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Research Article

Prevalence of Antibiotic Resistance in Clinical Pet Dog Practice

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Abstract

Antimicrobial resistance (AMR) poses a global threat to humans and animals due to the widespread use of antibiotics in veterinary and human healthcare. With the increase in pet ownership, there has been a surge in veterinary care expenditure, leading to elevated antibiotic usage. Consequently, AMR has spread among animals, posing a risk to human health through close contact and potential transmission of resistant pathogens. In India, the situation is aggravated by the lack of comprehensive reporting on antimicrobial usage, limited monitoring of antibiotic resistance levels, and inadequate adherence to Antibiotic Sensitivity Testing (ABST) before prescribing antibiotics for animals. This study evaluated the prevalence and resistance patterns by conducting ABST on samples collected from pet dogs. The findings revealed a concerning emergence of resistance to commonly used antibiotics such as Ampicillin, Penicillin, Cloxacillin, and Cephalexin, with resistance rates ranging from 90.625% to 100% among tested pathogens. However, certain antibiotics retained their sensitivity. This research emphasizes the urgent need to address AMR in pets as it directly impacts humans through close contact and the potential spread of resistant strains. To combat the serious AMR situation in India, it is crucial to implement improved reporting systems, robust monitoring of antibiotic resistance, and prioritize ABST before prescribing antibiotics to animals. Promoting judicious antibiotic use is essential to mitigate resistance, safeguard antibiotic effectiveness, and preserve human and animal health and well-being.

Keywords: Pet Dogs, Antimicrobial Resistance (AMR), Antimicrobial Sensitive Test (ABST)

Introduction

Antibiotics are crucial in promoting health and well-being in humans and animals. However, the emergence of antibiotic-resistant pathogens poses a significant threat to public and animal health worldwide [1]. The issue of antibiotic resistance stems from the exposure of bacteria to antibiotics, whether through veterinary clinics or the close contact, animals have with their owners [2]. As the number of pets and the focus on their welfare continues to rise [3], so does the number of antimicrobial treatments administered to animals. Thus, these animals are more likely to develop resistant bacteria [4,5]. This is also evident in our study, where many infected pet dogs exhibited resistance to certain antibiotics.

Numerous studies have identified pets as potential reservoirs for transmitting antimicrobial-resistant bacteria and zoonotic infections to humans due to the extensive use of antibiotics and close interaction with humans [6-8]. This situation is deeply concerning for humans and animals, as critically important antibiotics such as cephalosporins and penicillins, vital for treating bacterial infections, are at risk of losing their effectiveness against microor-

ganisms. According to the AWaRe classification, the World Health Organization (WHO) has classified antibiotics into three major categories: Access, Watch, and Reserve. Watch category antibiotics are considered "highest-priority critically important antimicrobials" and should be used with caution.

The World Organisation for Animal Health (OIE) has also compiled a list of critically important antimicrobials known as Very Critically Important Antibiotics (VCIA). In order to minimize the risk of antimicrobial resistance, this list serves as a reference for prescribing antibiotics to animals. A principal objective of our study is to identify antibiotics, that have lost their efficacy against pathogenic bacteria based on the WHO and OIE classifications. By examining the resistance patterns of these antibiotics, we aim to contribute to the understanding of antimicrobial resistance in the context of pet dogs, emphasizing the importance of judicious antibiotic use to mitigate the spread of resistance and preserve the efficacy of these vital drugs for the benefit of both human and animal health.

Materials and Methods

Thirty-two samples were collected from pet dogs exhibiting clinical infections to detect resistance/sensitivity among 30 antibiotics between February 2022 and July 2023. The samples were obtained from dog breeds, including Pug, Labrador, German Shepherd, Rottweiler, Crossbred, Beagle, Golden Retriever, Siberian Husky, Boxer, and Persian. The sample types were selected based on the specific disease present in each animal, encompassing urine, ear discharge, scrap from skin lesions, skin lesion exudate, stool, throat swabs, vaginal discharge, milk, and pus.

The agar plates used in the study were prepared by dissolving solid agar (Mueller-Hinton Agar) in distilled water. The agar-water mixture was thoroughly mixed and autoclaved at 121°C for 15 minutes. Once autoclaved, the sterilized Petri plates were obtained, and the agar medium was poured into the plates. The plates were labelled on the back to identify the sample source quickly. To inoculate the agar plates, a sterile swab was taken, and one end of the swab was dipped into the respective sample vial. The agar plates were then evenly inoculated by streaking the entire plate with the swab. Special care was taken to minimize the exposure of agar plates to the environment, as prolonged exposure could lead to contamination.

Following the inoculation, the agar plates were divided into sections to accommodate the placement of antibiotic discs. The discs were carefully placed on the agar surface, and gentle pressure was applied with tweezers to ensure adherence of the discs to the agar. After completing the disc placement, the plates were incubated at 37°C for 48 hours. Upon completion of the incubation period, the plates were removed from the incubator, and the zones of inhibition were observed. The diameter of the zones was measured, and the antibiotic sensitivity level and resistance were determined using a reference table. This methodology ensured standardized and systematic evaluation of antibiotic resistance/sensitivity patterns among the collected samples from pet dogs.

Results and Discussion

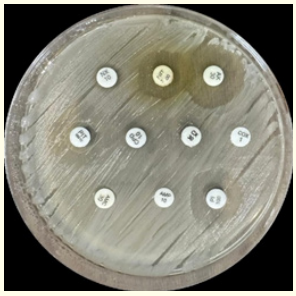

Figure 1: Petri Plate having zones of inhibition after incubation of sample and embedding antibiotic discs.

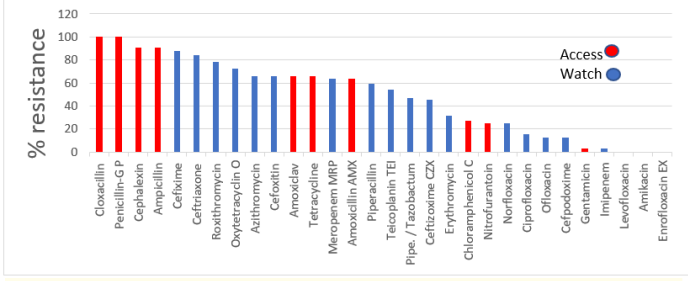

Figure 2: The chart displays the resistance percentages observed against different antibiotics.

Antibiotic resistance poses a significant threat to public health, affecting humans and animals. In this study, we conducted Antibiotic Sensitivity Testing (ABST) on samples from pet dogs to assess the resistance patterns of various antibiotics. Our findings highlight the urgent need for judicious antibiotic use in veterinary practice to combat the rising prevalence of antibiotic resistance.

The results of our study indicate that certain antibiotics exhibited resistance to pathogens while others demonstrated sensitivity. According to the guidelines provided by the World Health Organization (WHO), antibiotics such as Ampicillin, Cloxacillin, Penicillin-G, and Cephalexin, listed in the "Access" category, showed high re-

sistance rates ranging from 90.625% to 100%. This alarming trend emphasizes the potential threat these antibiotics pose in treating infections. However, antibiotics like Amoxiclav (63.636%), Nitrofurantoin (25%), Tetracycline (65.625%), Gentamicin (3.125%), and Amikacin (0%), also classified under the "Access" category, showed relatively lower resistance rates, suggesting their continued efficacy in treating infections. It is crucial to employ these antibiotics prudently to preserve their effectiveness.

The resistance observed in antibiotics listed in the WHO's Watchlist category raises concerns about their misuse by practitioners or owners. Antibiotics such as Ceftriaxone, Cefixime, Azithromycin, Cefoxitin, Piperacillin, and Roxithromycin displayed resistance rates ranging from 76.1% to 90%. This indicates a lack of judicious use and highlights the urgent need for more responsible antibiotic prescribing practices in human and veterinary medicine.

The study also reveals an important overlap between the WHO and the World Organisation for Animal Health (OIE) classifications. Antibiotics such as Ampicillin, Amoxiclav, Cloxacillin, Cephalexin, Penicillin-G, Amikacin, and Gentamicin are categorized under the "Veterinary Critically Important Antimicrobials" (VCIA) by OIE, which aligns with the WHO's "Access" category. This correlation underscores the necessity for collaboration between these organizations to identify antibiotics of concern for both human and animal use. Due to the shared environment between humans and animals, antimicrobial resistance (AMR) is significantly increased through common antibiotics.

Our Study highlights a worrisome trend of antibiotic resistance, particularly among commonly used broad-spectrum antibiotics. Our data indicate that many broad-spectrum antibiotics have developed resistance in many cases, which could have disastrous consequences. Antibiotics in the Access category demonstrate activity against a wide range of commonly encountered susceptible pathogens while exhibiting lower resistance potential. Unfortunately, our findings reveal that most drugs in the Access category have already shown resistance in most cases, except for Amoxiclav, which displayed resistance in only 60% of cases. Antibiotics in the Reserve category are considered "last resort" and should only be used when all other alternatives have failed [9]. The depletion of antibiotic reserves is evident, as many cases displayed resistance to these broad-spectrum antibiotics. This underscores the urgent need to preserve the effectiveness of these medications through judicious use.

The overarching goal of our research is to emphasize the importance of judicious antibiotic use, treating these "non-renewable" resources with utmost care. This involves limiting their usage to situations where they are necessary, administering them for the shortest duration required, using the optimal dose, and starting with narrow-spectrum antibiotics before escalating to broader options when necessary. Consulting with veterinarians and considering proper laboratory results is essential in making informed treatment decisions that minimize toxicity and reduce the emergence of resistant bacteria. Our Study reveals alarming levels of antibiotic resistance among pet dogs, highlighting the urgent need for prudent antibiotic use in veterinary practice. Collaborative efforts between organizations such as the WHO and the OIE are crucial in identifying antibiotics requiring human and animal use attention. By implementing strategies to limit antibiotic use, we can mitigate the spread of antimicrobial resistance and preserve the effectiveness of these vital medications to benefit both human and animal health [10].

Conclusion

Our study findings highlight trends in antibiotic resistance among pet dogs, specifically regarding the major classes of Penicillin and Cephalosporins. These antibiotics, already classified in the Watch and Access categories by the WHO demonstrated resistance in the microorganisms present in the samples we analyzed. It indicates a rise in antimicrobial resistance (AMR) in pet dogs, which limits the options for treating animal infections. Moreover, the presence of resistance in antibiotics commonly used by humans suggests that pet dogs could potentially serve as reservoirs for AMR, with the risk of transmission to their owners. The diminishing number of antibiotics showing sensitivity to the microorganisms further highlights the urgency of addressing this issue. Although our Study provides insights from a limited sample size, it offers valuable implications for the global scenario of AMR. To mitigate the spread of AMR in pet dogs and its potential impact on human health, concerted efforts are required from veterinary and human healthcare professionals and regulatory bodies. Promoting responsible antibiotic use, surveillance of resistance patterns, and collaborative strategies between relevant organizations are crucial steps toward preserving the efficacy of antibiotics and safeguarding the health of both animals and humans.

Ethical Approval

A formal ethics approval was obtained from the Institutional Animal Ethics Committee of the College of Veterinary Sciences and Animal Husbandry in New Delhi [140/IAEC/23, 2023-07-17] for the conduct of this Study.

Limitations of the Study

Our Study did not include the data of some antibiotics which fall under "Reserve drugs" by WHO because of the unavailability of the antibiotic disc during the study dura

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