7)
Antibiotic use in chickens requires a prescription from a veterinarian or animal health worker.	3 (1.1)	18 (6.8)	13 (5.0)	143 (54.1)	87 (33.0)
When an animal has a disease that cannot be treated with antibiotics, it is extremely dangerous.	5 (1.9)	29 (11.0)	13 (5.0)	151 (57.2)	66 (25.1)
Stopping antibiotic use before selling chickens (for slaughter) is necessary.	6 (2.3)	16 (6.0)	6 (2.3)	114 (43.2)	122 (46.2)

However, a small proportion of farmers also reported using antibiotics for non-disease conditions, such as slow growth (13, 4.9%), weather changes (15, 5.7%) or when disease was reported in nearby farms (26, 9.8%).

Farmers relied mainly on their own experience when selecting and using antibiotics (94, 35.6%) or veterinary officers (86, 32.6%), while fewer reported consulting veterinary pharmacists (28, 10.6%) or other farmers (18, 6.8%). About half of respondents (135, 51.1%) reported purchasing antibiotics without receiving a prescription or professional consultation.

In terms of antibiotic management, most farmers reported checking the expiry date before use (220, 83.3%) and not using expired antibiotics (246, 93.2%). Nevertheless, inappropriate practices were observed, including disposing of antibiotics in household garbage (139, 52.7%) and using human antibiotics for animals (65, 24.6%). Record-keeping related to chicken management was generally poor, with 212 (80.3%) farmers reporting that they did not keep any records. Altogether, 217 (82.2%) reported unsafe practices related to antibiotic use (data not shown).

Interviews revealed several inappropriate antibiotic use practices consistent with the quantitative findings. Many farmers purchased antibiotics directly from veterinary pharmacies without veterinary consultation and used them based on personal experience (**Supplementary Table 4**). Others relied on experience or informal information sources when treating disease. Routine or seasonal antibiotic use for disease prevention was also common. Although some farmers reported consulting veterinary officers, treatment practices were often inconsistent and poorly documented. These findings suggest that antibiotic use decisions were frequently based on convenience, experience and accessibility rather than professional guidance, which might contribute to the high prevalence of inappropriate practices observed in the survey.

Factors associated with KAPs

Univariate and multivariable logistic regression analyses identified several factors significantly associated with KAPs regarding antibiotic use (**Table 5**). Age, ethnicity and sex were not significantly associated with KAP outcomes. Higher annual household income was independently

Table 4. Practices of chicken farmers regarding antibiotic use and management in chicken production, Lau Thuong Commune, Viet Nam (N = 264)

Practice	Category	No. (%)
Antibiotic use		
Occasions for antibiotic use	Diagnosed disease	184 (69.7)
	Abnormal clinical signs	160 (60.6)
	Disease reported in nearby farms	26 (9.8)
	Weather changes	15 (5.7)
	Slow growth (without signs of disease)	13 (4.9)
	Do not use antibiotics	16 (6.1)
Sources of advice for antibiotic selection and use	Personal experience	94 (35.6)
	Veterinary officer	86 (32.6)
	Veterinary pharmacists	28 (10.6)
	Other farmers	18 (6.8)
	Other sources	17 (6.4)
	Relatives	9 (3.4)
	Drug company representatives	6 (2.3)
Prescription or professional consultation when purchasing antibiotics	Friends	6 (2.3)
	Yes	129 (48.9)
	No	135 (51.1)
Factors considered when choosing antibiotics	Remaining shelf life (longer time before expiration)	144 (54.5)
	Trusted pharmacy	54 (20.5)
	Advice from veterinary pharmacists	44 (16.7)
	Specific pharmaceutical company	14 (5.3)
	Advice from family/friends	4 (1.5)
	Other	4 (1.5)
Antibiotic management		
Antibiotic storage location	Medicine cabinet	88 (33.3)
	Anywhere	67 (25.4)
	Refrigerator	60 (22.7)
	Chicken coop	42 (15.9)
	Other	7 (2.7)
Check antibiotic expiry date before use	Yes	220 (83.3)
	No	44 (16.7)
Practice when antibiotics expire	Stop using	246 (93.2)
	Continue using (higher dose)	17 (6.4)
	Other	1 (0.4)
Length of withdrawal period before selling chickens	<2 days	16 (6.1)
	2 days	1 (0.4)
	5 days	7 (2.7)
	>5 days	240 (90.9)

Practice	Category	No. (%)
Disposal of leftover antibiotics	Household garbage	139 (52.7)
	Burning	59 (22.3)
	Keep for future use	40 (15.2)
	Give to neighbours/other farms	15 (5.7)
	Bury	11 (4.2)
Record-keeping for chicken management	No records kept	212 (80.3)
	Vaccination records	31 (11.7)
	Breeds	4 (1.5)
	Information about buyer	4 (1.5)
	Flock size	3 (1.1)
	Antibiotic use	3 (1.1)
	Feed	2 (0.8)
	No. of times disinfectant used	2 (0.8)
	Other	3 (1.1)
Use of human antibiotics for animals	Yes	65 (24.6)
	No	199 (75.4)

associated with satisfactory knowledge (aOR: 3.33, 95% CI: 1.12–8.89; $P = 0.02$) and appropriate antibiotic use practices (aOR: 2.92, 95% CI: 1.27–5.86; $P = 0.02$). In univariate analysis, farmers with more than 10 years of experience in chicken farming had lower odds of satisfactory knowledge (OR: 0.49, 95% CI: 0.30–0.90; $P = 0.02$) and appropriate antibiotic use practices (OR: 0.52, 95% CI: 0.27–0.99; $P = 0.05$) than those with less experience; however, these associations were no longer statistically significant after adjustment. In addition, farmers raising chickens together with other animals (polyculture) had lower odds of satisfactory knowledge and appropriate antibiotic use practices (both aOR: 0.16, 95% CI: 0.04–0.67; $P = 0.03$) than those raising chickens only.

Higher educational attainment was independently associated with appropriate antibiotic use practices (aOR: 4.22, 95% CI: 1.46–9.64; $P = 0.02$). Farmers whose chickens had experienced disease more than 12 months previously had higher odds of appropriate antibiotic use practices than those whose flocks had experienced disease within the past 12 months (aOR: 2.86, 95% CI: 1.04–7.63; $P = 0.03$). In addition, farmers using combined cage and semi-free-range systems had higher odds of desirable attitudes towards antibiotic use than those using caged systems (aOR: 3.34, 95%

CI: 1.14–9.17; $P = 0.03$). Feeding practices were also significantly associated with KAP outcomes, particularly among farmers using household waste or a combination of commercial feed and household waste.

Neither knowledge (OR: 0.78, 95% CI: 0.34–1.80; $P = 0.57$) nor attitude (OR: 0.61, 95% CI: 0.31–1.23; $P = 0.17$) was significantly associated with antibiotic use practices (Table 5).

Overall, higher annual household income was independently associated with satisfactory knowledge and satisfactory practices, whereas farming method and feeding practices were associated with both knowledge and practices.

DISCUSSION

This study reveals substantial gaps in KAPs regarding antibiotic use among chicken farmers in Lau Thuong Commune. Inadequate knowledge, attitudes that may lead to inappropriate antibiotic use, and unsafe practices were common. Several socioeconomic and farming-related characteristics, including household income, farming experience, educational attainment, farming systems and feeding practices, were associated with KAP outcomes.

Table 5. Univariate and multivariable logistic regression analyses of factors associated with knowledge, attitudes and practices regarding antibiotic use among chicken farmers, Lau Thuong Commune, Viet Nam (N = 264)

Variable	Category	Unsatisfactory n (%)	Satisfactory n (%)	Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
Knowledge							
Sex	Male	111 (42.0)	30 (11.4)	Reference	–		
	Female	100 (37.9)	23 (8.7)	0.85 (0.46–1.56)	0.60		
Age group (years)	≤35	30 (11.4)	10 (3.8)	Reference	–		
	36–54	93 (35.2)	22 (8.3)	0.71 (0.30–1.70)	0.50		
	≥55	88 (33.3)	21 (8.0)	0.72 (0.30–1.70)	0.50		
Ethnicity	Kinh	111 (42.0)	24 (9.1)	Reference	–		
	Other ethnicities	100 (37.9)	29 (11.0)	1.34 (0.70–2.50)	0.36		
Educational attainment	Primary school or below	42 (15.9)	9 (3.4)	Reference	–		
	Secondary school	144 (54.5)	37 (14.0)	1.20 (0.50–2.80)	0.67		
	Tertiary education	25 (9.5)	7 (2.7)	1.31 (0.40–4.10)	0.64		
Annual household income	Below local average	164 (62.1)	27 (10.2)	Reference	–	Reference	–
	Above local average	47 (17.8)	26 (9.8)	3.36 (1.80–6.10)	<0.01	3.33 (1.12–8.89)	0.02
Farming experience (years)	≤10	61 (23.1)	24 (9.1)	Reference	–	Reference	–
	>10	150 (56.8)	29 (11.0)	0.49 (0.30–0.90)	0.02	0.47 (0.24–1.13)	0.06
Experience with poultry diseases	Within past 12 months	164 (62.1)	39 (14.8)	Reference	–		
	More than 12 months ago	47 (17.8)	14 (5.3)	1.30 (0.60–2.40)	0.52		
Farming method (mono- or poly-culture)	Raising chickens only	14 (5.3)	20 (7.6)	Reference	–	Reference	–
	Raising chickens with other animals	197 (74.6)	33 (12.5)	0.12 (0.06–0.26)	<0.01	0.16 (0.04–0.67)	0.03
	Caged	17 (6.4)	9 (3.4)	Reference	–		
Farming system	Semi-free-range	70 (26.5)	14 (5.3)	0.40 (0.20–1.20)	0.12		
	Combined caged and semi-free-range	122 (46.2)	30 (11.4)	0.50 (0.20–1.30)	0.16		
	Commercial feed	32 (12.1)	22 (8.3)	Reference	–	Reference	–
Chicken feed	Household waste	84 (31.8)	12 (4.5)	0.21 (0.09–0.47)	<0.01	0.20 (0.08–0.49)	0.04
	Combined commercial feed and household waste	97 (36.7)	19 (7.2)	0.28 (0.14–0.59)	<0.01	0.26 (0.12–0.81)	0.03

Variable	Category	Unsatisfactory n (%)	Satisfactory n (%)	Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
Attitudes							
Sex	Male	87 (33.0)	54 (20.5)	Reference	–		
	Female	74 (28.0)	49 (18.5)	1.07 (0.65–1.75)	0.80		
Age group (years)	≤35	27 (10.2)	13 (4.9)	Reference	–		
	36–54	69 (26.1)	46 (17.4)	1.40 (0.70–3.00)	0.45		
	≥55	65 (24.6)	44 (16.7)	1.40 (0.70–3.00)	0.45		
Ethnicity	Kinh	89 (33.7)	46 (17.4)	Reference	–		
	Other ethnicities	72 (27.3)	57 (21.6)	1.50 (0.90–2.50)	0.10		
Educational attainment	Primary school or below	36 (13.6)	15 (5.7)	Reference	–		
	Secondary school	104 (39.4)	77 (29.2)	1.80 (0.90–3.60)	0.10		
	Tertiary education	21 (8.0)	11 (4.2)	1.26 (0.49–3.24)	0.64		
Annual household income	Below local average	119 (45.1)	72 (27.3)	Reference	–		
	Above local average	42 (15.9)	31 (11.7)	1.22 (0.70–2.11)	0.48		
Farming experience (years)	≤10	59 (22.3)	26 (9.8)	Reference	–		
	>10	102 (38.6)	77 (29.2)	1.71 (0.99–2.96)	0.06		
Experience with poultry diseases	Within past 12 months	126 (47.7)	77 (29.2)	Reference	–		
	More than 12 months ago	35 (13.3)	26 (9.8)	1.20 (0.70–2.20)	0.51		
Farming method (mono- or poly-culture)	Raising chickens only	16 (6.1)	18 (6.8)	Reference	–		
	Raising chickens with other animals	145 (54.9)	85 (32.2)	0.52 (0.25–1.08)	0.09		
	Caged	21 (8.0)	5 (1.9)	Reference	–	Reference	–
Farming system	Semi-free-range	57 (21.6)	28 (10.6)	2.10 (0.70–6.00)	0.19	2.21 (0.94–4.98)	0.34
	Combined cage and semi-free-range	83 (31.4)	70 (26.5)	3.50 (1.30–9.90)	0.02	3.34 (1.14–9.17)	0.03
	Commercial feed	15 (5.7)	18 (6.8)	Reference	–	Reference	–
Chicken feed	Household waste	82 (31.1)	34 (12.9)	0.35 (0.15–0.82)	0.02	0.42 (0.12–0.94)	0.04
	Combined commercial feed and household waste	64 (24.2)	51 (19.3)	0.66 (0.29–1.47)	0.32	0.84 (0.16–1.62)	0.12
Practices							
Sex	Male	114 (43.2)	27 (10.2)	Reference	–		
	Female	103 (39.0)	20 (7.6)	0.85 (0.46–1.56)	0.60		

Variable	Category	Unsatisfactory n (%)	Satisfactory n (%)	Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
Age group (years)	≤35	33 (12.5)	7 (2.7)	Reference	–		
	36–54	88 (33.3)	27 (10.2)	1.50 (0.60–3.60)	0.51		
	≥55	96 (36.4)	13 (4.9)	0.60 (0.20–1.70)	0.42		
Ethnicity	Kinh	110 (41.7)	25 (9.5)	Reference	–		
	Other ethnicities	107 (40.5)	22 (8.3)	0.90 (0.50–1.70)	0.87		
Educational attainment	Primary school or below	45 (17.0)	6 (2.3)	Reference	–	Reference	–
	Secondary school	153 (58.0)	28 (10.6)	1.37 (0.50–3.60)	0.53	1.04 (0.41–2.12)	0.72
	Tertiary education	19 (7.2)	13 (4.9)	5.13 (1.73–15.20)	<0.01	4.22 (1.46–9.64)	0.02
Annual household income	Below local average	168 (63.6)	23 (8.7)	Reference	–	Reference	–
	Above local average	49 (18.6)	24 (9.1)	3.58 (1.86–6.88)	<0.01	2.92 (1.27–5.86)	0.02
Farming experience (years)	≤10	64 (24.2)	21 (8.0)	Reference	–	Reference	–
	>10	153 (58.0)	26 (9.8)	0.52 (0.27–0.99)	0.05	0.58 (0.09–1.93)	0.12
Experience with poultry diseases	Within past 12 months	176 (66.7)	27 (10.2)	Reference	–	Reference	–
	More than 12 months ago	41 (15.5)	20 (7.6)	3.18 (1.63–6.22)	<0.01	2.86 (1.04–7.63)	0.03
Farming method (mono- or poly-culture)	Raising chickens only	14 (5.3)	20 (7.6)	Reference	–	Reference	–
	Raising chickens with other animals	203 (76.9)	27 (10.2)	0.09 (0.04–0.21)	<0.01	0.16 (0.04–0.67)	0.03
Farming system	Caged	15 (5.7)	11 (4.2)	Reference	–	Reference	–
	Semi-free-range	71 (26.9)	14 (5.3)	0.27 (0.10–0.72)	<0.01	0.24 (0.08–0.77)	0.01
	Combined cage and semi-free-range	131 (49.6)	22 (8.3)	0.23 (0.09–0.57)	<0.01	0.20 (0.08–0.51)	0.01
	Commercial feed	12 (4.5)	21 (8.0)	Reference	–	Reference	–
Chicken feed	Household waste	119 (45.1)	5 (1.9)	0.02 (0.01–0.08)	<0.01	0.10 (0.08–0.59)	0.02
	Combined commercial feed and household waste	86 (32.6)	21 (8.0)	0.14 (0.06–0.36)	<0.01	0.21 (0.09–0.86)	0.03
Knowledge on antibiotic use	Sufficient	45 (17.0)	8 (3.0)	Reference	–	Reference	–
	Insufficient	172 (65.2)	39 (14.8)	0.78 (0.34–1.80)	0.57	0.81 (0.42–2.13)	0.62
Attitudes towards antibiotic use	Desirable	169 (64.0)	32 (12.1)	Reference	–	Reference	–
	Undesirable	48 (18.2)	15 (5.7)	0.61 (0.31–1.23)	0.17	0.65 (0.27–1.81)	0.21

CI: confidence interval; OR: odds ratio.

Bold *P* values indicate statistical significance (<0.05).

ORs were estimated using logistic regression with satisfactory knowledge, attitudes or practices (KAPs) as the outcome. Therefore, OR >1 indicates higher odds of satisfactory KAPs, whereas OR <1 indicates lower odds of satisfactory KAPs.

The high prevalence of inadequate knowledge may indicate limitations in farmers' understanding of antibiotic indications, dosing and withdrawal periods. Similar findings have been reported across Viet Nam and in other low- and middle-income countries (LMICs), where misconceptions about antibiotic effectiveness and safe use remain common among small-scale chicken producers.^{1,2,4} Although ethnicity was not significantly associated with KAP outcomes in this study, ethnic minority populations in rural Viet Nam may face barriers to education, veterinary services and health information, particularly in remote areas. Therefore, communication strategies should consider local cultural and language contexts.² These disparities may reflect broader systemic challenges, including limited veterinary extension services and insufficient dissemination of evidence-based guidelines.¹⁹ Without addressing these constraints, inappropriate antibiotic use may persist and contribute to AMR.

Misconceptions were common, particularly the beliefs that antibiotics can treat all animal diseases and that higher doses accelerate recovery (Tables 2–4), consistent with previous studies.²⁰ Limited awareness of withdrawal periods raises concerns about antibiotic residues in chicken products and potential public health risks.¹ Although regulations exist in Viet Nam,⁵ their implementation among small-scale farmers remains limited.

Attitudes that could contribute to inappropriate antibiotic use were also common, especially the tendency to change an antibiotic immediately after treatment failure. This may lead to incomplete treatment courses and irrational drug selection, contributing to AMR.¹⁹ In small-scale production systems, concerns about disease-related financial loss may encourage preventive or unsupervised antibiotic use.¹⁹ Evidence from other LMICs suggested that community-based training combined with improved veterinary services can strengthen antibiotic stewardship, defined as improving the appropriate use of antibiotics (i.e. the right drug, timing and duration).^{1,21}

Unsafe practices were widely reported, including antibiotic administration without veterinary consultation and prophylactic use without clear clinical indication, consistent with earlier studies in rural Viet Nam.⁴ Lower educational attainment and lower household income were associated with less appropriate antibiotic use practices, consistent with findings from other LMIC settings.²² Financial constraints may further discourage seeking

professional advice, potentially reinforcing reliance on self-directed antibiotic use. The multivariable analysis further showed that higher household income was independently associated with better knowledge and more appropriate antibiotic use practices. In contrast, farmers raising chickens together with other livestock had lower odds of satisfactory knowledge and appropriate practices, possibly because antibiotics available on the farm may be used interchangeably across species without veterinary guidance. These findings suggest that educational and veterinary support interventions should particularly target small-scale mixed-livestock farms. Although knowledge and attitudes are generally considered important determinants of behaviour, neither was significantly associated with antibiotic use practices in the present study. This finding suggests that improving knowledge alone may be insufficient to change farmers' behaviours, particularly when antibiotic use decisions are constrained by economic pressures, farming conditions and access to veterinary services. Similar observations have been reported in previous KAP studies, where structural and contextual factors often outweighed individual knowledge in shaping antibiotic use practices.^{2,14}

Structural factors may further contribute to inappropriate antibiotic use. Limited access to veterinary services and weak enforcement of regulations may facilitate the unregulated availability of antibiotics in livestock production. Strengthening the veterinary system and regulatory enforcement could help reduce misuse. Viet Nam's National Action Plan on AMR (2023–2030) provides a One Health framework for coordinated interventions across sectors.²³

The qualitative findings complemented the quantitative results by showing that antibiotic use decisions were often shaped by practical constraints rather than knowledge alone. Farmers described frequent disease occurrence, economic pressure and limited access to veterinary support as reasons for using antibiotics routinely or without professional guidance. Some participants believed that chicken production is difficult without antibiotics, while others relied on personal experience or advice from veterinary pharmacists. These insights suggest that inappropriate use reflects a combination of behavioural and structural factors, requiring multifaceted interventions.

These results have practical implications. Educational interventions should target farmers with

lower educational attainment and those facing barriers to accessing veterinary services and reliable antibiotic-related information. Efforts to improve affordable veterinary support and strengthen prescription regulations may also help promote rational antibiotic use. Experiences from other WHO regions indicate that coordinated surveillance, stewardship programmes and regulatory enforcement can reduce antibiotic use in agriculture, although adaptation to local contexts is necessary.²⁴

Limitations

This study has several limitations. Its cross-sectional design precludes causal inference, and self-reported data may be subject to recall and social desirability biases. The use of predefined KAP cut-offs may have led to some misclassification, particularly for respondents with borderline scores. Logistic regression was used to estimate associations; however, for common outcomes, odds ratios may overestimate effect sizes. Alternative approaches, such as Poisson regression with robust variance, may provide more accurate estimates. Despite these limitations, the study provides valuable insights into antibiotic use among small-scale chicken farmers in rural Viet Nam.

Conclusions

This study highlights notable gaps in KAPs regarding antibiotic use among chicken farmers in Lau Thuong Commune. Inadequate knowledge, attitudes that may lead to inappropriate antibiotic use, and unsafe practices were common, while socioeconomic and farming-related factors influenced KAP outcomes. These findings underscore the need for context-specific interventions that combine farmer education, improved veterinary support and stronger regulatory oversight to promote rational antibiotic use and reduce the risk of AMR.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

This study was approved in accordance with Decision No. 99/2024/YTCC-HD3 by the Institutional Review Board of the Hanoi University of Public Health. All methods were conducted in compliance with the committee's relevant guidelines and regulations. Written informed consent was obtained from all study respondents.

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