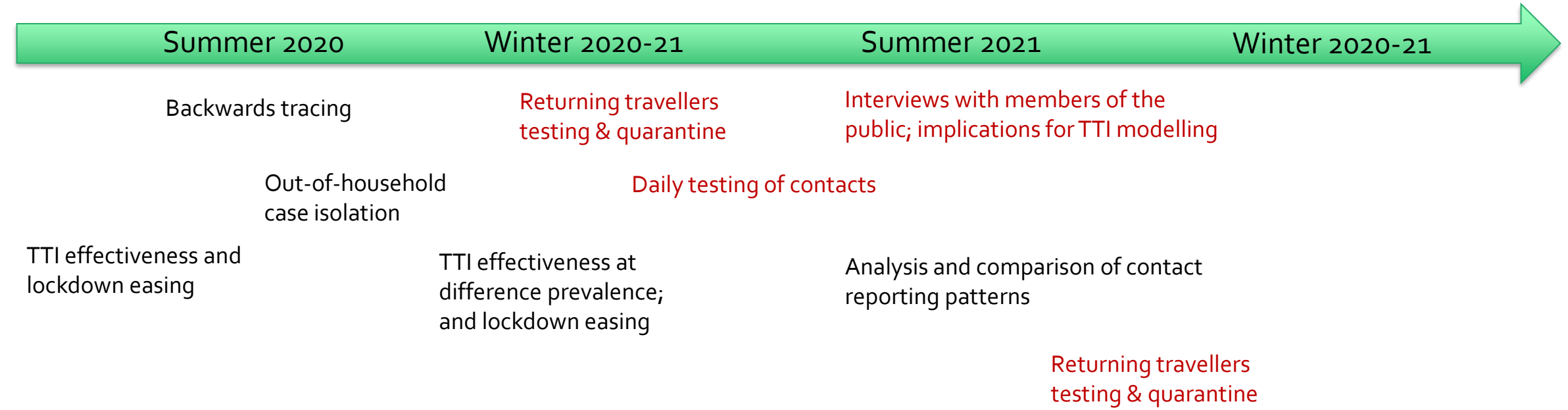
Lessons learnt from research to support Test, Trace and Isolate policies in the UK during 2020–2021

Elizabeth Fearon and the TTI project

June 7, 2022

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

TTI Project: research topics timeline



Talk overview

1. TTI and control of SARS CoV-2: motivation for asymptomatic testing
2. Targeted asymptomatic testing: **daily contact testing**
3. Population asymptomatic testing: **regular screening**
4. How the **population interacted with testing** policies
5. Key questions going forward:
   - role of asymptomatic testing in controlling Covid
   - other infections

Key factors influencing TTI effectiveness

Early learning about control of SARS CoV-2 via TTI:

- Importance of **timing/reducing delays**
- **Identifying a high proportion of cases** is key
- **Limitations to symptoms-based case identification**
  - asymptomatic transmission, phenotypes
  - lack of symptom specificity and PCR testing capacity constraints
- Usefulness of exploiting **clusters** (eg HH's, backwards tracing, pingdemic?)
- Enabling **uptake and adherence** is key

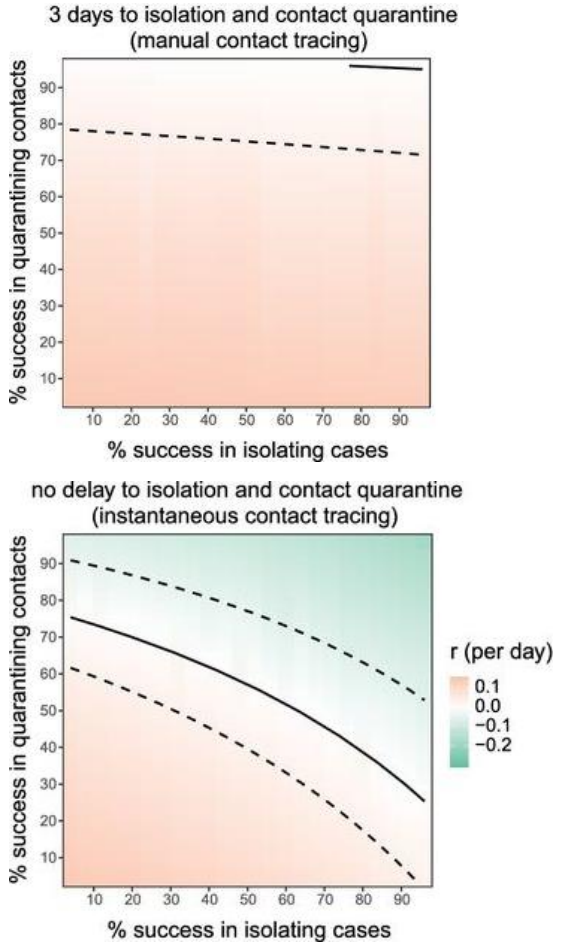


Figure compares growth rates assuming manual (top) versus instantaneous (bottom) contact tracing. Ferretti et al. (2020) Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. Science 36:6491.

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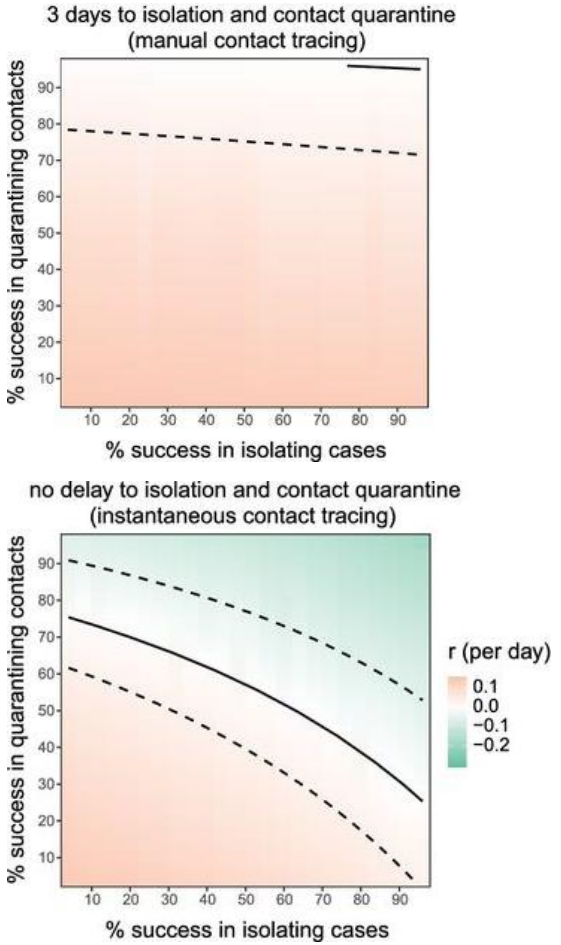

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Viral load and test sensitivity over time

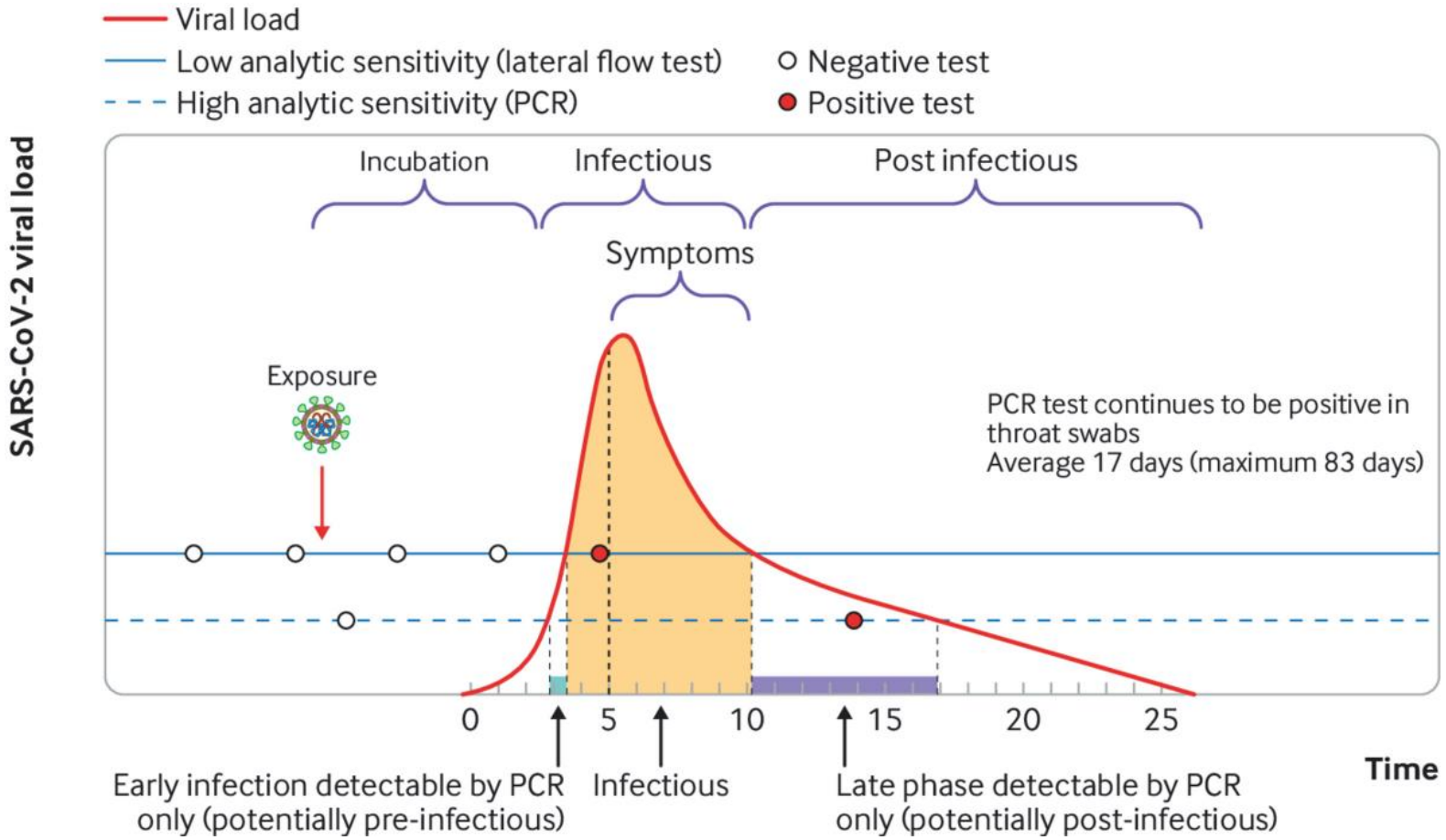


Figure from Crozier A, Rajan S, Buchan I, McKee M. Put to the test: the use of rapid testing technologies for covid-19. BMJ 2021;372:n208.

Lateral Flow Device testing in the England

PHE LFD test evaluation Oct 2020

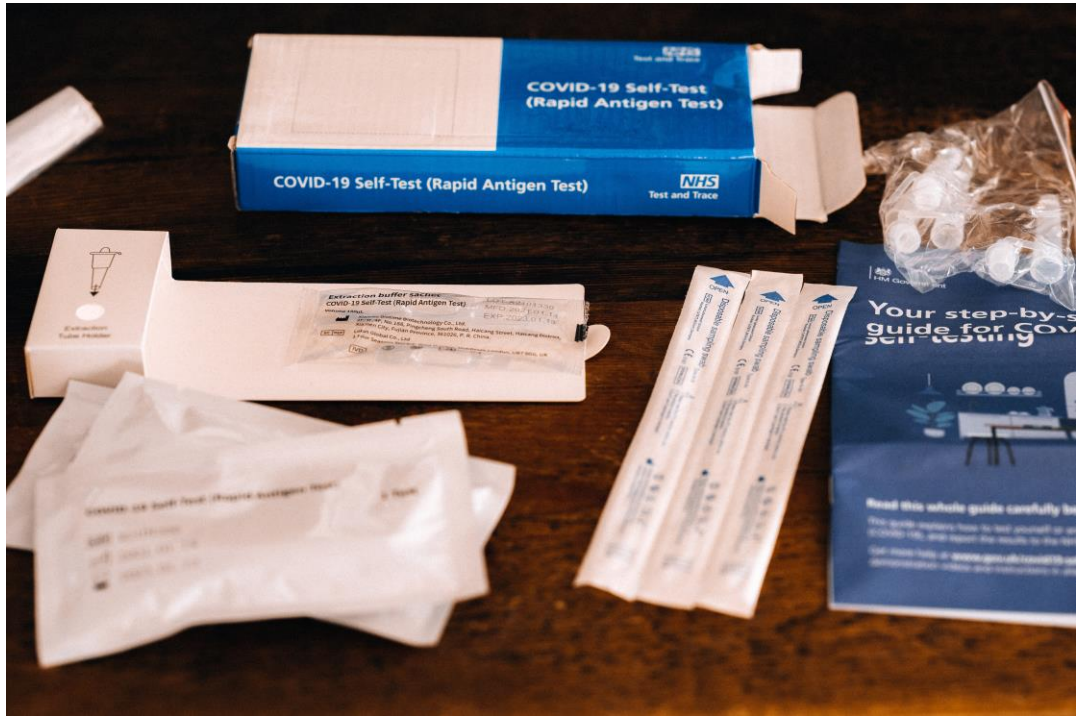
Liverpool Study Nov-Dec 2020

Early 2021 targeted to specific groups

- Higher risk settings
- People working outside the home
- Pilot among contacts

From March 2021: schools, households of school children

Winter 2021/22: advice to test pre-gatherings



Targeted asymptomatic testing: Daily Contact Testing

Can repeat (daily) testing of case contacts replace quarantine?

Motivations:

- Quarantine of case contacts is burdensome
- Contacts are at high risk of having been infected; use tracing to identify additional cases, initiate further tracing, etc
- LFD tests enable rapid return of results and frequent testing

Daily Contact Testing (DCT)

What is the effectiveness of DCT among case contacts, compared to status quo of 10-day at-home quarantine?

- for different durations: 3, 7, 10 days post-tracing notification
- among non-household contacts only versus among all contacts
- with/without PCR confirmation of LFD tests

Modelled using:

Martyn Fyles et al. 2021. Using a household-structured branching process to model contact tracing for COVID-19 control in the UK. Phil Trans R Soc B 376:20200267. https://doi.org/10.1098/rstb.2020.0267

Code: https://zenodo.org/record/5139630#.Yp3QBGDMKDU

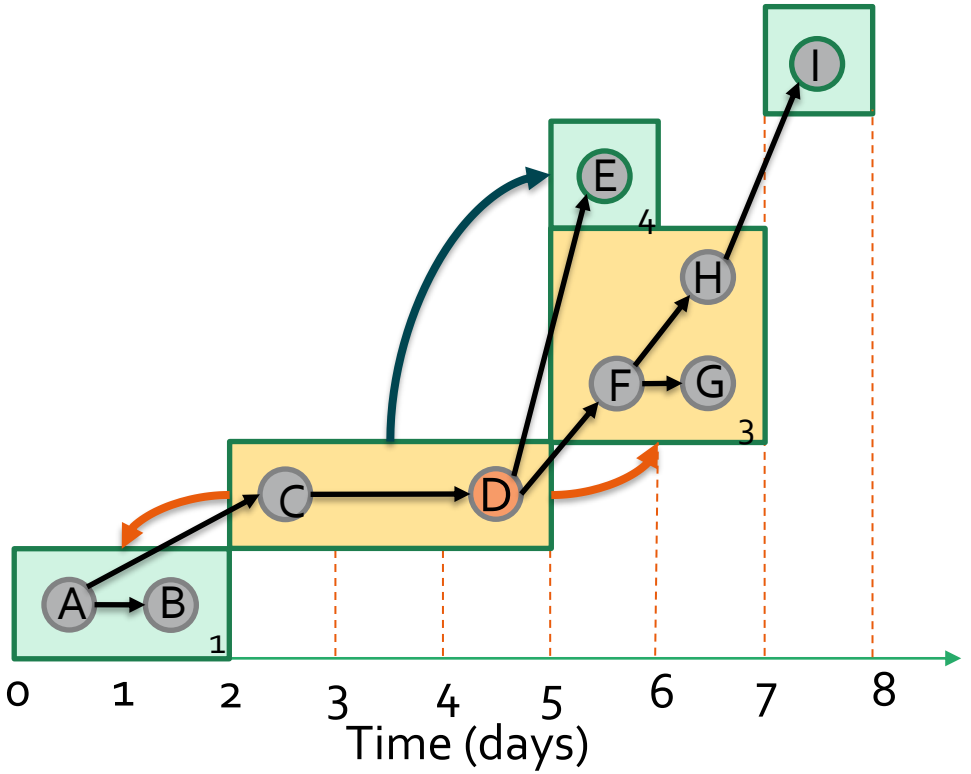


Figure illustrates a household-structure branching process of infection (black) and successful (green) and unsuccessful (red) contact tracing.

DCT Findings

DCT among ALL contacts (non-HH and HH): LFA 3, LFA 7 , LFA 10 = LFA testing for 3, 7 and 10 days post tracing. +PCR adds a 'confirmatory PCR' testing delay to initiate contact tracing. *Assuming 100% adherence to each policy*, contemporary estimates of delays and % of symptomatic cases testing.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/976324/S1146_SPI-M-O_Daily_contact_testing.pdf
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/950771/s0897-testing-of-traced-contacts.pdf

Population-wide asymptomatic testing

Autumn/Winter 2021-2022

How to avoid lockdowns in the presence of rising cases and pressure on health systems?

Key questions

1. What is the effectiveness of regular LFD testing among asymptomatic individuals in reducing the total number of infections, in addition to symptomatic TTI, across testing frequencies and levels of adherence?
2. What percentage non-household contact reduction would be required to get the same effectiveness?
3. What are the associated 'costs' in terms of numbers of days people are asked to isolate at home and numbers of tests required?

Covasim model

Dynamic multilayer network model.

- Household (repeat daily)
- School (repeat daily)
- Workplace (repeat daily)
- Community (random daily)

Age-structured based on

- CoMix (Aug/Sept 2020)
  - mean 5.7 non-HH contacts
- Polymod (prepandemic)
  - mean 9.8 non-HH contacts

Networks layers generated using a configuration model with negative binomial contact distribution

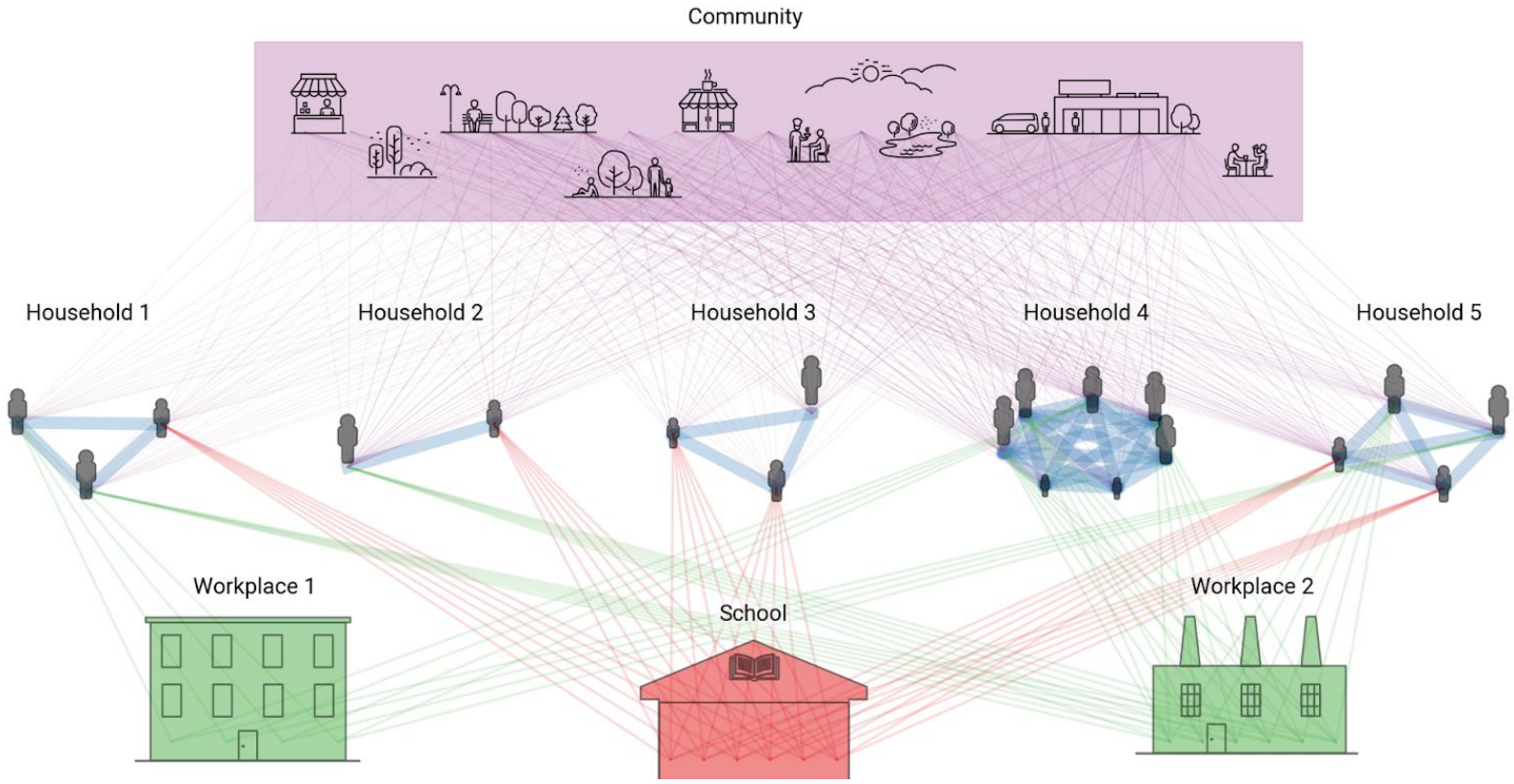


Figure from Kerr et al (2021) Covasim: an agent-based model of COVID-19 dynamics and interventions. PLoS Comput Biol 17(7): e1009149.

Covasim model

Vaccinated population

90% aged > 40 yrs 2x AZ vaccine

45% <40 yrs 2 x Pfizer vacc

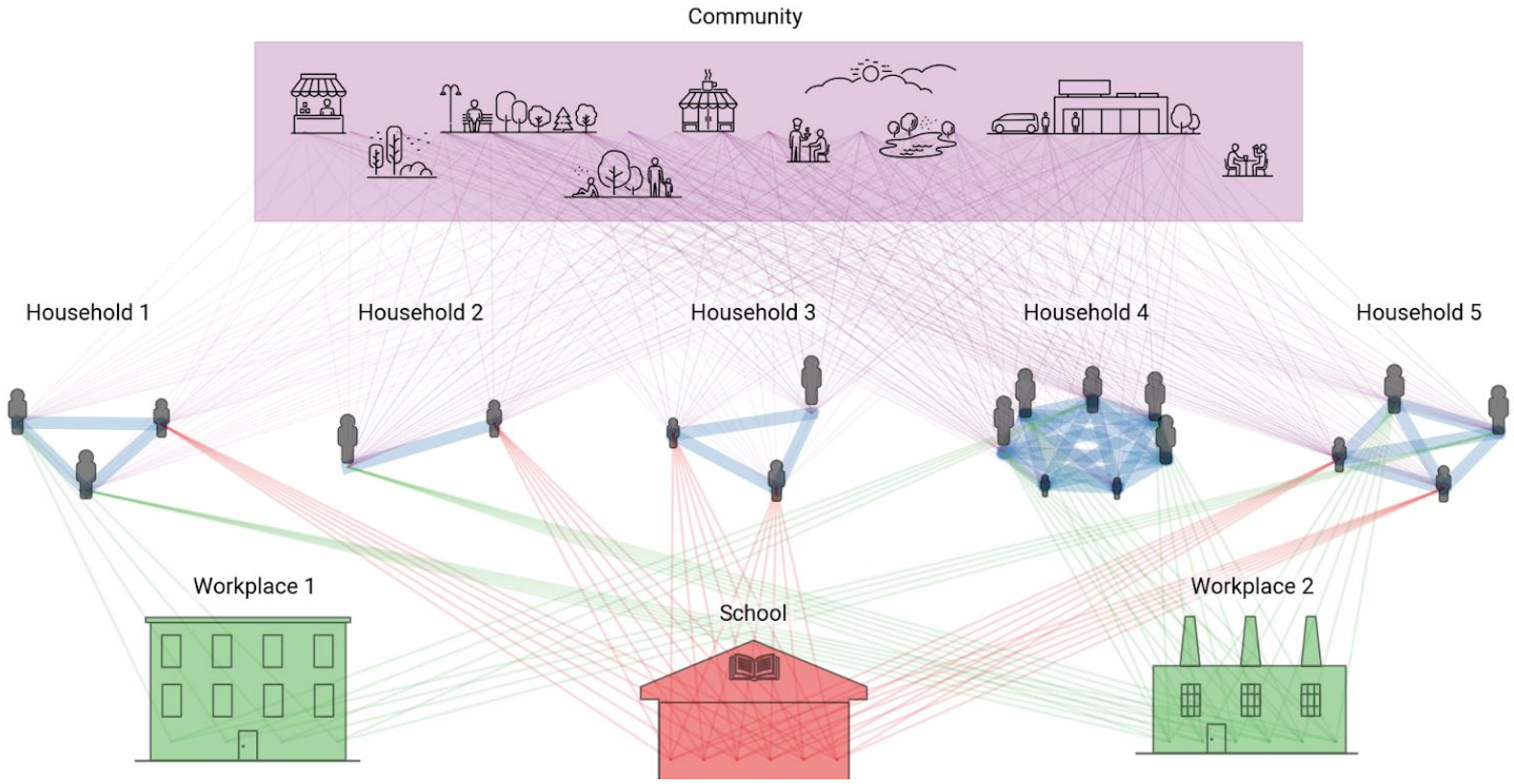
=> 67% total adult population

Infectivity proportional to time since infection

Test sensitivity proportional to time since infection from Hellewell et al. (2021) Estimating the effectiveness of routine asymptomatic PCR screening at different frequencies for the detection of SARS-CoV-2 infections, BMC Medicine 19: 106.

Calibrated beta parameter to growth rates r = 0.025 – 0.3

Modified Covasim release 3.0.2.



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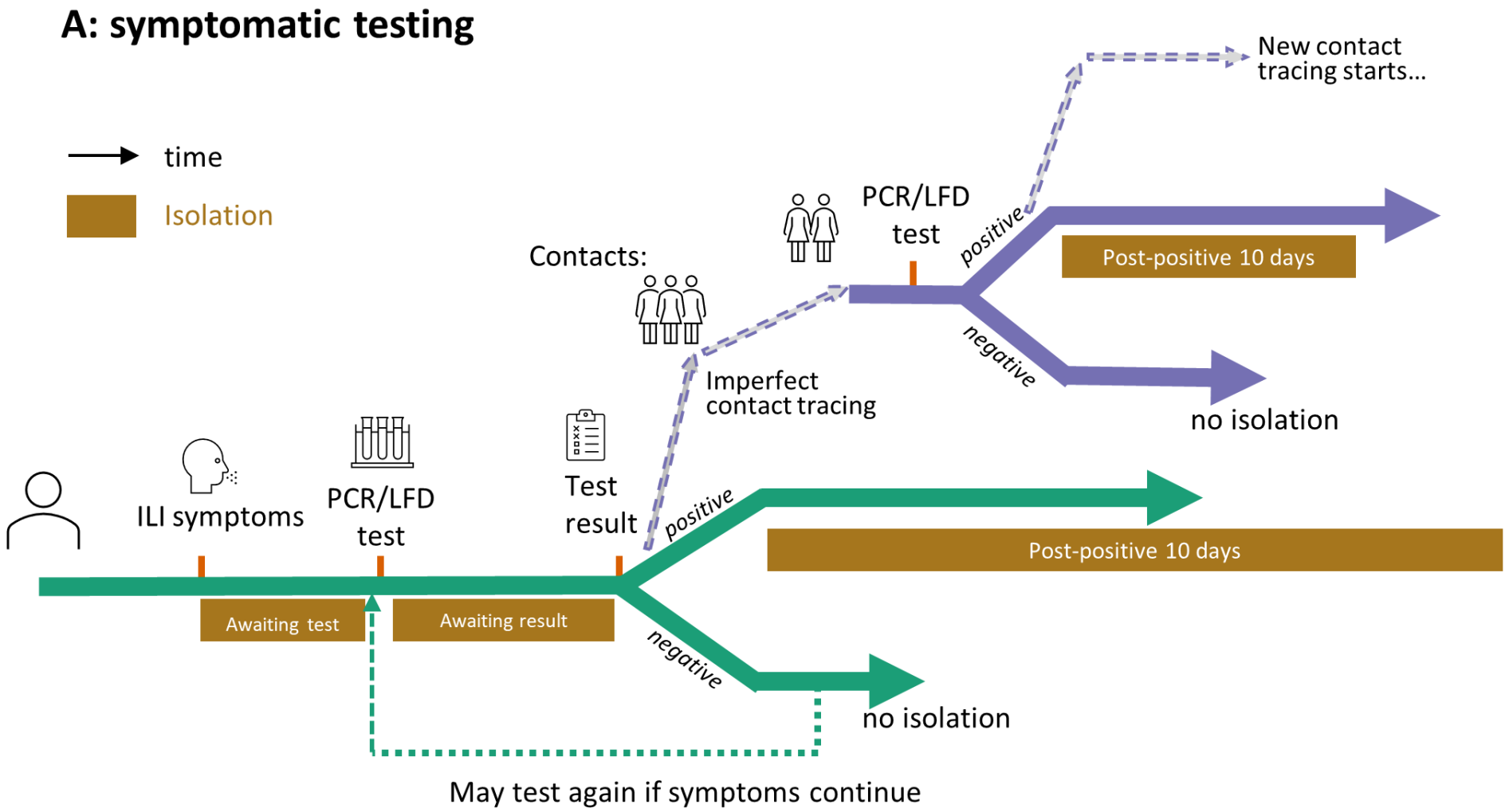
Testing, tracing and isolation pathways



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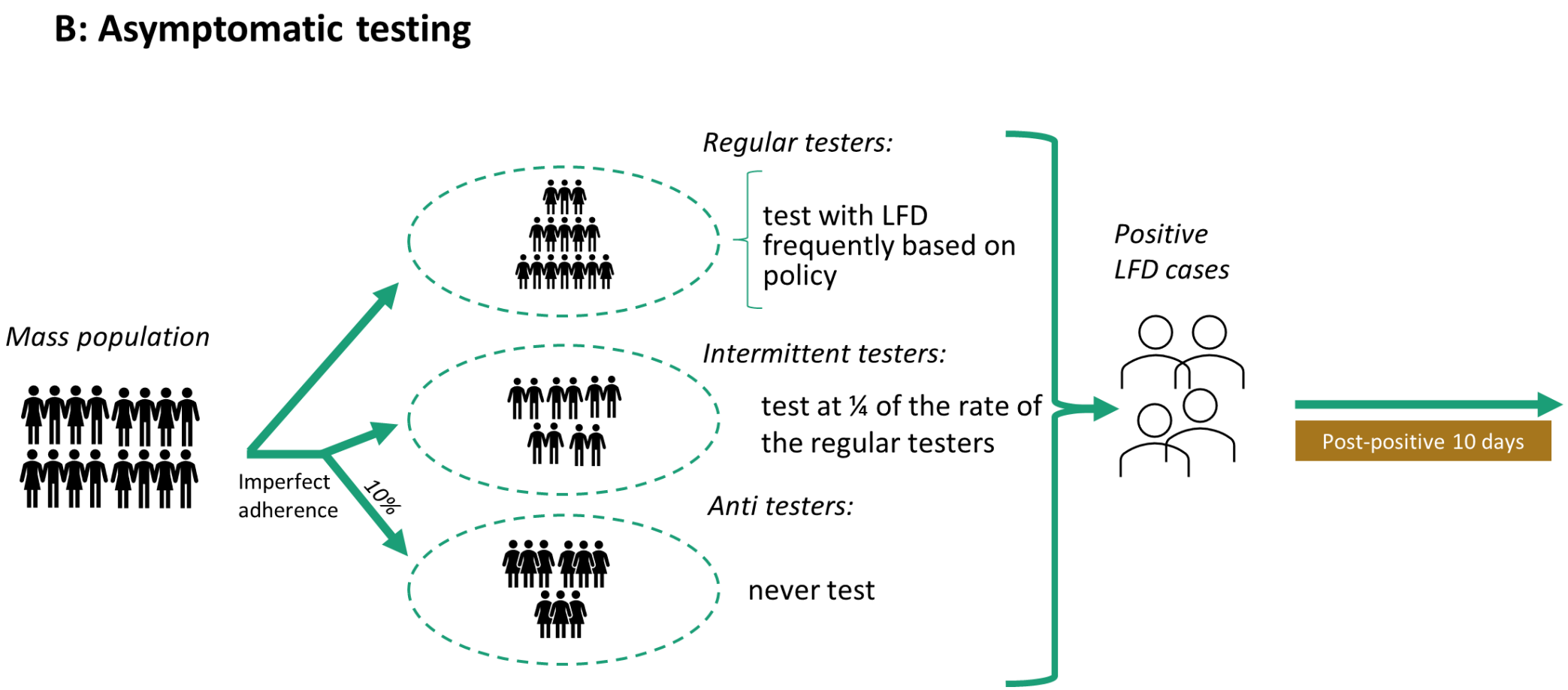
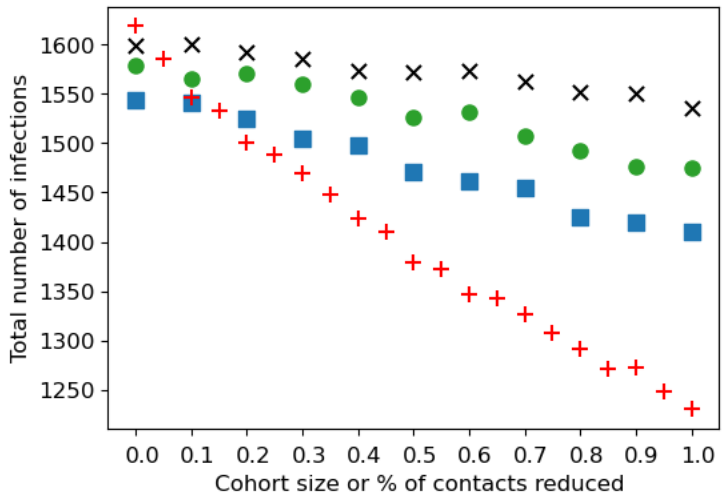
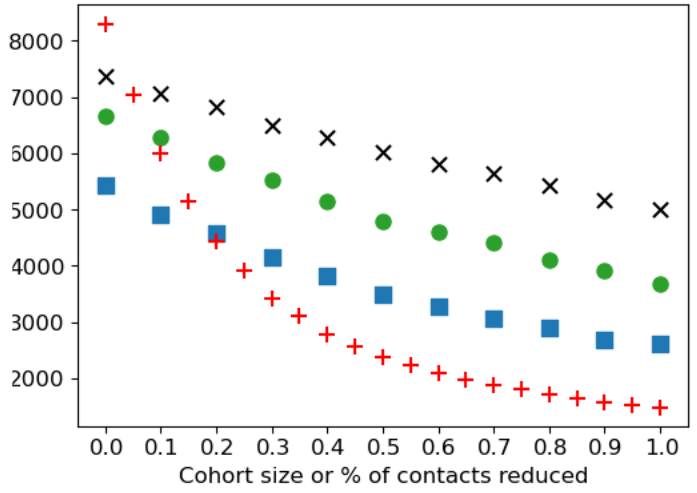


Effectiveness of asymptomatic testing vs contact reductions

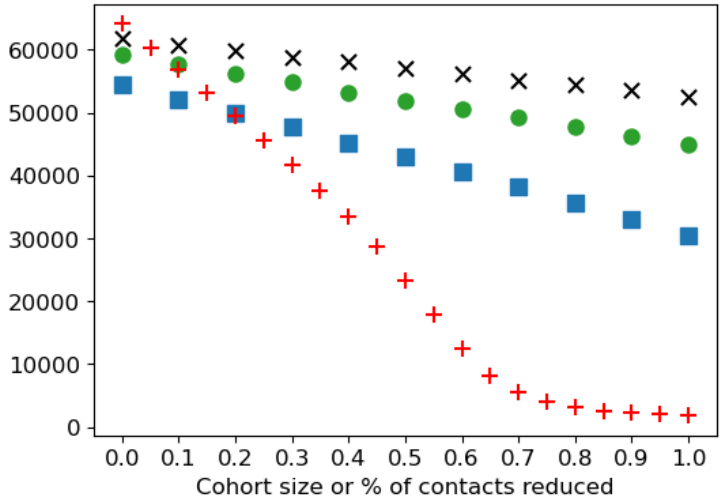
Low growth rate, 0.025

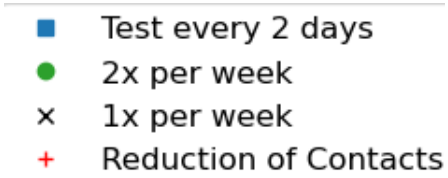


Medium growth rate, 0.15



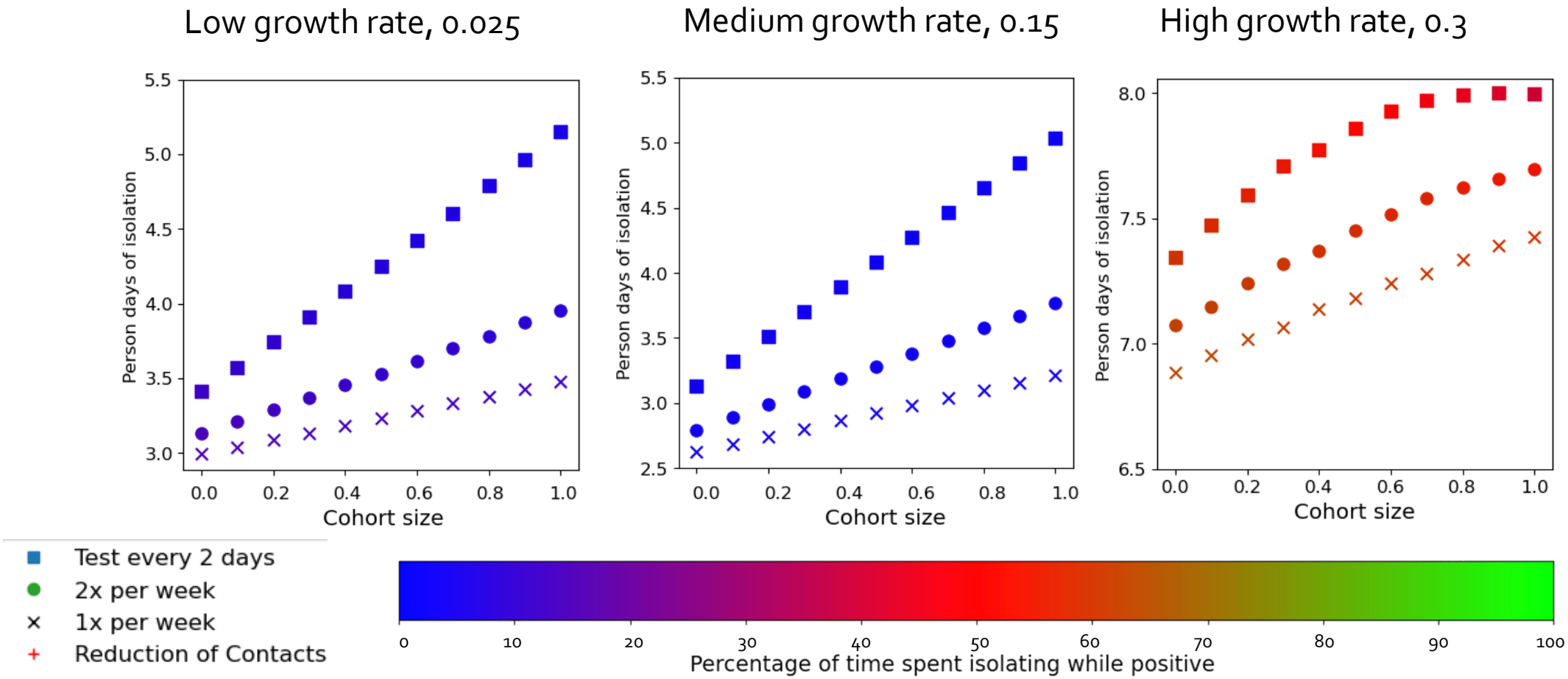
High growth rate, 0.3





Figures show mean of 100 simulated epidemics, over 180 days, for each policy and growth rate combination. Contact patterns as per Polymod.

Person days in isolation



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Caveats

- Not modelling individual viral load trajectories
- Aspects of the contact structure not realistic – eg community contacts not more likely to be shared by household, workplace, school contacts.
- Did not vary uptake of symptomatic TTI while investigating effectiveness of asymptomatic testing
- Further sensitivity analyses as to asymptomatic testing cohorts would be useful
- No correlation in testing/isolation behaviour between contacts

Conclusions

- Asymptomatic testing can play an **important role in reducing the size of an epidemic wave**, even *in addition* to moderate symptomatic TTI
- However, **testing and isolation struggle when growth rate is high***
- **Effectiveness increases with frequency** and take-up
- Results held for different mean levels of contact
- **Person days in isolation** among SARS-CoV-2 negative individuals increases with increasing testing frequency

BUT harm of alternative control interventions - is a 25% reduction in non-HH contacts equivalent to being isolated at home for 1 out of every 4 days?

Miguel Silva et al. The role of regular asymptomatic testing in reducing the impact of a COVID-19 wave. Preprint forthcoming.

Public perceptions of LFDs

Findings from 20 interviews with the public (England) June-July 2021:

- Accessibility and speed make them a popular choice.
- Useful for reducing anxiety.
- Regular testing easier to remember and ritualise but can get fed up.
- Trust in LFDs is very low, but people are generally happy to trust negative results.
- Negative LFD test interpretation: You do not have COVID. People will not isolate even if required to.
- Positive LFD test interpretation: You probably have COVID and should take PCR test to be sure. If they bothered to take an LFD test they would do this.

Full report and analysis in: Guy Marshall et al, 2022. Public perceptions and interactions with UK Test, Trace, and Isolate policies and implications for pandemic infectious disease modelling.
https://www.medrxiv.org/content/10.1101/2022.01.31.22269871v1.full.pdf

Personal priorities impacting TTI

- Protect vulnerable people that they know (especially family).
- Follow sensible guidance (institution/government/healthcare); assumed that others did too.
- Comply with work requirements
- To be able to plan
- Not miss out on social events
- Manage mental health

https://www.youtube.com/watch?v=gmHgYxACqIo
From NHS Inform Scotland: COVID-19

Next questions

Clustering of TTI uptake and adherence on the network

Considering varying network characteristics of sub-groups

Effectiveness of *targeted* asymptomatic testing interventions

- Some evidence from settings (DCT in schools, Liverpool)
- On the population level (eg as Dec 2021, pre-gathering testing)?

Public-driven testing interventions

- Assess and develop testing interventions based on how the public used LFD tests

Consider metrics for assessment of infectious diseases testing/screening

- e.g. account change in sensitivity of a test over course of infection

When is asymptomatic testing useful for transmission control?

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Infection

Proportion asymptomatic/pauci-symptomatic cases

Specificity and timing of symptoms

Population

Characteristics of the population and contact network most affected (by transmission, by disease)

Testing technology

Characteristics of the test sensitivity/specificity over time and relative to infectiousness; usability; acceptability, costs

Testing intervention

Relative importance of early case detection to control measure efficacy

Embedding within full TTI policies/processes, alongside other technologies

Costs compared to alternative transmission control policies

e.g. compared to blanket contact reductions, or quarantine burden to contacts

Thank you

We thank the **MRC** through **the UKRI/NIHR COVID-19 Rapid Response** call for their support for our project: *An analytical framework for Test, Trace and Isolate in the UK,* MR/V028618/1.

TTI Project group and contributors: Joshua Blake, Peter Crowther, Rajenki Das, Emma L Davis, Martyn Fyles, Ann Gledson, Ian Hall, Deirdre Hollingsworth, Thomas House, Caroline Jay, Petra Klepac, Tim CD Lucas, Guy Marshall, Graham Medley, Lorenzo Pellis, Li Pi, Miguel Silva, Rigina Skeva, Helena B Stage, Tom Wingfield, Lucy Yardley, and Elizabeth Fearon.

Covasim expertise: Jasmina Panovska-Griffiths

Interviewees

SPI-M secretariat, members and contributors

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