Screening with Rapid Tests to Prevent COVID-19 Transmission in Long-Term Care (LTC)

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Screening with rapid tests has two benefits, both which reduce the harm due to COVID-19

1. preventing introductions from happening
2. learn of exposures earlier, intervening sooner, reducing outbreak size

Note: Transmission of COVID can happen from people who are
asymptomatic –who never develop symptoms
presymptomatic –have not developed symptoms yet

As an example: Panbio COVID-19 Ag Rapid Test

- results can be ready in 15 minutes
- 90% sensitivity (accuracy on positive cases)

Our results apply to any test with a quick turnaround time and that level of sensitivity.

Waiting 1-2 days for results leads to much less effective screening.

Methods for estimating (1) – preventing introductions

We use data on infectiousness through time, and on the pre-symptomatic infectious period (1-2 days). We use the observation that not all COVID-19 infections lead to any symptoms.

Screening of HCW and visitors has the potential to identify infections before transmission begins, or shortly afterwards (but still before symptoms arise) as well as after symptoms as with regular tests.

Screening every *n* days: no more than *n* days pass between infection and screening. With a test at (e.g.) 90% sensitivity, there is a 90% probability that we detect an infection, if present.

After a positive screen, the individual does not expose the setting.

Methods for estimating (2) – earlier intervention can reduce outbreak size

We use a stochastic individual-based model describing COVID-19 transmission.

It takes the possibility of asymptomatic infection, pre-symptomatic transmission and symptomatic transmission into account.

We fit the model to reflect LTC home sizes and outbreak sizes in LTC in BC (Vijh et al., 2020)

When an exposure is detected we model a reduction in transmission in the LTC setting, in a way that matches estimates for the impact of interventions in LTC homes in BC.

Screening helps reduce outbreak sizes by initiating that same intervention sooner.

Preventing Initial Introductions from Happening

Screening before every visit: possible for visitors?

90% reduction in number of exposures

Periodic screening, every three days or every week: possible for staff?

Reduces *exposure duration* = how long someone is infectious at the site

Every week gives 25-40% reduction of exposure duration.

Every three days gives 45-55% reduction of exposure duration.

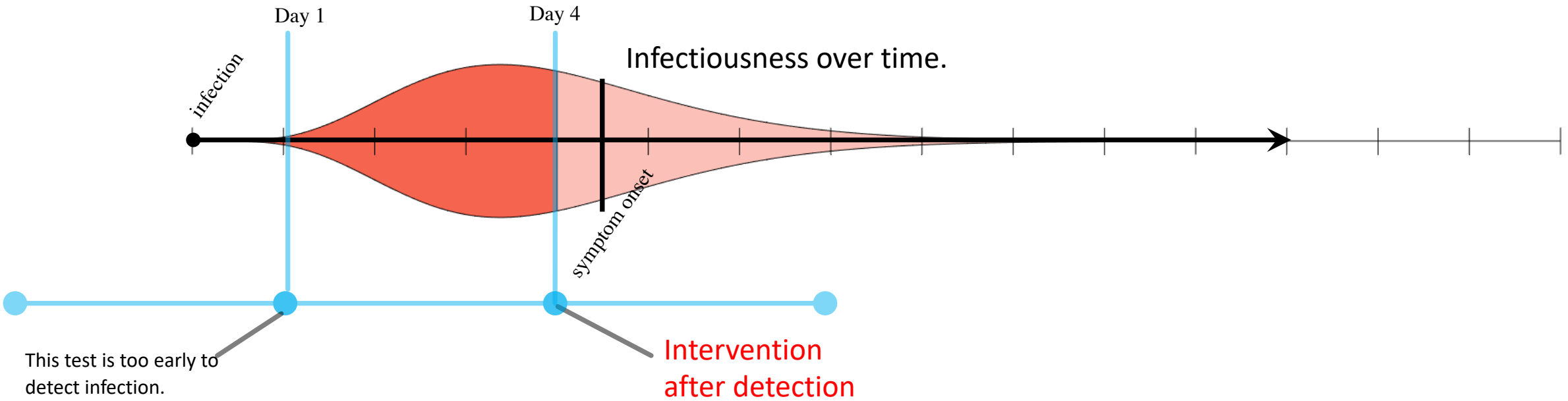
This is relative to only testing symptomatic individuals.

Assumptions: 20% of index cases are asymptomatic, with 60% infectiousness. Asymptomatic infections are infectious for 7-14 days; those who will get symptoms are infectious for 2 days before they develop symptoms, at which time they isolate. (Byambasuren et al., 2020; Tindale et al., 2020; Cevik et al. 2021.)

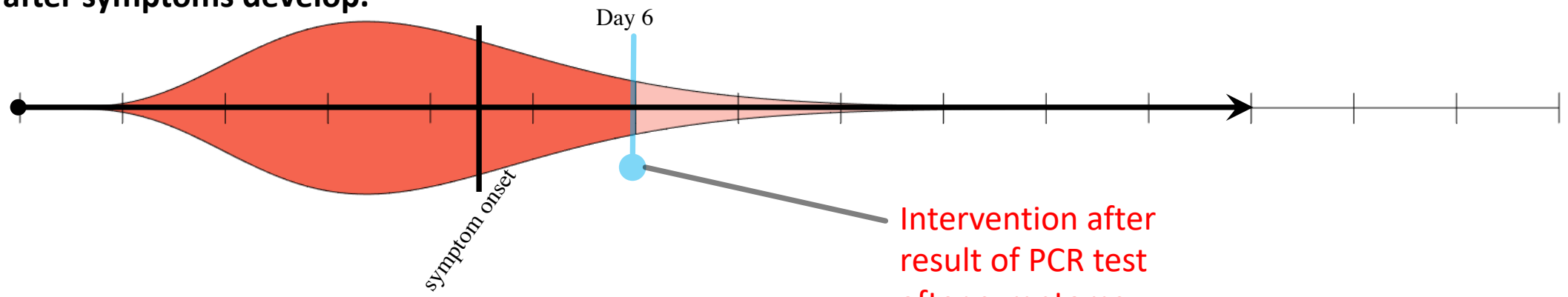
This is based on a simplified model with uniform transmission during the infectious period.
More complex models give similar results.

Preventing Transmission with Earlier Detection: Symptomatic Index Case

Screening every three days.



Testing after symptoms develop.



Parameters from Ganyani et al, 2020.

What if we had been able to use rapid screening last year?

In BC, there have been approximately 600 deaths in long-term care, independent, and assisted living. https://www.cbc.ca/news/canada/british-columbia/long-term-care-data-covid19-bc-1.5865755

If COVID is introduced by staff, and if the probability of exposure leading to an outbreak is proportional to exposure duration, then:

Screening with rapid antigen tests every seven days would have prevented about 25-40% of the outbreaks (on average 150-240 deaths).

Screening with rapid antigen tests every three days would have prevented about 45-55% of the outbreaks (on average 270-330 deaths).

Faster Detection Allows Faster Intervention to Reduce Outbreak Size

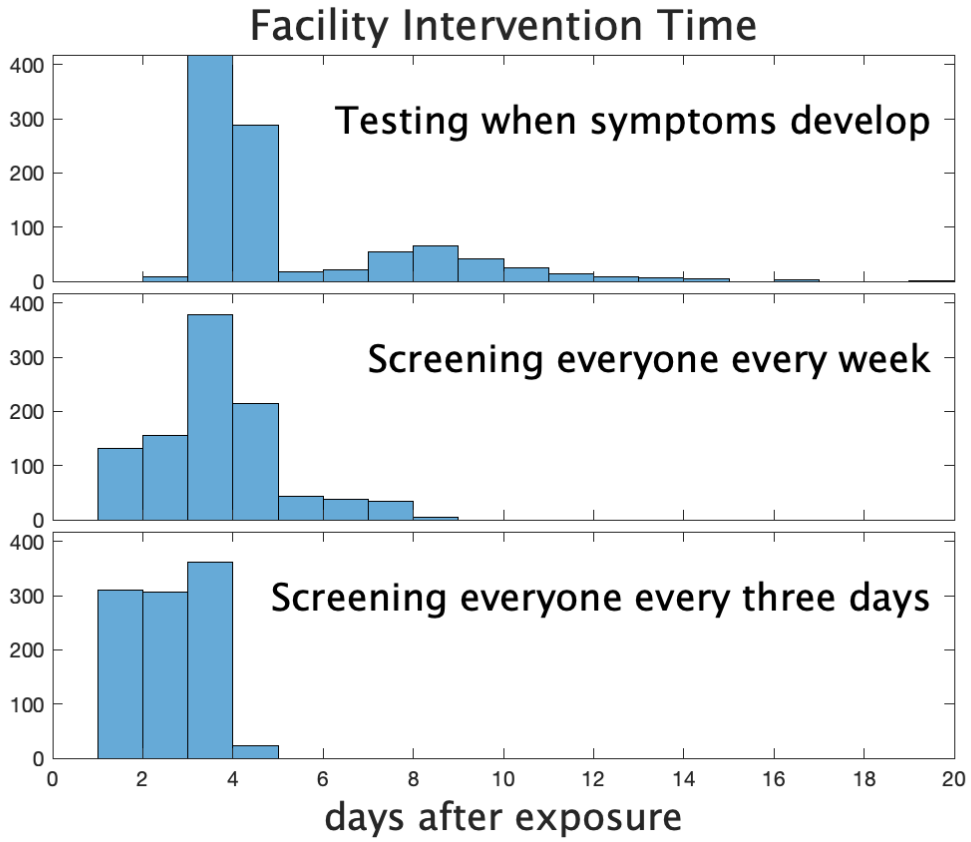
Simulation of LTC home: 160 staff, 160 residents grouped into 16 neighbourhoods
Reduced transmission between neighbourhoods.

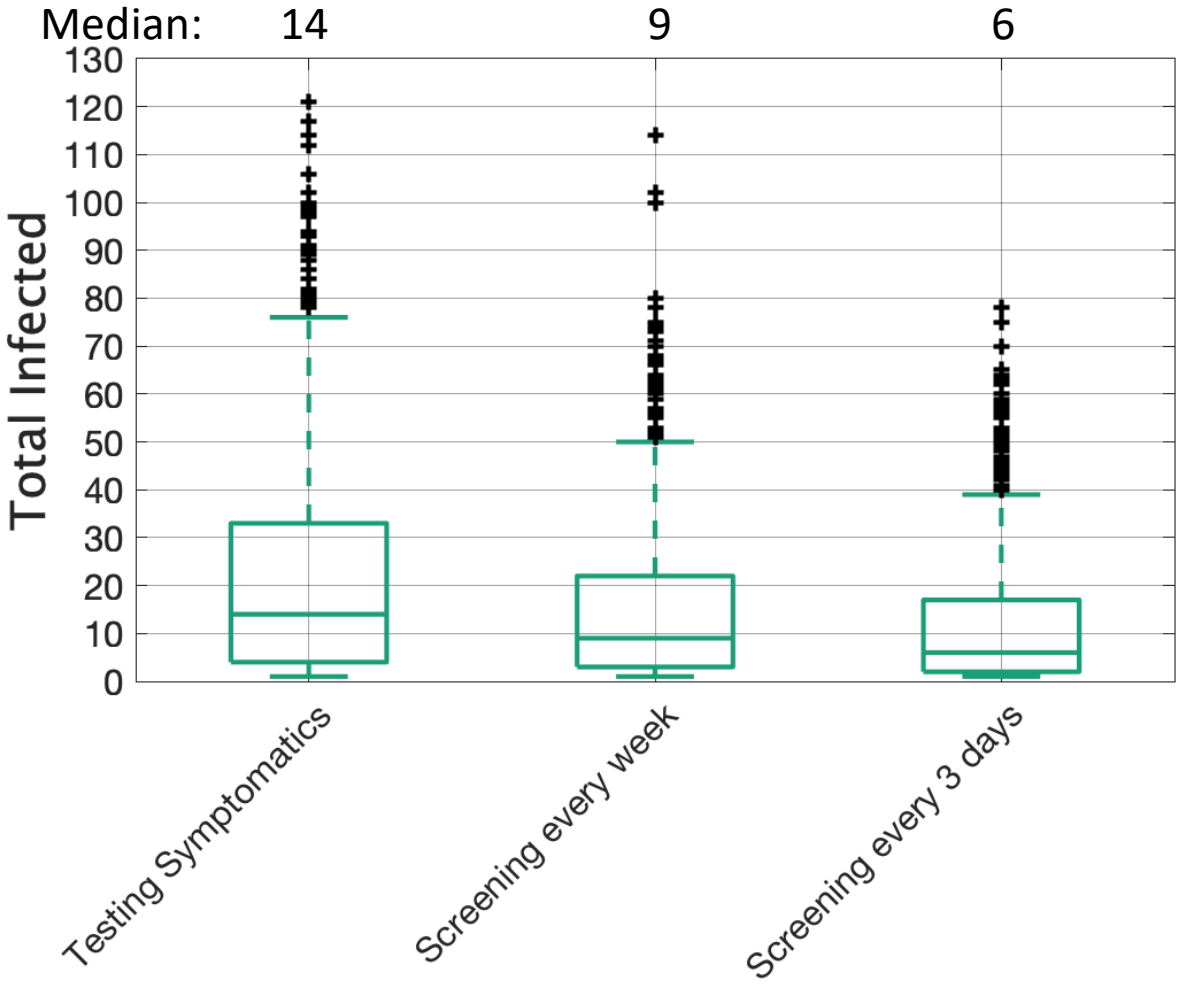
Three different protocols for detecting infection:

1. Testing when symptoms develop.
2. Screening everyone every week.
3. Screening everyone every three days.

Parameters in simulation were set using data from outbreaks in LTCH in BC. (Vijh et al., 2020).

Faster Detection Allows Faster Intervention to Reduce Outbreak Size

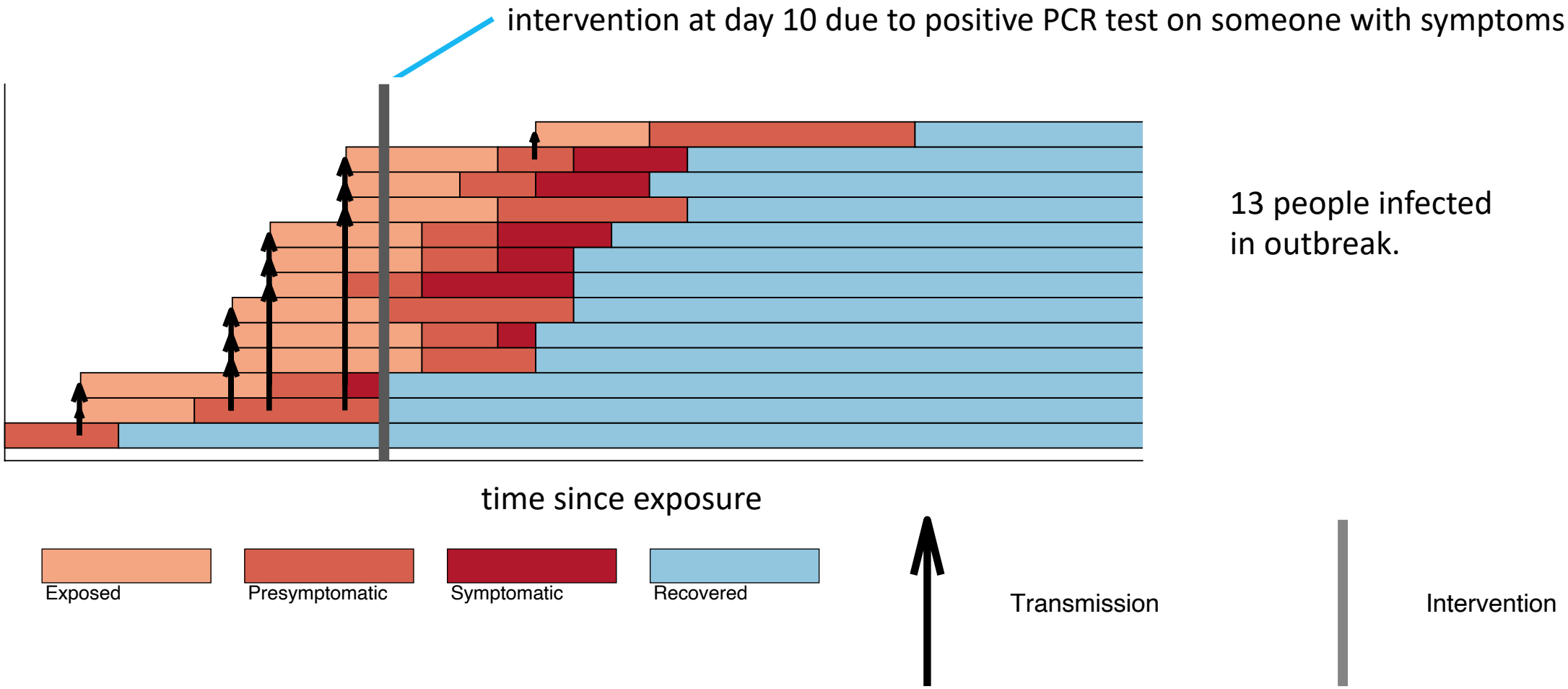




Method: stochastic simulations similar to Tupper et al., 2020.
Adapted to fit BC long term care outbreak size distribution (Vij et al., 2020).

What do outbreaks look like?

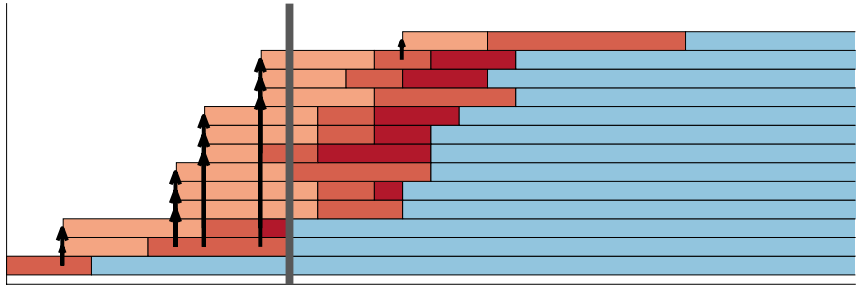
Illustrative example showing the early part of a simulated outbreak:



Interventions reduce transmission, but infections still occur at slower rate.

Faster Detection Allows Faster Intervention, Reducing Outbreak Size

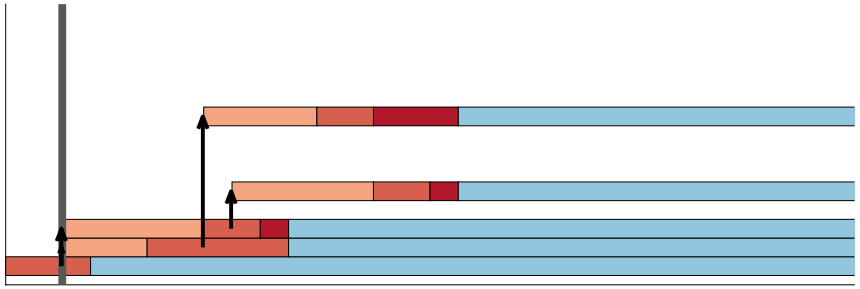
testing when symptoms develop



Intervention on day 11

Outbreak size: 13

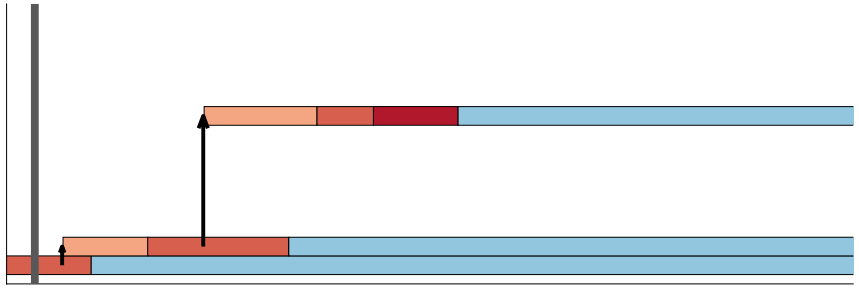
screening everyone every week



Intervention on day 3

Outbreak size: 5

screening everyone every 3 days



Intervention on day 2

Outbreak size: 3

The same intervention – strong reduction in transmission after the outbreak is detected – is applied earlier, reducing the size of outbreaks.

How does this change with vaccination?
Two major possibilities (with many intermediate possibilities)

1. Vaccines prevent disease, but not transmission.

Assume vaccines are 80-90% effective at preventing mortality, other severe outcomes, but do not change the probability of infection, or transmission to others.

2. Vaccines prevent transmission and disease.

Assume vaccines are 80-90% effective at preventing disease (incl. mortality) **and** infection (and so transmission to others).

We assume that 75-90% of staff and residents are vaccinated with both doses.

1. If vaccines prevent disease, but not transmission:

In the short term:

- Vaccination will not lead to smaller outbreak sizes (because by hypothesis, it does not block transmission).
- Outbreaks may be larger, since infections will be harder to detect among those that have been vaccinated.
- Only a fraction 60%-80% of residents are protected (efficacy x coverage).
- The number of deaths would be reduced by 70% on average.

Rapid testing/screening will still reduce fatalities in the remaining ~30% not protected by vaccination, by preventing and reducing outbreaks

1. If vaccines prevent disease, but not transmission.

In the long term:

- Community prevalence will be higher than it is now, because other measures will be relaxed
- This will result in far more introductions to LTC.
- Infections will be harder to detect – currently we test symptomatic individuals, but more infections will be asymptomatic.

Rapid testing/screening will be even more important in LTC due to increased exposures from the community.

2. If vaccines prevent transmission and disease:

- 60-80% reduction in *R*, the basic reproductive number.
- *R* for LTC homes is estimated to be about 2.8 (most between 1 and 7), before interventions.
- Vaccination prevents most outbreaks, but not all.
- Outbreaks will be smaller and less extreme measures will be necessary to control them.

Rapid testing will still reduce fatalities, both by preventing introduction by the unprotected, and allowing faster detection of outbreaks.

References

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