**Introduction**

Antibiotic resistance is a growing global health concern, particularly in bacterial infections like gonorrhea, caused by *Neisseria gonorrhoeae*. This sexually transmitted infection (STI) is the second most common in Europe and has shown a significant increase in recent years. The emergence of antibiotic-resistant strains has made treatment more challenging, requiring continuous monitoring and new predictive models to guide treatment decisions.

This project aims to leverage machine learning to predict bacterial resistance based on DNA variations, specifically using unitigs—stretches of DNA associated with resistance. The focus is on three antibiotics: Azithromycin, Ciprofloxacin, and Cefixime. By analyzing genetic data, the goal is to build a binary classification model that can predict bacterial resistance to these antibiotics, aiding in the development of effective treatment strategies.

**Abstract**

Antibiotic resistance poses a significant challenge in treating bacterial infections, particularly *Neisseria gonorrhoeae*, which causes gonorrhea. This project focuses on developing a machine learning model to predict antibiotic resistance using DNA sequence variations. The dataset comprises unitigs, short DNA sequences that serve as genetic markers for resistance. Three antibiotics—Azithromycin, Ciprofloxacin, and Cefixime—are considered for analysis.

The study follows a structured approach: metadata collection, dataset preparation through DNA variation analysis, feature selection, model training, and validation. The classification model predicts whether a bacterial strain is resistant or susceptible to specific antibiotics, offering insights into treatment efficacy.

By implementing machine learning techniques, this project provides a data-driven approach to combat antibiotic resistance. The predictive model can assist healthcare professionals in making informed treatment decisions, potentially reducing the spread of resistant strains. This study highlights the potential of genomic data in guiding antibiotic usage and improving public health outcomes.