Predicting Antimicrobial Resistant Bacteriuria in Dogs Using Machine Learning
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Introduction
Antimicrobial resistance is increasing and having a substantial impact on both human and animal health. According to a published report from the CDC [1], about 2.8 million infections in people were caused by an organism harboring antimicrobial resistance. In dogs, methicillin resistance in Staphylococcus pseudintermedius isolates increased from <5% to near 30% over six years [2]. Another study assessing urinary tract infections (UTIs) in companion animals demonstrated that organisms most commonly responsible for UTIs, including Escherichia coli, Proteus spp., and Enterobacteriaceae spp., had significant increases in resistance over 16 years [3].

Clinical Significance in Veterinary Medicine
Current standard of care for simple UTIs in dogs allows for empiric treatment with amoxicillin [4]. Increasingly, dogs are not responding to empiric antimicrobials because of increasing antimicrobial resistance.

The goal of this project is to ultimately provide veterinarians with a tool that will act as a guide to alert clinicians when a patient may have high risk for antimicrobial resistant UTI and ineffectual empiric antimicrobial therapy.

Methods and Procedures
Phase 1 – Data Curation and Labeling
All dogs labeled as present or absent for:
1. Amoxicillin resistance
2. Multidrug resistance

Hypothesis
Patient risk factors and clinical data can be used to train a machine learning model that can predict the presence of antimicrobial resistant (AMR) bacteriuria.

Specific Aim 1: Machine learning model that can predict resistance to Amoxicillin
Specific Aim 2: Machine learning model that can predict multidrug resistance (MDR). For this study, MDR was defined as resistance to 3 or more different antimicrobial drug classes.

Study Design
• Retrospective study (January 5, 2015 – February 8, 2021)
• Dogs presenting to the VMTH
• Inclusion criteria: urinalysis and positive urine culture and susceptibility results
• Target sample size determined by the number of features included in the machine learning models

Limitations
• Bias: body of patients included in the study may not be representative of the general population
• Sample size
  • A conservative estimate of 11 features to be included in the models was initially decided
  • 27 features were ultimately included for the amoxicillin resistance prediction model and 26 were included for the MDR model

References

Financial Support Provided by the Students Training in Advanced Research (STAR) program