



Short Communication

Perception of Dairy Farmers Regarding Antibiotic Use and Antimicrobial Resistance in Bangladesh

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Abstract | Inappropriate antibiotic use in dairy farms poses a major hazard to food safety and leads to the development of antimicrobial-resistant microorganisms. We conducted a cross-sectional study to assess the perspective of dairy farmers regarding antibiotic use as well as its residual and resistance effect. We collected data from 101 dairy farmers in Chattogram, Bangladesh. The results revealed that ceftriaxone, gentamicin, streptopenicillin, amoxicillin, and sulfur drugs were the most frequently used antibiotics in the study area. Among the participants, 99% did not follow the withdrawal period of the drugs and claimed their prescribers did not advise them on it. Among participants, 81% were found unaware of the effect of antibiotic resistance on animal health. The univariable significance test showed the educational status of the farmer had a strong ($P < 0.01$) relationship with the knowledge of antimicrobial resistance. Only 27% of farmers were always following the prescription of a veterinarian. We found drug sellers/dealers, experienced local farmers, and the farmer's own self were three other important prescriber groups recommending antimicrobials. The study revealed the necessity of awareness programs for farmers and antimicrobial stewardship programs targeting veterinarians, and other stakeholders to reduce the antimicrobial resistance crisis.

Received | November 02, 2020; **Accepted** | April 03, 2021; **Published** | August 30, 2021

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Citation | Rahman, M.S., T. Ape, M. Islam and S. Chowdhury. 2021. Perception of dairy farmers regarding antibiotic use and antimicrobial resistance in Bangladesh. *Sarhad Journal of Agriculture*, 37(4): 1238-1243.

DOI | <https://dx.doi.org/10.17582/journal.sja/2021/37.4.1238.1243>

Keywords | Antimicrobial resistance, Antibiotic use, Dairy farm management, Farmer's knowledge, Food safety

Introduction

Antibiotics are used in farm animals for three vital purposes: to treat ill animals, to prevent infections in healthy animals (prophylactic uses), and as a growth promoter to increase body weight through boosting feed efficiency (Sawant *et al.*, 2005; Ventola, 2015). Inappropriate, unnecessary, and overuse of antibiotics in food animals has caused the accumulation of drug residues in animal originated food items and the development of antimicrobial-resistant microbes (Salehzadeh *et al.*, 2006; Stolker and Brinkman, 2005). Consequently, uncontrolled use of antibiotics has a significant impact on the development and spread of

resistant bacterial infections in humans and animals (Kuehn, 2007). Such imprudent usages are commonly practiced by livestock farmers in most developing nations. Moreover, farmers are not used to maintaining the withdrawal periods following the use of antibiotics for their animals. A withdrawal period is a time limit after administering a drug, which is required for drug residue to reach a tolerable and non-toxic level (EMEA, 2000). There has been growing concern about antimicrobial use in dairy cattle and the safety of milk for consumption. A few developed countries have established strategies to encourage producers, farm workers, and veterinarians towards the responsible use of antimicrobials, focusing on proper monitoring

of antimicrobial resistance (AMR) in farm animals (Landers *et al.*, 2012; Levy, 2014). But developing countries like Bangladesh, where veterinary services are limited, have either little or no effective monitoring of the antibiotic uses in dairy animals.

Although farmers are the primary contributor in the use of antibiotics, their role has been neglected in control strategies in Bangladesh. So, there is no information on the knowledge and attitudes of farmers about the use of antimicrobials and associated practices in Bangladesh. It is vital to assess the existing status of farmers to execute future intervention strategies aiming to reduce the AMR problem. Our hypothesis was that farmers' misuse of antibiotics could be due to their lack of knowledge on judicious use of antibiotics and associated health risks related to inappropriate use. In this context, we conducted this study to determine the perception of dairy farmers' regarding antibiotic use, management practices, and AMR problem. Large commercial dairy farms usually follow strict biosecurity measures and not allow others to access into their farm. They often recruit their own veterinarian for managing farm activities or consult expert veterinarians. So, there are fewer chances of misuse of antibiotics and malpractices. Therefore, we targeted small and medium dairy farmers in the present study. This study will serve as a primary report to facilitate further investigation and support the policymakers in developing evidence-based legislation and strategies to improve the farmers' perceptions.

Materials and Methods

Description of the study area

We carried out this study in the Chattogram district of Bangladesh. Chattogram is the 2nd largest city of Bangladesh having a total area of 160.99 square kilometers. Due to the great demand for milk and dairy products, commercial dairy farming is developed and the market is also quite large here. This region produces approximately 60 thousand liters of milk per day (Barua *et al.*, 2018).

Study design

We conducted this cross-sectional study from May to September 2019. A well-structured and pre-prepared questionnaire was developed for data collection. The final version of the questionnaire was then translated into Bengali, the mother tongue of the people. A list of dairy farms within the study area that had at least

three dairy cows was collected from the Department of Livestock Services, Chattogram. Almost four hundred dairy farms were operating in Chattogram metropolitan area, including 70 commercial dairy farms. We prioritised small and medium dairy farms in this study. Farms were selected based on the inclusion criterion- three to twenty dairy cows in each farm. A total of 101 dairy farms were surveyed through this study.

Data collection

Data were collected by face-to-face interviews of the farmers or from the farm attendants. We assigned a group of veterinary students to assist in data collection. Participants were chosen based on their willingness to take part in the research. Before the interview, the participants were informed of the study's intent, and verbal consent was received. Participation in this research was entirely voluntary, and it had no ties to either government or private interests. The questionnaire covered the following aspects: education level of the farmer, most commonly used antimicrobials, knowledge regarding antibiotics and antibiotic resistance, antibiotic residue, practices regarding antimicrobial usage following withdrawal period, record-keeping system, means of access to antimicrobials, and drug storage system.

Data analysis

A total of 101 complete questionnaire data was transferred in STATA-13 (Stata Corp, 4905, Lakeway Drive, College Station, Texas 77845, USA). To begin, descriptive statistics were performed to reveal the demographic status of participants and their knowledge, attitudes, and practices regarding antibiotic use and antimicrobial resistance. Then the univariable significance test was conducted with a P-value of 0.05 to observe the effect of the educational status of the farmer on the common perception of antibiotic use and antimicrobial resistance. The univariate analysis used for in a single variable distribution in one sample. We calculated the confidence interval for a proportion at a 95% level.

Results and Discussion

Although 91% of farmers knew about antibiotics, 80.2% did not know about antimicrobial resistance. However, 88.1% knew about antibiotic residues but 99% of them acknowledged they were not properly maintaining the withdrawal period of antimicrobials

in dairy cows as their prescriber groups never suggested it. Only 30.6% of farmers regularly keep records of the drugs used on their farms. Only 26.7% of respondents always follow the prescription of a veterinarian. We identified three other important actors, who were recommending antimicrobials to the farmers, these included drug sellers/dealers, experienced old farmers, and the farmer's own self. See [Tables 1](#) and [2](#) for detailed results.

Farmers under this survey recognized that dairy cattle

were mainly affected by mastitis, joint pain, fever, and diarrhea and used different types of antimicrobials to treat them. The most widely used antimicrobials in dairy cattle in the study area are depicted in [Figure 1](#).

[Table 3](#) represents the univariable significance test results. We found strong relationship ($P < 0.01$) between the knowledge of AMR and the educational status of farmers ([Table 3](#)), whereas 89% of farmers having primary to higher secondary level education had not enough idea about antimicrobial resistance.

Table 1: Description of the study population.

Variable	Category	Frequency	Percent (95% Confidence interval)
Education status of farmer	Until higher secondary	57	57.58 (47.2-67.5)
	Graduation	42	42.42 (32.5-52.8)
Advice on treatment	By own	5	4.95 (1.6-11.2)
	drug seller	3	2.97 (0.6-8.4)
	Another farmer	6	5.94 (2.2-12.5)
	Veterinarian	87	86.14 (77.8-92.2)
Purpose of antimicrobial use	Both (prevention and treatment)	18	17.82 (10.9-26.7)
	Treatment only	83	82.18 (73.3-89.1)
Storage of drug	Store room	90	89.11 (81.3-94.4)
	Cow shed	11	10.89 (5.6-18.7)

Table 2: Descriptive statistics of farmer's perception regarding antibiotic use and antimicrobial resistance.

Questions	Category	Frequency	Percent (95% Confidence interval)
What is antibiotic?	Act against bacteria	91	90.10 (82.5-95.1)
	Act against virus	4	3.96 (1.1-9.8)
	Don't know	6	5.94 (2.2-12.5)
What is antimicrobial resistance?	Don't know	81	80.20 (71.1-87.5)
	Poor response to treatment	9	8.91 (4.2-16.2)
	Treatment failure	11	10.89 (5.6-18.7)
Heard about antibiotic residue?	Yes	89	88.12 (80.2-93.7)
	No	12	11.88 (6.3-19.8)
Do you keep record of drugs?	Always	31	30.69 (21.9-40.7)
	Most frequently	1	0.99 (0.0-5.4)
	Sometimes	62	61.39 (51.2-70.9)
	Rarely	5	4.95 (1.6-11.2)
	Never	2	1.98 (0.2-7)
Do your Prescriber mentioned the withdrawal period?	Yes	0	0 (00-3.6)
	No	101	100 (96.4-100)
Did you complete an antibiotic course last time?	Yes	93	92.08 (85-96.5)
	No	8	7.92 (3.5-15)
Do you follow withdrawal period?	Yes	1	0.99 (0.0-5.4)
	No	100	99.09 (94.6-100)
Do you follow the prescription of a veterinarian?	Always	27	26.73 (18.4-36.5)
	Sometimes	74	73.27 (63.5-81.6)

Table 3: Association of educational status of the farmer with the perception of antibiotic use and antimicrobial resistance.

Questions	Categories	Until higher secondary (%)	Graduation (%)	P value
What is antibiotic?	Act against bacteria	4 (7)	2 (5)	0.49
	Act against virus	49 (85.9)	38 (90.5)	
	Don't know	8 (14)	4 (9)	
What is antimicrobial resistance?	Don't know	51 (89.5)	28 (67)	0.01*
	Poor response to treatment	3 (5)	6 (14)	
	Treatment failure	3 (5)	8 (19)	
Heard about antibiotic residue?	Yes	50 (89)	38 (91)	0.66
	No	7 (12)	4 (10)	
Do you keep records of drugs?	Always	17 (30)	14 (33)	0.56
	frequently	0	1 (2)	
	Sometimes	35 (61)	25 (60)	
	Rarely	3 (5)	2 (5)	
	Never	2 (4)	0	
Purpose of antimicrobial use	Both (prevention and treatment)	12 (21)	6 (14)	0.38
	Treatment	45 (79)	36 (86)	
Use of antimicrobials recommended by	Drug seller	6 (11)	2 (5)	0.32
	Another farmer	3 (5)	5 (12)	
	By own	8 (14)	3 (7)	
	Veterinarian	40 (70)	32 (76)	
Do you follow withdrawal period?	Yes	0	1 (2)	0.24
	No	57 (100)	41 (98)	
Do you follow the prescription of a veterinarian?	Always	16 (28)	10 (24)	0.63
	Sometimes	41 (72)	32 (76)	

* Significance at 1% level.

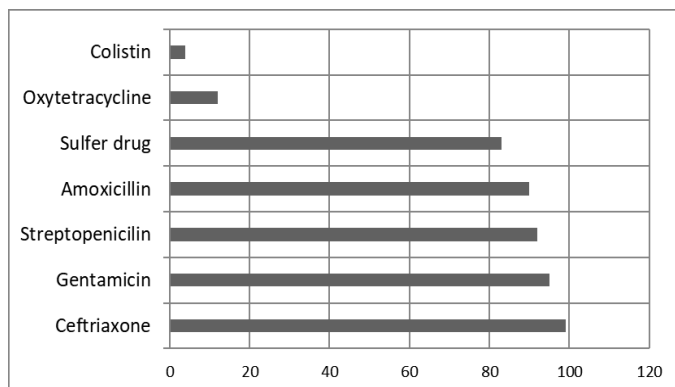


Figure 1: Different types of most commonly used antibiotics in the number of dairy farms.

In this study, we assessed the awareness levels and common practices of dairy farmers as well as their perception of risk towards the antimicrobial resistance and residual effect. The results showed the increasing involvement of educated young people in dairy farming in recent times, which will lead to the increasing perception and awareness of antimicrobial resistance. Farmers were familiar with the terms of

antibiotic residue and antimicrobial resistance due to the growing concern in recent times. However, the knowledge of the concept of AMR had a significant relation with the educational level of the farmer. A significant association between farmers' low education and inadequate knowledge of antibiotic use and antibiotic resistance was presented in a similar study conducted in Sudan (Eltayb *et al.*, 2012). A study in Turkey also stated a significant relationship between awareness of antibiotic use and resistance with the stage of education as well as other demographic variables such as age and geographic location (Ozturk *et al.*, 2019). In Nigeria, only 49.54% of dairy farmers had a strong understanding of AMR which was also significantly associated with higher education ($p = 0.01$) (Adesokan *et al.*, 2016). The majority of farmers were unconcerned about the harmful effects of antimicrobial resistance on animal and public health (Sadiq *et al.*, 2018).

We found a considerable number of farmers

using antibiotics for both purposes- treatment and prevention of diseases alike the findings of a previous study (Eltayb *et al.*, 2012). Literature proved prophylactic and therapeutic uses of antibiotics are the most important factors for antibiotic resistance (Ozturk *et al.*, 2019). Aminoglycoside, cephalosporin, beta-lactams, oxytetracycline, and sulfur drugs were the most commonly used antibiotic groups in this study area which coincide with the literature which revealed beta-lactams and OTC were imprudently used in commercial dairy farms for treatment purpose (Syt, 2011). To avoid enteritis in calves, 70 percent of the farms used oxytetracycline and neomycin as a prophylactic measure (Sawant *et al.*, 2005). A previous study in Bangladesh also supports our findings who stated that beta-lactam, tetracycline, aminoglycosides, quinolones, macrolides, and sulfonamides are used at commercial dairy farms for preventive and treatment purposes (Brogden *et al.*, 2003).

Our study revealed the presence of different actors along with veterinarians for prescribing antimicrobials. Although the majority of the farmers under the study reported using antibiotics recommended by veterinarians, only a small proportion of them always properly follow the given prescription. The prescription given by a veterinarian was very frequently manipulated by a dealer, drug seller, or directly by the farmer. Likewise, a previous study also stated that farmers intended to modify the advised dosage (Jones *et al.*, 2015). Just 32% of dairy farmers sought advice from a veterinarian before using antibiotics (Sawant *et al.*, 2005). For the care of their animals, a large number of farmers chose to follow the advice of other farmers (Ozturk *et al.*, 2019). These farmers generally use antimicrobials prescribed by themselves or rely on other expert local farmers due to the lack of veterinarians.

The majority of the farmers (92%) completed the course of antimicrobials the last time they used it. The result has similarity to a previous report (Jones *et al.*, 2015), which showed that over 80% of respondents completed the recommended antibiotic course. Just 33 of the 113 dairy farms surveyed maintained detailed antibiotic treatment reports (Sawant *et al.*, 2005). Besides, ignorance of following the advice of a veterinarian neglected record-keeping of drugs was also a common practice of dairy farmers in the study area.

Almost all respondents of this study did not follow the withdrawal period as their prescribers didn't mention it in their advice. This result is concordant to the findings reported from Nigeria where 81.02% were unaware of the withdrawal period of drugs and 91.67% of the livestock owners were never advised by their veterinarians to follow the antibiotic withdrawal periods (Adesokan *et al.*, 2016). So, it indicated the inappropriate veterinary services in the study area which impacted the knowledge and practices of dairy owners.

The use of veterinary students as interviewees proved advantageous because they were able to comprehend the local dialect of the farmers, which would have been impossible for other data collectors. This allowed for both protection and a proper understanding of the farmers' records. The limitation of the study was that the farmers who allowed us to access their farm and were able to provide all of the data were included in the report.

Conclusions and Recommendations

Our study explored whether farmers could play a role in addressing the growing danger of AMR in Bangladesh by proper usage of antibiotics. We found the knowledge on the concept of AMR had a significant relation with the educational level of the farmers. Periodic training programs could raise awareness among farmers. As a result, it is recommended that an effective control program should be initiated targeting the active engagement of farmers and veterinarians along with other stakeholders in order to reduce the prevalence of antibiotic residue and resistance.

Novelty Statement

Besides a veterinarian, three other actors recommending antimicrobials were drug seller/dealer, experienced local farmer and the farmer own self. Education status of farmer has strong correlation with the knowledge of antimicrobial resistance.

Author's Contribution

Md. Sahidur Rahman: Designed the experimentation, performed data collection, and wrote the first draft.

Tishita Ape: Performed data collection and wrote the first draft.

Md. Islam: Performed data collection and wrote the first draft.

Sharmin Chowdhury: Designed the experimentation, Analyzed the data, and reviewed the final manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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