Optimizing Delay of Vaccination Campaigns in Response to Infectious Outbreaks

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Introduction

- Vaccination campaigns in any given country are an immense undertaking involving many time-dependent factors.
- A delay in implementation of a vaccination campaign allows for better preparation in terms of refrigeration ability, larger quantities of vaccine available, and more trained volunteers to administer the vaccine.
- However, it comes with the cost of continued transmission and an increased number of infected people.

Objective of the Study

This study aimed to explore the trade-off between increased delay and the resulting coverage of the vaccination campaign to shape public policy decisions regarding a reactive immunization effort.

Methods

- Modeled three different relationships between delay and coverage: linear, convex, and concave
- Estimated the number of susceptible persons with varying birth rates and routine coverages to gain a comprehensive view of the unique conditions in different countries
- Plotted the number of susceptibles against delay vs. coverage

Results

- High Birth Rate with Low Routine Coverage
- Low Birth Rate with High Routine Coverage
- Total Years at Risk (Linear)
- Total Years at Risk (Convex)

Discussion

Contrasting the two extremes, we find that regardless of its relationship with coverage, no delay remains the best course of action. The gradients exhibit quick increases in number of susceptibles with even the slightest increases in delay. This could be due to the effectiveness of the vaccine in culling transmission swiftly after its introduction. The initial prediction that the “best case” is more forgiving of delay is maintained well. The “worst case” has a range of susceptibles from around 13000 to upwards of 18000 while the “best case” boasts a much smaller range of 560-760. This would mean that a country with conditions akin to the “best case” can afford a delay if need be.

Future Work

To further this work, I would tie in modeling of disease attack rates and vary transmission rates to imitate real world conditions. These can vary significantly with climate and population density.

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