Improving Hazard Characterization in Bacterial Pathogens: Predicting Efficiency of Antibiotics Using Machine Learning

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New species of bacteria are being discovered on a daily basis. Fast detection and risk characterization are vital for taking proper action. Current techniques and methods used for microbial risk assessment in clinical, environmental, and food samples rely upon conventional clinical microbiology monitoring approaches that are laborious, time-consuming, expensive, and suffer from a number of considerable drawbacks. Thus, the primary objective of this project is to improve hazard characterization in bacterial pathogens by predicting the efficiency of antibiotic concentrations using machine learning, specifically artificial neural networks (ANN). Algorithmically, opensource data on bacterial pathogens and related clinical literature were utilized to extract features that represent the relationship between drug exposure conditions and their outcome response (i.e. MIC of Penicillin on E. coli). The ANN predictors were developed using Python libraries (TensorFlow and scikit-learn). The predictors were trained using backpropagation algorithm and then validated based on annotated bacterial pathogens through k-fold cross validation. The predictors were then applied to currently unclassified novel bacterial pathogens and identified their antibiotic response with an accuracy score greater than 80%. This study proposes a futuristic assistive laboratory product, that is affordable and efficient in predicting hazardous bacterial life forms in laboratories, with the potential of advancing the field of biotechnology in various industries; such as, clinical research, drug discovery, diagnostics, and human health care worldwide.

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