

Yale SCHOOL OF PUBLIC HEALTH

Advanced modeling techniques from population biology

Jeffrey Townsend, Ph.D.
Elihu Professor of Biostatistics

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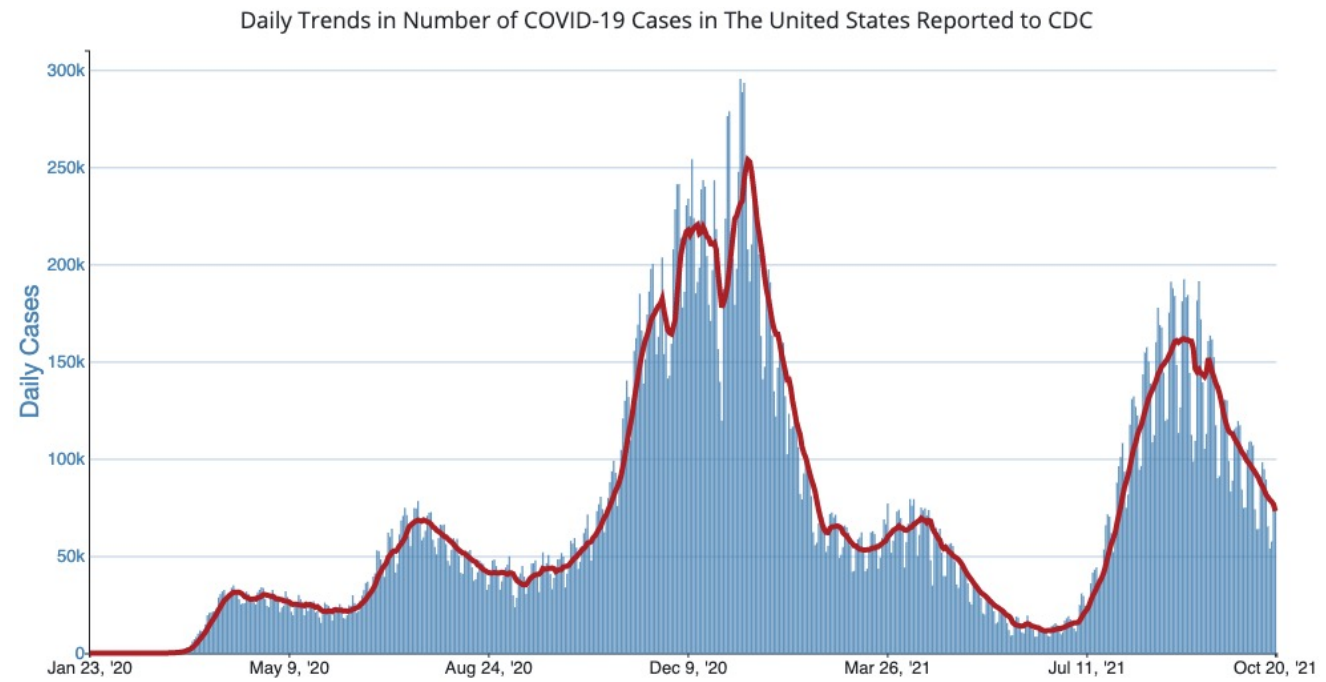
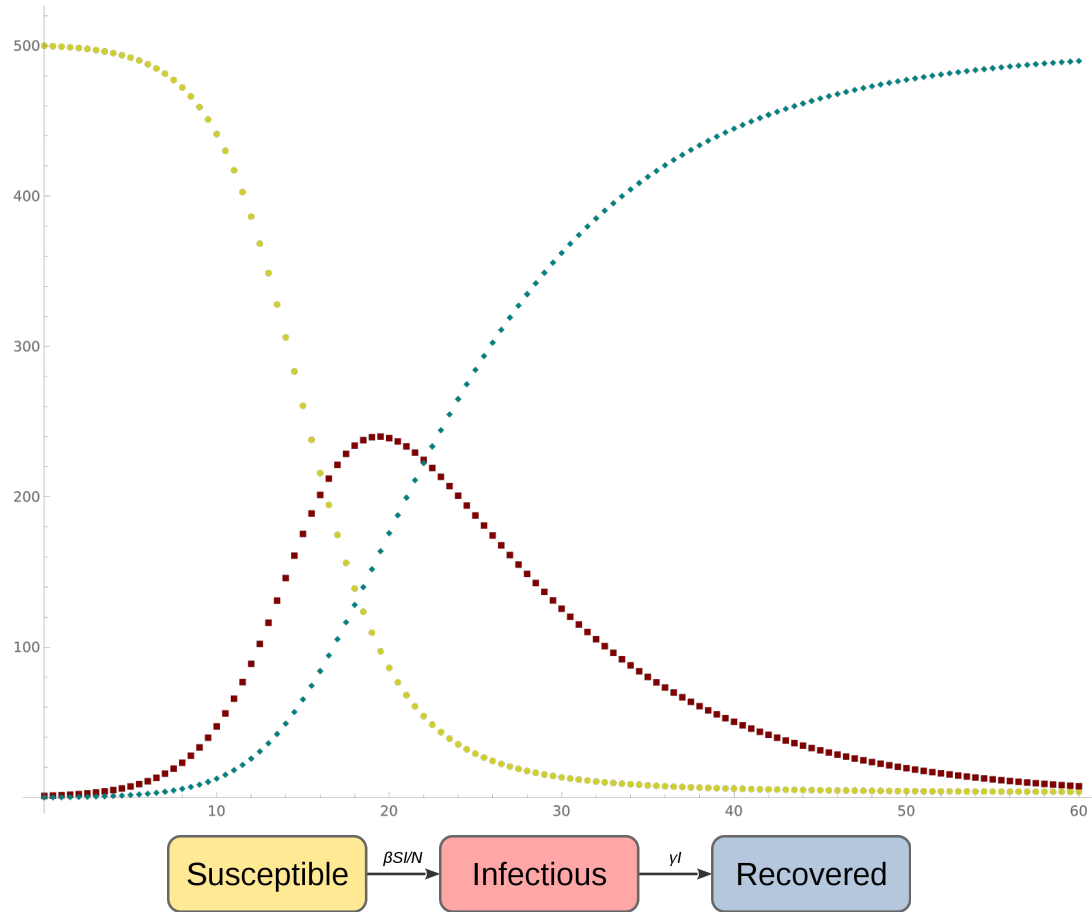
Advanced modeling techniques from population biology

- Modeling interventions via imminent infection
 - COVID-19 quarantine & testing
 - Travel quarantines late in pandemics
- Evolution-aware public health
 - Durability of immunity against natural infection by SARS-CoV-2

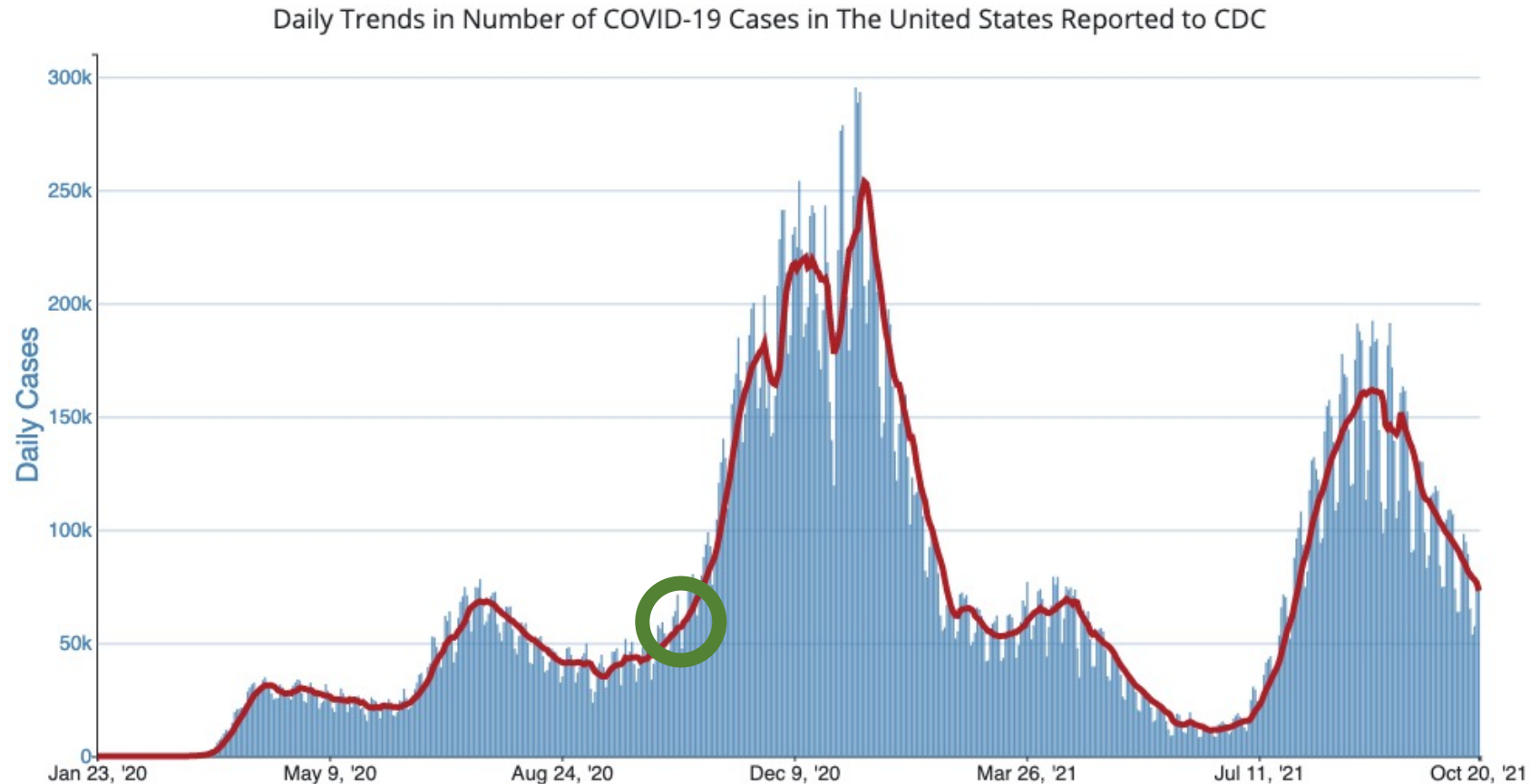
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Mathematical modeling typically models whole epidemics, but actual epidemics are typically too complex for that



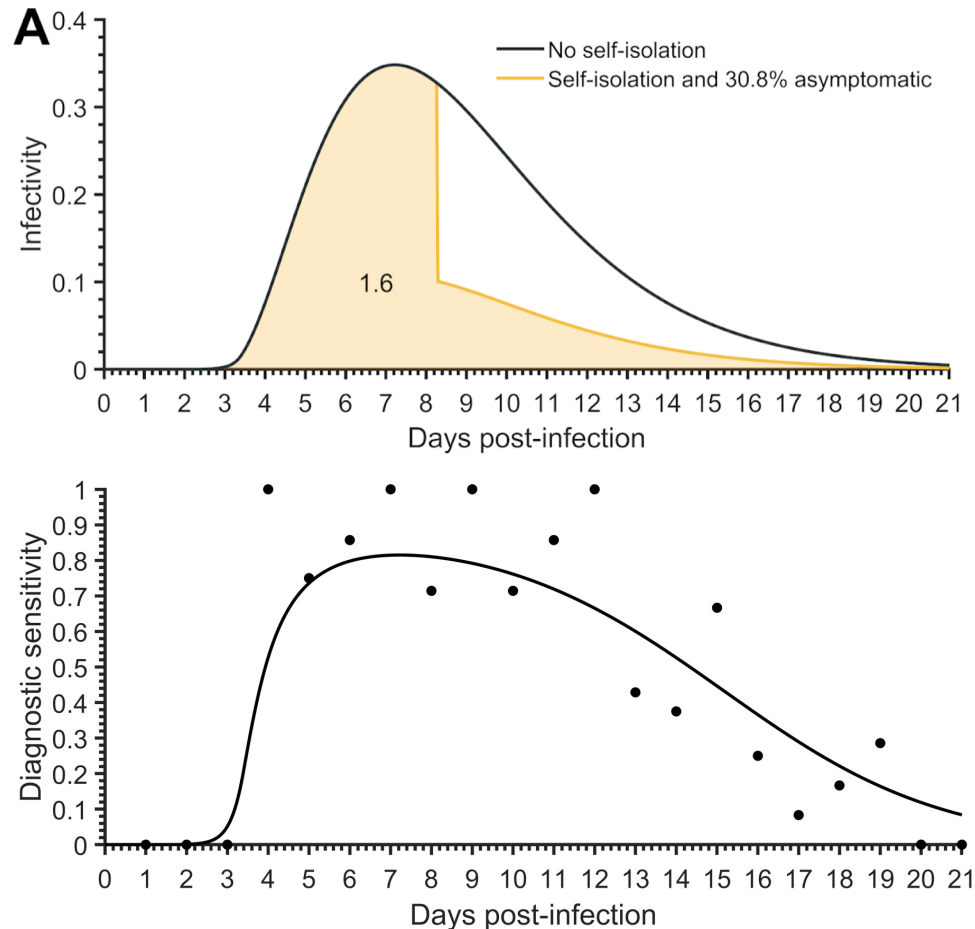
We can focus our analyses of interventions by use of the concept of imminent infection



We can focus our analyses of interventions by use of the concept of imminent infection

- What is the effect of an intervention on the current R_e ?
- Examine the “next generation” using next-generation matrices or integration over disease time course

Focusing on imminent infection enabled us to quickly evaluate the efficacy of different timings of quarantine and testing



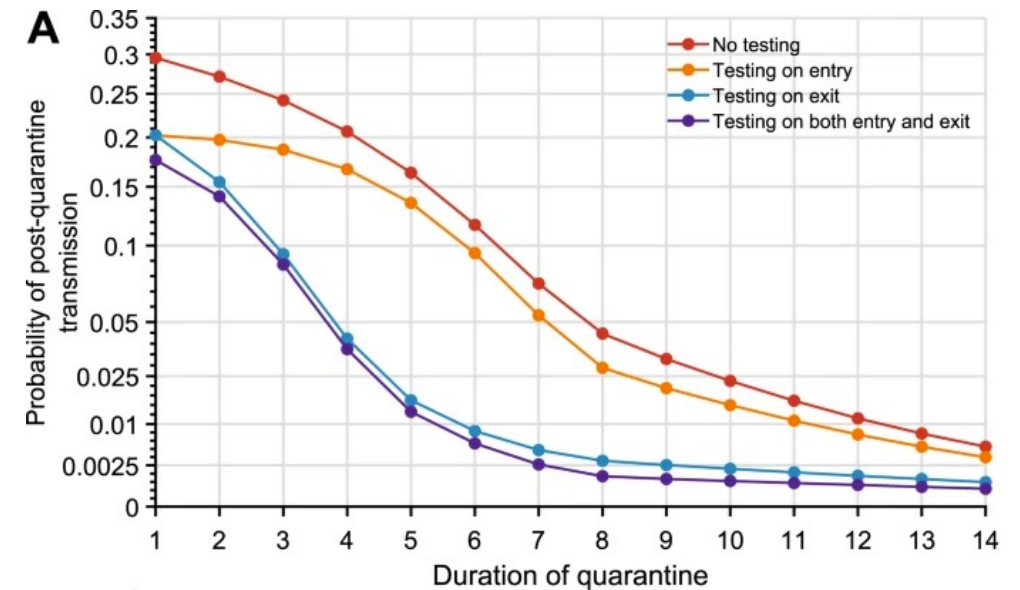
Article | [Open Access](#) | Published: 07 January 2021

Optimal COVID-19 quarantine and testing strategies

Chad R. Wells, Jeffrey P. Townsend , Abhishek Pandey, Seyed M. Moghadas, Gary Krieger, Burton Singer, Robert H. McDonald, Meagan C. Fitzpatrick & Alison P. Galvani

Nature Communications **12**, Article number: 356 (2021) | [Cite this article](#)

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Rapid, accurate analyses beneficially affect policy

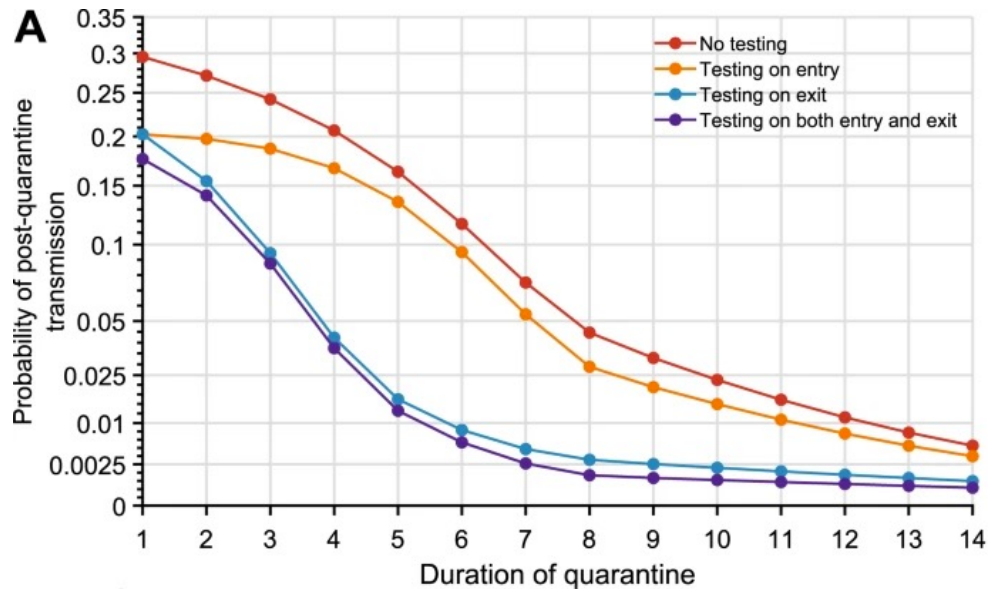
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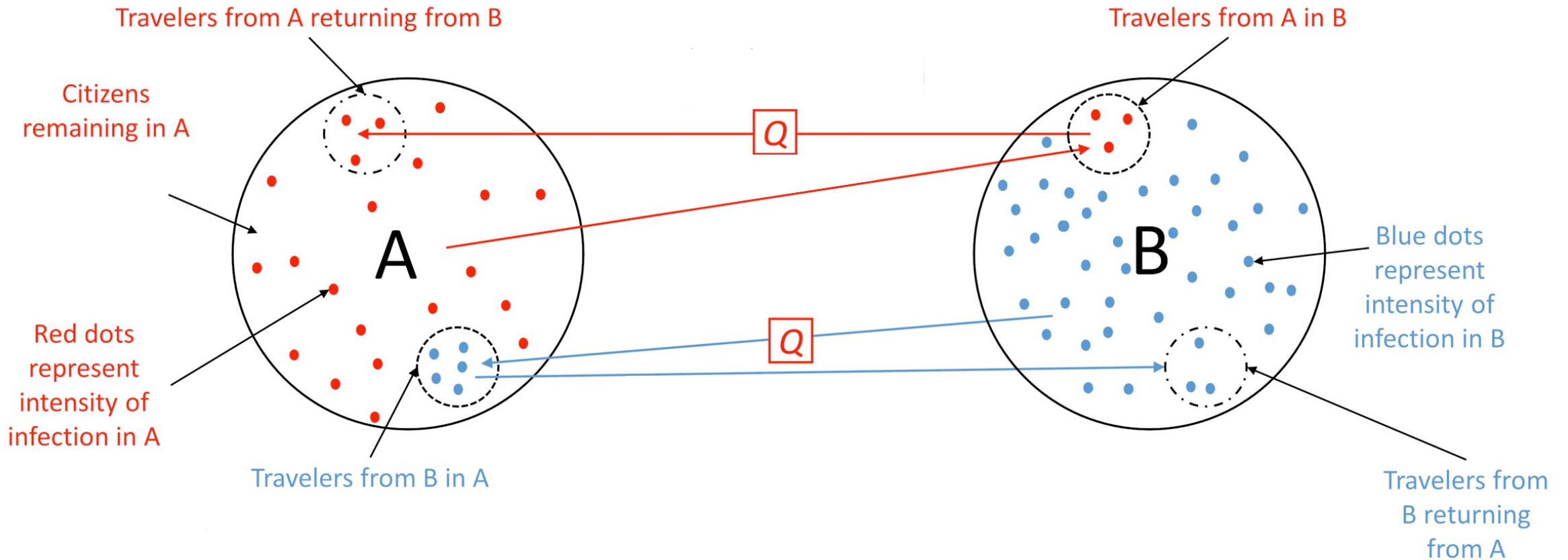


- Research cited by the US CDC in changing quarantine policy, and advised ECDC
- Results validated by two subsequently published peer-reviewed papers by independent teams using distinct methods
 - Quilty et al., *The Lancet Public Health*
 - Ashcroft et al., *eLife*)

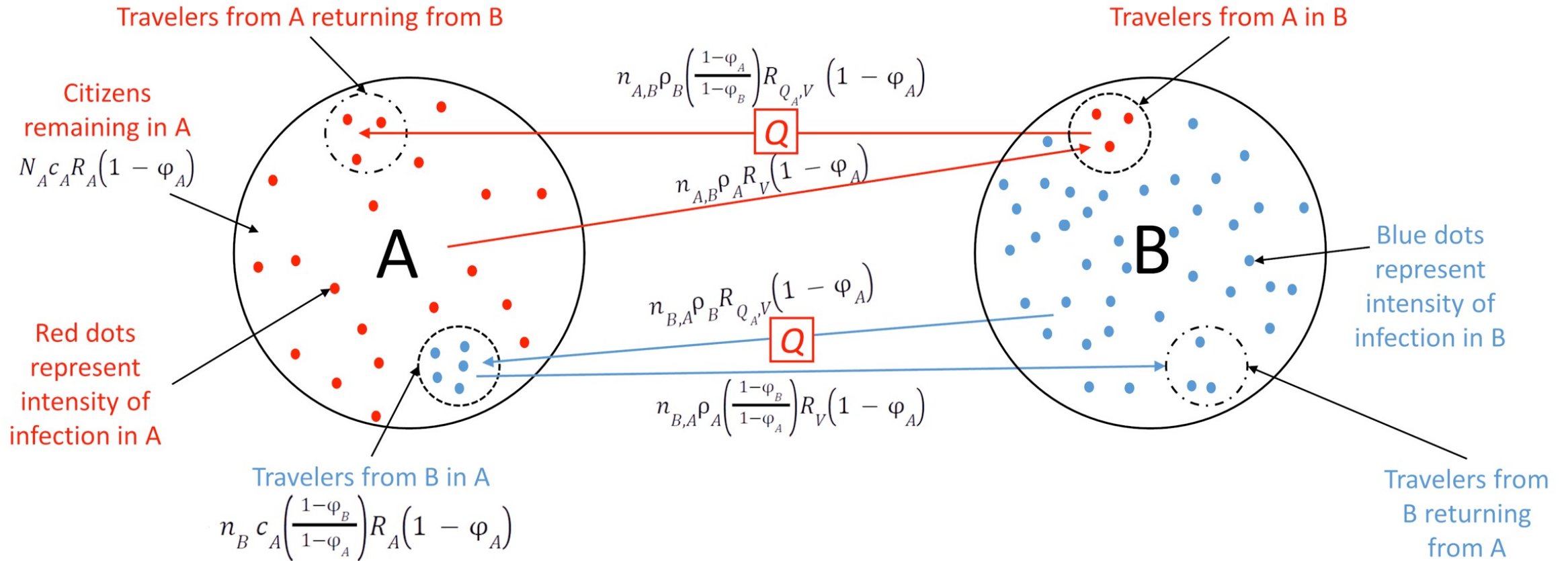
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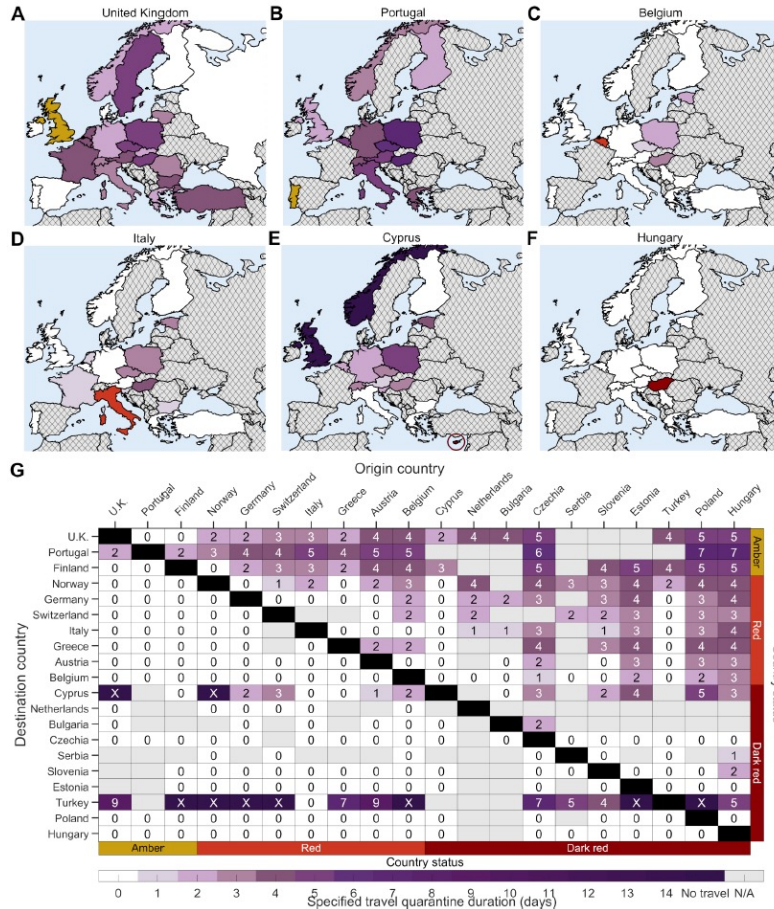
What is the effect of travel quarantines on in-country infection?



Impact on in-country imminent infection can be quantified



Imminent infection informs the impact of travel quarantines



- Late in the pandemic, the required quarantine to prevent more infections in-country than would *complete border closure* is much shorter than was typically imposed.
- Policy decisions should be made on public health merit, not politics.
- On MedRXiv

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The durability of immunity upon natural infection has been called the greatest unknown factor of the COVID-19 epidemic

COVID-19 - The Big Questions 6 Months On

VIDEO © Jul 22, 2020 | Taken from Nature Video, Youtube



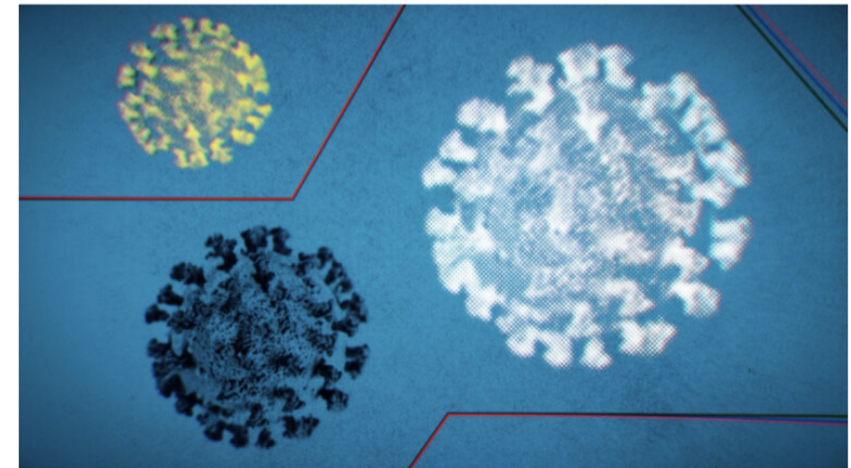
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HEALTH

Seven months later, what we know about Covid-19 — and the pressing questions that remain

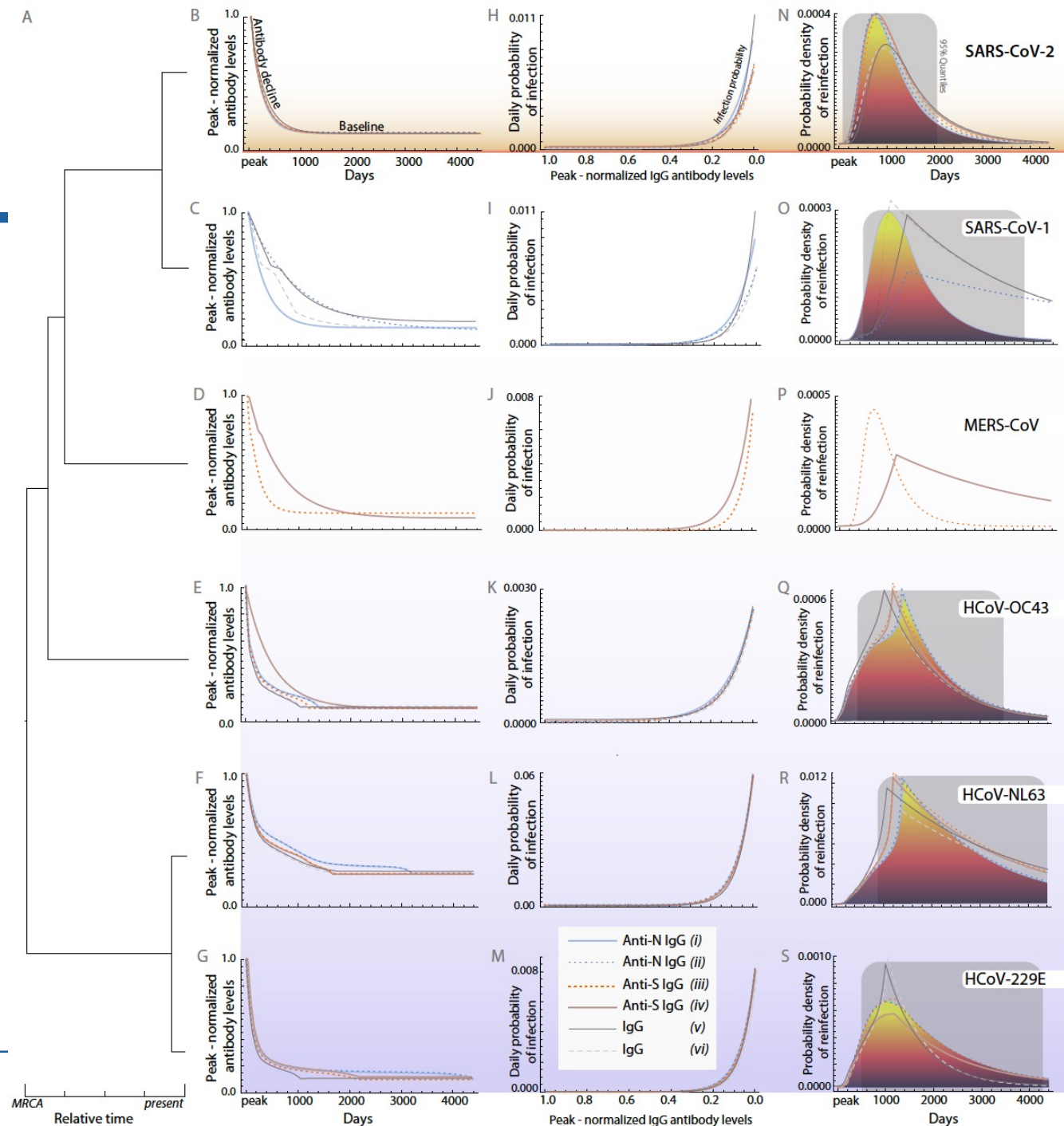
By ANDREW JOSEPH @DrewQJoseph, HELEN BRANSWELL @HelenBranswell, and ELIZABETH COONEY @cooney_liz / AUGUST 17, 2020

Reprints



Evolution can tell us the durability of immunity

- Convolution of
 - Data on antibody waning in response to each virus
 - Long-term serial infection data for endemic human coronaviruses
- Townsend et al 2021, *The Lancet Microbe*



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Something different

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