Contact tracing for COVID-19

Forwards and backwards: an introduction

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Outline

What does contact tracing do? Expected impact
Forward and backward contact tracing Discussion
Case study
What does contact tracing do?

Basic reproduction number

$$R_0 = \beta \cdot c \cdot D$$

- Transmissibility ($\beta$)
- Isolation
- Masks
- Hand hygiene
- Vaccine

- Contact rate (c)
- Size of gatherings

- Duration of infection (D)
- Contact tracing
- Drugs
Contact tracing

Why do we say ‘forwards’ and ‘backwards’?
Contact tracing

Why do we say ‘forwards’?

- Incubation
- Infectious
- Pre-symptomatic transmission
- Quarantine
- Stop forward transmission
Contact tracing

Why do we say ‘backwards’?

Incubation

Infectious

Search backwards for source

Symptoms

Source

Index case

Contact
SARS-CoV-2 transmission
The role of overdispersion


Overdispersion and contact tracing

Index case is disproportionately likely to have been infected by a source who also infected others in a cluster.

Drosten C. Die Zeit 33/2020, 06.08.20
Case study: COVID-19 outbreak
Forward and backward contact tracing

Day 1
- A 74 year old man has a mild fever, cough and fatigue
- He has a nasopharyngeal swab taken for a SARS-CoV-2 rapid antigen test, which is positive
- He has a second swab taken for RT-PCR, which is positive
- The index case is isolated at home and the case is notified

Disclaimer: All references to real persons or events are entirely coincidental

Photo credits: www.theguardian.com 02.10.20
Case study: COVID-19 outbreak
Forward contact tracing

Day 2
- A contact tracer asks the index case about his contacts in the two days before his symptoms started
- The index case was in close contact with his wife and children. He travelled to an event on a helicopter with his wife and an aide
- All go into quarantine and are tested

Photo credits: www.nytimes.com and www.theguardian.com 02.10.20
Case study: COVID-19 outbreak
Backward contact tracing

Day 2

- The contact tracer asks the index case about his activities in the two weeks before his symptoms started
- Did he go to any events where he was in contact with people for more than 15 minutes, without masks and without a distance of 1.5m or more?
- They make an activity map

Photo credit: www.nytimes.com 04.10.20
Case study: COVID-19 outbreak

Backward contact tracing

Day 3

- The index case had a garden party a week before he developed his symptoms
- The contact tracers cross-checked their records
- Some of the guests had tested positive for SARS-CoV-2

Photo credit: https://www.washingtonpost.com 03.10.20
Backward contact tracing

Day 4-6
- Contact tracers try to identify and contact all the staff at the index case’s home and guests across different states
- They send all guests into quarantine and ask them to be tested
- They find 20 additional cases
- The contact tracers carry on to test, trace, isolate and quarantine
- A potential superspreading event is avoided

Photo credit: https://www.washingtonpost.com, 03.10.20
Forward and backward contact tracing
What is the impact?

Mathematical model
A. Forward contact tracing only
   Identifies, at most, the mean number of secondary infections

B. Forward and backward tracing
   Increases cases found by factor 2-3
   Identifies high-risk settings

Endo A, et al. medRxiv preprint https://doi.org/10.1101/2020.08.01.20166595
Forward and backward contact tracing

Discussion

- Contact tracing effectiveness limited by
  - Pre-symptomatic transmission and overdispersion
- Forward contact tracing stops forward transmission through quarantine of contacts
- Backward contact tracing looks backward for the source
- Backward contact tracing finds clusters and could reduce the size of superspreading events
- Additional prevention measures contribute to effects
- What conditions make backward contact tracing feasible?
- What should the balance be?