

MODELING TUBERCULOSIS IN CHILEAN PRISONS

Piero Visconti

Departamento de Matemática
Universidad Técnica Federico Santa María
Valparaíso, Chile

Laboratoio de Modelación I - MAT282



CONTENTS

INTRODUCTION

MODEL FOR GENERAL POPULATION

PRISON POPULATION

FUTURE WORK

TUBERCULOSIS

- Tuberculosis is an infectious disease caused by the bacteria *Mycobacterium Tuberculosis*.
- Most carriers show no symptoms, this is called *latent tuberculosis*.
- Only patients whose lungs are infected can spread the condition.

STAGES

- S: Susceptibles, individuals who have never been affected by TB.
- L: Latency, individuals infected who show no external symptoms.
- T_i : Active TB, infective, individuals whose respiratory tracks are infected.
- T_n : Active TB, non-infective, individuals with symptoms whose respiratory tracks are not infected.
- R: Recovery, individuals who have recovered successfully from the disease.

BLOWER *et al.* (1995)

$$\begin{aligned}
 \frac{\partial S}{\partial t} &= \pi - \beta STi - \mu S \\
 \frac{\partial L}{\partial t} &= (1 - p)\beta STi - \nu L - \mu L \\
 \frac{\partial Ti}{\partial t} &= pf\beta STi + q\nu L + \omega R - cTi - \mu_T Ti - \mu Ti \\
 \frac{\partial Tn}{\partial t} &= p(1 - f)\beta STi + (1 - q)\nu L + \omega R - cTn - \mu_T Tn - \mu Tn \\
 \frac{\partial R}{\partial t} &= cTi + cTn - 2\omega R - \mu R
 \end{aligned} \tag{1}$$

DIFERENCES WITH GENERAL POPULATION

- Scale: Ratio $\frac{\text{Prison Population}}{\text{General Population}} \sim 0,002$.
- New individuals may enter the system in any stage, not only as susceptibles.

PROPOSED MODEL

The model proposed for prison population is

$$\frac{\partial S}{\partial t} = \pi \frac{S_{gen}}{N_{gen}} - \beta STi - \mu S$$

$$\frac{\partial L}{\partial t} = \pi \frac{L_{gen}}{N_{gen}} + (1-p)\beta STi - \nu L - \mu L$$

$$\frac{\partial Ti}{\partial t} = \pi \frac{Ti_{gen}}{N_{gen}} + pf\beta STi + q\nu L + \omega R - cTi - \mu_T Ti - \mu Ti$$

$$\frac{\partial Tn}{\partial t} = \pi \frac{Tn_{gen}}{N_{gen}} + p(1-f)\beta STi + (1-q)\nu L + \omega R - cTn - \mu_T Tn - \mu Tn$$

$$\frac{\partial R}{\partial t} = \pi \frac{R_{gen}}{N_{gen}} + cTi + cTn - 2\omega R - \mu R,$$

where $N_{gen} = S_{gen} + L_{gen} + Ti_{gen} + Tn_{gen} + R_{gen}$. And $(S_{gen}, L_{gen}, Ti_{gen}, Tn_{gen}, R_{gen})$ solves (1).

FUTURE WORK

The following topics are of particular interest for further research.

- Validation of the new model with real data.
- Incorporation of diagnostic strategies into the new model.
- Incorporation of treatment strategies into the new model.

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