Modeling the Treatment of Within-Host Active and Latent Tuberculosis

Alex Becker¹, Andreas Handel²

¹Courant Institute of Mathematical Sciences, New York University, New York, NY
²Department of Epidemiology and Biostatistics, University of Georgia, Athens, GA

Overview

- 2 billion people infected; 8-10 million new cases per year; 1-3 million deaths per year
- Standard treatment: 2 months Isoniazid (H), Rifampin (R/RIF), Ethambutol (E), and Pyrazinamide (Z), 4 months Isoniazid and Rifampin (2HRZE/4HR) daily or 3/week

Objective

- Make predictions for TB treatment regimens:
  - Create a mathematical model to simulate all four drugs
  - Investigate non-adherence to therapy
  - Incorporating the immune response into the model
  - Modeling drug resistant populations and TB-HIV co-infection

Model Description

- Active (A) and Latent (L) are the state variables for the model.
- A new rifampin-like drug with a longer half-life, a short half-median effective dose, and a low dosage could lessen the effect of patient non-adherence.

Model Predictions

- We matched our model against experimental data and can make predictions for future treatment options:
  - Rifabutin can increase treatment success, up to 99%, in 50 days
  - A new rifampin-like drug with a longer half-life, a short half-median effective dose, and a low dosage could increase treatment success, up to 100%, in 37 days.
  - Rifabutin and a slow decay drug could lessen the effect of patient non-adherence.

Model Confirmations

- We compared our model with experimental results produced from sputum samples. Sputum samples detect active TB bacteria, but may or may not detect latent bacteria. Our model matched data by Joloba et al. [1] well; both data sets fall below one around day 60.

References


[2] WORLD HEALTH ORGANIZATION (WHO). WHO; how many TB cases have been successfully treated?

Future Work

- Investigating non-adherence to therapy among migrant pulmonary tuberculosis patients in shandong, china: A quantitative survey study.

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