

Article

Managemental perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices: Bangladesh perspectives

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Abstract: Antibiotic drugs have identified to be one of the most valuable tools in preserving both human and animal health. With an increase in the use and availability of antibiotics, antibiotic residues in animal origin food as well as antibiotic resistance have become important public health concern and have received much attention from government agencies, consumer level, media and other concerned public interest groups. The main objectives of the study were to identify the managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices so that the development of relevant strategies for reducing antibiotic usage in veterinary practices could be achieved in context of environmental realities in Bangladesh. The survey was interpretive in nature using quantitative methods. A non-experimental and descriptive research design was used to conduct this study. The survey study was carried out at existing seven divisions (i.e. Rangpur, Rajshahi, Khulna, Dhaka, Sylhet, Barishal and Chittagong/ Chattogram) in Bangladesh during July, 2012 to June, 2018 (upto final reporting) by survey method using close ended questionnaires among randomly selected respondents (i.e. 390 Government Veterinary Surgeons as well as 390 Upazila Livestock Officers of DLS, Bangladesh). Survey instruments were also designed to capture the perspectives of two different groups of government veterinarians: Group 1– Veterinary Surgeons of DLS, Bangladesh and Group 2 – Upazila Livestock Officers of DLS, Bangladesh. Collected data were analyzed using SPSS (version 20.0, SPSS Inc., Chicago, IL) software. The findings indicated the knowledge, beliefs and perceptions of respondents. The research findings divulge that different managerial perspectives/dimensions in livestock production system associated with regular veterinary examination, allocation of appropriate nutrition, routine vaccination, arrangement of effective bio-security, use of probiotics, supply of hygienic water, arrangement of holistic therapies, arrangement of clean bedding as well as hygienic housing management, use of organic acids (e.g. Formic, acetic and propionic acids), use of plant extracts (e.g. essential oils of thyme, clove, turmeric, black pepper etc.) in poultry feed, use of prebiotics like Fructo Oligosaccharides(FOS), Manna Oligosaccharides(MOS) etc. in poultry feed, arrangement of hygienic as well as good quality feed management and maintaining hygienic air quality in the farming system had ‘moderate to substantial role’ in livestock production system for reducing antibiotic usage in veterinary practices in Bangladesh. Findings also indicated that the two groups of veterinarians possessed near to similar/same perceptions across different managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh and that no significant differences in perspectives existed ($p > .05$). Findings of this study could be implemented for formulation of effective policy as well as guideline with the development of relevant strategies for reducing antibiotic usage in veterinary practices for development of sustainable livestock production system in Bangladesh.

Keywords: managerial perspectives; relevant strategies; antibiotic usage; veterinary practices

1. Introduction

Antibiotics are used in different facets of livestock based agriculture and veterinary practices to treat bacterial infection, promote animal growth, and prevent disease outbreak. Although antibiotics are effectively used for disease prevention and control in both human and animal medicine for more than 50 years, the extensive use of antimicrobial agents has led bacteria to adapt defenses against antibiotics (Saini *et al.*, 2012; FDA, 2012; Levy, 1992). Antibiotic use in veterinary practices as well as livestock production systems has been controversial and disputed due to the potential transfer of antibiotic resistance from animals to humans (Sawant *et al.*, 2005), and much attention by the media as well as concerning stakeholders has been paid to the topic in recent years. Despite the origin, the potential transfer of antibiotic resistance from animals to humans could have hazardous public health implications as it could be cause of treatment failures and human costs, including death and prolonged illness associated with such failures (Kelly *et al.*, 2004). In order to encourage the judicious and rational use of antibiotics, the beliefs of all stakeholders who practice antibiotics must be considered and interlinked (Cattaneo *et al.*, 2009). Veterinarians are important sources of information regarding antibiotics, and therefore it is imperative to obtain understanding of the ways in which they perceive the managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices. Finally, this study identified some strategies for reducing antibiotic usage in veterinary practices for development of sustainable livestock production system in context of environmental realities in Bangladesh.

2. Materials and Methods

2.1. Research design

The survey was interpretive in nature using quantitative methods. A non - experimental and descriptive research design was considered to develop this study (Creswell and Clark, 2011).

2.2. Study area, population, sample and sampling

In this study, the samples were collected from two different stakeholder groups; namely group 1 which consist Government Veterinary Surgeons of existing seven divisions of Bangladesh (e.g. Rangpur, Rajshahi, Khulna, Barishal, Sylhet, Chittagong and Dhaka) and group 2 which consist Government Upazila Livestock officers (Only Veterinarians/DVM degree holder, but not any graduate of Animal Husbandry/B.Sc.in A.H. degree holder) of existing seven divisions of Bangladesh (e.g. Rangpur, Rajshahi, Khulna, Barishal, Sylhet, Chittagong and Dhaka). Considering the existing organogram of DLS (Collected from Website of DLS in 2012 and Bangladesh Veterinarians' Directory, 2012) and the total number of organized & old Govt. upazila/sub district Livestock Office of DLS, 460 (Four hundred sixty) number of Govt. Veterinary Surgeons (V.S.) as well as 460 (Four hundred sixty) number of Upazila Livestock Officers (U.L.O.) of DLS were considered as well as selected for overall study population. Due to time and budget it was not possible to cover all the number of total /overall population. This is why, based upon the total /overall population, the two formula [i.e. Yamane's mathematical formulae: $n = \frac{N}{1+Ne^2}$; Where N =Total number of Population, n = sample size and e = level of confidence =5%

and Random sampling formulae: $n = \frac{Z^2 pq}{e^2}$; where, n= sample size

Z= Tabulated value= 1.96 (For large sample at 5% level of significance),

P=estimated population proportion (0.5, this maximizes the sample size),

q= (1-p), e= Margin of error =0.05] were used to determine the study sample size.

Considering both Taro Yamane's mathematical formulae and random sampling technique, the total number of survey sample size for two stakeholder groups were 790 (Seven hundred ninety in total number) where Group 1 consists 395 respondents and Group 2 consists 395 respondents.

2.3. Time frame of research study

The whole activities of this research up to final report were conducted from July/2012 to May/2018.

2.4. Distribution of survey sample

Considering both Taro Yamane's mathematical formulae and random sampling technique as well as other favorable/convenience factors of survey work, the following distribution and sample size were considered as well as selected for the survey work of this study (Table 1).

Table 1. Distribution of survey sample.

Division Name	Survey sample size of Govt. veterinary surgeons at different division (Group 1)	Survey sample size of Govt. upazila livestock officers (Only Veterinarian, but not any graduate of animal husbandry) at different division (Group 2)
Rangpur	51	51
Rajshahi	58	58
Khulna	51	51
Barishal	30	30
Sylhet	29	29
Chittagong	74	74
Dhaka	102	102
Total	395	395

2.5. Instrumentation

The survey keenly took into considerations the use of a questionnaire, structured interviews and observation. Structured interviews were used to get detailed information from the respondents. The survey instrument of this study consisted Likert and Likert-type questions designed to capture the beliefs, knowledge, and practices focus of participants/ respondents using scaled responses. Various closed-ended questions were utilized to collect relevant information of this study.

2.6. Parameters studied

The survey instruments contained information namely, managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh and group perception about the variable “managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh”.

2.7. Reliability and validity of the instruments

Upon the development of survey questions, the instrument was tested for face and content validity by a panel of experts. Revisions to the survey were made based upon feedback from the panel and consisted of re-wording, re-ordering, and removing some questions. The process of establishing instrument validity allowed for linkages between variables and questions to be strengthened. Draft questions were submitted to experts in the field of study for comments before finalizing the questions. To obtain accuracy and reliability to data, care and caution were taken in the course of data collection.

2.8. Data collection procedure

Survey instrument was developed for data collection. Survey data were collected from concerning respondents through different means of communication. These were mobile phone, telephone, e-mail and direct face to face personal contact. Besides these, Survey data were also collected through workshop, seminar and focus group discussion. The mobile/cell phone, telephone and e-mail details were obtained/collected from both official website of DLS in 2012 and Bangladesh Veterinarians' Directory, 2012.

2.9. Data analysis

Respondent data from the surveys were transferred to SPSS (version 20.0, SPSS Inc., Chicago, IL) and quantitative data analysis was completed using the software. Descriptive and inferential statistics were used to analyze the data. Frequency distributions, percentages, means, and standard deviation were utilized as descriptive measures, while independent t-test was the inferential statistics used for data analysis.

3. Results and Discussion

3.1. Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh

The respondents were requested to indicate their level of agreement to the following statements on ‘managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh’.

The responses were rated on a five point Likert scale where: 1= No Role, 2= Minimal, 3= Not sure, 4= Moderate, 5= Substantial role

The mean, median and standard deviations were generated from SPSS and are as illustrated in table 1, 2 and 3 below. Data in Table 1 to 3 indicated that Veterinary Surgeons of DLS (under study) agreed as well as perceived the following findings/statements.

3.1.1. Regular veterinary examination

‘Regular veterinary examination’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.7899 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015) which support the effectiveness of improvements in biosecurity as well as improved management practices as alternatives to antibiotics where it was discussed that improved management practices could be used as effective means of preventing the introduction of diseases into herds or flocks.

3.1.2. Allocation of appropriate nutrition

‘Allocation of appropriate nutrition’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.7722 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.3. Routine vaccination

‘Routine vaccination’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.8228 and 5.0000 respectively). This finding is consistent with the findings of Oliver *et al.* (2009) which support the effectiveness of vaccines as alternatives to antibiotics where it was discussed that vaccines are promising substitutes for some antibiotic uses.

3.1.4. Arrangement of effective bio-security

‘Arrangement of effective bio-security’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.8000 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.* (2016); Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.5. Use of probiotics

‘Use of probiotics’ had ‘substantial role’ for reducing antibiotic usage in poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.7646 and 5.0000 respectively). This finding is consistent with the findings of Yueming Dersjant-Li *et al.* (2013) and Ritzi *et al.* (2014) which support the effectiveness of probiotics as alternative to antibiotics for promotion of productivity, health status as well as disease prevention of poultry.

3.1.6. Supply of hygienic water

‘Supply of hygienic water’ had ‘moderate to substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.6911 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.7. Arrangement of holistic therapies

‘Arrangement of holistic therapies’ had ‘moderate to substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.6709 and 5.0000 respectively). This finding is consistent with the findings of studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.8. Arrangement of clean bedding as well as hygienic housing management

‘Arrangement of clean bedding as well as hygienic housing management’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.8101 and 5.0000 respectively). This finding is consistent with the findings of studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.9. Use of organic acids

Use of organic acids (e.g. formic, acetic and propionic acids) had ‘moderate role’ for reducing antibiotic usage in poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.0025 and 4.0000 respectively). This finding is consistent with the findings of different studies (Partanen and Mroz, 1999; Suiryanrayna and Ramana, 2015) which support the effectiveness of probiotics as alternative to antibiotics where it was discussed that organic acids have positive impacts on disease prevention in animals.

3.1.10. Use of plant extracts

‘Use of plant extracts (e.g. essential oils of thyme, clove, turmeric, black pepper etc.) in poultry feed’ had ‘moderate role’ for reducing antibiotic usage in poultry production / rearing system in the localities of Bangladesh (The mean and median score 3.9671 and 4.0000 respectively). This finding is consistent with the findings of different studies (Cox *et al.*, 2001; Hyldgaard *et al.*, 2012; Perdue Farms Inc., 2017 and Cargill Inc., 2017) which support the effectiveness of phytochemicals as alternative to antibiotics where it was discussed that phytochemicals are plant-derived compounds which have antibacterial as well as growth promoting effects.

3.1.11. Use of prebiotics

‘Use of prebiotics like Fructo Oligosaccharides(FOS), Manna Oligosaccharides(MOS) etc. in poultry feed’ had ‘moderate role’ for reducing antibiotic usage in poultry production / rearing system in the localities of Bangladesh (The mean and median score 3.9722 and 3.0000 respectively). This finding is consistent with the findings of Francesca Gaggia *et al.* (2010) which support the effectiveness of prebiotics as alternatives to antibiotics for reduction of pathogens in gut as well as improvements of gut health status of poultry.

3.1.12. Arrangement of hygienic as well as good quality feed management

‘Arrangement of hygienic as well as good quality feed management’ had ‘substantial role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 4.7139 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

3.1.13. Maintaining hygienic air quality

‘Maintaining hygienic air quality’ in the farming system had ‘moderate role’ for reducing antibiotic usage in livestock as well as poultry production / rearing system in the localities of Bangladesh (the mean and median score 3.9924 and 5.0000 respectively). This finding is consistent with the findings of different studies (Tokach *et al.*, 2016; Scott *et al.*, 2002; Jeffrey, 1997; Dahiya *et al.*, 2006 and Lewerin *et al.*, 2015).

Table 1. Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh.

	Regular veterinary examination	Allocation of appropriate nutrition	Routine vaccination	Arrangement of effective Bio-security	Use of Probiotics
N Valid	395	395	395	395	395
Mean	4.7899	4.7722	4.8228	4.8000	4.7646
Median	5.0000	5.0000	5.0000	5.0000	5.0000
Std. Deviation	.51268	.52716	.47686	.50177	.53578

Table 2. Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh.

	Supply of hygienic water	Arrangement of holistic therapies	Arrangement of clean bedding as well as hygienic housing management
N Valid	395	395	395
Mean	4.6911	4.6709	4.8101
Median	5.0000	5.0000	5.0000
Std. Deviation	.59251	.60710	.49556

Table 3. Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh.

	Use of organic acids (e.g. Formic, acetic and propionic acids)	Use of Plant extracts (e.g. essential oils of thyme, clove, turmeric, black pepper etc.)	Use of Prebiotics like Fructo Oligosaccharides(FOS), Manna Oligosaccharides(MOS)	Arrangement of hygienic and good quality feed management	Maintaining hygienic air quality
N Valid	395	395	395	395	395
Mean	4.0025	3.9671	3.9722	4.7139	3.9924
Median	4.0000	4.0000	4.0000	5.0000	4.0000
Std. Deviation	.42450	.43505	.43541	.57147	.43623

3.2. Independent t-test results on group perception about the variable ‘Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh’

Data in table 5 indicated that the results of the independent t-test found no significant difference in perception scores between the two groups of Govt. Veterinary Surgeons and Govt. upazila Livestock officers for the variable on “managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh” ($t = 4.499, p > .05$).

Table 4. Group statistics.

	Type of respondent	N	Mean	Std. deviation	Std. error mean
Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh	Veterinary Surgeon, DLS	395	4.3711	.16623	.00836
	Upazila Livestock Officer, DLS	395	4.3094	.21584	.01086

Table 5. Independent samples test.

		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in Bangladesh	Equal variances assumed	17.100	.000	4.499	788	.000	.06166	.01371	.03476	.08857
	Equal variances not assumed			4.499	739.764	.000	.06166	.01371	.03475	.08857

4. Conclusions

The research findings express that potential stakeholder groups of veterinary services possessed important perceptions across different managerial perspectives in livestock production system associated with the reduction of antibiotic usage in veterinary practices in context of environmental realities in Bangladesh and generally agreed with the statements within the perspectives/dimensions. The intent of this study was not to generalize, but to identify current beliefs and knowledge of Government veterinarians regarding the relevant strategies for reducing antibiotic usage in veterinary practices. Finally, it is the hope that the descriptive findings of this study could provide valuable insight for veterinary practitioners, and stimulate thought and discussion

among the concerning stakeholder groups of veterinary profession to develop relevant strategies for reducing antibiotic usage in veterinary practices so that prudent use of antibiotics could be ensured in veterinary practices. The information obtained through the study will therefore be relevant in the development of educational materials and programs to benefit the veterinary profession as well as many other concerned stakeholder groups.

Conflict of interest

None to declare.

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