

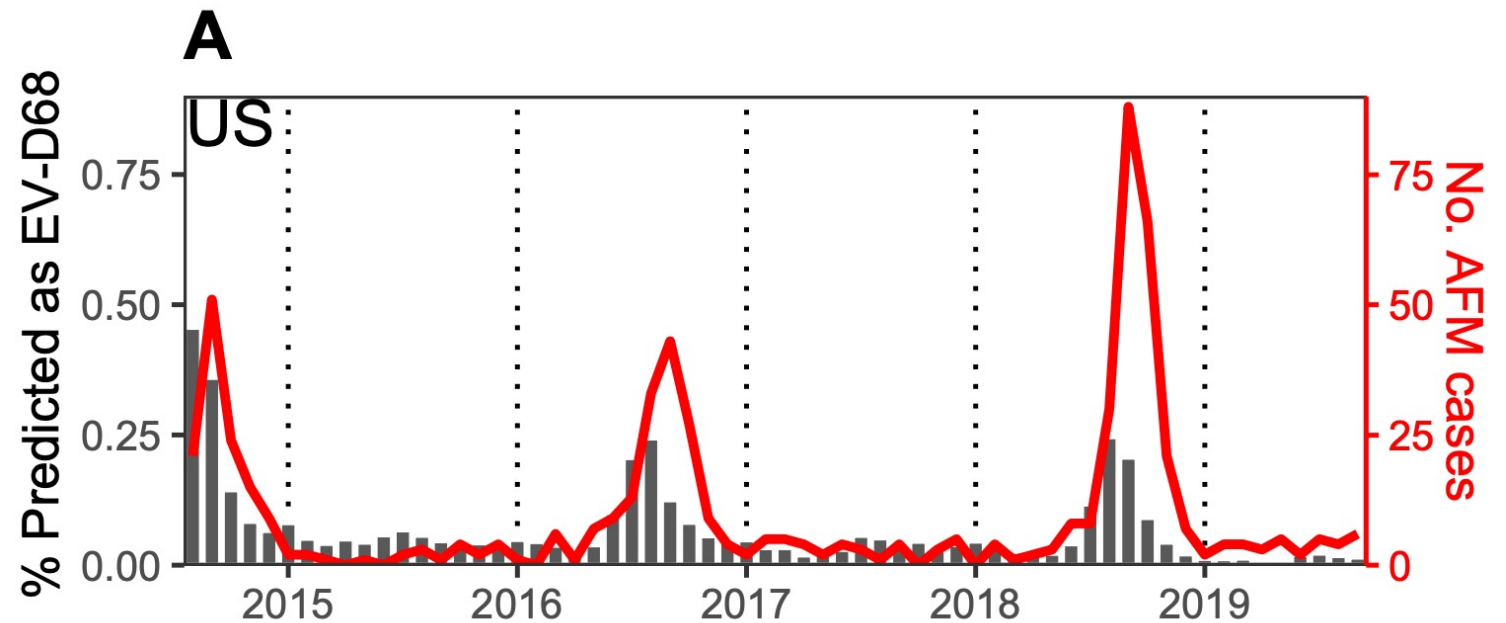
# Dynamical biases in epidemic inference

Sang Woo Park

Princeton University

# Introduction

- 3<sup>rd</sup> year PhD candidate at Princeton University
- Advisor: Bryan Grenfell
- Dynamics of childhood diseases, especially acute flaccid myelitis and enterovirus D68



# Reconciling early-outbreak estimates of the basic reproductive number and its uncertainty: framework and applications to the novel coronavirus (SARS-CoV-2) outbreak

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## The time scale of asymptomatic transmission affects estimates of epidemic potential in the COVID-19 outbreak

Sang Woo Park<sup>a</sup>, Daniel M. Cornforth<sup>b</sup>, Jonathan Dushoff<sup>c,d,e,\*</sup>, Joshua S. Weitz<sup>b,f,\*</sup>

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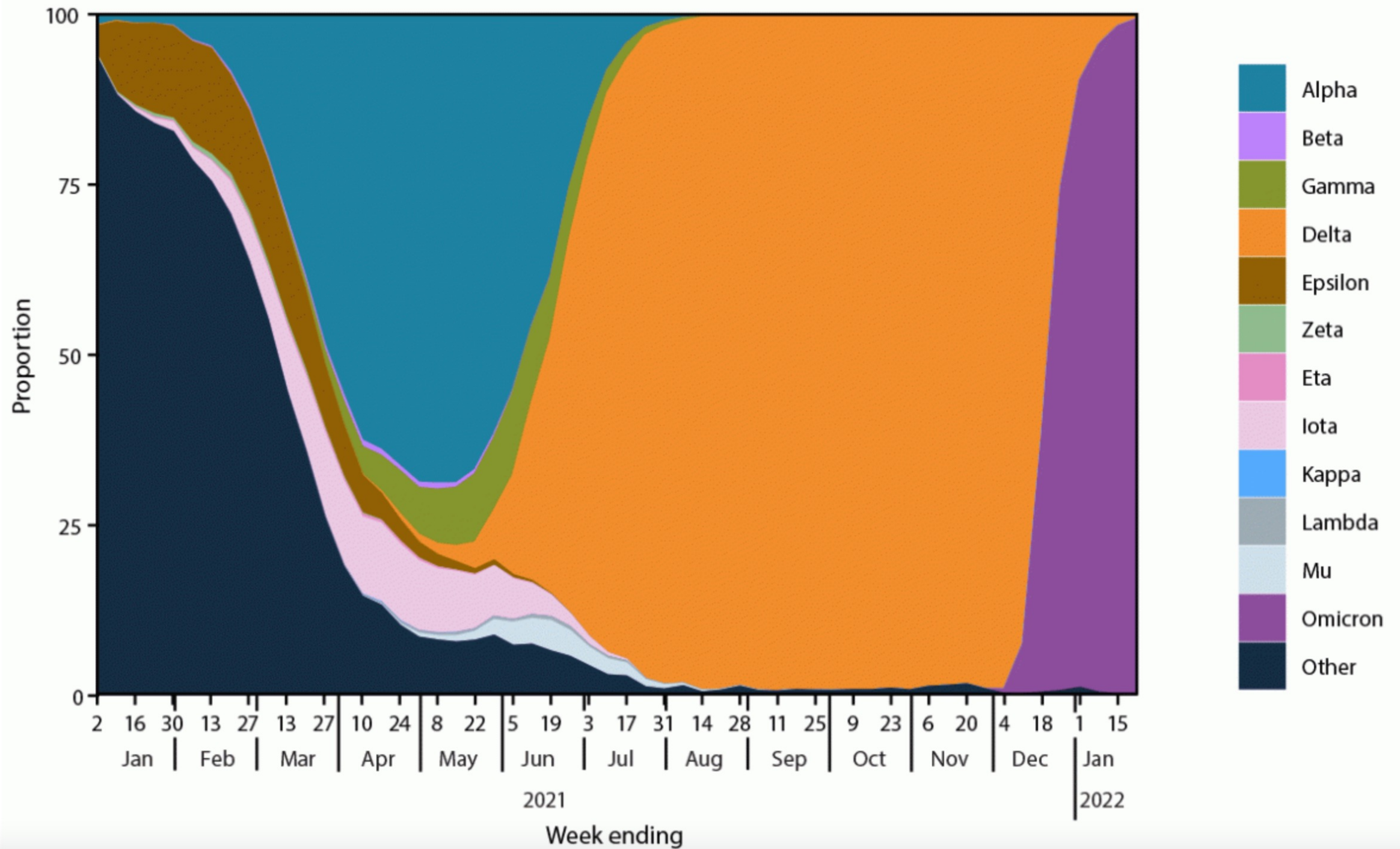
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## Roles of generation-interval distributions in shaping relative epidemic strength, speed, and control of new SARS-CoV-2 variants

Sang Woo Park<sup>1,\*</sup> Benjamin M. Bolker<sup>2,3,4</sup> Sebastian Funk<sup>5,6</sup> C. Jessica E. Metcalf<sup>1,7</sup>  
Joshua S. Weitz<sup>8,9</sup> Bryan T. Grenfell<sup>1,7,10</sup> Jonathan Dushoff<sup>2,3,4</sup>





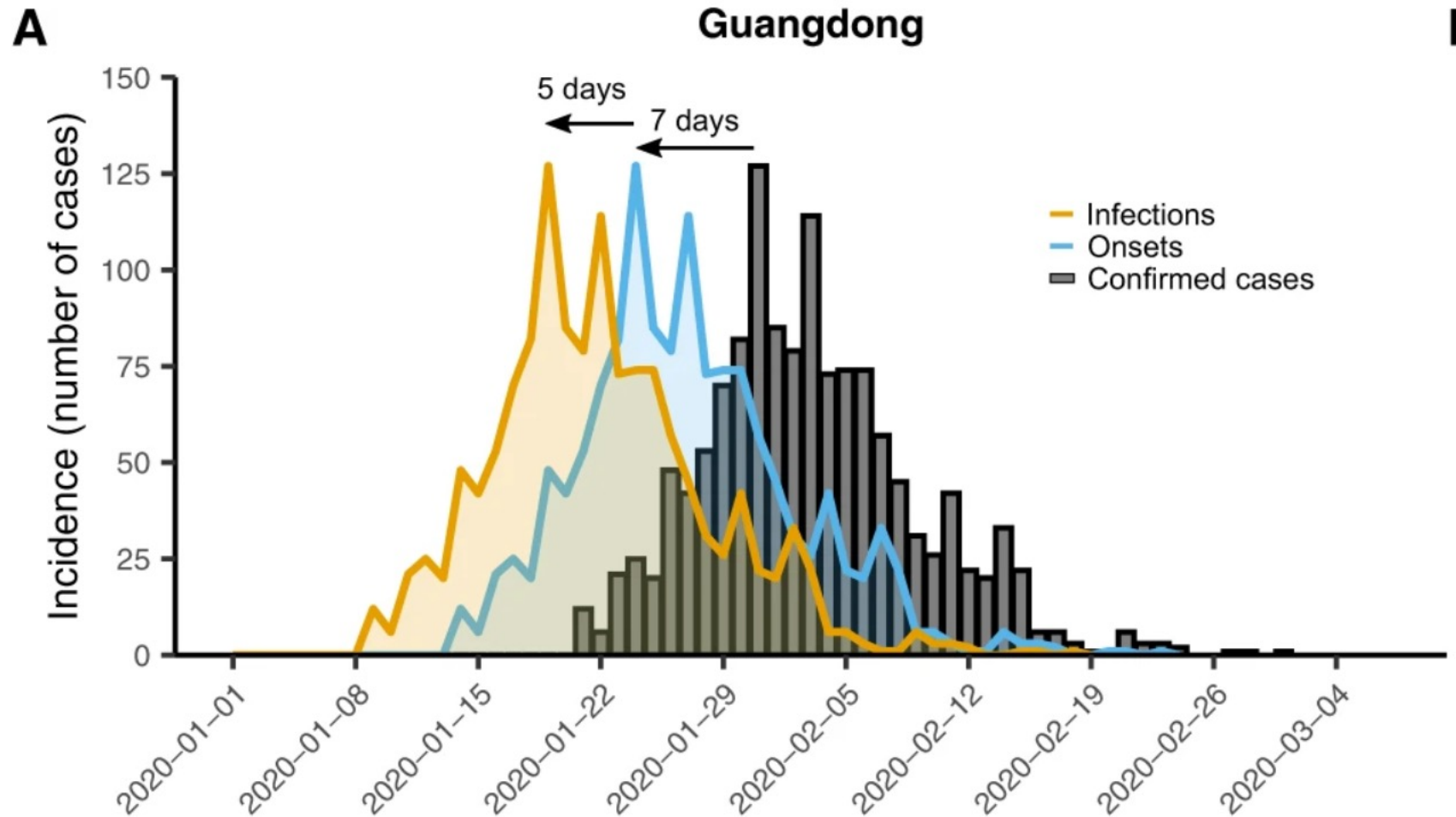
# Overview

1. Introduction to dynamical biases
2. Dynamical biases in serial-interval distributions
3. Application: incubation periods and generation intervals of the Omicron variant

# Introduction to dynamical biases

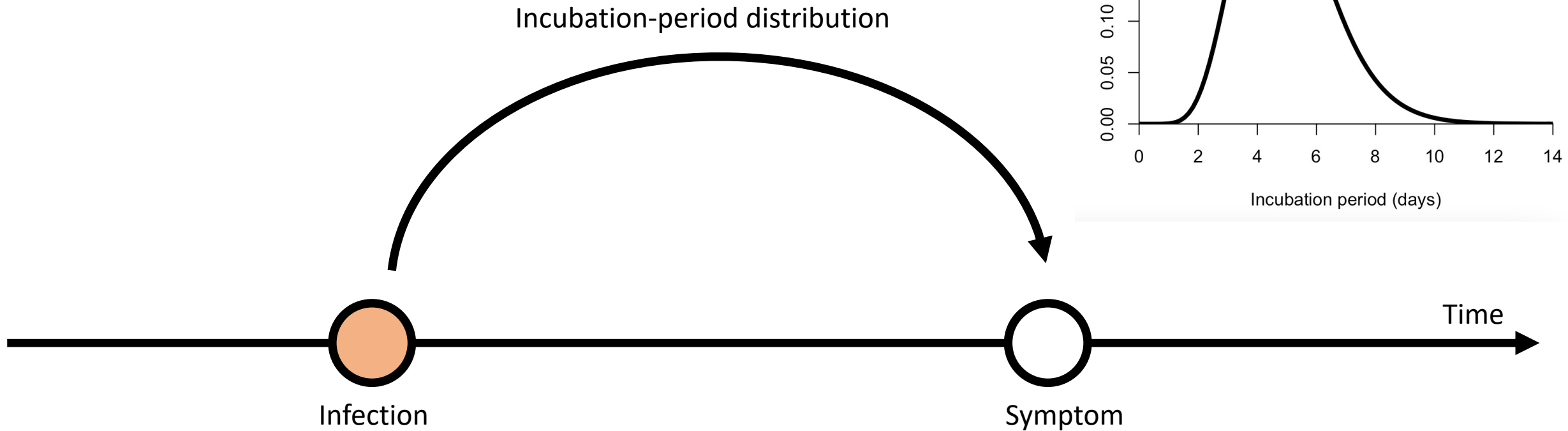


# Observed vs latent dynamics



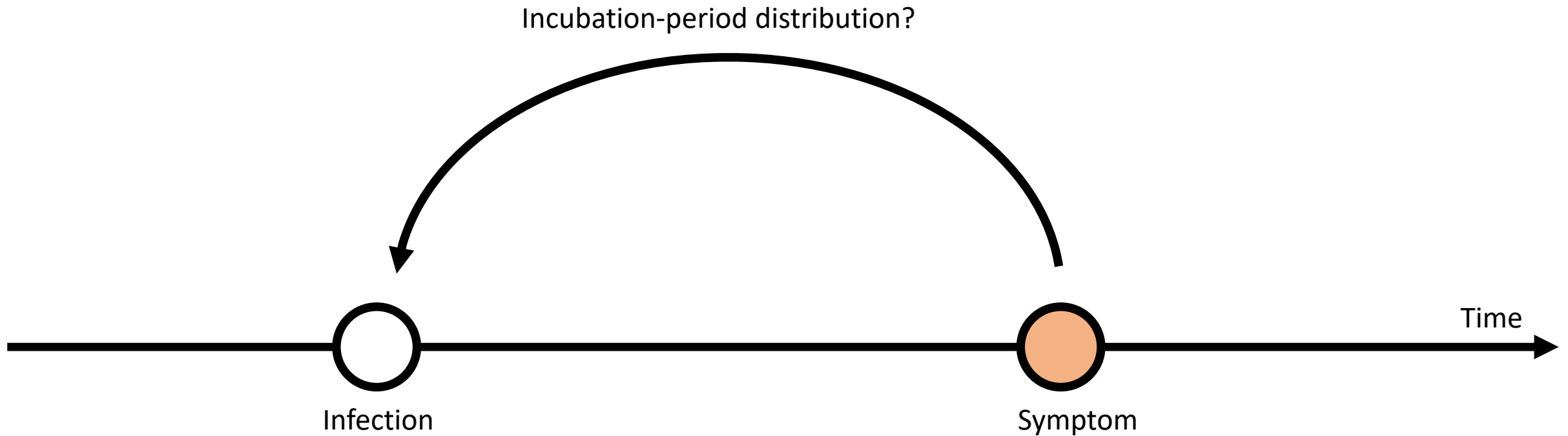
# Forward distribution

Measured from a cohort of individuals who were **infected at the same time**

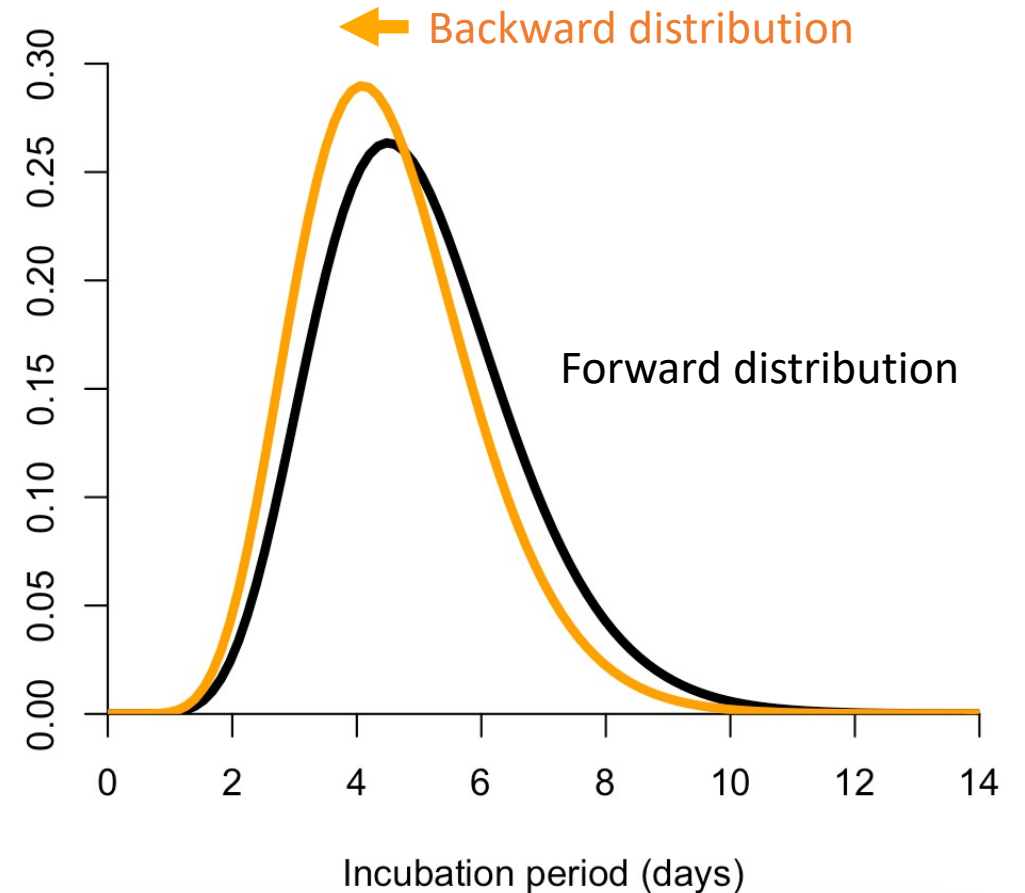
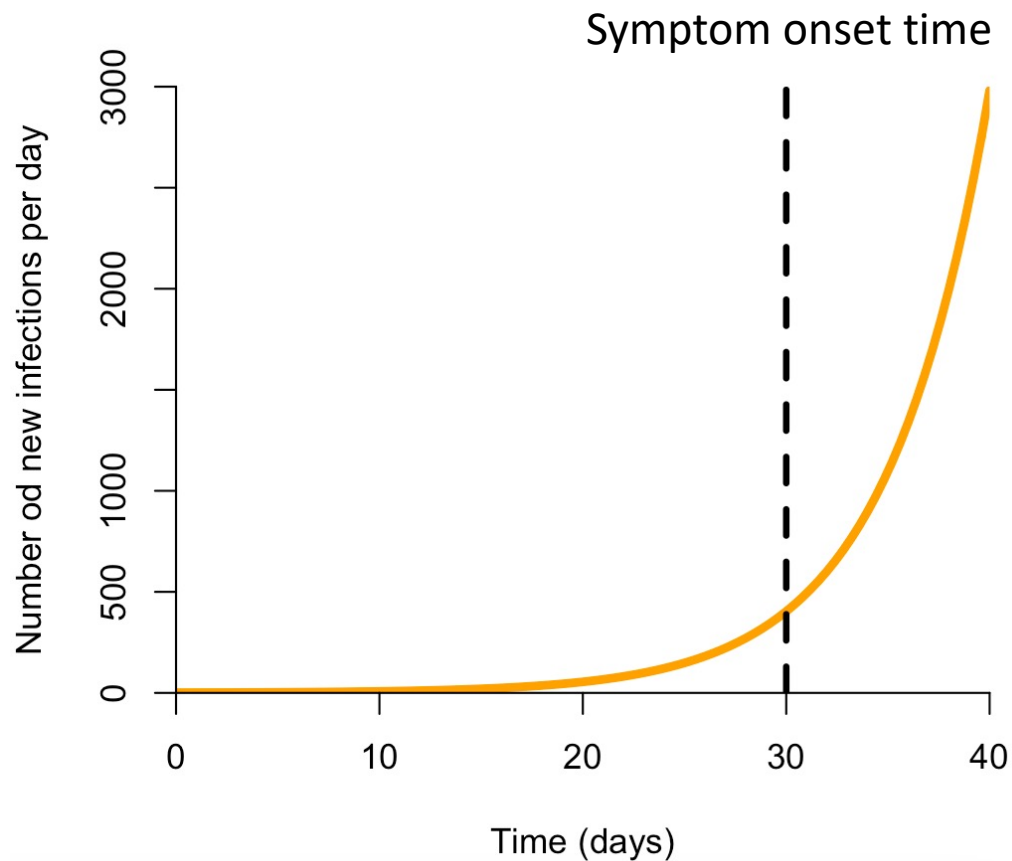


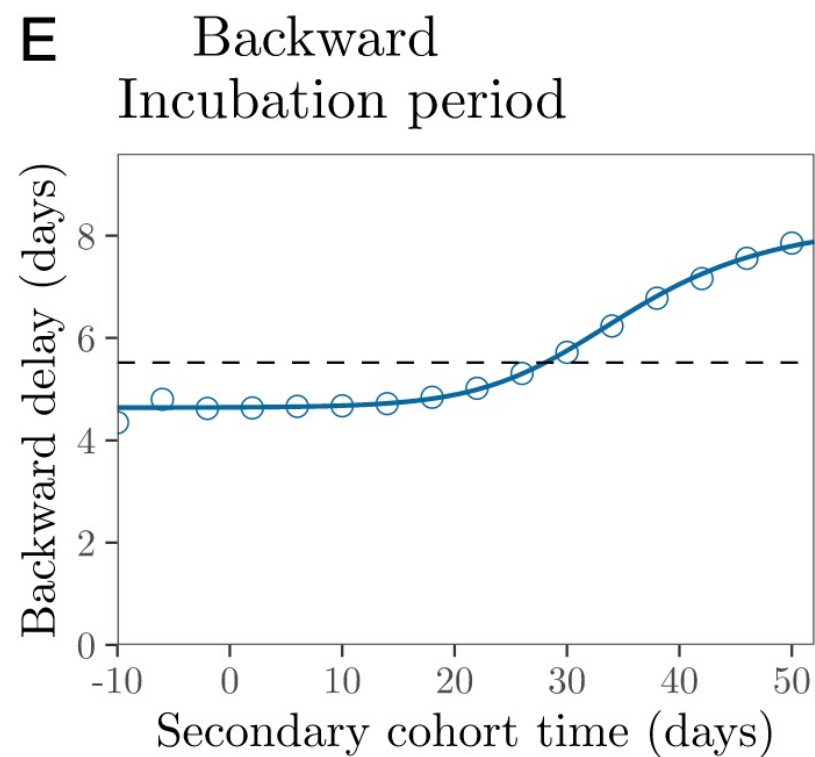
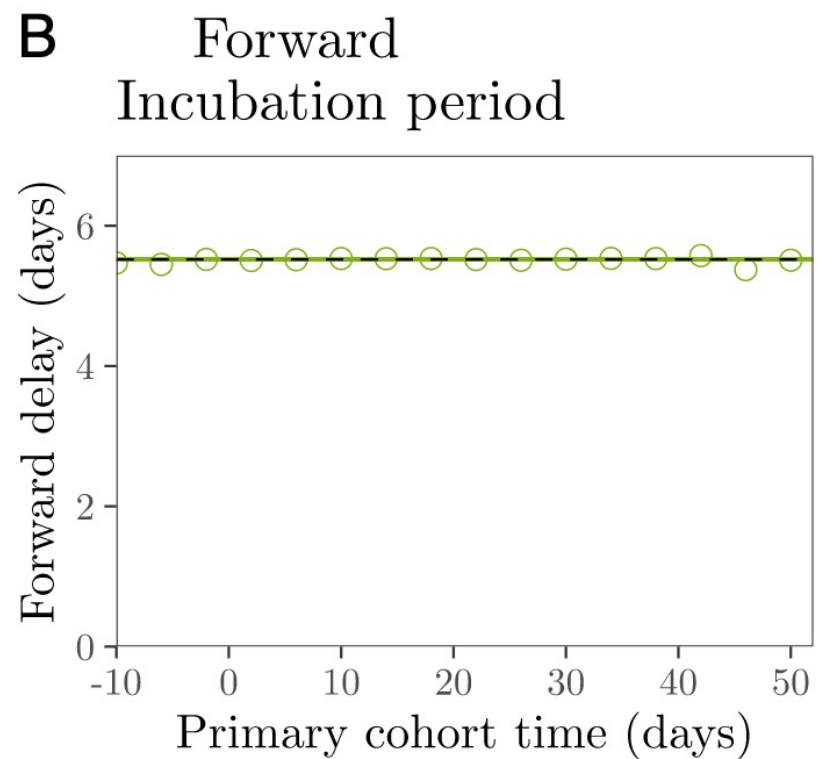
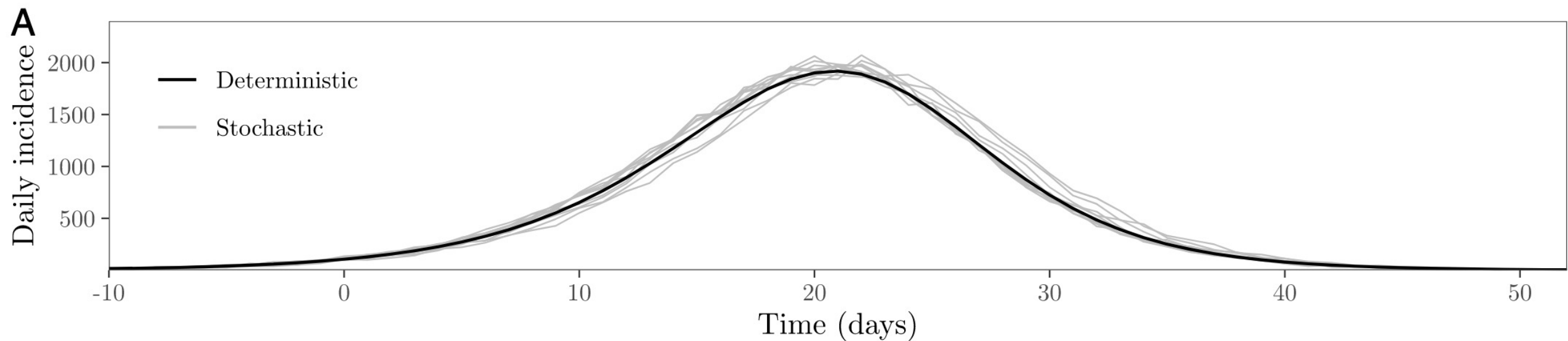
# Backward distribution

Measured from a cohort of individuals **developed symptoms at the same time**



# Exponential growth & Dynamical bias

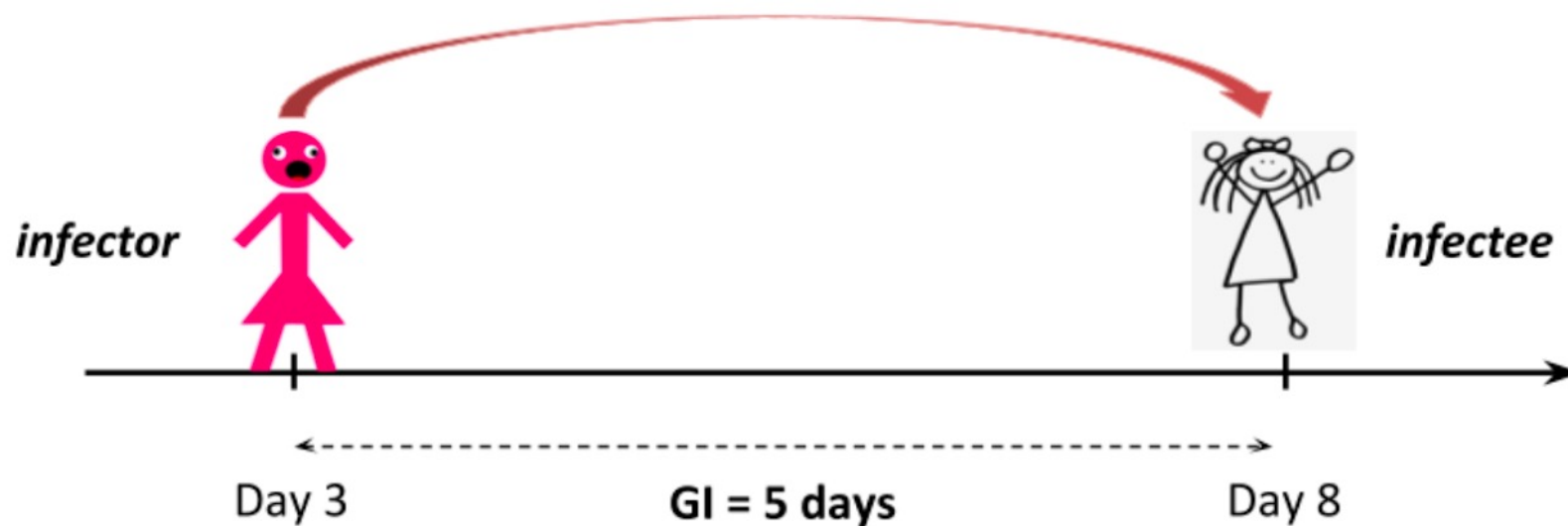




# Dynamical biases in serial- interval distributions

# Generation interval

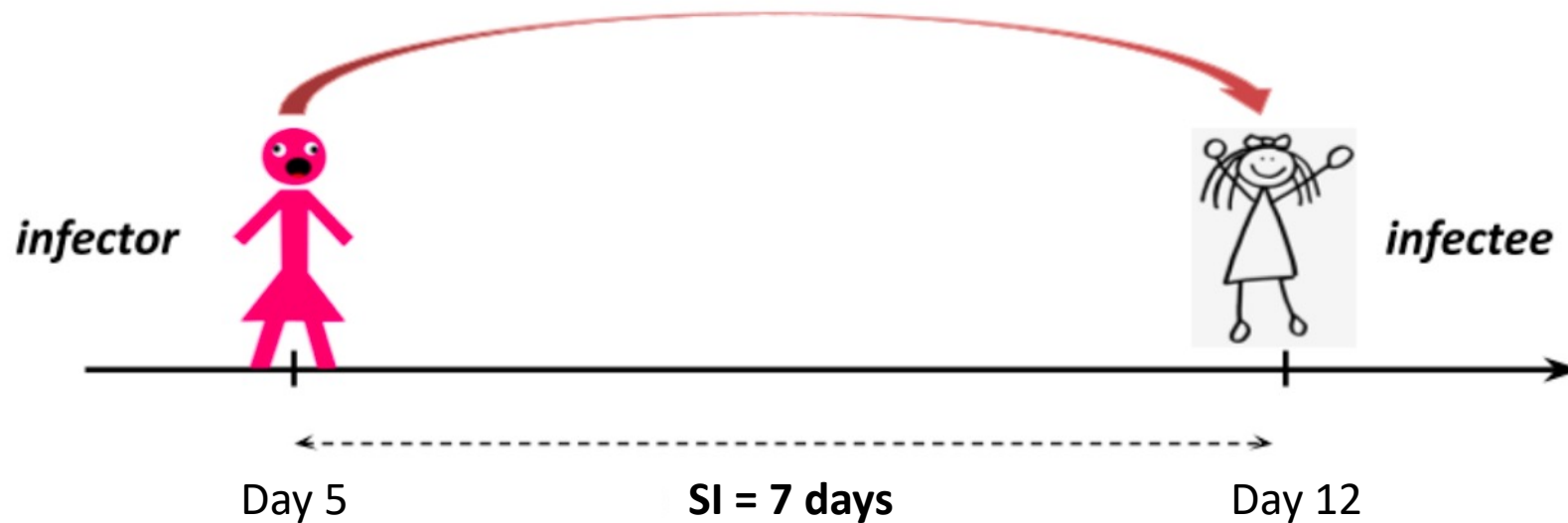
Time between when an individual (infector) becomes infected and when their infectee becomes infected





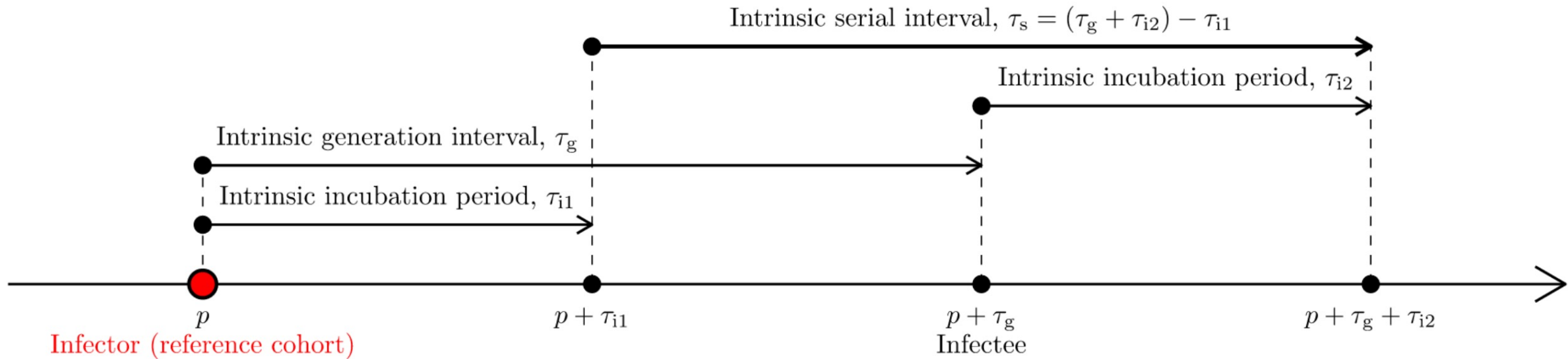
# Serial interval

Time between when an individual (infector) develops symptoms and when their infectee develops symptoms



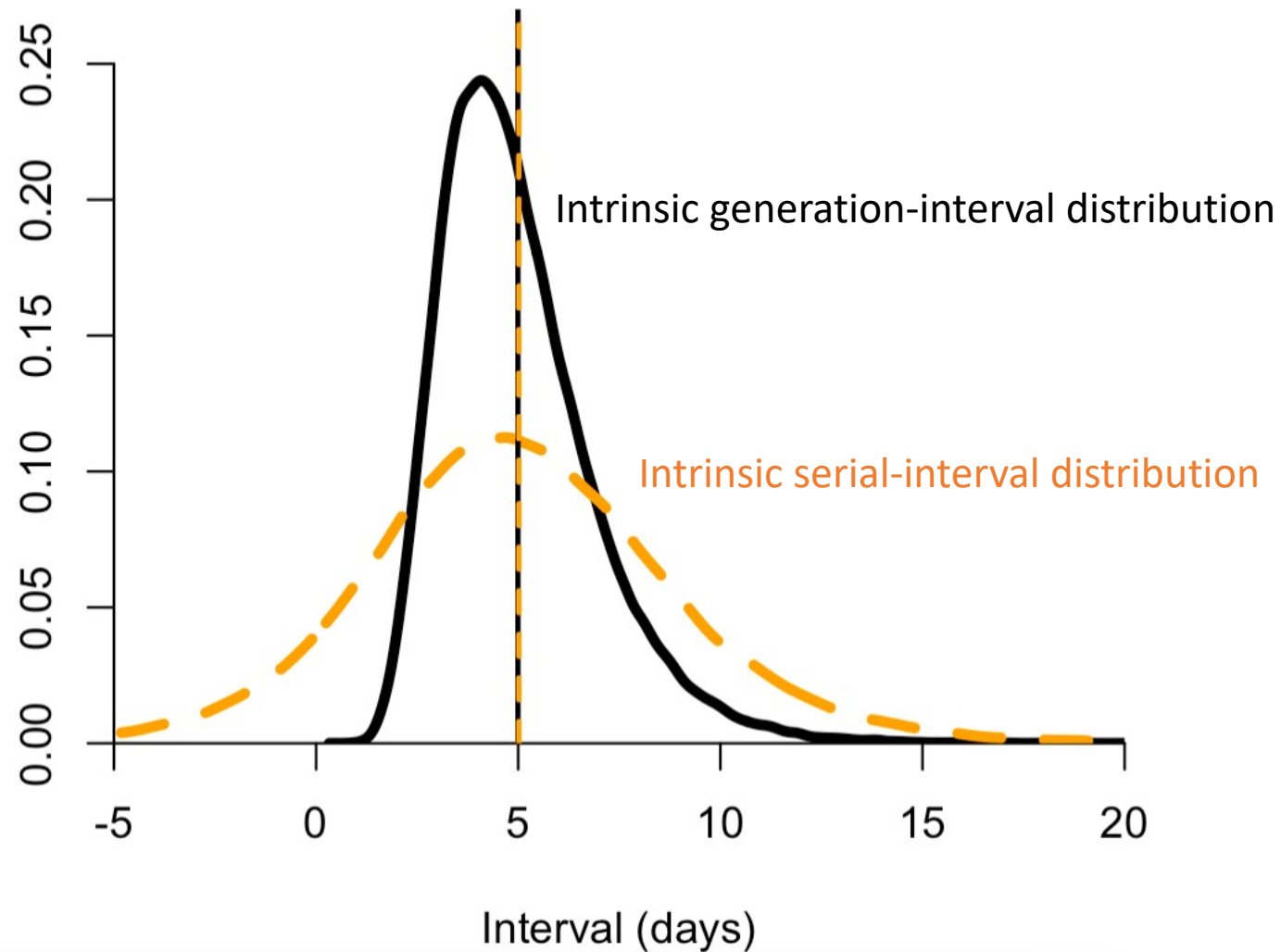
**A**

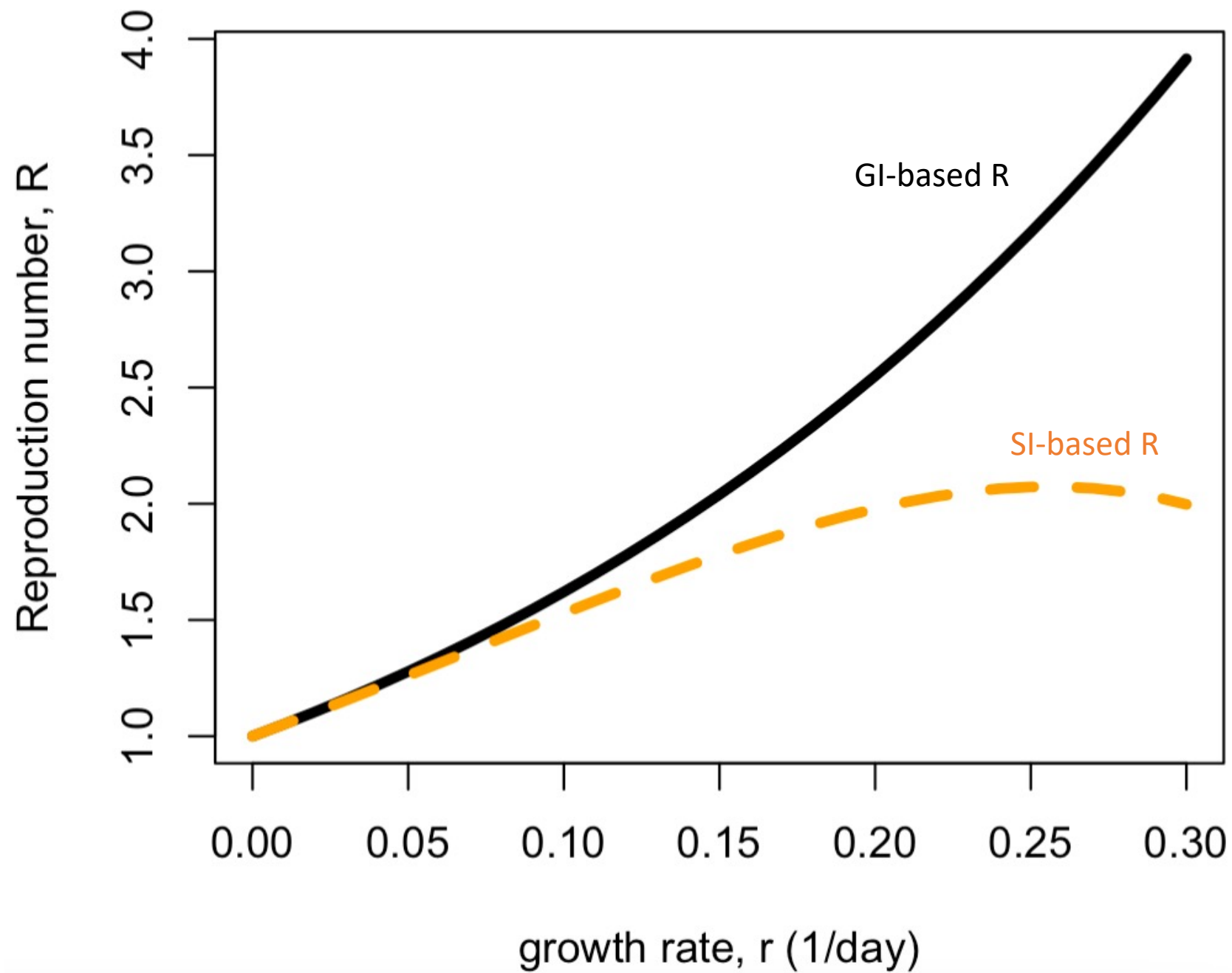
## Intrinsic serial interval



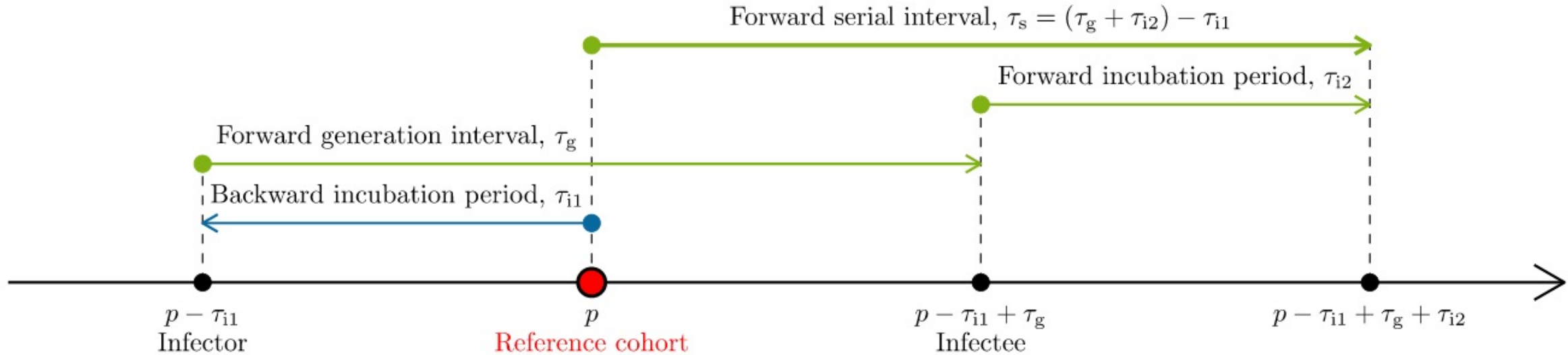
Intrinsic serial interval = -(intrinsic incubation period of the infector) +  
(intrinsic generation interval) +  
(intrinsic incubation period of the infectee)

Mean Intrinsic serial interval = Mean intrinsic generation interval

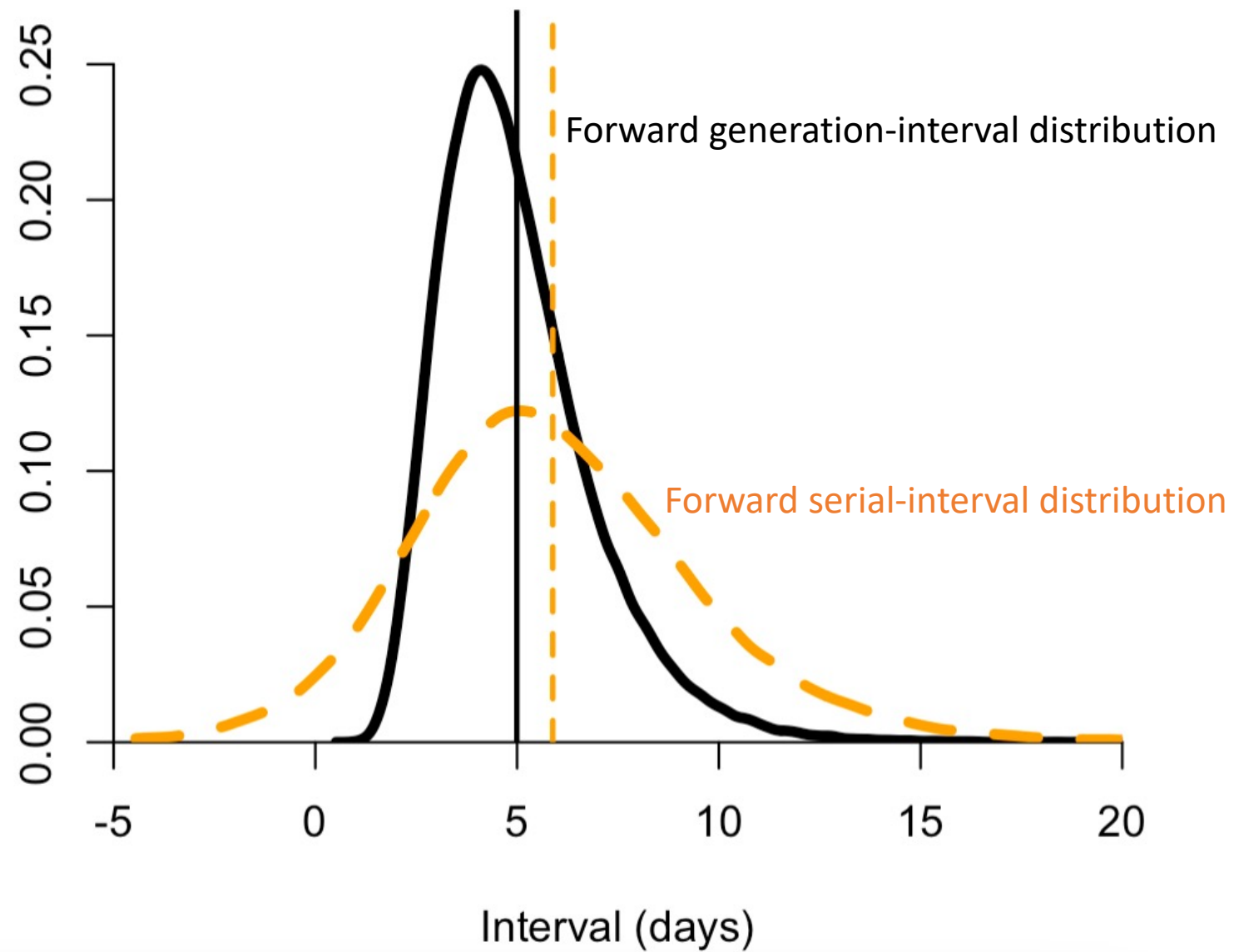


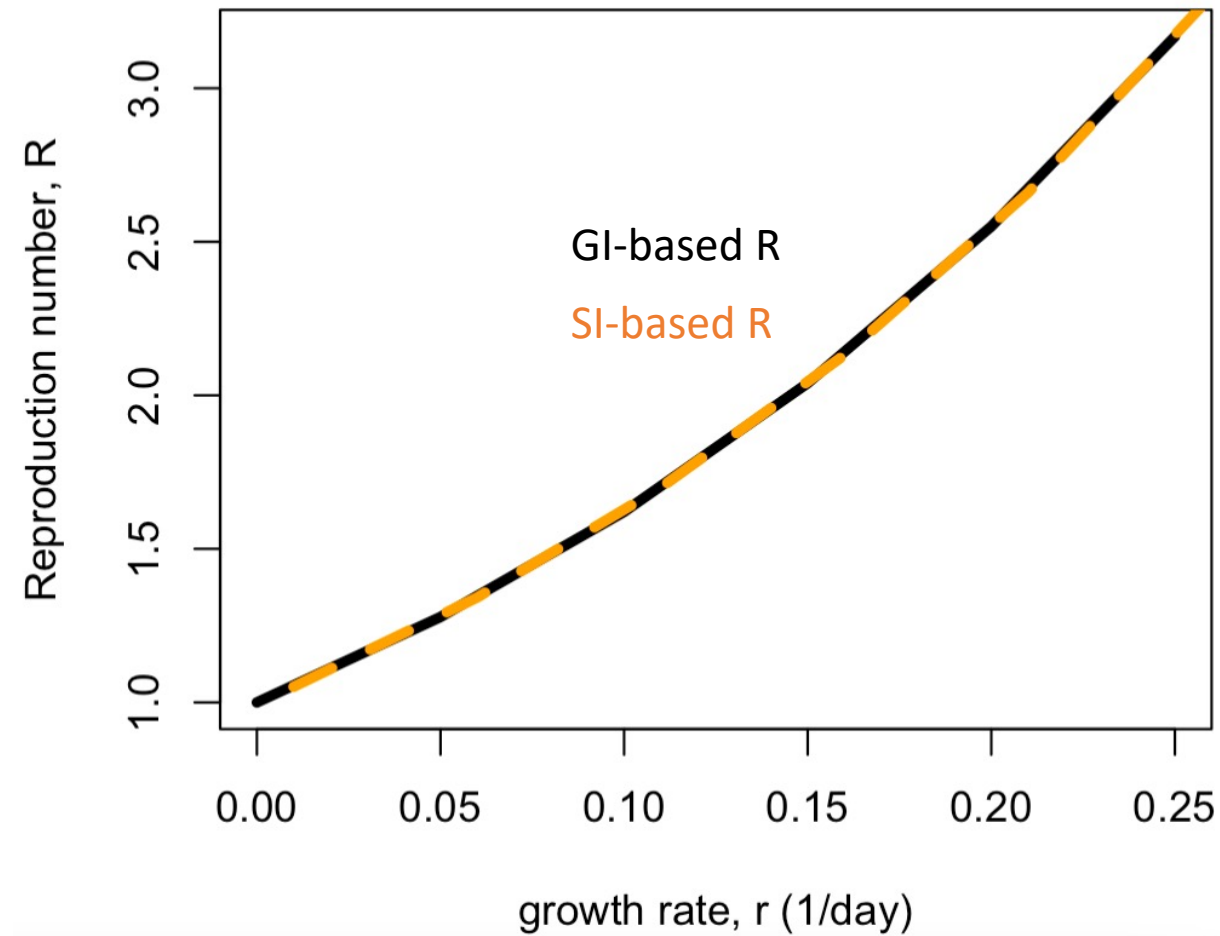
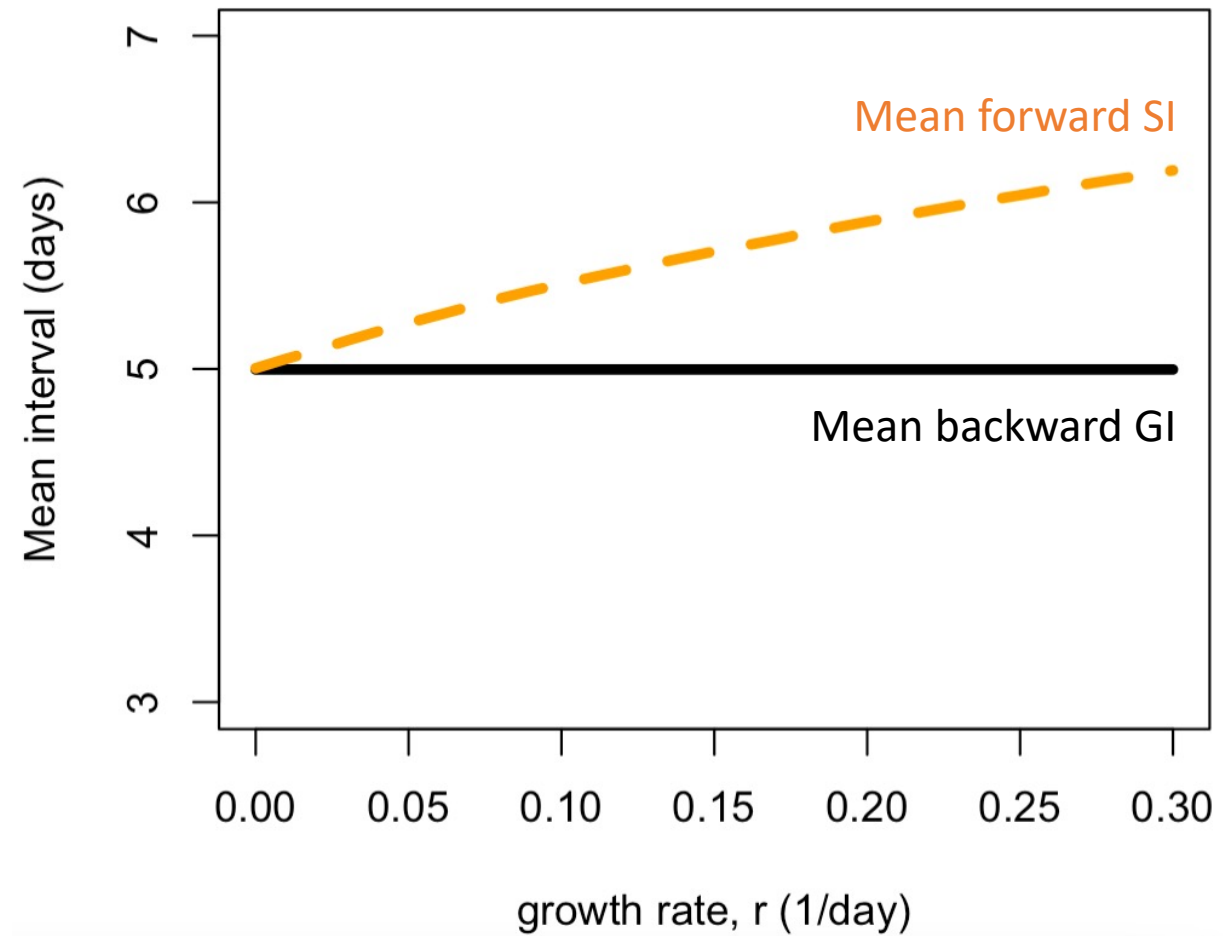


## B Forward serial interval

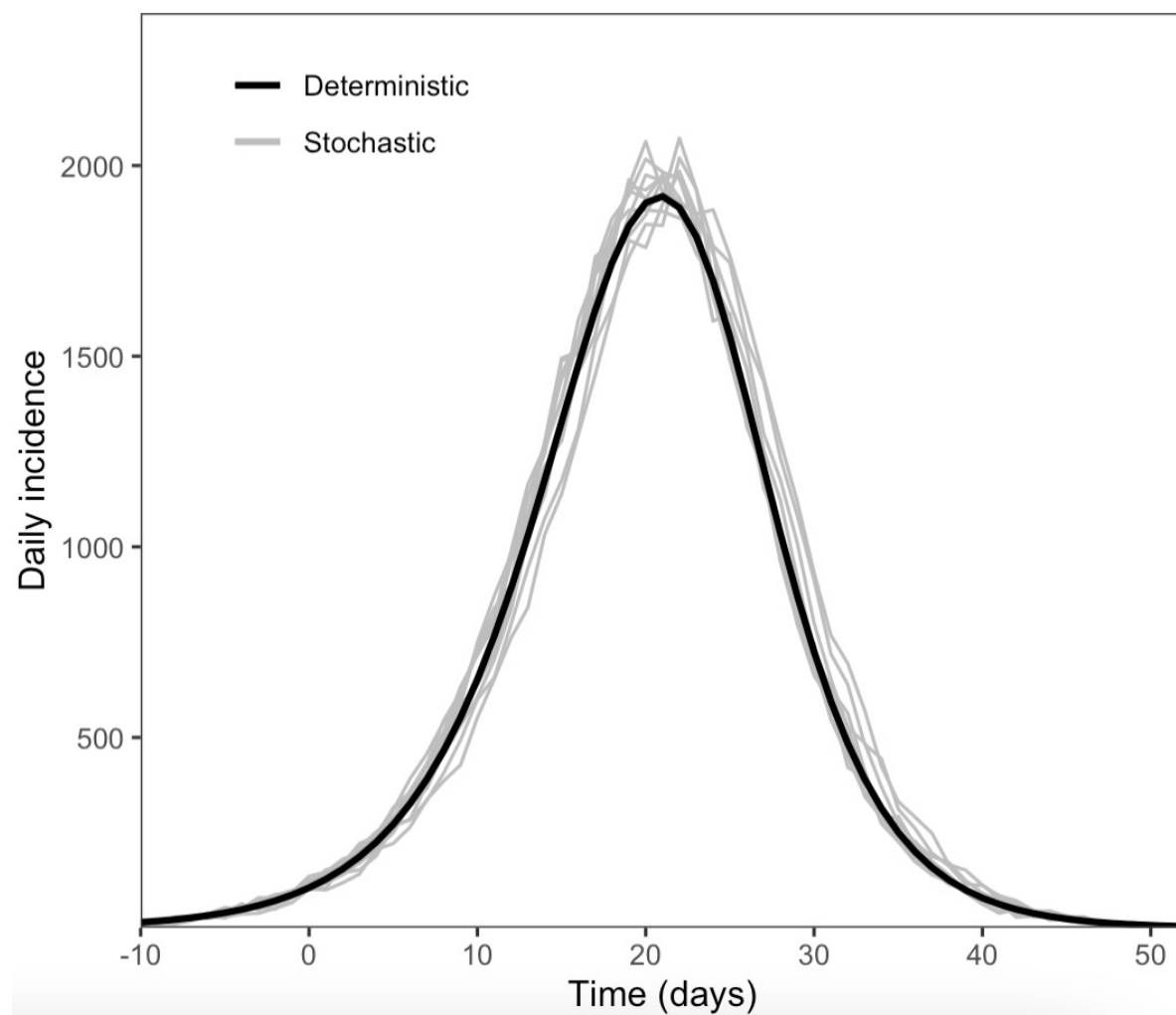


Forward serial interval = -(backward incubation period of the infector) +  
 (forward generation interval) +  
 (forward incubation period of the infectee)

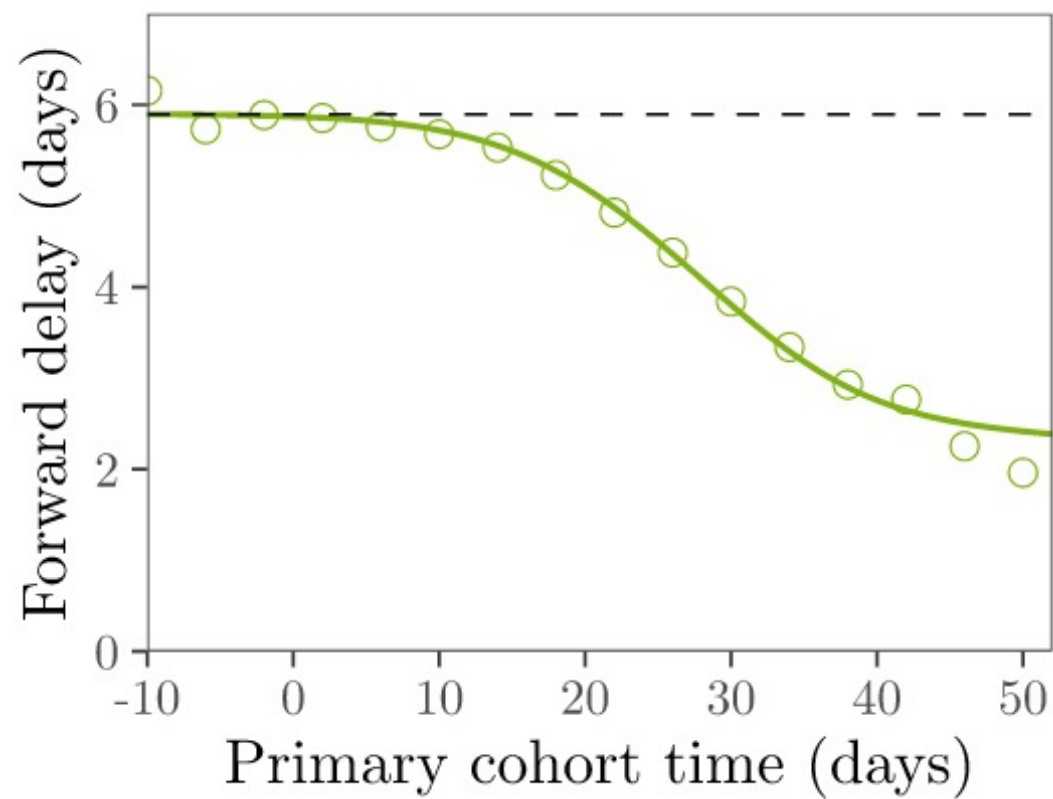






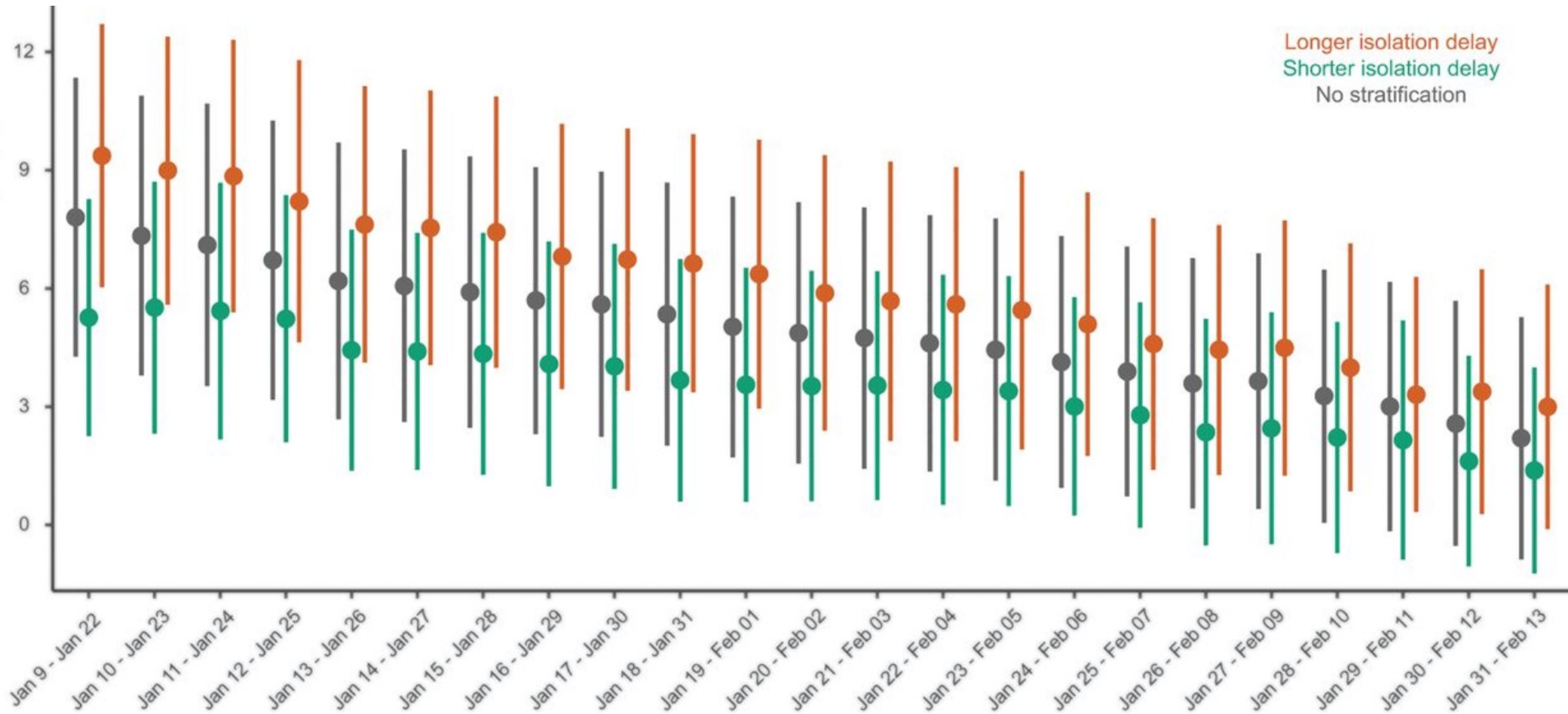


## D Forward Serial interval



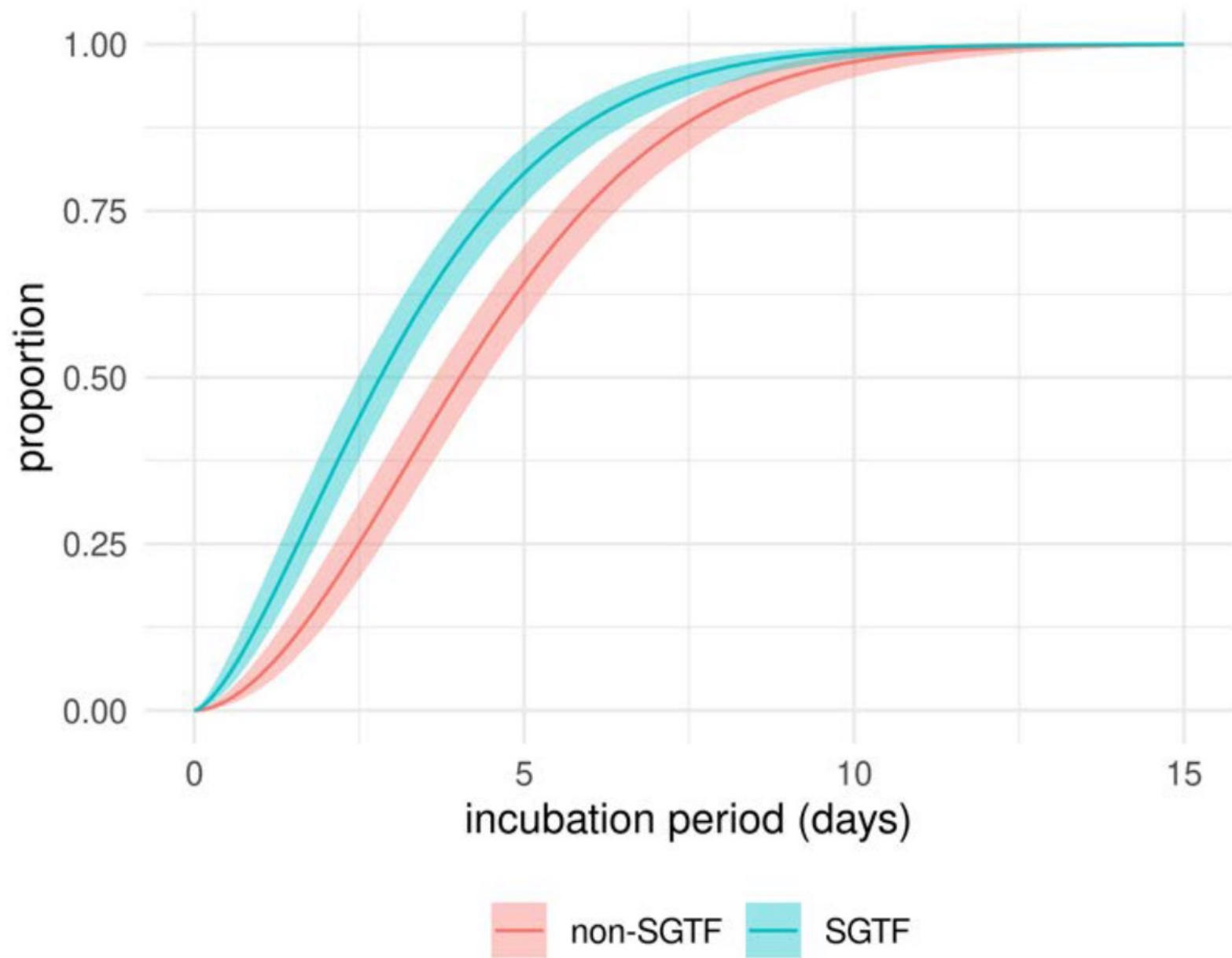
**A**

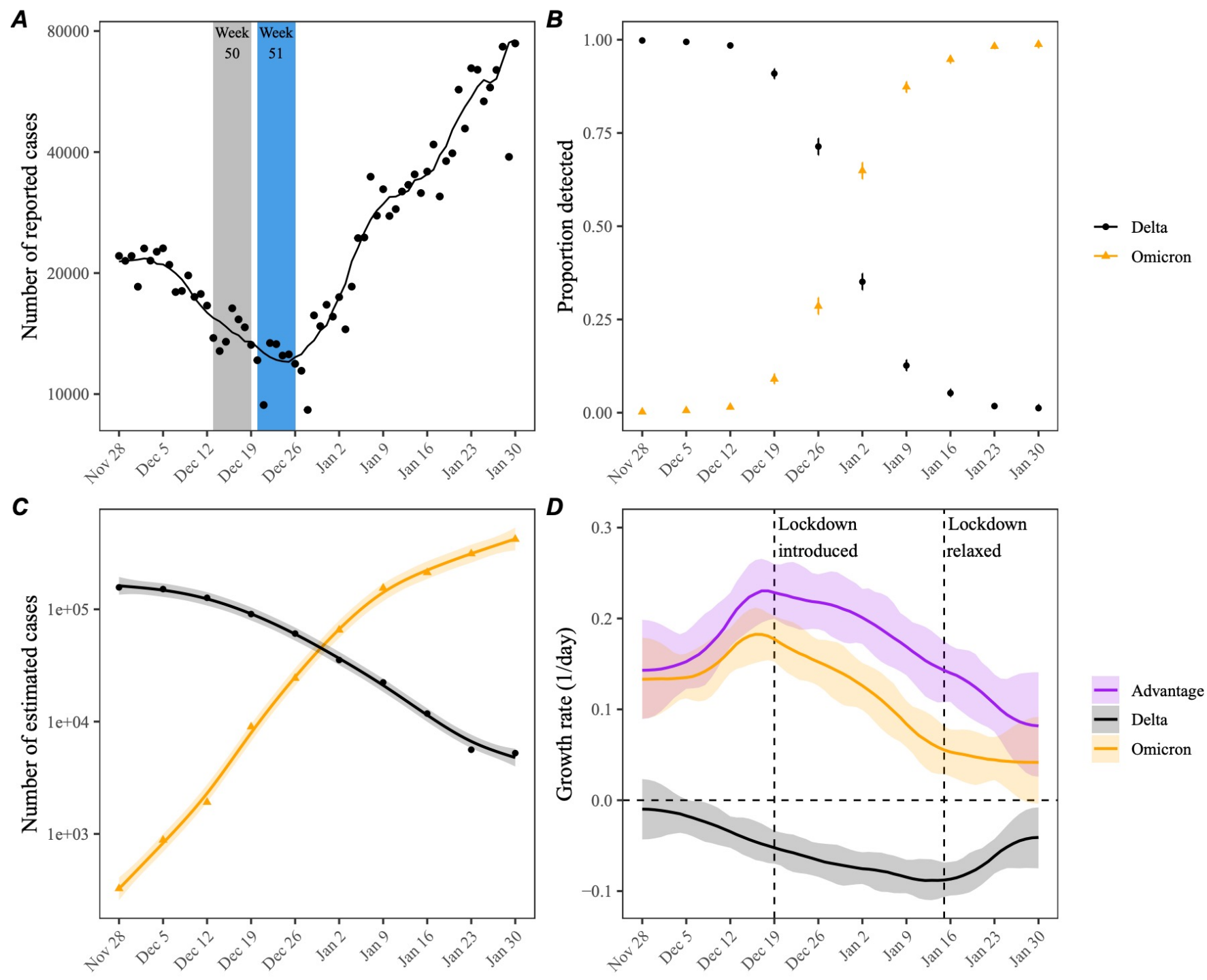
Fitted serial intervals (days)



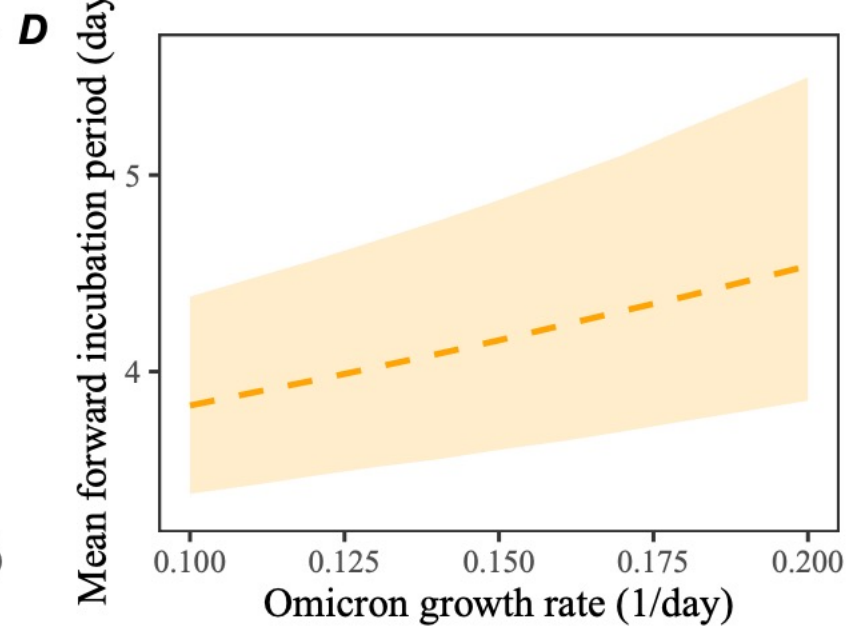
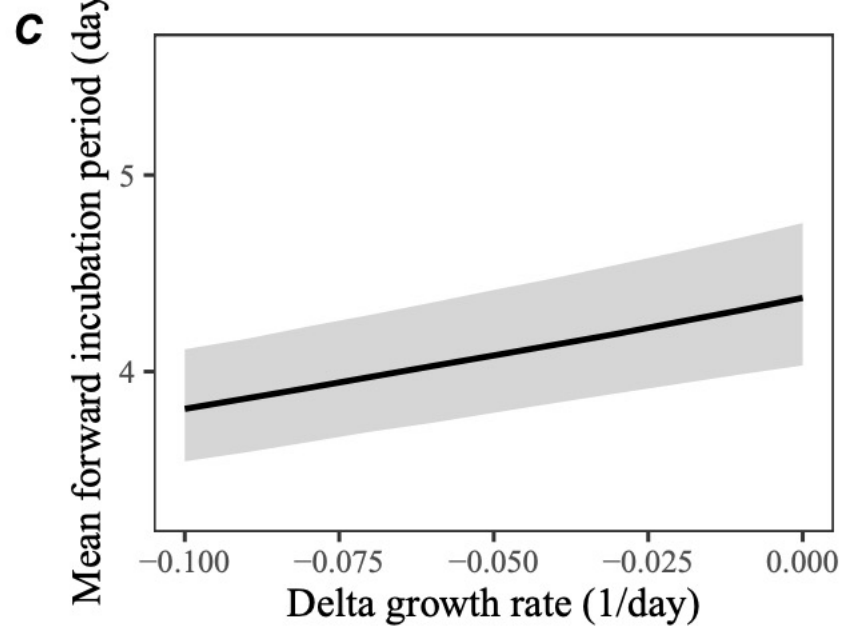
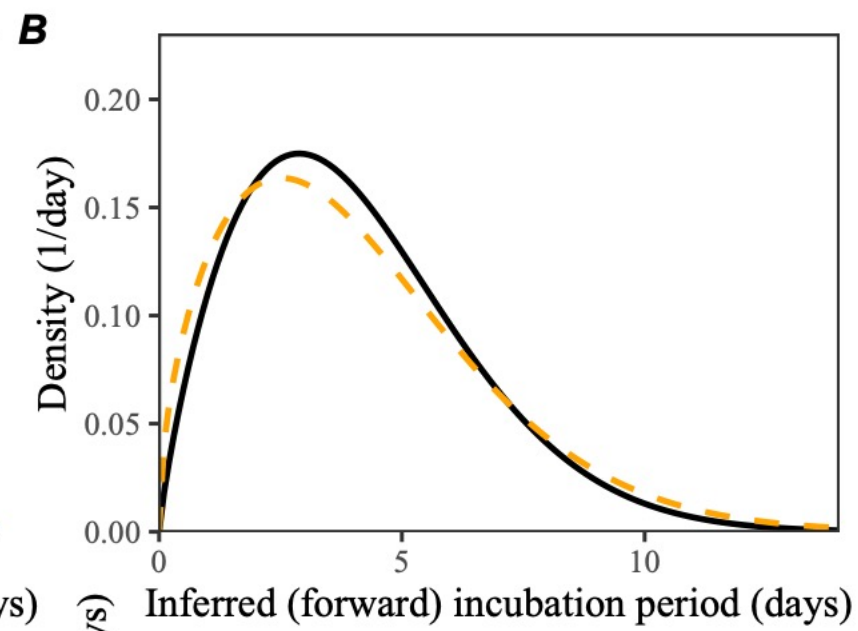
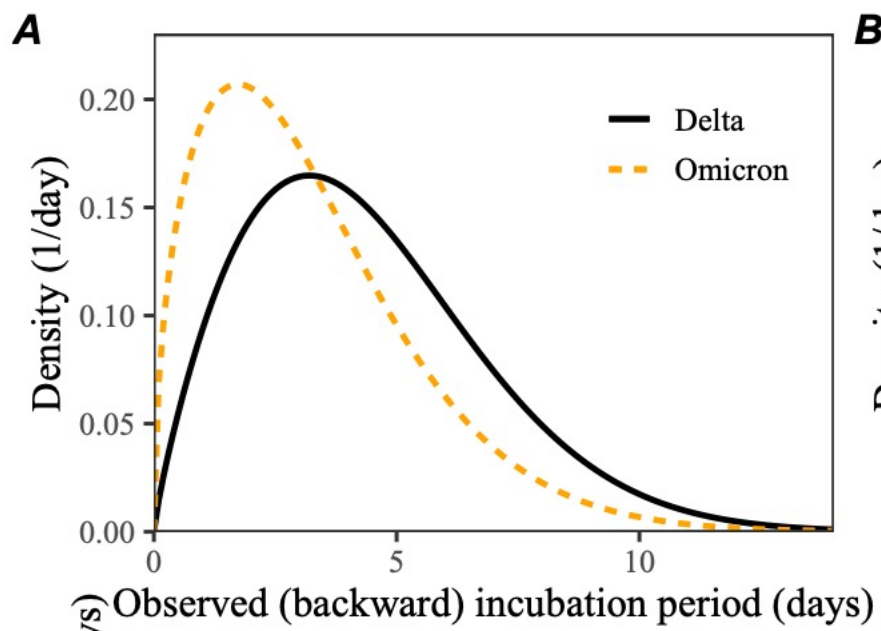
Application: incubation periods  
and generation intervals of the  
Omicron variant

Does the Omicron variant have shorter incubation periods and generation intervals than the Delta variant?

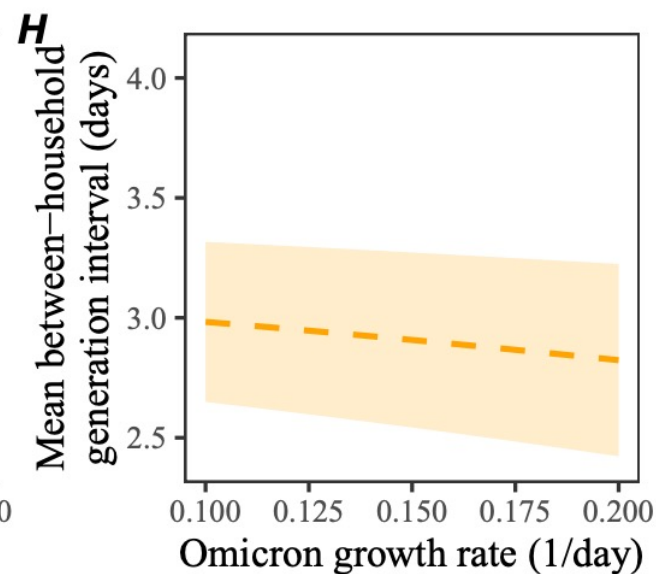
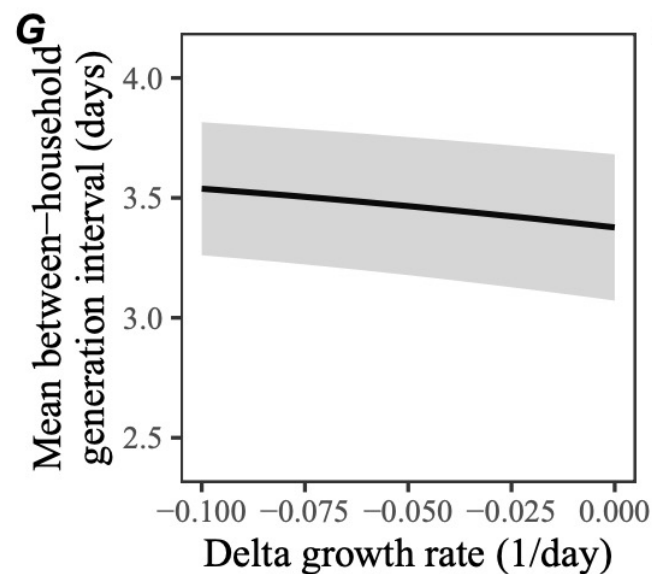
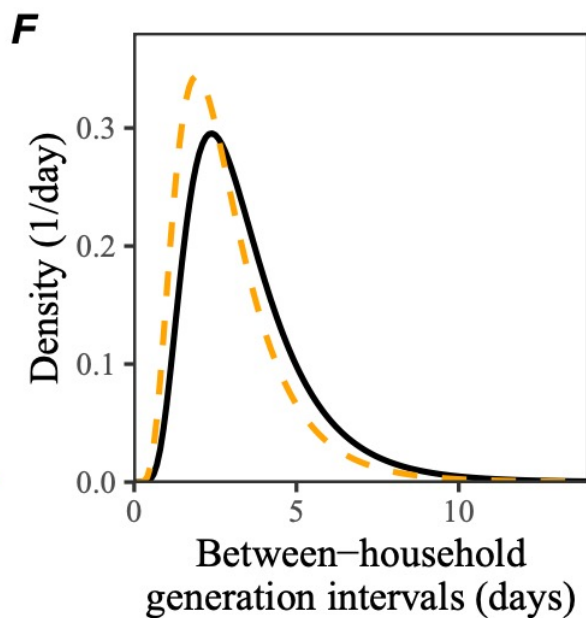
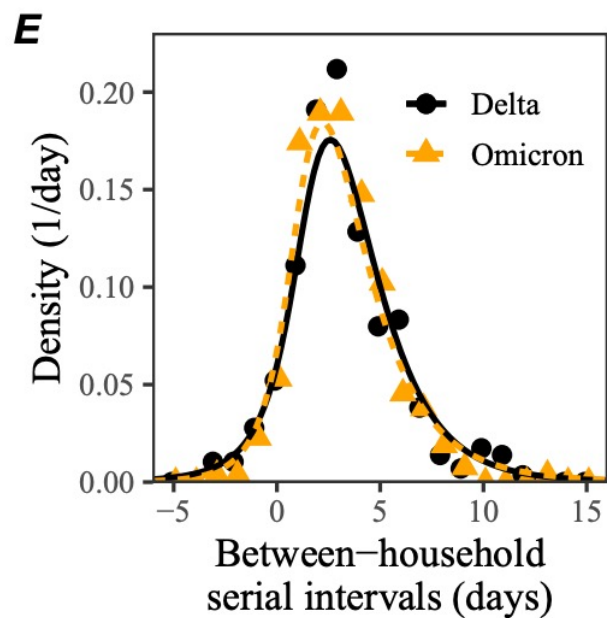
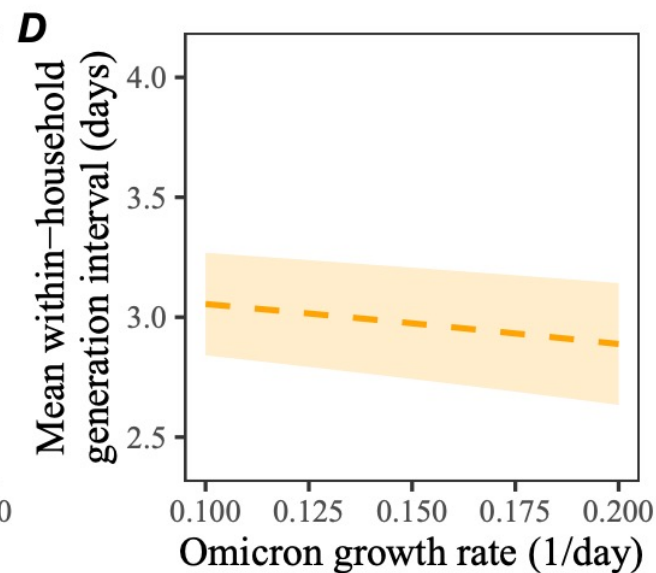
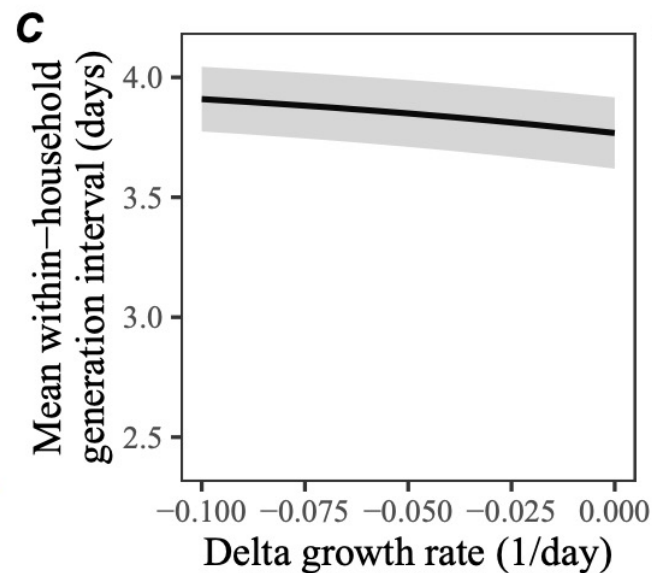
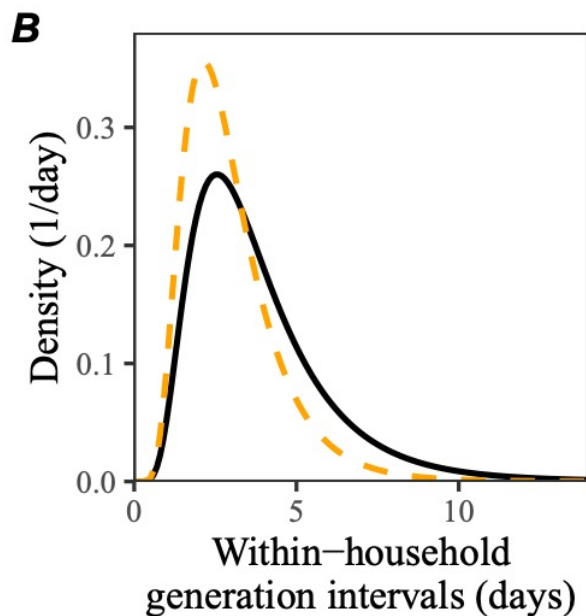
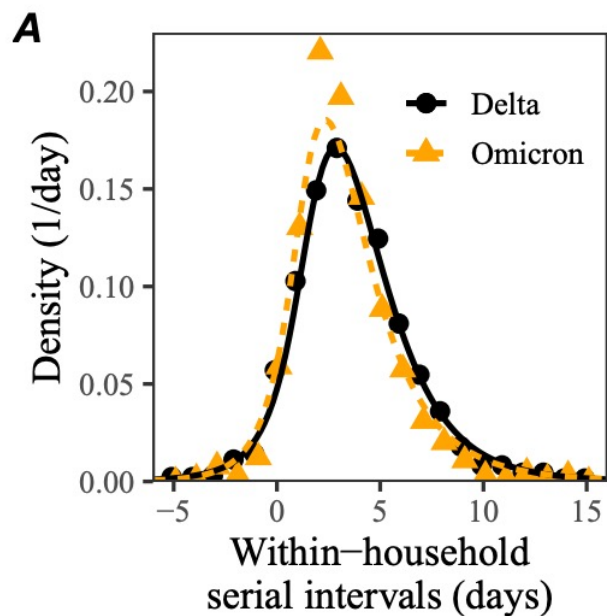


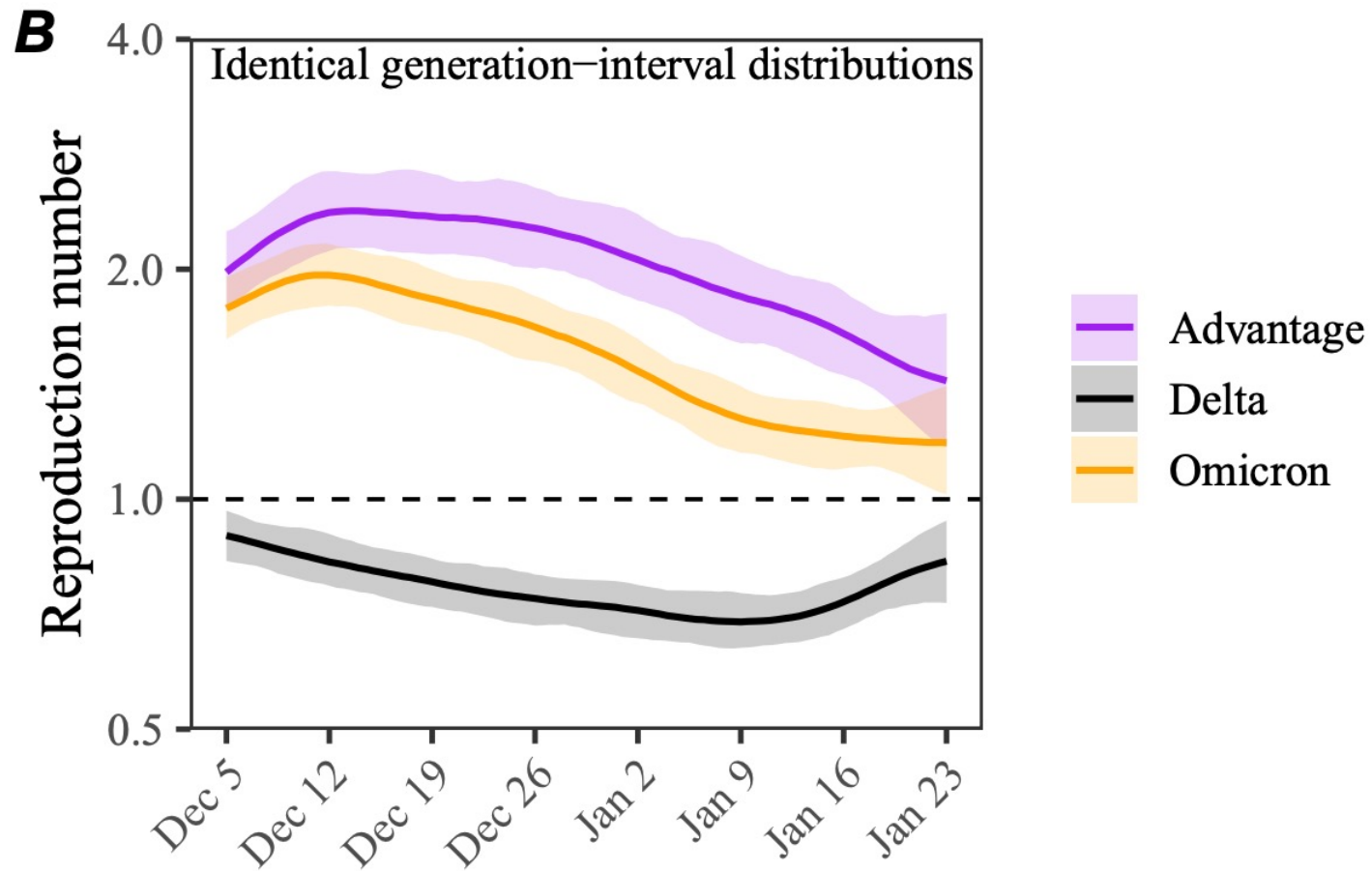
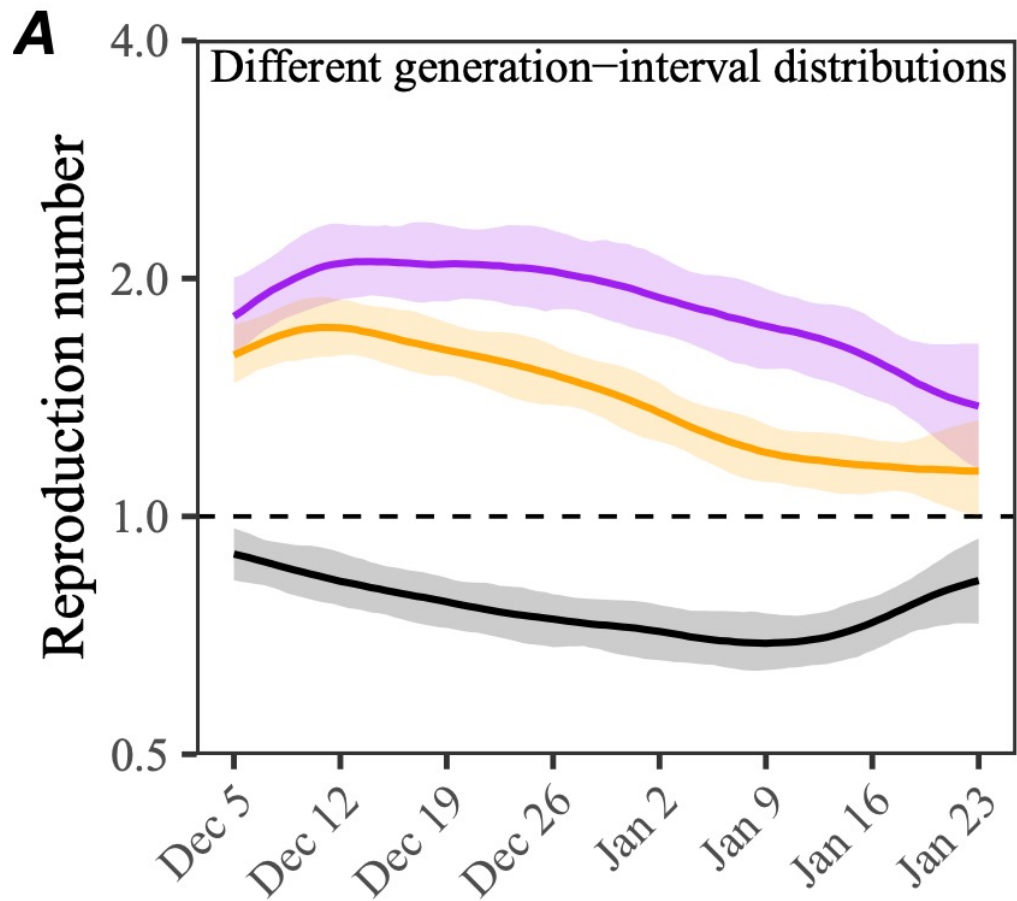


- Epidemic growth: shorter incubation periods for the Omicron variant
- Epidemic decay: longer incubation periods for the decay variant

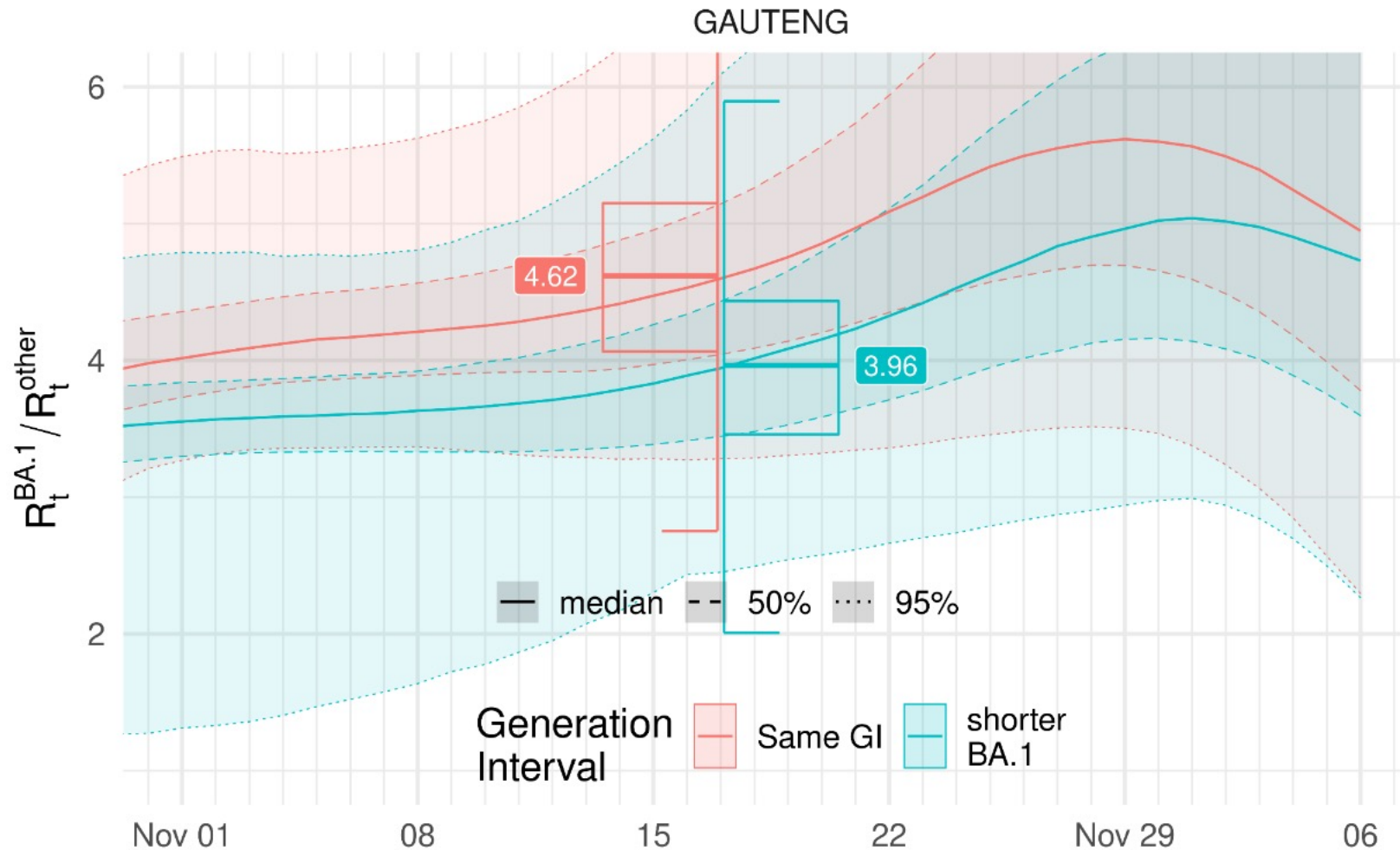








~10% bias



- Previous estimate: >4 fold reproduction advantage
- Revised estimate based on our GI estimates: 2.6 fold reproduction advantage

# Summary

- Accounting for dynamical biases are important for accurately estimating epidemiological delay distributions, especially when comparing variants with different growth rates
- Dynamical biases allow us to resolve the paradox between serial and generation intervals
- Neglecting uncertainties in variant generation intervals can lead to 10-50% difference in estimates of the Omicron transmission advantage

# Acknowledgements

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- Jonathan Dushoff
- Bryan Grenfell
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Questions?