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Identification of the Most Common Antibiotics Used for Broiler Chicken Production in Bangladesh

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ABSTRACT

The use of antibiotics indiscriminately in broiler without any veterinary consultation added in feed and water in sub-therapeutic doses for prophylaxis and growth promotion has increased antibiotic resistant bacteria transmitting to human. The aim of the study was to identify the most common antibiotic used by the broiler in Bangladesh. In this survey engaged 208 Upazila Livestock Offices (ULO) for interviewing 385 broiler farmers and veterinary medicine sales representative in all 8 divisions. Use of antimicrobial drugs for broiler production in different farm, medicine and feed used in the current flock were targeted to identify. Factor analysis was used to select respondents' knowledge variables and multinomial logistic regression was followed to determine factors associated with antibiotic used in broiler production. According to opinion of 208 Upazila Livestock officers, interview with farmer and veterinary medicine sales representative, everyone agreed the most of the farmers use antimicrobials for broiler production. The most common antibiotics were Amoxicillin (182/208), Ciprofloxacin (179/208), Colistin sulphate (167/208), oxytetracyclin (165/208), Enrofloxacin (146/208), Erythromycin (133/208), sulfaquinoxaline (46/208), followed by Gentamycin, Norfloxacin, Tiamulin, Tilmicosin, Toltrazuril, Doxycycline, flumequine, Neomycin, Tylosin, lincomycin, Flavomycin, Florfenicol and Clortetracycline. Under above circumstances large-scale use of antimicrobials had led to its resistance and residues in broiler chicken meat and liver which can lead to public health problems. The major broiler farm used antibiotics (amoxicillin and ciprofloxacin) and they did not follow withdrawal period. Although national regulations is in favor of control use of antibiotics, but were not well enforced.

Keywords: Antibiotics resistance, Broiler farm, and Outline of antibiotics use.

INTRODUCTION:

With a population of over 164.7 million people, there was extensive economic pressure on broiler chicken

(main part of poultry industry) as a vital source of animal protein for the teeming population of Bangladesh. The poultry industry in Bangladesh had

304.11 million birds and produces 44.40 lack metric tons of poultry meat annually Source BBS 2020, DLS 2020-2021. Demand for animal sourced protein for human consumption has increased day by day.

Antibiotics either natural or synthetic origins are used to both prevent proliferation and destroy bacteria. They are routinely used to treat and prevent infections both in humans and animals. However, scientific evidence suggests that the massive use of these compounds has led to increased problem of antibiotic resistance (Forgetta *et al.*, 2012; Furtula *et al.*, 2010), and presence of antibiotics residues in food and environment (Carvalho and Santos, 2016; Gonzalez Ronquillo and Angeles Hernandez, 2017), compromises human and animal health (Diarra *et al.*, 2010). This resistance was rendering antibiotics powerless against the deadly infections. It has now been recognized by the world health organizations (WHO) as one of the top health challenges for this modern era. Some of the causes are widely accepted for example, the use of antibiotics in poultry feed as growth promoters, overuse and inappropriate use of antibiotics for nonbacterial infections (Rahman *et al.*, 2019).

Many of the antibiotics used to treat bacterial infections in humans also have veterinary applications. The poultry industry uses antibiotics to improve meat production through increased feed conversion, growth rate promotion and disease prevention. Antibiotics used successfully at sub-therapeutic doses in poultry production to promote growth (Chattopadhyay, 2014; Khodambashi Emami *et al.*, 2012;) and protect the health of birds by modifying the immune status of broiler chickens (Lee *et al.*, 2012). This is mainly due to the control of gastrointestinal infections and microbiota modification in the intestine (Singh *et al.*, 2013). The mechanism remains unclear, but antibiotics are likely to act by remodeling microbial diversity and relative abundance in the intestine to provide an optimal microbiota for growth. For example, metagenome sequencing approaches have demonstrated that diets with salinomycin (60 ppm) has an impact on microbiome dynamics in chicken ceca (Fung *et al.*, 2013). A change in the intestinal microbiota of chickens can influence their immunity and their health. However, changes in the intestinal microbiota of

chickens can be influenced by several factors. These factors include housing conditions, exposure to pathogens, diet composition and the presence of antibiotics in feed (Lee *et al.*, 2012).

Antibiotics abuse has resulted in drug residues in animal products (Gonzalez Ronquillo and Angeles Hernandez, 2017). Several antibiotics such as penicillin, tetracycline, macrolide, aminoglycoside and amphenicol have been detected in foods (Diarra and Malouin, 2014). Residues in livestock production can actually have adverse impact on human health; this is the case for tetracycline's, which interfere with teeth development in young children (Kummerer, 2009). China is the first country in using antibiotics in food animals with a percentage of 23%. The order of the other countries was as follows: United States (13%), Brazil (9%), India (3%) and Germany (3%) (Van Boeckel *et al.*, 2015). In a number of countries has banned the use of certain antibiotics in livestock and poultry production. Most common used Legislation regarding the control of antibiotic residues in animals and their products that were given in European Union (EU) Council Directive 96/23/EC. The use of antibiotics in animal feed was prohibited in Bangladesh in 2010 by passing the Fish and Animal Feed Act. 2010.

MATERIALS AND METHODS:

Study Area and Study Design

A survey was conducted in all 8 divisions of Bangladesh. At the starting of my study periods I made a Questionnaire (normal practice). There were two parts of questionnaire where 1st part was Field level survey on available use of antimicrobial drugs for broiler production in Bangladesh and 2nd part was antimicrobials used by the farmers in the current flock with some other information. 1st Questionnaire contain name of antibiotics (list) used through water or feed or both with dose and used frequency (Disagree -, Nether disagree or Agree +, Agree ++, strongly Agree +++) and 2nd Questionnaire contain Name of Farm, Name of Farm Owner, Address, Mobile Number, farm size, Medicine and Feed Used in the current flock (Mathers N, Fox N. and Hunn A. Surveys and Questionnaires. The NIHR RDS for the East Midlands / Yorkshire & the Humber, 2007.)

Questionnaire Preparation

At the starting of my study periods I made a Questionnaire (normal practice) form with direct consultation of 29 newly promoted upazila livestock officer at BCS Livestock Academy, Savar, Dhaka, Bangladesh who previously worked as an either veterinary surgeon or poultry production officer under the Department of Livestock Services (DLS), Bangladesh. After that I also send that questionnaire in three senior field level practitioner for making

corrections and finally I got approval from my academic supervisor.

Study Participants and Sample Size

Either Upazila Livestock Officer or Veterinary surgeon and farmers were participating in the survey. There was 492 upazila livestock office in Bangladesh among that if I discard hilly and dairy zone it became 305, by using www.smartsurvey.co.uk/sample-size-calculator total sample size (no. of upazila) were 171 at 95% confident level and margin of error 5%.

Table 1: Division-wise participants in survey.

Name of Divisions	Type of participants (Variables)			Farmers	(% of total farms)
	Local officer (ULO/VS)	(% of local office)	Farmers		
Rangpur	21	36.21	38	0.59	
Rajshahi	27	37.50	49	0.46	
Khulna	19	28.36	61	0.51	
Barisal	14	33.33	29	0.51	
Dhaka	69	77.53	99	0.47	
Mymensingh	13	37.14	44	0.57	
Sylhet	13	34.21	19	0.52	
Chattogram	32	39.51	46	0.51	
Total	208	43.15	385	0.50	

As total number of farm (small scale, medium scale and large scale farm) in Bangladesh was 76278 by using 95% confident level with 5% error of margin, so

sample size was 382. (www.smartsurvey.co.uk/sample-size-calculator).

Table 2: Division-wise national Broiler farms database (2019-2020).

Division	Category-wise Number of Broiler Farms			Total
	500-1000 Broiler (Small Scale)	1001-2000 Broiler (Medium Scale)	2000+ Broiler (Large Scale)	
Rangpur	4415	1512	541	6468
Rajshahi	7045	2598	1088	10731
Khulna	9315	2003	661	11979
Barisal	4291	1133	262	5686
Dhaka	9910	9590	1500	21000
Mymensingh	5361	1640	664	7665
Sylhet	2614	831	209	3654
Chattogram	4322	2922	1851	9095
Total	47273	22229	6776	76278

Source: Department of Livestock Services, Bangladesh, Dhaka.

Table 3: Division-wise target number of survey Broiler farms.

Division	Category-wise Number of Broiler Farms			Total
	500-1000 Broiler (Small Scale)	1001-2000 Broiler (Medium Scale)	2000+ Broiler (Large Scale)	
Rangpur	22	8	3	33
Rajshahi	35	13	5	53

Khulna	47	10	3	60
Barisal	21	6	1	28
Dhaka	50	47	8	105
Mymensingh	27	8	3	38
Sylhet	13	4	1	18
Chattogram	23	15	9	47
Total	238	111	33	382

Data Collection

Data collection was performed during December, 2020 to August, 2021 by a trained Upazila Livestock Officer or Veterinary surgeon or Livestock Extension officer who had either Animal Husbandry or Veterinary science background. For getting maximum information, I send questionnaire through e-mail and discussed over telephone to 305 upazila livestock office in charge (discarding dairy and hilly zone) among 492 upazila livestock office (Either Upazila Livestock Officer or Veterinary surgeon). Field level survey on available use of antimicrobial drugs for broiler production in Bangladesh (1st part of questionnaire) was filled by Upazila Livestock Officer and/or Veterinary surgeon or Livestock Extension officer. For the 2nd part of questionnaire, Upazila Livestock Officer or Veterinary surgeon or Livestock Extension officer visited the selected farms and invited a responsible farmer (owner /manager) of the farm, to participate in the study. Written informed consent was obtained from all farmers after they agreed to participate in the study. The questionnaires were self-completed and each questionnaire took about 30min to complete. All participants in questionnaire were selected by random sampling.

Data Management and Analysis

Excel sheet was used for data entry. Descriptive statistics were used to scrutinize characteristics of the study farms and farmers. The farms were classified into 3 categories based on the total number of chickens: small (<1,000), medium (1,000 - 2,000), and large (>2,000). The illustration of the patterns of antibiotic used in broiler production was done by using Hierarchical heat map analysis. Factor analysis on knowledge about the use and resistance of antibiotic was performed to reduce the number of variables and used for model adjustment. Multinomial logistic regression was used to examine associated factors for antibiotic use.

RESULTS:

208 Upazila Livestock office incharge (Upazila Livestock Officer or Veterinary surgeon) and 385 farmers from broiler farms willingly participate in the study.

Demographic Structure and Characteristics of Respondents

The Upazila Livestock office incharge (Upazila Livestock Officer or Veterinary surgeon) were both male and female, aged between 29 and 52 years and had worked in livestock services for between 2 and 22 years. Among the 208 officers 5 had PhD education, 35 had doctor in veterinary medicine (DvM) education and 168 had master in science (MS) of different department under the faculty of Animal Husbandry and/or veterinary science faculty. They also have different training on livestock and poultry production either/both in-country and abroad. The order of Upazila Livestock office in charge (participate) in bangladesh was Dhaka> Chitagong> Rajshahi> Rangpur> Khulna> Barishal> Mymensing> Sylhet.

The poultry farmers were either male or female, aged between 22 and 55 years and worked in poultry farm from 1 to 26 years. For all participants, poultry farming was the main income source with some supplementary income from seasonal crops. The majority reported a monthly income between 10,000 and 45,000 Taka (US\$115 –523) from their poultry business. The flock size of the farms ranged from 500 to 5,000 birds on the day of interview. The order of broiler farmers (participates) in bangladesh was Dhaka> Khulna> Rajshahi> Chitagong> Mymensing> Rangpur> Sylhet. The Upazila Livestock office in charge (Upazila Livestock Officer or Veterinary surgeon) who interviewed as a key-informant was male or female and had been working in that Upazila for 1-5 years but they served in the upazila level (in different upzila) for 2-22 years.

Table 4: Demographic structure of respondents.

Name of Divisions	Type of participants	
	Local officer (ULO/VS) (%)	Farmers (%)
Rangpur	21	38
Rajshahi	27	49
Khulna	19	61
Barisal	14	29
Dhaka	69	99
Mymensingh	13	44
Sylhet	13	19
Chattogram	32	46
Total	208	385

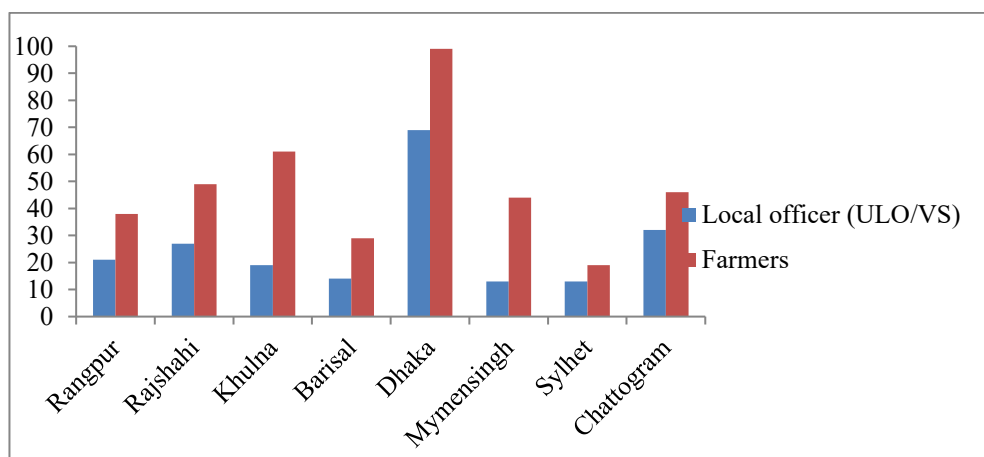


Fig. 1: Demographic structure of respondents.

Farm Characteristics

Table 2 indicates the characteristics of the study farms. Most broiler farms were small (58%) and medium sized (30%), identified as a family business with a small number of employees, and 12% were large sized. Most farmers had more than 10 years’ experiences in farming. All farms used commercial feeds, the majority of which were pellet feed. Most farms directly discarded their waste products into the environment without any purification. Most farmers were male, middle aged, married and completed a lower school level of education. Few had any formal training in animal husbandry. One-third of farmers’ families earned less than 2000 BDT per month. The order of broiler farm in bangladesh was Dhaka> Khulna> Rajshahi> Chitagong> Mymensing> Rangpur> Sylhet. The number of broiler farm in Dhaka division was 25.71% (small sized 47.47%, medium sized 39.39% and large sized 13.14%), Khulna division was 15.84%(small sized 68.85%,

medium sized 24.59% and large sized 06.56%), Rajshahi division was 12.73% (small sized 69.39%, medium sized 10.20% and large sized 20.41%), Chitagong division was 11.95% (small sized 47.83%, medium sized 36.96% and large sized 15.21%), Mymensingh division was 11.43% (small sized 47.72%, medium sized 38.64% and large sized 13.64%), Rangpur division was 09.87% (small sized 57.89%, medium sized 28.95% and large sized 13.16%), Sylhet division was 04.94% (small sized 73.68%, medium sized 21.05% and large sized 05.27%) and barishal division was 07.53% (small sized 68.97%, medium sized 24.14% and large sized 06.89%).

Patterns of Antibiotic Used in Broiler Production

According to 208 Upazila Livestock office in charge’s opinion and their interview with farmer and veterinary medicine sales representative showed that all broiler chicken farmers used antibiotics throughout the broiler production system either though water or feed.

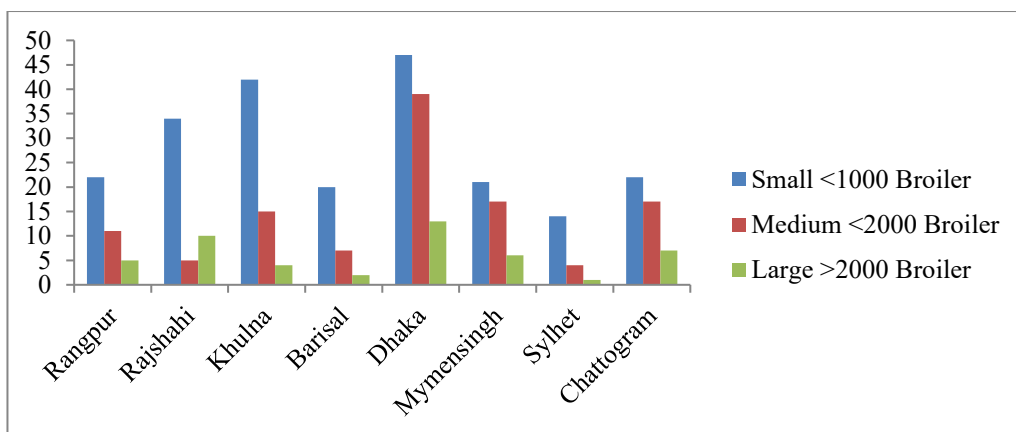


Fig. 2: Characteristics of the study farms.

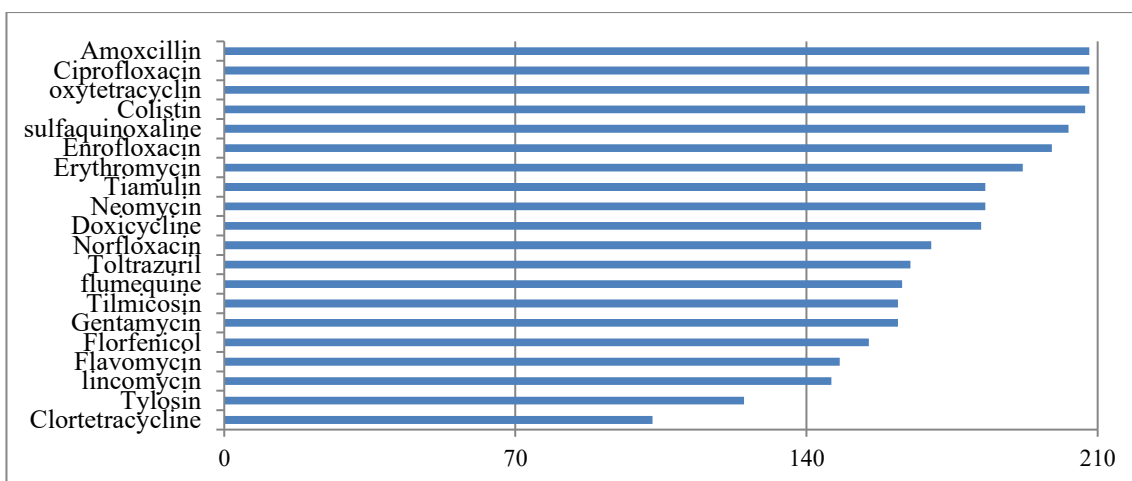


Fig. 3: Pattern of antimicrobials used in broiler farm in Bangladesh.

Everyone agreed all antimicrobials (listed in survey) were used in broiler production. The antibiotics observed at the time of interview that used by the farmer were Amoxicillin (182/208), Ciprofloxacin (179/208), Colistin sulphate (167/208), oxytetracyclin (165/208), Enrofloxacin (146/208), Erythromycin

(133/208), sulfaquinoxaline (46/208), followed by Gentamycin, Norfloxacin, Tiamulin, Tilmicosin, Toltrazuril, Doxicycline, flumequine, Neomycin, Tylosin, lincomycin, Flavomycin, Florfenicol and Clortetracycline (Toyeeb *et al.*, 2022).

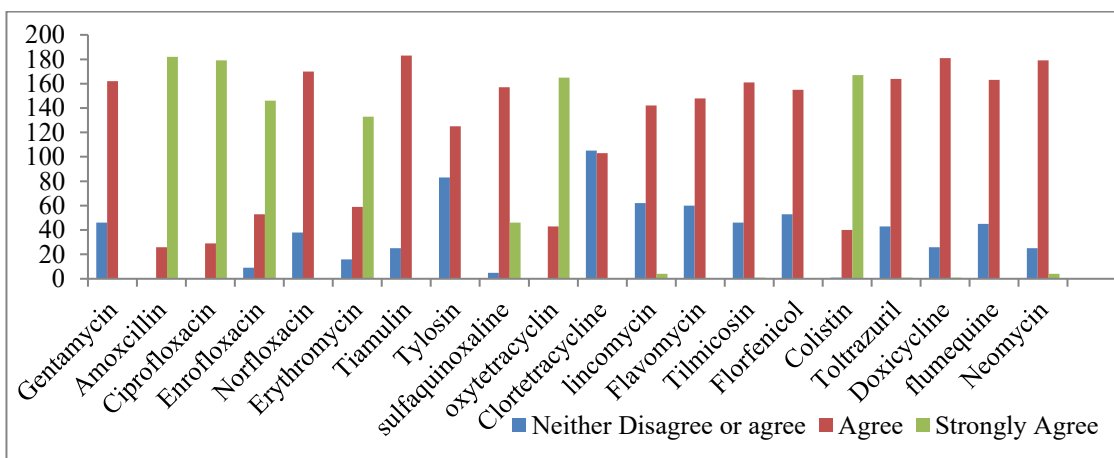


Fig. 4: Routinely used antimicrobials in Broiler farm in Bangladesh, Source: Survey Data.

By using pie chart among 208 Upazila Livestock office in charge’s opinion and their interview with farmer (385) and veterinary medicine sales representative exposed three patterns of antibiotic used based on the distribution of antibiotics used in each farm. The first pattern (outer part) was characterized by excessive use, the second pattern (middle part) was characterized by moderate use, the third pattern (inner part) was characterized by lower use of antibiotics. So the farms can be classified as excessive users, low users and moderate users.

Famers’ Practice of Using Antibiotics

Escherichia coli infection was a common infection on chicken farms followed by three viral diseases. Most farmers immunized their chickens with required and elective vaccines, and used traditional medicine as well as antimicrobials. Antimicrobials were excessively used for contagion prevention rather than treatment. Farmers included in the study can easily access and purchase antibiotics from local drug stores and feed dealer with or without prescription. The availability of antibiotics has a strong influence on farmers’ decision making therefore, veterinarians/ pharmacists also played critical roles in antibiotic use and misuse. In fact, Bangladesh restrict on use of antibiotics by passing The Fish and Animal Feed Act. 2010 and Food Safety Act. 2013. Furthermore, only

one-third of farmers keep the record of antibiotic that used in farm as instructed by the government. Lack of data and monitoring makes it challenging to manage and reduce the problem. Spot observation the most common used antimicrobials were Amoxicillin and ciprofloxacin; the 2nd most common antimicrobials were Erythromycin, Oxytetracyclin, tylosin, Doxycyclin and colistin sulphate. They also used combined antimicrobials that are Doxycyclin + Oxytetracyclin, colistin sulphate + Amoxicillin and Erythromycin + Sulphadiazine + Trimethoprim. Farmers use different antibiotics at a time with the aim to decrease the risk of development of resistance bacteria in chickens. However, they were unaware that this may lead to multiple resistant bacterial strains in both animals and human.

Antibiotics on the prohibited list have been determined as hazardous drugs and their use has been banned by the Bangladesh government. Although these drugs were preferable among our study farmers (their use improved their chicken production leading to economic profits), neglecting the consequences to human health. Previous studies reported high concentrations of several antibiotics in Commercial Broiler feeds in Bangladesh. Our study found that all farmers used commercial feeds on their farms. Thus, they may have unknowingly used growth promoters.

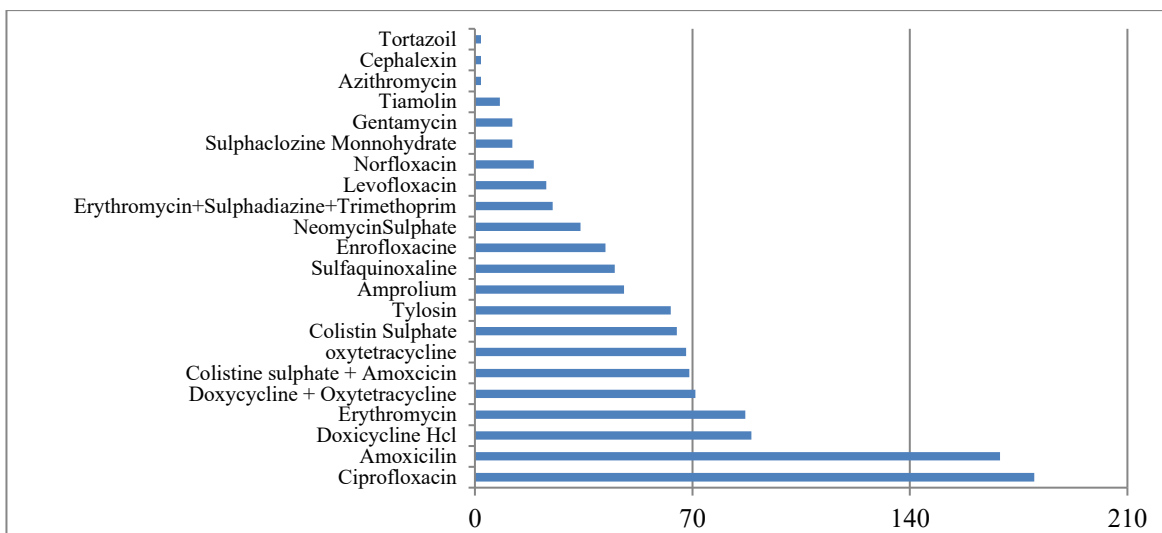


Fig. 5: Antimicrobials used in broiler farm in Bangladesh during survey, Source: Survey Data.

Table 5: Regulations related to antibiotic use in food animals vs findings in this study.

Regulation Facts	in this study
Do not use of any prohibited listed	87% (participate in survey) strongly agreed on use of prohibited antibiotics in

antibiotic.	chickens. In the spot observation 37% of farms used prohibited antibiotics.
Do not continue of antibiotics during the withdrawal period.	62% (participate in survey) agreed farmers extended antibiotic use into the withdrawal period.
Nobody purchase of antibiotics without a veterinary prescription.	65% of farmers purchased antibiotics without a prescription.
Farmers should record their used antibiotic	69% of farmers did not record their antibiotic use.

DISCUSSION:

This study revealed that farmers habitually used antibiotics. Multiple antibiotics were applied from day 1 of the production cycle to the point of sale. At least 25 antibiotics were used in broiler chicken production in Bangladesh, not only for treatment of chick birds, but also for disease prevention and to promote growth. Most farmers use antibiotics to prevent diseases infection not according to the prophylactic or therapeutic dosage, length of treatment and withdrawal time indicated on the product label, but most of them use a higher or lower dosage and don't respect the recommendations of the drug producer. There are 25 antibiotics identified in this survey, Among those Amoxcillin, Ciprofloxacin, Colistin sulphate, oxytetracyclin, Enrofloxacin, Erythromycin, sulfa-quinolaxaline are the most commonly used.

Policy vs Reality

The national parliament of the Peoples Republic of Bangladesh passed act and rules to restrict the use of antibiotic in food animals to control antibiotic resistance over the last decades. However, there were gap between policy and reality that were shown in **Table 5**. The implementation of the regulations is deemed a crucial issue.

Limitations

Due to shortage of knowledge among farmers, some farmers did not report the types of antibiotics used, which may have undervalued the antibiotic use reported in this study.

CONCLUSION:

Over the years, antibiotics have played a significant role in struggling infectious diseases and stimulating poultry growth. Scientific evidence suggests that their enormous use has led to antibiotic resistance and residues in the food and environment which can generate to public health complications. This study reports the extensive use of un-prescribed antibiotics

in broiler chicken production in Bangladesh. The major farm was received antibiotics (amoxicillin and ciprofloxacin) and the withdrawal period of antibiotics was not maintained. A rising global concern of antibiotic use in broiler chicken diets due to its potential adverse effects on birds and human health, food safety and the environment has led to a complete ban or restricted use in some countries. Although national regulations of Bangladesh to control antibiotic use are available, they are not well imposed. It is necessary not only to strengthen the monitoring system, veterinary network, antibiotic use guidance issues, but also to improve aware and ethics of farmers and veterinary drug sellers as well as training of diploma-veterinarians or livestock services provider (learn by training or short course), feed dealers or veterinary pharmacists and farmers especially on small and medium scale farms.

AUTHOR CONTRIBUTIONS

M.A.K. designed the study. K.M.S.I.; and M.A.I. performed the methodology. S.K. carried out the data analysis. M.A.M. composed the manuscript. All the authors checked and approved the final manuscript.

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CONFLICTS OF INTEREST:

The authors certify that there is no conflict of interest.

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