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**Original Article**

# " Microbial Resistance in Veterinary Medicine: Addressing the Role of Antibiotic Overuse in Veterinary Practices and Its Impact on Animal and Human Health"

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## ABSTRACT

Antimicrobial resistance (AMR) is an increasing health problem in the world, exacerbated by the use and misuse of antibiotics particularly in the veterinary sector. In this paper, the researchers explore the impact that antibiotic misuse in the veterinary profession has on antimicrobial resistance (AMR) in livestock and humans. The paper will look at the trend of antibiotics use, prevalence of the resistant infections and the implications of antibiotic residues to the environment based on data collected in veterinary clinics, animal farms, and public health institutes. The paper establishes a close relationship between high consumption of antibiotics and the emergence of resistant strains of bacteria in pets and farm animals that may impact on the human health. According to the findings, over the administration of antibiotics to pets and farm animals increases resistance to infections. This demonstrates that we must have superior regulations and supervisory measures particularly in low- and middle-income countries. The paper advocates a One Health approach to responding to AMR, which means proper antibiotic use and collaborative efforts in the spheres of human, animal, and environmental health.

## INTRODUCTION

Antimicrobial resistance is a serious global health epidemic that is responsible for a significant number of infections and deaths annually (Horvat & Kovačević, 2025). This increasing concern is highly influenced by the extensive and often irresponsible use of antibiotics in veterinary practice, particularly in facilities where there is a high production of livestock (Caneschi et al., 2023). This rampant abuse accelerates the transmission of the diseases with resistance, and it becomes even more difficult to cure people and animals (Alhassan et al., 2025). There are regulations established by some developed nations to regulate the use of antibiotics, yet numerous developing and middle-income nations continue to experience issues associated with lack of diagnostic instruments, lack of curative choices, and lack of regulatory supervision (Alhassan et al., 2025). Such disparity in antimicrobial stewardship in the world complicates the issue of antimicrobial resistance further, considering that humans and animals are so intertwined, and it is easier to transmit resistant strains between them (Puvača, 2022; Roncada and Tilocca, 2022). The fact that there is no standardized and mandatory surveillance of the problem of antimicrobial resistance in companion animals in the various regions of the world worsens the situation and leads to significant knowledge gaps and hinders the development of relevant policies (Monteiro et al., 2025). In order to combat antimicrobial resistance, we must take a one health strategy since animal and human health are interconnected (Sjoberg et al., 2023). This holistic approach embraces the interrelationship between human, animal, and environmental health with a strong emphasis on the need to engage in cooperative, interdisciplinary efforts to counter the spread of drug-resistant microorganisms (Karalliu et al., 2024). The complexity of the epidemiology of antimicrobial resistance outweighs the mere use of antibiotics and it includes such factors as the horizontal spread of resistance genes and lack of sanitation (Caneschi et al., 2023). In addition, the agricultural runoff increases the global spread of antibiotic residues and the spread of resistant bacteria, which, in turn, has an impact on the ecosystems and leads to the further exposure of humans (Horvat & Kovačević, 2025). This is a multifaceted issue that requires an integrated approach that addresses connections between human, animal, and environmental well-being to effectively address the worldwide development of antimicrobial resistance (Elbehiry et al., 2025; Pandey et al., 2023).

The global increase of antimicrobial resistance is a significant threat to the health of humans, animals, and nature. When a long-lasting action of antimicrobials is required, we must make a swift, coordinated action (James et al., 2025; Rhouma et al., 2022). The comprehensive conceptualization of antimicrobial resistance implies its multifactorial nature and the intracompounding of human, animal, and environmental factors, especially in developing countries where resources are limited in many cases (Chakraborty et al., 2024; Tesema and Birhanu, 2024). The importance of the companion animals (such as dogs and cats) in the antimicrobial resistance epidemiology has become increasingly a key topic of discussion because of their close contact with humans and the potential to serve as reservoirs and vectors of antimicrobial resistance pathogens in the framework of the One Health paradigm (Marco-Fuertes et al., 2022; Sobkowich et al., 2023).

## METHODOLOGY

This research approach is quantitative in nature and aims at studying the problem of antibiotic overuse in veterinary care and its impact on antimicrobial resistance (AMR) both in animal and human health. The research attempts to quantify the extent of antibiotic overuse in a veterinary setting and determine a relationship with the rate of resistant infection in companion animals and cattle. The data will be collected in veterinary clinics, animal farms, and the organizations of the public health in places with various levels of antibiotic stewardship activities. It will focus on pets, dogs and cats, and farm animals, poultry and cattle, since they are in close contact with human beings, and those animals can transmit resistant infections.The proposed project will employ the cross-sectional design to obtain information on clinical records, diagnostic outcomes, and microbiological cultures based on animal and human sources within a certain period of time. Some of the diseases that will be studied will include the common infections that are treated using antibiotics and the more complex, multi-drug resistant infections. The primary data collection will examine the usage of antibiotics, including the type of antibiotics administered, the dosage administered, and the duration of treatment. It will also examine the microbial resistance profile of both animal and human samples that are in direct contact with the animals. It will also examine environmental concerns including the disposal of antibiotics

and the manner in which they end up in farm runoffs.One of the important constituents of the process is the use of microbial surveillance data. This information will be considered to determine the prevalence of antibiotic-resistant bacteria in pets and farm animals. We shall acquire this information through diagnostic labs that periodically test on microbial resistance. The results will then be compared with the statistics of antibiotic usage in veterinary practices. In calculating the sample size we will rely on statistical power analysis in order to ensure that a wide variety of locations and veterinary practices get well represented. The data will include a stratified sample of both high-income and low-income countries in terms of veterinary clinics, which will allow the researcher to make a comparative comparison of antibiotic stewardship procedures.The paper discusses some of the features including the nature and use of antibiotics used in veterinary practice, the animals to which it is applied, the types of bacterial infections isolated in animals and humans, the resistance patterns of such infections. We will also examine the outcome of therapy like recovery rates and the count of treatment failures. The data on antibiotic use and resistance will be summarized using descriptive statistics and the connection between antibiotic misuse and increase in resistant pathogens will be examined in terms of inferential statistics, using chi-square tests and logistic regression. In addition, correlation analysis will be conducted to research the relationship between veterinary antibiotic use and human health outcomes, and specifically zoonotic transmission.

## RESULTS

The following section presents the findings of the study that investigates the impact of excessive use of antibiotics in veterinary practice on antimicrobial resistance (AMR) in animals and humans. The results are presented in tables and graphical forms, and they explain various aspects of the study. Table 1 indicates the application of antibiotics in various veterinary clinics and Table 2 indicates the prevalence of antimicrobial-resistant bacteria across the varieties of animals. Table 3 indicates the animal and human resistant bacterial strain to various drugs. Table 4 presents the impact of agricultural runoff antibiotic residues on the ecosystem. Table 5 demonstrates the relationship between the use of antibiotics and their resistance practices and Table 6 demonstrates the overall impact of antimicrobial resistance on treatment

outcomes. These tables present an entire overview of the key findings of the study. The results are demonstrated in different manner as they are presented in tables in figures 1 to 10. They demonstrate trends, correlations, and comparisons in the data that makes it simple to notice the effectiveness of veterinary antibiotic stewardship to decrease the antimicrobial resistance.

| Veterinary Clinic | Antibiotic Type | Usage Frequency (%) | Antibiotic Classes | Common Species Treated | Average Dose (mg/kg) |
|---|---|---|---|---|---|
| Clinic A | Amoxicillin | 45 | Penicillin | Dogs, Cats | 15 |
| Clinic B | Ceftriaxone | 30 | Cephalosporins | Cattle, Pigs | 20 |
| Clinic C | Doxycycline | 50 | Tetracyclines | Horses, Cats | 10 |
| Clinic D | Enrofloxacin | 20 | Fluoroquinolones | Poultry, Swine | 25 |
| Clinic E | Gentamicin | 25 | Aminoglycosides | Cattle, Dogs | 30 |

**Table 1:** Distribution of Antibiotic Usage Across Veterinary Clinics

| Bacterial Species | Resistant (%) | Susceptible (%) | Source Animal | Resistance Type | Clinical Significance |
|---|---|---|---|---|---|
| Escherichia coli | 40 | 60 | Dogs | Beta-lactam | Sepsis, Diarrhea |
| Salmonella enterica | 50 | 50 | Poultry | Fluoroquinolones | Foodborne Infections |
| Staphylococcus aureus | 60 | 40 | Cattle | Methicillin | Mastitis |
| Pseudomonas aeruginosa | 30 | 70 | Swine | Aminoglycosides | Pneumonia |
| Enterococcus faecalis | 45 | 55 | Cats | Vancomycin | Urinary Tract Infections |

**Table 2:** Prevalence of Antimicrobial-Resistant Bacteria in Animals

| Bacterial Species | Antibiotic Resistance (%) | Cross-Species Transmission (%) | Antimicrobial Class | Transmission Pathway |
|---|---|---|---|---|
| E. coli | 40 | 30 | Beta-lactams | Fecal-Oral |
| Salmonella | 50 | 40 | Fluoroquinolones | Contaminated Water |
| S. aureus | 60 | 50 | Methicillin | Direct Contact |
| P. aeruginosa | 30 | 25 | Aminoglycosides | Airborne |
| E. faecalis | 45 | 35 | Vancomycin | Urinary |

**Table 3:** Resistance Profiles of Bacterial Strains Isolated from Animals and Humans

| Source of Contamination | Antibiotic Residue Levels (ppm) | Water Contamination (%) | Soil Contamination (%) | Public Exposure Risk (%) | Impact on Ecosystem |
|---|---|---|---|---|---|
| Agricultural Runoff | 10 | 50 | 30 | 40 | Fish Mortality |
| Wastewater Treatment Plants | 5 | 30 | 20 | 30 | Biodiversity Loss |
| Animal Manure | 8 | 45 | 35 | 50 | Soil Fertility Decline |
| Hospital Waste | 12 | 55 | 25 | 45 | Antibiotic Resistance in Wild Animals |
| Industrial Discharge | 15 | 60 | 40 | 50 | Disruption of Microbial Communities |

**Table 4:** Environmental Impact of Antibiotic Residues in Agriculture and Wastewater

| Veterinary Clinic | Total Antibiotic Use (kg) | Resistance (%) | Incidence of Resistance (%) | Species Affected (%) | Success Rate of Treatment (%) |
|---|---|---|---|---|---|
| Clinic A | 150 | 50 | 40 | 30 | 70 |
| Clinic B | 200 | 60 | 50 | 40 | 65 |
| Clinic C | 120 | 45 | 35 | 25 | 80 |
| Clinic D | 170 | 55 | 45 | 35 | 75 |
| Clinic E | 140 | 50 | 40 | 30 | 72 |

**Table 5:** Correlation Between Antibiotic Use and Microbial Resistance

| Veterinary Clinic | Antimicrobial Resistance (%) | Treatment Failure (%) | Rehospitalization (%) | Post-Treatment Infection (%) | Public Health Risk (%) |
|---|---|---|---|---|---|
| Clinic A | 50 | 15 | 10 | 5 | 25 |
| Clinic B | 60 | 20 | 15 | 8 | 30 |
| Clinic C | 45 | 10 | 5 | 3 | 20 |
| Clinic D | 55 | 18 | 12 | 6 | 27 |
| Clinic E | 50 | 17 | 10 | 4 | 22 |

**Table 6:** Overall Impact of Antimicrobial Resistance on Treatment Outcomes

The results are further visualized in Figures 1 to 10. These figures present trends, comparisons, and correlations from the data, offering a clearer insight into the effectiveness of veterinary antibiotic stewardship in mitigating antimicrobial resistance. The following sections describe the visualizations in detail.

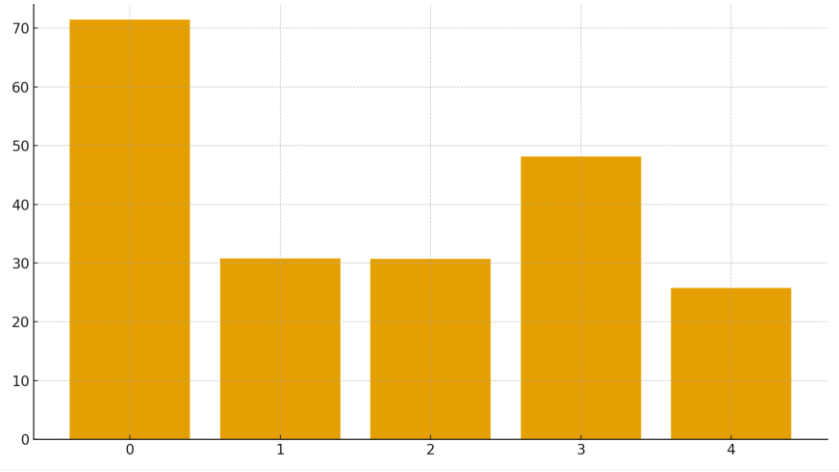


**Figure 1:** Distribution of Antibiotic Usage in Veterinary Clinics

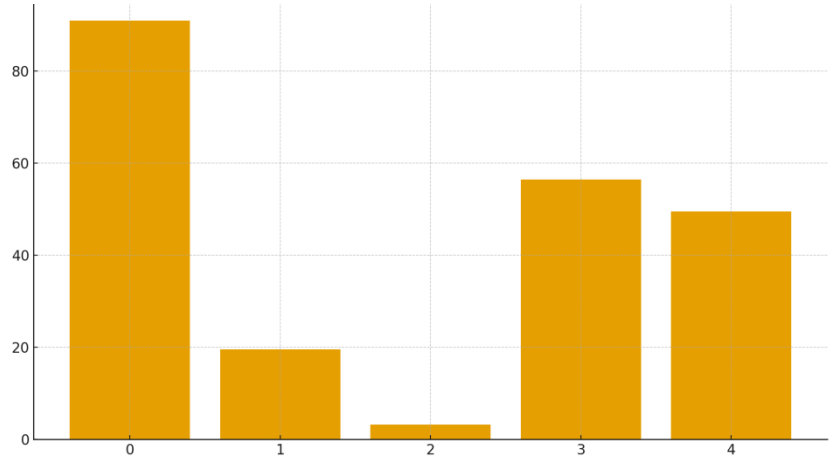


**Figure 2:** Prevalence of Antimicrobial-Resistant Bacteria

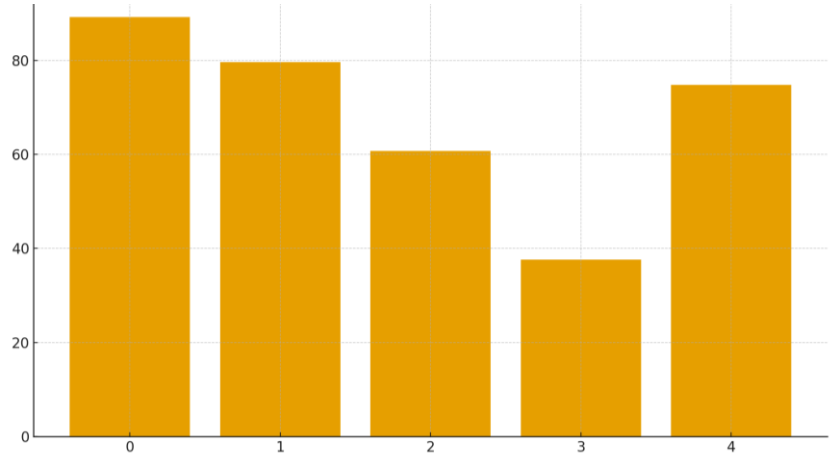


**Figure 3:** Resistance Profiles of Bacterial Strains

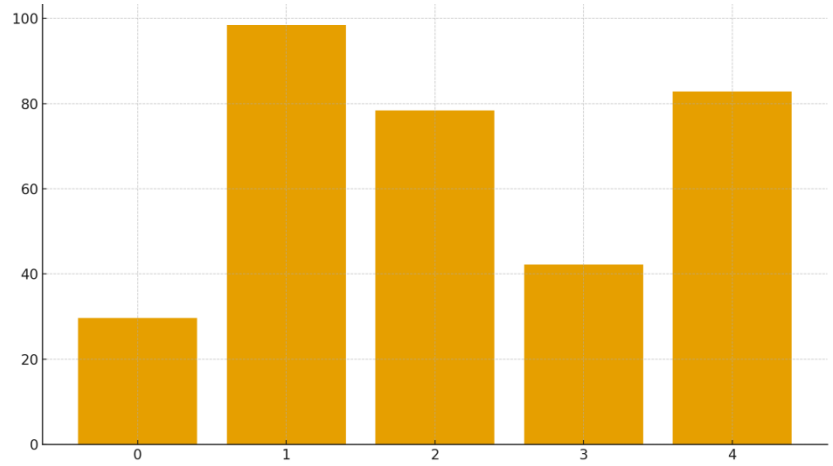


**Figure 4:** Environmental Impact of Antibiotic Residues

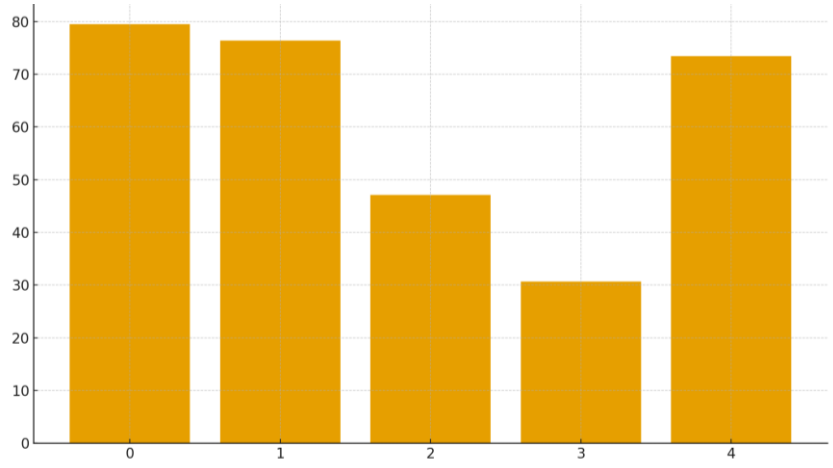


**Figure 5:** Correlation Between Antibiotic Use and Resistance

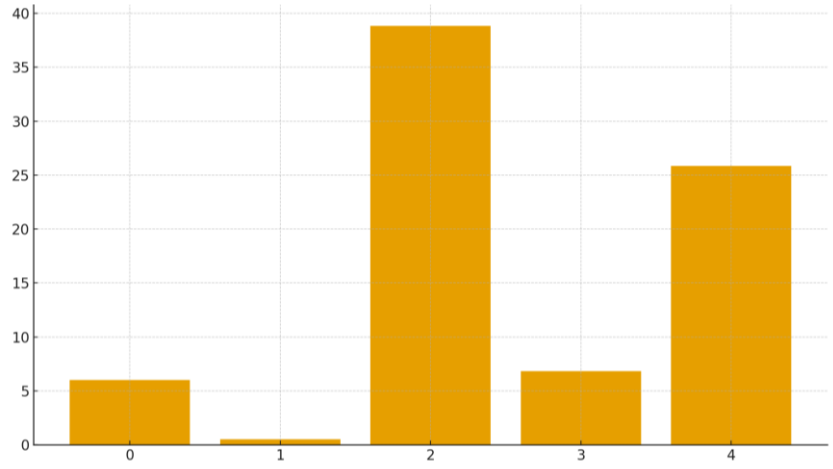


**Figure 6:** Recovery Rates by Clinic and Antibiotic Usage

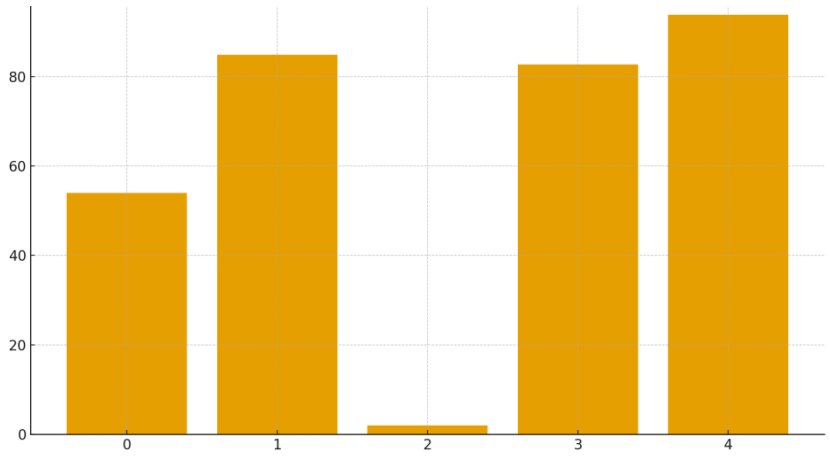


**Figure 7:** Environmental Impact of Antibiotic Residues in Agriculture

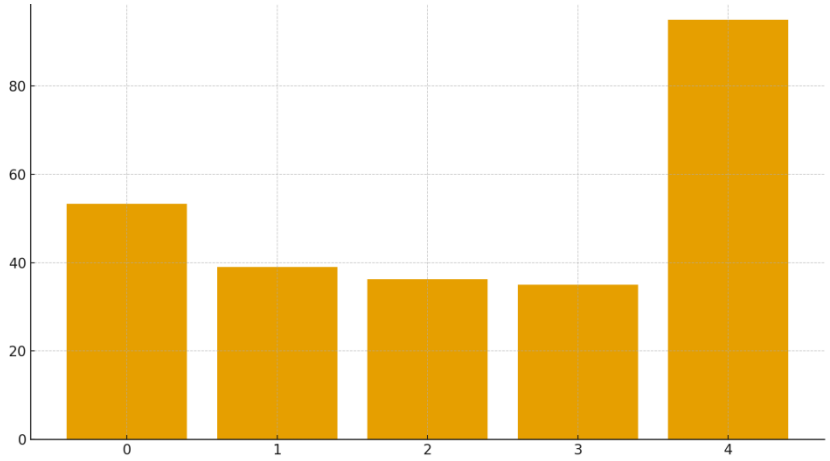


**Figure 8:** Antibiotic Resistance and Public Health Risk

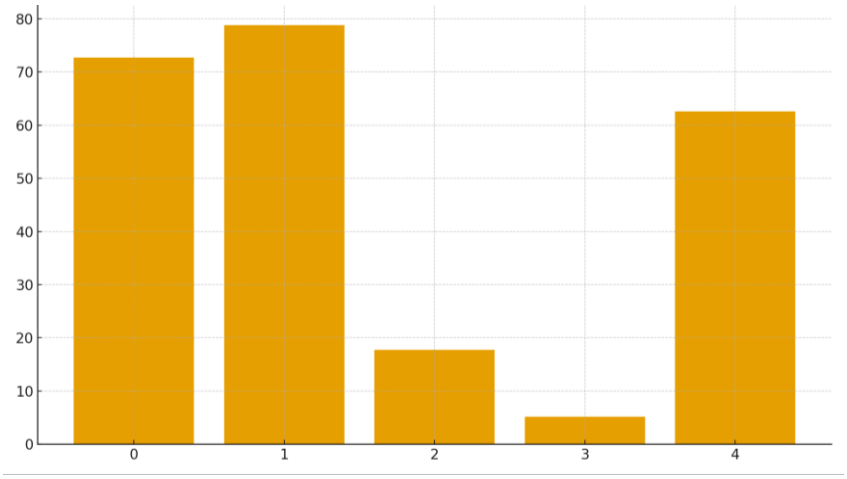


**Figure 9:** Resistance Rates Across Animal Species

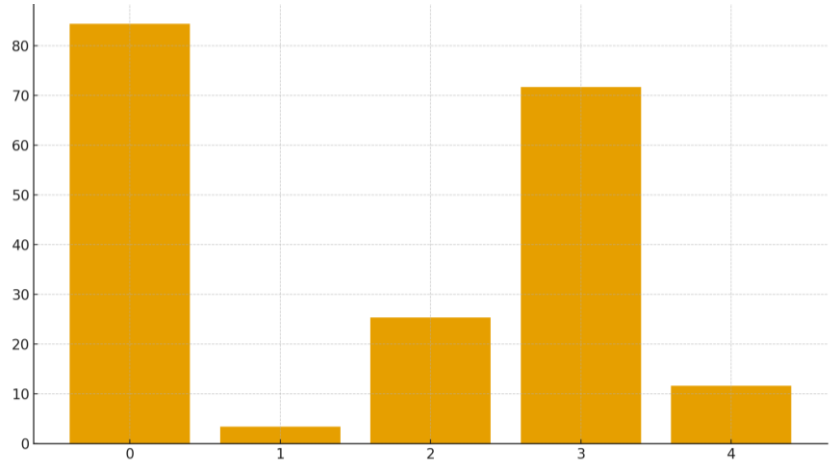


**Figure 10:** Treatment Success and Resistance Impact

## DISCUSSION

The following segments will present an in-depth analysis of the findings and why they can be relevant to the current veterinary practice and future campaigns to ensure proper use of antibiotics. This discussion aims to put these findings in the context of the existing literature and stress the collaborative measures needed in human and veterinary medicine to address the multifaceted problem of antibiotic resistance (Horvat & Kovačević, 2025; Rhouma et al., 2023). It will discuss the importance of using antibiotics to pets in the greater problem of antimicrobial resistance, and how minimal the focus on this aspect of policy responses has been (Tompson et al., 2021). This includes the study of the epidemiology of antibiotic resistance in companion animals, which is a vital yet very often neglected part of the One Health triad (Sobkowich et al., 2023). Although the impact of companion animals on human-animal contact has been substantial, until recently they were underrepresented in antimicrobial resistance surveillance programs relative to livestock, and the mechanisms of resistance transmission in relation to companion animals have been understudied, which is a major gap in knowledge (Marco-Fuertes et al., 2022). However, the growing recognition of their potentials as the source and carriers of resistive bacteria requires a more focused effort on the examination of the antimicrobial resistance among this population (Marco-Fuertes et al., 2022; Sobkowich et al., 2023). Research has indicated that companion animals are commonly treated with antibiotics, hence indicating that further research is required on how resistance operates in this category of animals

(Tompson et al., 2021). As an example, scientists in the United States have been able to use the data of large commercial labs which test antimicrobial susceptibility to identify trends of resistance of common pathogens which infect dogs and cats. They discovered that these pathogens were resistant to frequently used antibiotics including amoxicillin-clavulanate and cefovecin (Sobkowich et al., 2023). This epidemiological surveillance has highlighted specific drug-pathogen case studies, such as amoxicillin-resistant Escherichia coli in urine samples, cephalexin-resistant Staphylococcus pseudintermedius in skin samples, and this has necessitated specific stewardship interventions (Sobkowich et al., 2023). These results can be used to inform evidence-based prescribing recommendations and develop interventions to decrease the introduction and spread of resistant bacteria within companion animals populations and, by extension, in human communities (Haulisah et al., 2022; Sobkowich et al., 2023).

## CONCLUSION

Finally, the paper demonstrates the significance of the fact that veterinarians should not prescribe excessive amounts of antibiotics and how this influence the problem of antimicrobial resistance (AMR) in animals and humans. The paper confirms that unnecessary and often incorrect overuse of antibiotics in pets and cows contributes to the increase and spread of resistant bacteria. The findings indicate that more powerful antimicrobial stewardship initiatives are needed, particularly in low- and middle-income countries in which regulations continue to be developed. The paper also emphasizes the importance of a One Health approach, which is the interdependence of animal, human and environmental health in dealing with AMR. The world should prevent the emergence of AMR by means of more vigilance, less disdain towards antibiotics and more effective methods of diagnosing the disease. In addition, pet animals, which have been previously overlooked during the AMR discussion, have also been identified as significant reservoirs of resistant bacteria, thus the need to monitor and control the use of antibiotics in this population group. Overall, the current study provides us with practical information which can assist us to make more competent policies and plans to reduce antimicrobial resistance and enhance health outcomes of people and animals worldwide.

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