The Cost-Effectiveness of Contact Tracing for Endemic Diseases
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Abstract
Contact tracing is an important intervention for diseases such as TB, HIV, and other STDs (for which it is often called partner notification). However, its cost-effectiveness has not been modeled much. Using a stylized compartmental model of an endemic disease we show that contact tracing is a cost-effective alternative to screening when the disease prevalence is below some threshold. We use a simulation model of contact tracing and disease spread on a network to compare the costs and effectiveness of varying levels of random screening with and without contact tracing. Contact tracing will increase the number of cases found by a factor of K.

Introduction

What is contact tracing?
- goal: find additional infected persons
- method: given an infected case, find its contacts and test them for the disease
- also known partner notification for HIV and other STDs

What diseases is it used for?
TB, HIV, other STDs. In the US it is required that health departments contact trace TB. The CDC recommends it for HIV. It is also practiced for other STDs.

What are the alternatives?
Screening, vaccination, behavior change.

What are the tradeoffs? Contact tracing is labor intensive but is likely to find infected people.

What has been done so far?
Small empirical studies and models of effectiveness but not of costs.

Related work: Contact tracing is also done for epidemics such as SARS and the avian flu. It is related to ring vaccination.

Conclusions
- Contact tracing is part of the optimal strategy when the disease prevalence is below a threshold.
- This threshold depends on the relative cost per case found by screening versus contact tracing.
- Investment in contact tracing has diminishing returns to scale.
- These models (appropriately tailored) provide a useful policy tool.
- Little is known about the actual network structure for a particular disease and more research is needed.

References
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When is Contact Tracing Cost-Effective?
We build an SIS compartmental disease-transmission model and compare the costs and effectiveness of varying levels of random screening with and without contact tracing. Contact tracing will increase the number of cases found by a factor of K.

S→I→R model

- S per capita rate of outside infection
- I per capita rate of outside infection
- μ per capita death rate
- η per capita rate of outside infection

βS/N+η(N−S)

Extending S→I→R model

- p=N/S
- ηI

Introduction

Intervention 1: random screening at rate δ
- reduces prevalence rate pδ
- cost per capita is C(Cs+pδ)

Intervention 2: contact tracing
- δ=1 if program exists, 0 if it does not
- Kc=number of infected contacts per index case
- Cc=cost per index case, C(c+Cp)

Cost per capita

Cost = min(C(c+Cp), Cs+pδ)

Minimizing Cost per Capita

1. Cost of finding n infected persons prevalence given and fixed (n small)

Cost = min(C(c+Cp), Cs+pδ)

2. Long-term (steady-state) cost prevalence given and fixed

Minimizing Cost per Capita

Cost = min(C(c+Cp), Cs+pδ)

3. Total cost includes cost of untreated disease initial prevalence given η(I(0)+δI(0)) and δ(I(0)+δI(0)) vary with time

Cost = min(C(c+Cp), Cs+pδ)

References

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