Modelling of TB Diagnostics

Presenter
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TB is difficult!

- TB is a highly complex disease. Its very complexity is its great strength enabling its success. This is demonstrated by its persistence for thousands of years even in modern times despite antibiotics and concerted efforts of health authorities.
- We need to improve our understanding of the dynamic epidemiology of the disease so that we are better equipped to fight it. With knowledge comes power!
- Mathematical modelling has proved to be a powerful paradigm for this purpose.

Goal of the sessions this morning

To answer the following questions:

- What is mathematical modelling (as applied to TB diagnostics)?
- What can modelling do for the TB researcher?
- Do I need to engage with this?
- How do I involve modelling in my research?

Objectives of Session 1 - Basics

- Consider the reasons for using modelling
- Describe how we model TB, including how we:
  - Conceptualize the pathogenesis of TB
  - Decide on and parameterize key model inputs
- Outline key modelling terminology and understand differences between types of models
- Outline approaches to sensitivity analysis in modelling

Objectives of Session 2 - Examples

- Turn to the literature to look at how TB models have evolved over time
- Outline some key contributions
- Use case studies to illustrate steps involved in generating a modelling study

Objectives of Session 3 - Diagnostics

- To describe the (recent) history of TB diagnostics modelling
- To discuss key published papers in the field
- To give an overview of what modelling has taught us about TB diagnostics to date

Objectives of Session 4

- To describe limitations of TB diagnostics models
  - Uncertain parameters
  - Uncertain assumptions
- To characterize future directions for models of TB diagnostics
  - Meaningful parameters
  - Appropriate assumptions

Some Other Diagnosis Related Papers

A Threshold Value for the Time Delay to TB Diagnosis.

Uys PW, Warren RM, van Helden PD. (2007) PLoS ONE 2(1):e757.

The analysis presented here shows that typical delays to diagnosis present a major obstacle to the control of a TB epidemic. Control can be achieved by optimizing the rapid identification of TB cases together with measures to increase the threshold value. A calculated and aggressive program is therefore necessary in order to bring about a reduction in the prevalence of TB in a community by decreasing the time to diagnosis in all its ramifications.

The Effect of Diagnostic Delays on the Drop-out Rate and the Total Delay to Diagnosis of Tuberculosis

- Millen SJ, Uys PW, Hargrove J, Van Helden PD, Williams BG. (2008) Plos ONE. 3(4):e1933

Conclusions/Significance: The results show that in a developing country a number of delay factors, particularly the low sensitivity of the initial sputum smear microscopy test, potentially increase total diagnostic delay times experienced by TB patients significantly. The results reinforce the urgent need for novel diagnostic methods, both for smear positive and negative TB, that are highly sensitive, accessible and point of care, in order to reduce mean delay times.

Potential of Rapid Diagnosis for Controlling Drug-susceptible and Drug-resistant Tuberculosis in Communities where Mycobacterium Tuberculosis Infections are Highly Prevalent.

Pieter W. Uys, Robin Warren, Paul D. Van Helden, Megan Murray And Thomas C. Victor. Journal Of Clinical Microbiology, May 2009, 1484–1490

- Showed that cost of treating the increasing number of MDR cases would eventually exceed that of treating susceptible TB unless rapid diagnosis methods are introduced