

Irrational Use of Antimicrobials in Poultry Farms and Antimicrobial Resistance: A Cross-Sectional Study

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ABSTRACT




Background: The rampant use of antimicrobials in poultry farms is creating a global public health threat as antimicrobial resistance (AMR) in humans may arise from such practice. This study was conducted with the objective of quantification and hence assessment of the level of antimicrobial use in Pakistani poultry farms so that appropriate utilization of such agents can be assured.

Methods: Six randomly selected poultry farms of Pakistan with ten production cycles with 20,000- 30,000 birds in every production cycle were selected for the study from 2018 to 2019. The average dosage utilized on-farm was described by the defined daily dose (DDD) and used daily dose (UDD).

Results: It was found that enrofloxacin, amoxicillin, doxycycline, tylocin, and lincomycin were the antimicrobials commonly used by all poultry farms. However, only Enrofloxacin (UDD/DDD = 0.95) was being used within the rational therapeutic range. All the antimicrobials were used irrationally without proper indication and suggestion by the veterinarian. No records on antimicrobials use were found on any farm.

Conclusion: The irrational use of antimicrobials in poultry farms may lead to antimicrobial resistance which has been a global public health threat. The speedy action should be implemented to discourage such rampant use of drugs in poultry farms in Pakistan and countries with similar farming practices for the effective use of antimicrobials in the proper indication.

Keywords: Anti-Bacterial Agents, Enrofloxacin, Pakistan, Poultry, Drug Resistance

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INTRODUCTION

Antimicrobial resistance (AMR), according to the World Health Organization (WHO), is one of the top 10 global public health threats.¹ If it is not controlled in time, it is predicted that by 2050, due to the increase in drug-resistant infections, millions of lives a year and a huge economic output will be at risk.² Poultry is one of the most extensive food industries worldwide, where broiler is the most commonly farmed species, with over 90 billion tons of chicken meat produced per year.³

For AMR in humans, there is growing evidence that antimicrobial use in livestock plays an important role through the zoonotic spread of resistant bacteria. Resistance may spread to humans through either direct contact with animals, meat consumption, and contamination of vegetable matter with manure or indirectly through environmental pathways.⁴ Though the use of antibiotics in poultry and livestock production is favorable to farmers and the economic growth, the likely dissemination of AMR due to their rampant use and thus the production of different strains of micro-organisms and their further transmission to humans via the food chain could lead to serious consequences on public health.^{3,5}

In 2007, the WHO strongly recommended stopping intensive routine use of antimicrobials in the production of animals.⁶ Then since January 2012, the UK poultry industry has adopted veterinary measures on the use of antimicrobials categorized by WHO as a critically important measure for human health. The UK's poultry meat sector has reduced the use of antibiotics by 71% in the last four years, while production has increased by 11%.⁷ The countries such as Germany, UK, Norway, and the Netherlands have developed antimicrobial consumption monitoring programs to prevent AMR in animals and humans⁸.

Pakistan is a country where commercial poultry production was started in the 1960s and about 5 million broilers are slaughtered every day.⁹ Thus, the poultry sector has played a vital role in the supply of proteins.¹⁰

In such a context, appropriate use of antibiotics guided by user-friendly guidelines for the poultrymen can have a significant impact in business as well as health points of view. Therefore, this study was conducted with the objectives of quantification and hence assessment of the level of antimicrobial use in Pakistani poultry farms.

MATERIALS AND METHODS

Study design and sampling: Ten broiler farms holding at least 2 lakh birds were randomly selected from the city of Lahore, Multan, and Gujranwala in this observational study. Out of them, six (60%) farms

agreed to participate in this study (Figure 1). These 6 farms had ten production cycles with 20,000- 30,000 birds in every production cycle. Among the six farms, three farms were producing one production cycle each, and two farms were producing two production cycles each, whereas the other one was producing three production cycles at a time. The farms were visited twice a week to note the data in the year 2018 to 2019.

Data collection: The data of antibiotics used were collected whereby time and duration of administration, name of antibiotic administered, amount administered, route of administration and indication for administration were recorded. Different types of antibiotics were being used on different days of the cycle. We monitored and

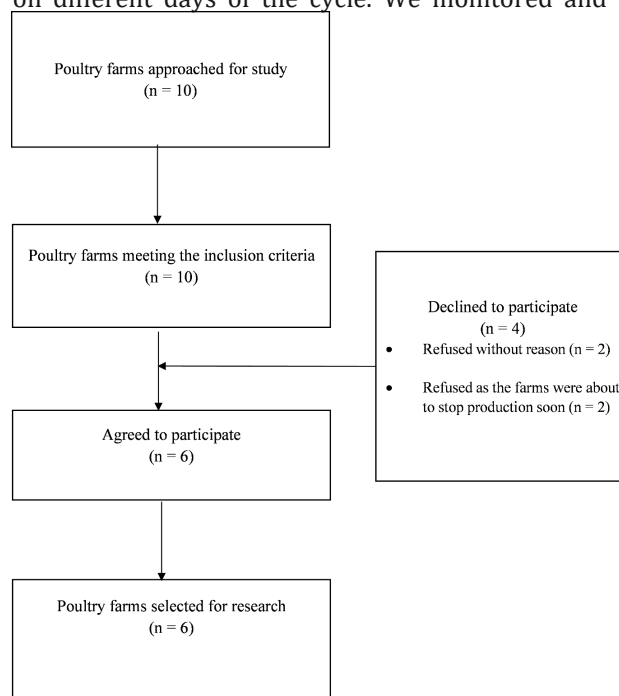


Figure 1: Flow chart of study selection

recorded each one of them separately. We consulted with the owners and veterinary doctors on the individual farms. But we could not access the data on antibiotics used in hatchery because the regular details were not given with the day-old chicks.

The data of the amounts of antimicrobials, indications for use, and accuracy of dosing were collected during consecutive 10 production cycles in enrolled poultry farms.

Data analysis: All the data were entered in an Excel spreadsheet. Volumes of antimicrobials administered were converted to mg of active substance per kg live weight. The frequency of use of the different active substances used was calculated as the ratio of production cycles where the compound was used to the total number of cycles followed.

Weight indicators were chosen for the quantification of drug use. The defined daily dose (DDD) is defined as the nationally determined average maintenance dose per day and per kg chicken of a specific drug.¹¹ For poultry, the DDD¹² was estimated based on the dosages mentioned in the Belgian Compendium on Veterinary Medicines and the drug's instruction leaflet.¹³

The used daily dose (UDD) describes the amount of active substance administered to the animals in mg per kg. The UDD was calculated by dividing the amount of antimicrobial compound administered (mg) by the number of broilers times the average weight at treatment to define a standard treated bird. The UDD/DDD ratios were calculated as a way to assess the correctness of dosage. Ratios between 0.8 and 1.2 were considered as correct dosing. Values less than 0.8 and greater than 1.2 were considered to be under-dosing and overdosing, respectively.¹³

Ethics approval: The ethics approval was granted by the Institutional Review Board/Ethical Committee, University of the Punjab, Lahore. Informed consent to participate in the study was obtained from participants.

RESULTS

All the farmers were using the same antibiotics in a similar pattern in all the studied farms in 10 production cycles that were monitored. The administration pattern of antibiotics was depicted in table 1.

The average dosage utilized on-farm was described by the DDD and UDD in table 2. From the ratio of UDD/DDD, it was found that only Enrofloxacin (UDD/DDD = 0.95) was being used within the rational therapeutic range (UDD/DDD = 0.8-1.2). All of the other antibiotics were under-dosed (Figure 2).

Medication records to describe antimicrobial use data were not found in farms. The antimicrobials were being used without prescription. We could not

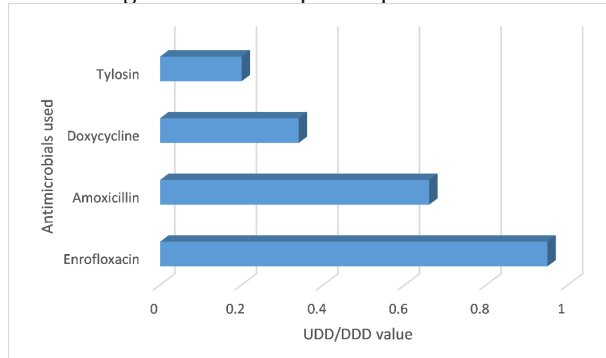


Figure 2: UDD/DDD* ratio of antimicrobials used
*DDD: Defined daily dose, UDD: Used daily dose

Table 1: Administration pattern of antibiotics

Compound	Age of broiler	Indication	UDD (mg/kg)
Enrofloxacin	1-5 days	Prophylaxis	9.51
Amoxicillin	11-16 days	Prophylaxis	13.2
Doxycycline	28-32 days	Prophylaxis	5.04
Tylosin	19-23 days	Prophylaxis	21.4
Lincomycin	14-30 days	Prophylaxis	22.68

Table 2: UDD/DDD* ratio of antibiotics used

Antibiotics	DDD	UDD	Ratio(UDD/DDD)
Enrofloxacin	10	9.51	0.95
Amoxicillin	20	13.2	0.66
Doxycycline	15	5.04	0.34

*DDD: Defined daily dose, UDD: Used daily dose

find any indications of using antimicrobials and they were using such agents prophylactically. We also noticed that that farmer used to consult veterinarians if some disease conditions were observed and used medications separately.

DISCUSSION

Among the 10 farms selected for the study, only six were included in the study because two farms refused to be enrolled in the study, and the rest two farms were planning to cease poultry farming soon. All the farms approached were using the same technique of antimicrobials usage where they were found using the same type of antibiotics but on different days of the production cycle. To obtain reliable data on antimicrobial consumption patterns, registration cards were asked but the registration system for antimicrobial usage was not found prepared and maintained by any farms.

The farmers were using antibiotics prophylactically without any indication of the same pattern in every production cycle. This is in line with a study conducted by Nonga et al. (2010) in Tanzania which revealed that all farmers were using 85% antimicrobials among all the drugs for prophylactic or treatment purposes among which almost two-thirds (65%) were treating broilers in poultry farm.¹⁴

The antimicrobials used were enrofloxacin, tylosin, amoxicillin, doxycycline, and lincomycin. A similar report was furnished by a study done in Pakistan by Mashkoo et al. (2019) where the agents such as tylosin, doxycycline, and enrofloxacin were the most common antimicrobials for prophylactic or therapeutic use in poultry farms.¹⁵

According to WHO classification, all the antimicrobials used in the current study are classified as class 1 or critically important class in human health. Amoxicillin and enrofloxacin are broad-spectrum antibiotics. The fact is when the developed countries are trying to produce antibiotic-free farms, developing countries like Pakistan are still using antimicrobials haphazardly without awareness.¹⁶ The legal steps had not had been taken adequately by the concerned authority against such usage. A great majority of important antibiotics are sold for poultry which can be used in a rational way for routine disease prevention.¹⁷ The poultry industry in Pakistan is relatively unorganized and largely unregulated, making the challenges deeper than the other countries of the world.

There are 25000 poultry farms across the country and producing annually 1220 million kg of chicken meat.¹⁸ Antibiotics misuse is a growing problem in Pakistan where many people take unnecessary antibiotics and avoidable.^{19,20}

The ubiquity of AMR can be expected with such rampant use of antimicrobials on poultry which has been reported by several distinct studies carried out in different parts of the world.²¹ The AMR develops when low or sub-therapeutic doses of antibiotics are given to poultry. The antimicrobial consumption pattern of the current study also signifies that the AMR is inevitable with such practice in Pakistan.

All the antimicrobials were irrationally administered via drinking water in the poultry farms. A study conducted in Tanzania by Rugumisa et al. (2016) is comparable with the current research which has shown that antibiotics were given by similar pattern mixing with food and drinking water and because of which resistance developed against amoxicillin, ampicillin, and few other antibiotics in commercial layer chicken.²² Such resistance can be acquired in humans even without taking antibiotics after consumption of their meat.²³

Many international and regional efforts to control antibiotic resistance have been imposed including the WHO-global action plan.²⁴ The Ministry of National Health Services Regulations and Coordinations over the last two years and the national strategic framework for containment of antimicrobial resistance 2016 was developed and then followed up with the draft; National Action Plan on AMR in May 2017 through a comprehensive consultation process.²⁵ But the farmers were not found compliant with such a national strategic framework and no initiative had been taken by the government to take legal action against them.

The use of antibiotics should be banned immediately in Pakistan otherwise most people will become resistant to antibiotics by their therapeutic misuse or consuming meat from poultry raised with the

routine use of antibiotics meant to treat human illnesses.

Limitations: There were certain limitations to consider in disseminating the findings of this research. Firstly, it was conducted in only six poultry farms which might not reflect the scenario of whole Pakistani farms as there are around 25000 poultry farms across the country. Secondly, the AMR could not be assessed due to the limited availability of resources but it was anticipated that AMR can be the definite result of such irrational use of antimicrobials.

CONCLUSION

Our findings emphasize the rising demand for broiler meat in low- and middle-countries, which has led the growers to irrationally use the antimicrobials in broilers chicken as a growth promoter and for routine disease prevention. The study urges immediate action to stop the overuse of antimicrobials in poultry farms in Pakistan and countries with similar farming practices to avert a public health crisis such as antimicrobial resistance.

Author Contributions:

TMZA: Data collection, Writing - Original draft preparation.

MS: Conceptualization, Supervision, Writing - Reviewing and editing.

AS: Methodology, Writing - Reviewing and editing.

SK: Writing - Original draft preparation, Data analysis.

RPG and PA: Data collection, Literature search.

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