Project Title:

Antimicrobial Resistance (AMR) Risk Monitoring: Understanding Mechanisms and Predicting Transfer Risks

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Project Abstract/Proposal Summary:

Antimicrobial Resistance (AMR) is a growing concern that arises when human pathogens, such as bacteria, develop resistance to previously effective medications. AMR has caused up to 1.2 million deaths annually, and this number is still rising. Unfortunately, the clinical pipeline for discovering new antibiotics cannot keep pace with the evolving AMR, as only two of the eleven identified antibiotics after 2017 belong to new classes. Given the serious impact of AMR on multiple sectors, AMR is listed as one of the top 10 human health threats by World Health Organization (WHO).

The mechanisms by which bacteria acquire AMR are complex and multifaceted. The rapid evolution of these microorganisms and the intricate interactions between different bacteria can lead to the acquisition of new resistance mechanisms. For instance, the high antibiotic use in hospital settings creates selective pressure, promoting the emergence and spread of resistant bacteria within these environments. It is known that the prevalence of AMR increases by the selection of mutations as well as the acquisition of AMR genes through horizontal gene transfer (HGT). For example, genetic mutations in a bacterial strain may alter the target site of an antibiotic, rendering the drug ineffective.

Understanding the mechanisms of AMR development and predicting the risk of AMR dissemination in human-related ecosystems is of paramount importance. The current methods are not adequate for comprehensively monitoring the risks and spread of AMR. Our goal in this proposal is to provide a more robust framework for risk assessment and prediction of AMR evolution. To achieve this goal, we will build an AI system that leverages the rapidly accumulating experimental data and advanced deep learning models to identify the key factors driving the acquisition of AMR. We will use AI to learn not only the importance of a single feature but also the cooperative behavior of different features, which helps researchers

elucidate the complicated mechanisms of AMR acquirement. These learned features (factors) will be deposited into an open-source database, which provides important resources for more comprehensive AMR monitoring.