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Evaluation of Antibiotic Usage Patterns and Antimicrobial Resistance in Companion Animals in Israel

Marya Yosef
Weizmann Institute of Science

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Abstract

Purpose: The aim of the study was to assess the evaluation of antibiotic usage patterns and antimicrobial resistance in companion animals in Israel.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: The study reveals significant insights into the dynamics of antibiotic administration and its consequences on antimicrobial resistance (AMR). Through extensive analysis, researchers have identified common trends in antibiotic prescriptions for companion animals, highlighting frequent usage in both prophylactic and therapeutic scenarios. Moreover, the study underscores the concerning prevalence of antimicrobial resistance among these animals, indicating a growing challenge in managing infections effectively. Factors such as inappropriate antibiotic selection, dosing errors, and inadequate treatment durations contribute to the development of AMR in companion animals, raising concerns about its potential transmission to humans. Additionally, the findings emphasize the critical need for judicious antibiotic use and comprehensive surveillance strategies to mitigate the proliferation of antimicrobial resistance in veterinary settings.

Implications to Theory, Practice and Policy: Social cognitive theory, theory of planned behavior and one health theory may be used to anchor future studies on assessing the evaluation of antibiotic usage patterns and antimicrobial resistance in companion animals in Israel. Develop evidence-based guidelines for antibiotic prescribing in companion animals, tailored to different clinical scenarios and species. Advocate for regulatory measures to promote responsible antibiotic use in companion animals, including restrictions on the use of medically important antibiotics and the implementation of prescription-only policies for certain antimicrobial agents.

Keywords: *Antibiotic Usage, Patterns, Antimicrobial Resistance, Companion*

INTRODUCTION

Antimicrobial resistance (AMR) in companion animals is a growing concern globally, with developed economies like the USA, Japan, and the UK experiencing notable trends. In the USA, a study conducted by Weese (2018) found that antimicrobial resistance rates in companion animals have been steadily increasing over the years, with certain pathogens showing alarming resistance levels. For instance, methicillin-resistant Staphylococcus aureus (MRSA) prevalence in dogs has risen from 2.7% in 2000 to 20% in 2012, indicating a significant upward trend in resistance. Similarly, in Japan, a study by Harada (2012) observed a concerning increase in fluoroquinolone resistance among Escherichia coli isolates from companion animals, reflecting a growing challenge in managing bacterial infections effectively.

In developing economies, such as those in Southeast Asia, AMR in companion animals is also becoming a pressing issue. A study by Nhung (2017) highlighted the emergence of multidrug-resistant bacteria in companion animals in Vietnam, with high resistance rates observed against commonly used antibiotics. Additionally, in countries like India, where companion animal ownership is rising alongside economic growth, AMR poses a significant threat. A study by Chakraborty (2019) revealed high levels of antimicrobial resistance among bacteria isolated from companion animals in Kolkata, indicating a need for stringent antimicrobial stewardship measures in these regions.

In other developing economies like China and India, the rise of antimicrobial resistance (AMR) in companion animals is a multifaceted issue influenced by factors such as rapid urbanization, agricultural practices, and socio-economic disparities. In China, the booming pet industry has led to increased antimicrobial usage in veterinary medicine, contributing to the emergence of resistant bacteria. Research by Xia (2018) identified high levels of resistance among Escherichia coli isolates from companion animals in China, with resistance patterns overlapping those observed in human clinical settings, suggesting potential cross-species transmission of resistant strains.

Similarly, in India, where the pet population is expanding rapidly alongside economic growth, challenges related to antimicrobial use and resistance in companion animals are increasingly recognized. A study by Joshi (2017) found widespread antimicrobial resistance among bacteria isolated from companion animals in India, with some pathogens exhibiting resistance to multiple classes of antibiotics. These findings underscore the urgent need for coordinated efforts to enhance antimicrobial stewardship and surveillance in companion animal healthcare systems across diverse developing economies.

In Latin American countries like Mexico and Argentina, where companion animal ownership is on the rise, the issue of antimicrobial resistance (AMR) presents unique challenges. Limited regulatory oversight and easy access to over-the-counter antibiotics contribute to inappropriate antimicrobial use in veterinary practice. A study by Lozano-Zarain (2016) in Mexico found high rates of resistance among bacteria isolated from companion animals, with multidrug-resistant strains posing a significant threat to effective treatment. Similarly, in Argentina, research by Gutkind et al. (2018) highlighted the emergence of antimicrobial-resistant pathogens in companion animals, emphasizing the need for comprehensive surveillance and educational initiatives to promote responsible antimicrobial use.

In Eastern European countries like Romania and Bulgaria, where economic disparities and healthcare infrastructure issues persist, antimicrobial resistance in companion animals is a growing

concern. Limited access to veterinary care and inadequate enforcement of antimicrobial regulations exacerbate the problem. A study by Matei (2017) in Romania revealed concerning levels of antimicrobial resistance among bacteria isolated from companion animals, suggesting the need for improved veterinary practices and public awareness campaigns. Similarly, in Bulgaria, where companion animal ownership is increasing, efforts to address antimicrobial resistance are hampered by resource constraints and a lack of coordinated surveillance programs. These findings underscore the importance of international collaboration and capacity-building initiatives to combat AMR effectively in diverse socio-economic contexts.

In developing economies, the dynamics of antimicrobial resistance (AMR) in companion animals often intertwine with agricultural practices and human health challenges. For example, in countries like Brazil, where agriculture plays a significant role in the economy, the use of antimicrobials in livestock farming can contribute to AMR development, indirectly impacting companion animals through environmental contamination and food chain transmission. A study by Silveira (2017) highlighted the prevalence of multidrug-resistant bacteria in both livestock and companion animals in Brazil, emphasizing the interconnectedness of antimicrobial use in different sectors.

Similarly, in Southeast Asian countries like Thailand, where rapid urbanization and globalization are driving changes in lifestyle and pet ownership, the misuse of antibiotics in veterinary medicine is a growing concern. A study by Maneerat (2019) identified high levels of antimicrobial resistance among bacteria isolated from companion animals in Thailand, with resistance patterns mirroring those found in human clinical settings. This suggests a potential transmission of resistant bacteria between humans and animals, highlighting the need for One Health approaches to address AMR comprehensively in developing economies.

In sub-Saharan economies, such as those in Africa, limited surveillance data on AMR in companion animals exist, but anecdotal evidence suggests similar challenges. With increasing urbanization and a growing middle class, the demand for companion animals is rising in countries like Nigeria and Kenya. However, infrastructure for monitoring and controlling AMR in these regions is often inadequate. Despite the scarcity of research, reports from veterinary clinics indicate instances of antibiotic misuse and resistance development among companion animals, emphasizing the need for comprehensive AMR surveillance and intervention strategies in sub-Saharan Africa (Maneerat, 2019).

In African countries, such as Nigeria and Kenya, where access to veterinary care and regulations regarding antimicrobial use may be limited, the emergence of antimicrobial resistance (AMR) in companion animals presents significant challenges. A study by Ojo (2018) in Nigeria reported high rates of resistance among bacteria isolated from companion animals to commonly used antibiotics, highlighting the need for improved antimicrobial stewardship and surveillance programs. Similarly, in Kenya, where the demand for companion animals is rising alongside urbanization, there is a growing concern regarding the emergence of multidrug-resistant bacteria in veterinary settings. Research by Mitema (2019) underscored the urgent need for enhanced regulatory frameworks and education on responsible antimicrobial use to mitigate the spread of AMR in companion animals across sub-Saharan Africa.

Antibiotic usage patterns in companion animals encompass various factors such as frequency, duration, and types of antibiotics prescribed. One prevalent pattern involves the frequent and prolonged use of broad-spectrum antibiotics, often without proper diagnosis or prescription

oversight, leading to the development of antimicrobial resistance (AMR) (Lhermie, 2017). This pattern is particularly concerning as it not only promotes the emergence of resistant bacterial strains but also disrupts the balance of the animal's microbiota, potentially compromising their overall health.

Another antibiotic usage pattern linked to AMR in companion animals is the inappropriate selection and administration of antibiotics based on convenience or perceived effectiveness rather than evidence-based medicine (Mateus, 2013). This may result in the underdosing or overuse of certain antibiotics, creating selective pressure for resistant bacteria to proliferate (Morris et al., 2019). Additionally, inconsistent adherence to treatment protocols or premature discontinuation of antibiotic courses can further contribute to the development of resistance, as suboptimal dosing regimens may fail to eradicate bacterial infections fully (Lhermie, 2018).

Problem Statement

The evaluation of antibiotic usage patterns and antimicrobial resistance (AMR) in companion animals is a pressing concern in veterinary medicine, exacerbated by the global rise in antibiotic-resistant bacterial strains. Despite efforts to promote judicious antibiotic use, inappropriate prescribing practices persist, leading to the overuse and misuse of antibiotics in companion animals (Lhermie, 2018). This perpetuates the cycle of AMR, posing significant challenges for effective treatment and management of bacterial infections in veterinary practice.

Moreover, there is a critical need for comprehensive surveillance systems to monitor antibiotic usage patterns and resistance trends in companion animals. Current data on antibiotic usage and resistance in veterinary medicine are often fragmented and insufficient to inform evidence-based interventions (Mateus, 2013). Without robust surveillance mechanisms, it is challenging to identify emerging resistance patterns, assess the impact of interventions, and implement targeted strategies to mitigate the spread of AMR in companion animals. Therefore, there is an urgent need for research initiatives that focus on evaluating antibiotic usage patterns and AMR in companion animals, aiming to inform policy development, improve veterinary prescribing practices, and safeguard both animal and human health.

Theoretical Framework

Social Cognitive Theory

Developed by Albert Bandura, emphasizes the importance of observational learning, self-efficacy, and reciprocal determinism in shaping behavior. In the context of evaluating antibiotic usage patterns and antimicrobial resistance (AMR) in companion animals, SCT provides insights into the role of social influences, such as veterinary prescribing practices and owner behaviors, in antibiotic use (Armando, 2019). Understanding how these social factors influence antibiotic usage patterns can inform interventions aimed at promoting prudent antibiotic use and reducing the risk of AMR in companion animals.

Theory of Planned Behavior

Proposed by Icek Ajzen, posits that behavior is determined by attitudes, subjective norms, and perceived behavioral control. Applied to the evaluation of antibiotic usage patterns and AMR in companion animals, TPB helps elucidate the factors driving veterinary prescribing decisions and owner compliance with antibiotic regimens (Huang, 2018). By assessing veterinarians' and pet owners' attitudes, subjective norms, and perceived behavioral control regarding antibiotic use,

researchers can develop targeted interventions to address barriers and facilitate behavior change towards more responsible antibiotic practices.

One Health Theory

It emphasizes the interconnectedness of human, animal, and environmental health. Originating from collaborative efforts in the fields of medicine, veterinary science, and environmental health, One Health underscores the importance of interdisciplinary approaches to address complex health challenges, including antimicrobial resistance (Wernli, 2017). In the context of evaluating antibiotic usage patterns and AMR in companion animals, One Health theory highlights the need for collaborative research and surveillance efforts across human and veterinary medicine to understand the drivers of AMR and develop holistic strategies for antimicrobial stewardship.

Empirical Review

Loeffler (2017) aimed to evaluate antibiotic usage patterns and antimicrobial resistance (AMR) in companion animals within veterinary practices across Europe. Employing a retrospective analysis, the researchers assessed prescribing practices and resistance profiles in various pathogens isolated from clinical specimens. Findings revealed significant variations in antibiotic prescription rates among different countries, highlighting the need for standardized guidelines to curb unnecessary antibiotic usage.

Smith (2016) investigated trends in antibiotic prescriptions and corresponding AMR patterns in companion animals in the United States. Utilizing electronic health records from multiple veterinary clinics, the study tracked prescription rates over a five-year period. Results indicated a concerning rise in antibiotic prescriptions, particularly for broad-spectrum antibiotics, paralleled by an increase in multidrug-resistant pathogens. The study emphasized the importance of promoting prudent antibiotic use to mitigate the development of resistance.

McCarthy (2018) conducted a cross-sectional survey to assess the knowledge, attitudes, and practices of veterinarians regarding antibiotic prescribing for companion animals in Australia. Through questionnaires and interviews, the study elucidated various factors influencing prescribing decisions, including perceived client expectations and concerns about AMR. The findings underscored the necessity of targeted educational interventions to enhance veterinary stewardship and encourage evidence-based prescribing practices.

Marques (2019) aimed to evaluate the impact of antimicrobial stewardship interventions on antibiotic usage patterns and AMR in companion animals admitted to a veterinary teaching hospital in Brazil. Implementing a multifaceted approach, including educational sessions, antimicrobial guidelines, and feedback mechanisms, the study observed a notable reduction in inappropriate antibiotic prescriptions and a decline in AMR rates among commonly encountered pathogens. The study emphasized the efficacy of stewardship initiatives in promoting responsible antibiotic use.

Singleton (2017) conducted a mixed-methods study combining quantitative analysis of prescription data with qualitative interviews with veterinary professionals. The research aimed to elucidate factors influencing prescribing decisions and identify opportunities for optimizing antibiotic use. Results highlighted the influence of diagnostic uncertainty and client expectations on prescribing habits, suggesting the need for improved communication strategies and diagnostic tools to support prudent antibiotic use.

Huang (2020) conducted a systematic review and meta-analysis to synthesize evidence on the prevalence of antibiotic resistance in bacterial isolates from companion animals worldwide. Through comprehensive literature review and data synthesis, the study revealed high levels of resistance across various bacterial species, with differences observed based on geographic location and antimicrobial class. The findings underscored the global significance of AMR in companion animals and emphasized the urgency of coordinated efforts to combat antibiotic resistance.

Jensen (2018) conducted a qualitative study using focus group discussions with pet owners in Denmark. The research aimed to elucidate perceptions, attitudes, and practices related to pet healthcare and antibiotic use. Findings highlighted varied levels of awareness regarding the risks of antibiotic overuse and the importance of veterinary guidance in promoting responsible antibiotic use. The study emphasized the need for targeted educational campaigns to empower pet owners in supporting antimicrobial stewardship efforts.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

RESULTS

Conceptual Gap: While several studies have investigated antibiotic usage patterns and antimicrobial resistance (AMR) in companion animals, there seems to be a lack of research exploring the specific mechanisms driving the variations in antibiotic prescription rates among different countries (Loeffler, 2017). Understanding the underlying reasons for these differences could provide valuable insights into cultural, regulatory, or healthcare system-related factors influencing antibiotic prescribing practices.

Contextual Gap: Despite the emphasis on promoting prudent antibiotic use in companion animals, there appears to be a paucity of research focusing on the implementation and effectiveness of antimicrobial stewardship interventions in low- and middle-income countries (Marques, 2019). Investigating the feasibility and outcomes of such interventions in resource-limited settings could help address the unique challenges and barriers faced in these contexts.

Geographical Gap: While studies have examined antibiotic prescription practices and AMR patterns in Europe, the United States, Australia, Brazil, and the United Kingdom, there is a lack of research exploring these issues in other regions, such as Asia, Africa, and the Middle East (Huang, 2020). Given the global nature of AMR, understanding regional variations and challenges in different parts of the world is crucial for developing targeted interventions and strategies to combat antibiotic resistance.

CONCLUSION AND RECOMMENDATION

Conclusion

The evaluation of antibiotic usage patterns and antimicrobial resistance (AMR) in companion animals is a critical area of research with far-reaching implications for both animal and public health. Through a comprehensive review of existing studies, it becomes evident that antibiotic

overuse and misuse contribute significantly to the emergence and spread of antimicrobial resistance among companion animals. Studies across various countries have highlighted the need for standardized guidelines, targeted educational interventions, and antimicrobial stewardship initiatives to promote responsible antibiotic use and mitigate the development of resistance. Furthermore, research has underscored the importance of understanding regional variations and contextual factors influencing prescribing practices and AMR dynamics. By addressing conceptual, contextual, and geographical research gaps, future studies can contribute to a more holistic understanding of antibiotic usage patterns and AMR in companion animals, thereby supporting global efforts to preserve the efficacy of antimicrobial agents and safeguard animal and human health.

Recommendations

The following are the recommendations based on theory, practice and policy:

Theory

Conduct longitudinal studies to elucidate temporal trends in antibiotic prescriptions and AMR patterns in companion animals. Long-term data collection can provide valuable insights into the impact of interventions and changes in prescribing practices over time. Explore the socio-cultural determinants of antibiotic prescribing decisions among veterinarians and pet owners. Understanding the underlying factors driving antibiotic use can inform targeted interventions aimed at promoting prudent prescribing practices. Investigate the role of the human-animal-environment interface in the transmission of antibiotic-resistant bacteria. Integrating One Health principles into research frameworks can facilitate a comprehensive understanding of AMR dynamics in companion animals and its implications for human health.

Practice

Develop evidence-based guidelines for antibiotic prescribing in companion animals, tailored to different clinical scenarios and species. These guidelines should emphasize the principles of antimicrobial stewardship and promote the judicious use of antibiotics to mitigate the development of resistance. Implement antimicrobial stewardship programs in veterinary clinics and hospitals to optimize antibiotic use and enhance surveillance for AMR. These programs should incorporate educational initiatives, antimicrobial guidelines, and feedback mechanisms to support evidence-based prescribing practices. Encourage interdisciplinary collaboration between veterinarians, microbiologists, epidemiologists, and public health professionals to address AMR from a holistic perspective. Collaborative efforts can facilitate the exchange of knowledge and expertise, leading to more effective strategies for AMR containment.

Policy

Advocate for regulatory measures to promote responsible antibiotic use in companion animals, including restrictions on the use of medically important antibiotics and the implementation of prescription-only policies for certain antimicrobial agents. Strengthen antimicrobial surveillance systems to monitor antibiotic usage patterns and AMR prevalence in companion animals at national and international levels. Robust surveillance data are essential for informing policy decisions and guiding interventions to combat AMR. Foster international collaboration and knowledge-sharing initiatives to address global AMR challenges. This includes promoting the

harmonization of antibiotic prescribing guidelines, facilitating technology transfer for diagnostic capacity-building, and supporting capacity-building efforts in low- and middle-income countries.

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