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Original Article

Knowledge, attitudes, and practices of broiler chicken farmers toward antimicrobial resistance

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Summary

One important issue in using antibiotics in veterinary medicine is the emergence of antimicrobial resistance (AMR). Understanding farmers' knowledge, attitudes, and practices could highlight the factors that influence decision-making in using antibiotics on the farm. Ninety-four poultry farmers from Fars province, southern Iran, were asked to complete a structured questionnaire regarding AMR. A high proportion of farmers (> 90%) acknowledged the association between antibiotic use and AMR in poultry, while one-third of farmers failed to recognize the relationship between antibiotic use in poultry and AMR in humans. Most farmers (66%) appreciated that using antibiotics for the treatment of diseases is very important in inducing AMR. However, the majority failed to acknowledge the high importance of antibiotic usage for growth promotion (71%) or diseases prophylaxis (61%) in inducing AMR. Less than half always adhered to using the recommended dosage of drugs and selecting the antibiotics without culture and susceptibility testing was practiced to some extent by 52% of farmers. Statistical analyses using logistic regression showed that farmers with a history of completing official training for poultry production had more positive attitudes (OR = 4.0, P = 0.02) and better practices (OR =3.1, P = 0.03) toward AMR compared with farmers who had not the history of training. Most farmers cited veterinarians as their main favorite source of information to learn more about the concept of AMR. This study establishes baseline estimates for knowledge, attitudes, and practices of poultry farmers toward AMR. Program planning for the transfer of relevant information to farmers, in particular association of antibiotic use in poultry and AMR in humans and importance of antibiotic use for growth promotion in inducing AMR, as well as instructing them about the prudent use of antibiotics are highly warranted. These tasks are preferentially better to be implemented by veterinary practitioners.
Keywords: Antibiotic, Attitudes, Broilers, Iran, Knowledge, Resistance

Introduction

In veterinary medicine, antibiotics are commonly used for many purposes, such as prevention and treatment of diseases, and to a lesser degree, for growth promotion. Prevention of zoonotic diseases and food-borne illnesses, also the safety of products from animal origins, are public health benefits related to antibiotic usage in livestock. However, one important issue in using antibiotics is the emergence of antimicrobial resistance.

Antimicrobial resistance (AMR) is a natural phenomenon in which microorganisms adapt to antimicrobial agents, including antibiotics, and causes medications to be ineffective for the treatment of diseases (FAO, 2016).

A close association exists between some antibiotics used in veterinary and human medicine, and it has been suggested that the emergence of AMR in bacteria in food animal populations is connected to the emergence of AMR in bacteria that infect humans (Singer et al., 2003; Marshall and Levy, 2011; Landers et al., 2012; Lazarus et al., 2015).

In Iran, poultry meat production is under progressive development and continues to expand. In the last four decades, investment in this sector has grown considerably and poultry production is now one of the most important economic activities in Iran (Kamalzadeh et al., 2009). Despite the advancements in the poultry industry, the issue of food-borne pathogens, drug and chemical residues have remained. For instance, oxytetracycline (Salehzadeh et al., 2006) and enrofloxacin residues (Salehzadeh et al., 2007) have been reported from different parts of Iran above the maximum allowable residue level in the chicken tissues, and E. coli isolates with resistance to a variety of antimicrobial drugs have been recovered from poultry in different parts of the country (Rahimi, 2013). To limit and reduce consumption of antibiotics in livestock and to reduce antibiotic resistance, some actions have been undertaken by Iran Veterinary Organization during the recent years, such as suspension of the usage of antibiotics as growth promoters and quality control improvement of antibiotics used in livestock. However, there has been no assessment of the impacts of those actions on farmers' practices and subsequent antimicrobial consumption. To implement effective programs for control of AMR, information on the level of knowledge, attitudes, and practices of farmers toward antibiotic usage and resistance are necessary.

There are already some studies about knowledge, attitudes, and practices on antibiotic use and AMR on dairy farmers (Friedman et al., 2007; Zwald et al., 2004; Jones et al., 2015), veterinarians (Cattaneo et al., 2009; Speksnijder et al., 2015), or a mixed group of animal farmers (Eltayb et al., 2012; Om and Aclaws, 2016); however, specific studies on poultry producers are scare. The advantage of these types of studies is their ability to recognize the weaknesses and strengths in this area.

The purpose of the present study was to determine the level of knowledge of poultry farmers about antibiotic use and antibiotic resistance and to evaluate their attitudes and practices toward this subject. The study was conducted in Fars province, southern Iran, based on a structured questionnaire. The obtained information can provide a framework for planning and implementing educational programs and prioritizing areas for continuing education of farmers to induce changes in their behavior toward the prudent use of antibiotics in their farms.

Materials and methods

Study area and subjects

This cross-sectional study was conducted in Fars province, southern Iran. Fars province is one of the largest provinces in the country (coordinates 27°–31° N and 50°–55°E) with an approximated area of 122,604 km^2. The study population consisted of broiler chicken farmers in this region. Among 20,520 broiler chicken production units in the country, 1,226 farms (6%) are located in Fars province (Statistical Center of Iran, 2018). Poultry farmers were contacted through private poultry clinics or veterinary networks. A total of 94 poultry farmers (~7.7% of the study population) were recruited for the present study, mainly by their willingness to participate. To evaluate the representativeness of the selected sample, a comparison of the demographic characteristics of the respondents with that of the population of poultry producers of the Fars province was performed. The relevant data were obtained from the Agriculture Jihad Organization of the province.

Questionnaire structure

A structured questionnaire was designed, and its content and questions were evaluated by a poultry specialist with good experience on this subject

(third author). At the beginning of the questionnaire, the terms antimicrobial and AMR were briefly described. General questions were designed to obtain demographic information, such as age, sex, education, years of employment (as a poultry producer), completion of official training courses in poultry production, average flock size, and number of production cycles during the previous year.

Other questions consisted of binary responses (true/ false or yes/ no), multiple choices, ranking, and open queries regarding antibiotic use and AMR. Knowledge, attitudes, and practices of respondents were measured by generating scores from a series of questions organized into a scale. To combine the individual questions into a scale, an overall score was computed by simply summing the score of each item (Streiner and Norman, 2009).

In the knowledge part, there were seven close-ended questions regarding antibiotic resistance, an association between AMR and inappropriate use of antibiotics in poultry production, withdrawal period, antibiotic residue and their effects on public health, and awareness of antibiotic-free production programs. Each question was provided by three possible answers (true/ false or yes/ no, and do not know), and the knowledge scores were assigned to respondents according to their answers (1 for correct, 0 for incorrect, and do not know). An overall score for every respondent's answers was computed by summing the scores of each item.

The attitudes of farmers were evaluated using nine questions about the importance of several items in the production of healthy foods, such as compliance with biosecurity measures and withdrawal periods, consultation with veterinarians for antibiotic use, and performing laboratory tests for antibiotic residues in poultry meat. Opinions of farmers regarding the importance of using antibiotics as therapeutic, growth-promoting, and prophylactic drugs, as well as completing the entire course of treatment, and using the appropriate dosage of antibiotics in relation to the emergence of AMR were also evaluated. Participants were asked to indicate the level of importance of each statement using a rating scale (very important, 2; relatively important, 1; and not important/ no idea, 0). An overall score for every respondent's answers was computed by summing the scores of each item (ranging from 0 to 18).

The self-reported practices were investigated using 11 questions; five multiple choices for the reasons of antibiotic use in the production cycle, the selection process of the antibiotics, their dosage and duration, and the corresponding person for administration of the drugs. No scoring was used for these questions, and the results were reported based on the frequency distribution of the respondents' answers. Moreover, six rating questions were designed to evaluate how often they adhere to culture and susceptibility testing before treatment of infectious diseases, drug withdrawal period, the label instructions for period and dosage of antibiotics, biosecurity measures (biocontainment and bio-exclusion), and routine vaccination program (always, 4; often, 3; sometimes, 2; rarely, 1 and never 0). The overall score range was from 0 to 24 for these six questions. While there is no direct association between the vaccination program and antibiotic resistance, adherence to a regular vaccination program is an important issue that can help to evaluate the overall performance of the farmers regarding healthy behavior.

In the questionnaire, the farmers have also been asked to name the three most prevalent diseases which they have used antibiotics for treatment and/or prevention of, and the three antibiotics they most commonly use; to state their confidence in the results of the culture and susceptibility testing, to rank their current and preferred information sources about antibiotic use, and finally to express if they are interested in learning more about AMR.

Statistical analysis

The structured questionnaires were completed by farmers and data were encoded, and entered into statistical software for further analysis. Statistical analysis was performed in SPSS software for windows, version 26. Numerical and categorical data were presented as mean and standard

deviation (SD), and number and percentages, respectively. Comparison of age of the sample with the age of farmers in Fars province was performed using one-sample student's t-test; Pearson's chi-square was used to compare their gender and education.

Two cut-off points (terciles) were determined for the overall scores of knowledge and practices to categorize the respondents into three nearly equal-sized groups, namely poor, fair and good. For attitudes, the median of the total score was used to classify the farmers into nearly two equal-size groups as positive and negative attitudes groups. The orderly categorized overall scores for knowledge and practices of farmers were used as the outcome variable. Association of the outcome variable with explanatory variables including age (continuous), years of employment (continuous), average flock size (continuous), education (three levels), official training (yes/ no), and attendance at educational seminars (yes/ no) was determined using univariable and multivariable ordinal logistic regression analyses. Variables with P-value < 0.2 in the univariable analysis were eligible for inclusion in multivariable models. A manual backward elimination approach was used to evaluate the association of predictor variables with the outcome. Variables with a P-value < 0.05 were retained in the final model. If biologically plausible two-way interactions were significant, they were considered and retained in the model. Collinearity among predictor variables was evaluated using Spearman's rank correlation coefficient and Pearson's chi-square. Correlation coefficient > ± 0.6 and chi-square < 0.05 were considered as collinearity. Evaluation of the ordinal logistic model was performed using -2log-likelihood change and goodness of fit chi-square, and to assess the assumption of proportional odds of cumulative logit, the test of parallel lines was used. A similar approach was used to determine the association of explanatory variables mentioned above with farmers' attitudes, using univariable and multivariable binary logistic regression analysis. In all analyses, a final two-tailed *P-value* < 0.05 was considered significant.

Results

A total of 94 poultry farmers participated in this study, and 98% (92 persons) of them were male. The mean age ± SD was 44 ± 11 (range: 24 - 77). All farmers were educated; about 74.5% had education levels up to high school (28.7% elementary or intermediate level, and 45.8% high school), and 25.5% had higher education. Among 24 persons with higher education, 4 were veterinarians and 6 had their training in the fields related to animal farming. Results for the comparison of age, gender, and education level of the selected sample with the population of poultry producers in Fars province are as follows, respectively: mean age 44 *vs.* 54 (P < 0.05), male 98% *vs.* 95% (P = 0.22) and higher education level 25.5% *vs.* 24.2% (P = 0.77). Considering these results, we must acknowledge that our sample was younger than the population of poultry farmers in Fars province. Other characteristics of the study participants are presented in Table 1.

Table 1. General characteristics of poultry farmers (N = 94) in the study for assessment of knowledge, attitudes and practices regarding antibiotic resistance in Fars province, southern Iran

	Mean	SD	Q1	Median	Q3
Age (years)	44.1	11	36	41.5	51.8
Years of experience as poultry farmer	13.9	9.2	7	10	20
Average flock size	31320	16100	20000	30000	35000
Number of production cycles/year	3.7	1.1	3	4	4

Note: SD is standard deviation; Q1 and Q3 are first and third quartiles, respectively.

Mean and median for years of employment as a poultry producer were 14 and 10, respectively. Only 21% of respondents reported completion of official training courses for poultry production, while nearly 65% had a history of attendance in various educational seminars on the subject.

Mean ± SD and median of the overall score for knowledge was 6.1 ± 1.04 and 6 (range: 3-7). Based on the two cut-off points, the overall score of 7, 6, and less than 6 were considered as good, fair, and poor knowledge, respectively. A total of 47.2% of farmers had a good degree of knowledge, while 31.5 and 21.3% had fair and poor degrees of knowledge, respectively. Tables 2 summarizes the results regarding the knowledge of the respondents. The range for the proportion of the individual true responses was from 69 to 96%. Nearly 30.8% of the farmers (29 persons) were not concerned with the importance of the relationship between antimicrobial use in poultry production and AMR in humans (Table 2).

Table 2. Summary of questions and number of responses for assessment of respondents' knowledge, attitudes, and practices regarding antibiotic resistance in poultry farmers (N = 94) in Fars province, southern Iran

Knowledge	**True**	**False**	**Do not know [a]**
• Inappropriate use of antibiotics in poultry could induce antibiotic resistance in poultry	85	4	5
• Inappropriate use of antibiotics in poultry could induce antibiotic resistance in human	65	7	22
• Adhering to antibiotic withdrawal period is beneficial for public health	90	1	3
• Antibiotic residue in poultry meat could be hazardous for public health	88	2	4
	Yes	**No**	**Do not know [a]**
• Have you ever heard anything about antibiotic resistance[b]	87	7	-
• Have you ever heard about antibiotic free production cycles[b]	76	18	-
• Do you think that antibiotic free production cycles are practically possible	74	12	8

Attitudes

How important is in inducing antibiotic resistance:	**Very important**	**Relatively important**	**Not important/ No idea[a]**
• Using antibiotics for treatment of diseases	62	23	4/5
• Using antibiotics for growth promotion	27	21	27/19
• Using antibiotics for prevention of diseases	37	22	24/11
• Completeness of duration of antibiotics for treatment	65	18	2/9
• Using appropriate dosage of antibiotics	74	15	0/5
How important is in production of safe foods:			
• Adhering to biosecurity measures in production cycle	81	11	0/2
• Adhering to drug withdrawal period	81	9	1/3
• Consultation with veterinarian for using antibiotics	75	13	1/5
• Examining poultry meat for antibiotic residues	47	36	0/11

Practices

• **How often do you adhere to:**	**Always/Often**	**Sometimes**	**Rarely/never [a]**
• Biosecurity measures	75/16	0	0/3
• Drug withdrawal period	61/ 28	0	2/3
• Routine vaccination programs	82/8	1	0/3
• Using recommended dosage of antibiotics	37/38	13	1/5
• Completing the entire course of antibiotic treatment	43/38	9	0/4
• Doing culture and susceptibility testing before using antibiotics	27/18	22	24/3

[a] Occasional cases of missing responses were added to this column
[b] The "do not know" option was not applied for these questions

Mean ± SD and median of the overall score for attitudes was 13.7 ± 2.83 and 13, and its range was from 5 to 18. The farmers were categorized into two groups based on the median of the overall score: < 14 and ≥ 14 as farmers with negative and positive attitudes, respectively. A total of 52.2% of the farmers were in the negative attitudes group, and 47.8% were in the positive category. More than half of the participants in the study (66%) had the idea that using antibiotics for treatment of diseases is very important in inducing antibiotic resistance. However, corresponding measures for using antibiotics for growth promotion or disease prophylaxis were 29% and 39%, respectively. A significant portion of the respondents (20%) had no idea about the importance of using antibiotics for growth promotion in AMR. Most farmers (86%) acknowledged the importance of biosecurity measures and drug withdrawal period, while only half believed that examining poultry meat for antibiotic residues is very important in the AMR issue (Table 2).

Table 3. Summary statistics for practices regarding antibiotic use in poultry farmers (N = 94) in Fars province, southern Iran

	Number [a]	%[a]
Consult for selection of antibiotic with		
Veterinarian	83	88
Pharmaceutical representative	14	15
Personal experience	24	26
Product label	0	0
Other farmers	7	7
Consult for antibiotic dosage with		
Veterinarian	79	84
Pharmaceutical representative	16	17
Personal experience	20	21
Product label	12	13
Other farmers	4	4
Consult for duration of treatment with		
Veterinarian	79	84
Pharmaceutical representative	13	14
Personal experience	25	27
Product label	5	5
Other farmers	5	5
Preparing and administration of antibiotics by		
Veterinarian	2	2
Farmer himself	39	41
Workers	53	56
Different in various situations	12	13

[a] Column totals can exceed number of enrolled farmers because options were not exclusive choices.

Based on their self-reported practices, the median and mean ± SD of the overall score for practices were 20, 20.4 ± 2.5, and the min and max of the scores were 16 and 24, respectively. After computing the overall practices score for each farmer, they were classified into three ordered categories; less than 19, 19-21, and 22-24 based on the two cut-off points as farmers with poor, fair, and good practices, respectively. More than one-third of the farmers (37.8%) implemented good practices, one-third (33.3%) complied with fair and 28.9% had poor adherence to standard practices. Concerning individual questions, the results showed that the lowest proportion for standard practices was for performing culture and susceptibility testing before using antibiotics; less than half of the farmers (48%) reported that they always or often carry out that practice (Table 2).

There were other questions for the evaluation of farmers' practices. The results showed that 66% of the farmers claimed that they use antibiotics only for treatments, while others indicated that they use

antibiotics for other purposes too, including disease prevention and growth promotion. Most respondents consult with others (veterinary practitioners, pharmacists, and other poultry farmers) to select type, dosage, and duration of used antibiotics. The majority of the farmers consult specifically with veterinarians (Table 3).

In univariable ordinal logistic regression analyses, knowledge did not show a significant association with any explanatory variable (all *P-values* > 0.2). Attitudes showed relationships with education level (P = 0.10), completion of official training (P = 0.006), years of employment (P = 0.01) and attending seminars (P = 0.07). Practices had significant associations with official training (P = 0.04) and education level (P = 0.04) (Figure 1). No collinearity was detected between explanatory variables. Results for final logistic regression models are displayed in Table 4. Official training had a significant association with attitudes, and the odds ratio (OR) showed that farmers with a history of official training were more likely to have positive attitudes toward AMR compared with farmers without that history (OR = 4.02, P = 0.02). Education level and attending seminars were not significant and were removed from the final model for attitudes. In modeling practices, official training remained in the final model, and education level was removed. Based on the results, the farmers who have completed official training courses for poultry production showed better standard practices compared with those without a history of training (OR = 4.45, P = 0.03).

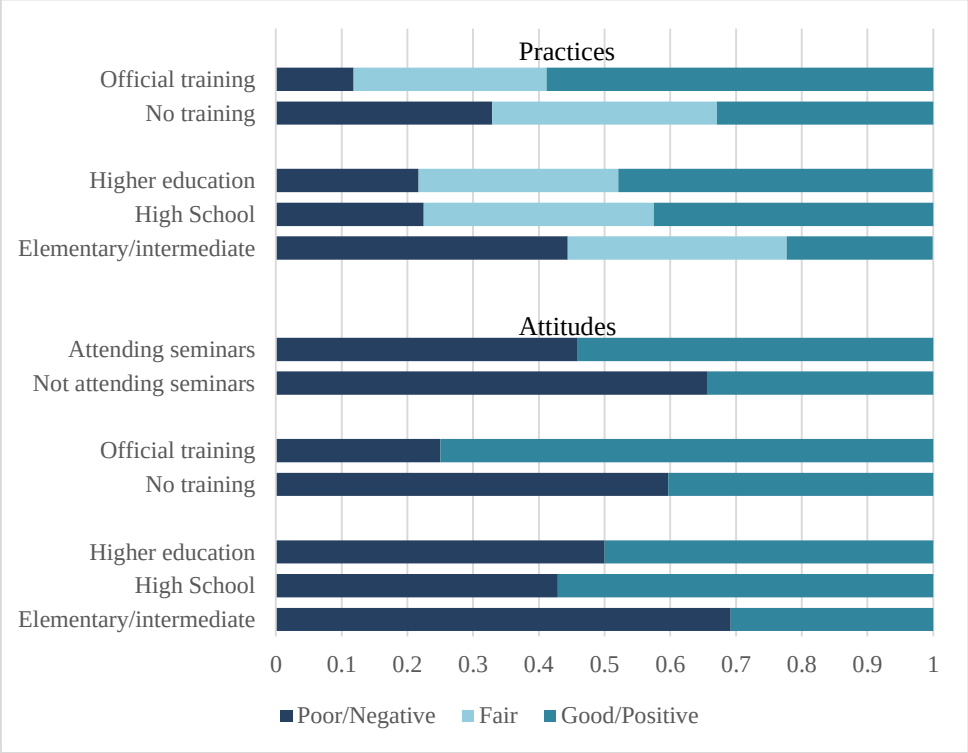

Fig 1. Distribution of the farmers' attitudes and practices, based on the education level, completion of official training and attending educational seminars in poultry farmers in Fars province, southern Iran.

Approximately 97% of the farmers were interested in acquiring more information about any issue regarding poultry production (76% were highly interested), and their desired resource for educational materials were veterinarians (68%; 31% specifically and 37% in addition to other resources).

Table 4. Results of the final multivariable ordinal logistic regression analyses for association of education and official training with attitudes and practices regarding antibiotic resistance in poultry farmers (N = 94) in Fars province, southern Iran.

Parameters	β	SE	Odds ratio	95% Confidence Interval	P-value
Attitudes [a]					
Constant	-1.25	0.44	-	-	-
Years of employment	0.07	0.03	1.07	1.01, 1.13	0.01
Official training					
Yes	1.39	0.59	4.02	1.27, 12.78	0.02
No (ref)	-	-	1	-	-
Practices [b]					
Constant 1	-0.73	0.24	-	-	-
Constant 2	0.73	0.24	-	-	-
Official training					
Yes	-1.12	0.53	3.07	1.08, 8.69	0.03
No (ref)	-	-	1	-	-

[a] Model information for attitudes in two groups, positive and negative by binary logistic regression: Omnibus test chi-square (-2log Likelihood change) =6.689, df= 2, P=0.035; Hosmer and Lemeshow goodness of fit chi-square= 8.28, df= 7, P=0.31.

[b] Model information for practices in three groups, poor, fair and good: -2log Likelihood change= 4.795, df= 1, P=0.029; Goodness of fit chi-square= 0.104, df= 1, P=0.747; Test of parallel lines chi-square= 0.104, df= 1, P=0.747

Based on the opinion of the respondents, chronic respiratory disease, infectious bronchitis, and colibacillosis were the three most prevalent diseases for which farmers use antibiotics in preventing and treating. Regarding the three most used antibiotics by farmers in their farms for therapeutic or prophylactic uses, fosfomycin, doxycycline, and enrofloxacin were among the most frequently named drugs.

Discussion

The results of the present study showed relatively acceptable knowledge, meanwhile fair to poor attitudes and practices regarding AMR in poultry farmers from southern Iran. Their level of knowledge was satisfactory in most questioned issues related to AMR. For example, a high proportion of all respondents (> 90%) had heard of AMR, discerned that adherence to antibiotic withdrawal period is beneficial, that the presence of antibiotic residue in poultry meat is hazardous for public health, and acknowledged the association between use of antibiotics in poultry and antibiotic resistance in them. However, relatively one-third failed to recognize the relationship between using antibiotics in poultry and antibiotic resistance in humans. This finding is in agreement with a previous survey on knowledge and attitudes toward food safety and the use of good production practices among Canadian broiler chicken producers, which showed only 26.6% of broiler farmers believed AMR in humans is linked to antimicrobial use in the broiler chicken industry (Young et al., 2010). Similarly, in a study on dairy farmers in South Carolina, Friedman et al. showed that most farmers (86%) were not concerned that overuse of antibiotics in animals could result in antibiotic resistance among farm workers (Friedman et al., 2007). Obviously, topics related to public health are more impressive than those related to animal health, and the information that "misuse of antibiotics in poultry can induce antibiotic resistance in humans" needs to be transferred to the farmers.

There were some areas in the part of attitudes which need more attention. Most farmers (66%)

appreciated that using antibiotics for the treatment of diseases is very important in inducing antibiotic resistance. However, the majority of them failed to acknowledge the high importance of antibiotic usage for growth promotion (71%) or disease prophylaxis (61%) in inducing AMR. Furthermore, a significant portion of the respondents (49%) had no idea about the importance of using antibiotics for growth promotion in inducing AMR or believed that it is not important. It has been clearly shown that sub-therapeutic use of antibiotics for long periods, as it is used for growth promotion, is considerably more important in inducing AMR compared with therapeutic doses (Landers et al., 2012). Therefore, these points should be emphasized in any planned educational program. In a study on Canadian broiler chicken producers, more favorable results were observed. A total of 10.3% of respondents stated that the most important cause of AMR is antibiotic use for disease treatments, while 74.1% believed that the most important causes are using antibiotics for growth promotion and/or disease prophylaxis (Young et al., 2010).

The answers to the parts of practices of the questionnaire were disappointing. Less than half of the respondents (29 to 46%) indicated that they were always committed to doing some important aspects of prudent use of antibiotics, such as using the recommended dosage of drugs, completing the entire course of antibiotic treatment, and selecting the antibiotics based on culture and susceptibility testing. The weakest area was related to performing susceptibility test, where the choices "sometimes, rarely and never" comprised 52% of all responses. Nearly 66% of farmers indicated that they use antibiotics only for treatment, and the rest reported that they use antibiotics for other purposes, too, including prevention and growth promotion. Although these results could be somewhat satisfactory, they should be interpreted with caution due to the nature of the self-reporting practices. It has been shown that response bias may occur in self-reported data for various reasons, for example, when the participant wants to look good in the survey, even if the survey is anonymous (Rosenman et al., 2011).

Lack of association between knowledge, attitudes, and practices with education level is consistent with previous studies, which indicated that more education does not necessarily correlate with knowledge (Hardefeldt et al., 2018) or change in behavior (Arlinghaus et al., 2018). Education is a necessary component but not sufficient for behavior change. Indeed, regarding health behavior change, tailored education is necessary to increase awareness and to provide skills on how to do change successfully (Arlinghaus et al., 2018). On the other hand, completion of official training for poultry production had significant associations with attitudes, and practices and trained farmers had more acceptable practices and more positive attitudes toward prudent use of antibiotics. Therefore, adapting teaching strategies to farmers' needs, will be necessary if farmers are to pay careful attention to the information (Friedman et al., 2007).

Veterinarians were specified as the desired source of information by most farmers. Thus, it would be recommended that consultant veterinarians take the responsibility of transferring relevant and important information about AMR and prudent use of antibiotics to their clients. However, developing national practical legislation and regulatory frameworks are also necessary to guarantee a better practice as a result of the rising level of knowledge from the farmers.

The recent guidelines of WHO on the use of medically important antimicrobials in food-producing animals recommended complete restriction of the use of all classes of medically important antimicrobials in food-producing animals for prevention of infectious diseases and growth promotion purposes (Aidara-Kane et al., 2018). Therefore, the high frequency of administration of antibiotics such as fosfomycin and doxycycline in poultry farms warrants intervention.

Small sample size and sampling method (willingness to participate) could be considered as the two potential limitations of the present study. It

should be noted that the poultry farmers' refusals to participate in the present study were mostly motivated by the lack of free time and their workload. Therefore, the sample in the present study might be regarded as a relatively representative sample of the poultry farmer population, with no considerable bias, at least at the provincial level. This is evident from the comparison of the demographic characteristics of our sample population with that of Fars province poultry producing population, which revealed common characteristics except for the younger age. Nevertheless, the selection of respondents from private poultry clinics or veterinary networks may impact the representativeness of our sample, and consequently our results, as well as the possibility of self-selection bias due to unknown factors that drive persons to participate in the study could not be excluded. Conducting similar surveys, preferentially with random sampling methods and at the national level in the near future, by considering the results of the present study as preliminary baseline data, is highly recommended.

Conclusion

This study established baseline estimates for broiler chicken producers' knowledge, attitudes, and practices toward antibiotic resistance. Lack of knowledge about the relationship between using antibiotics in poultry and AMR in humans, improper attitudes toward the importance of the usage of antibiotics for growth promotion or disease prophylaxis in inducing AMR, and poor compliance for prudent use of antibiotics in practice, were among the weakest areas recognized in the present study. Significant positive relationships were observed between the completion of official training with the attitudes and practices of the respondents, respectively. Planning programs for the transfer of relevant information to poultry farmers and instructing them about prudent use of antibiotics and negative impacts of overuse and misuse of these drugs on animal and human health is highly warranted. This task is preferentially better to be implemented by farm veterinarians, as they are considered as the key persons who can change and influence the behavior of farmers toward antibiotic use in the farm animals. At the same time, developing national policies and supervisory regulations is mandatory to increase the effectiveness of educational programs.

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Conflict of Interest Statement

The authors declared that there is no conflict of interest.

Ethical approval

Not applicable

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