Virtual Childcare Centers: Predicting Optimal Strategies against the Spread of SARS-CoV-2 Variants

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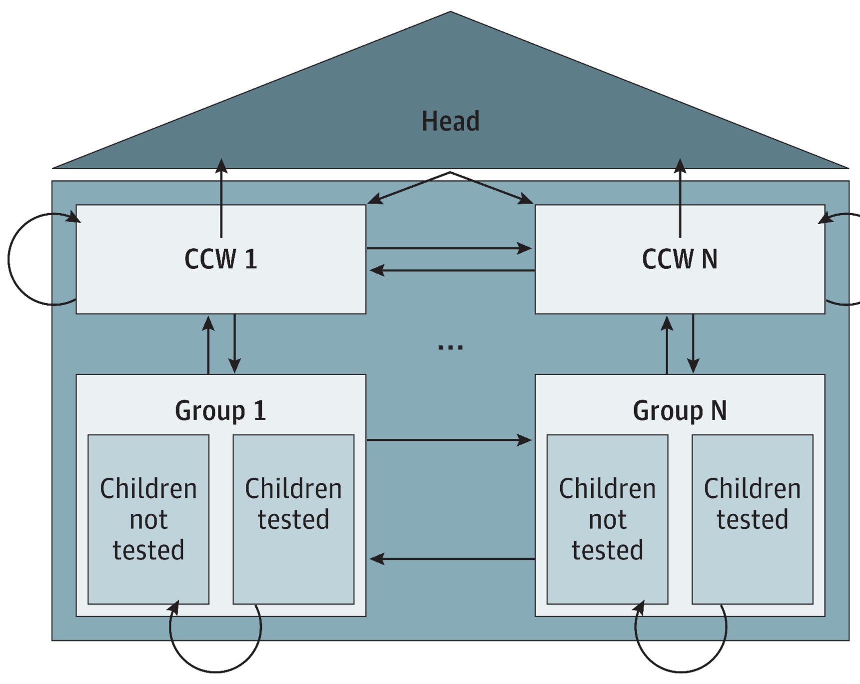
Background

- global closure of day care centers to prevent viral spread
- results include negative effects on children's well being
- viral spread through interactions inside day care centers [1]
- temporal viral load governs transmission dynamics [2]

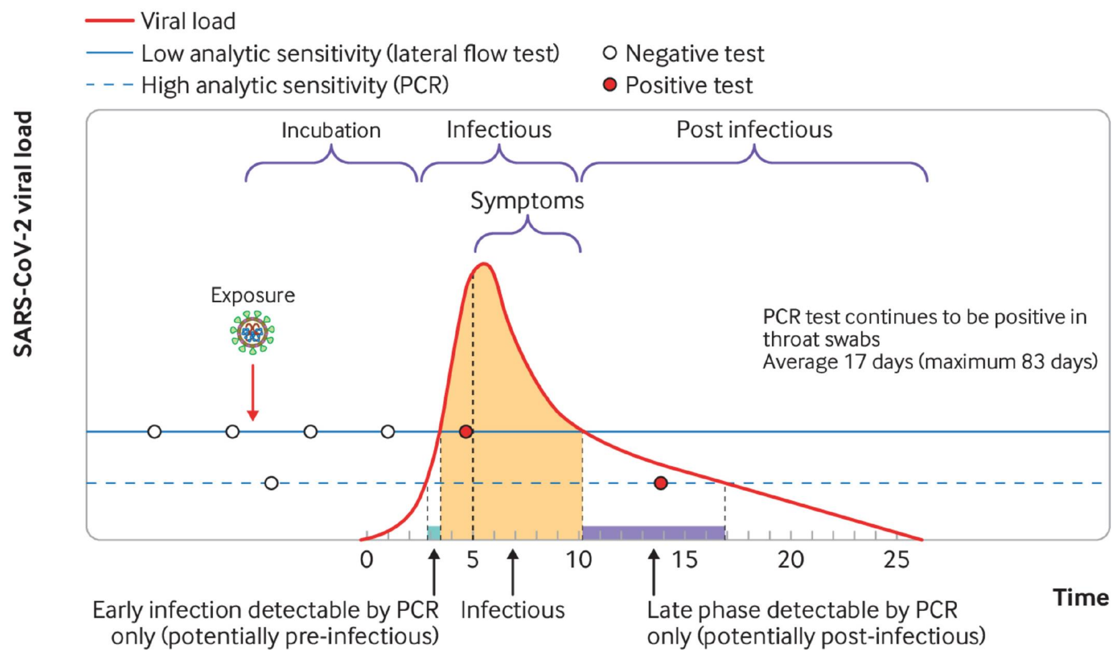
Objective:

Prediction of optimal surveillance strategies to prevent viral spread while keeping day care centers open by computational modeling

Day care center (DCC) structure

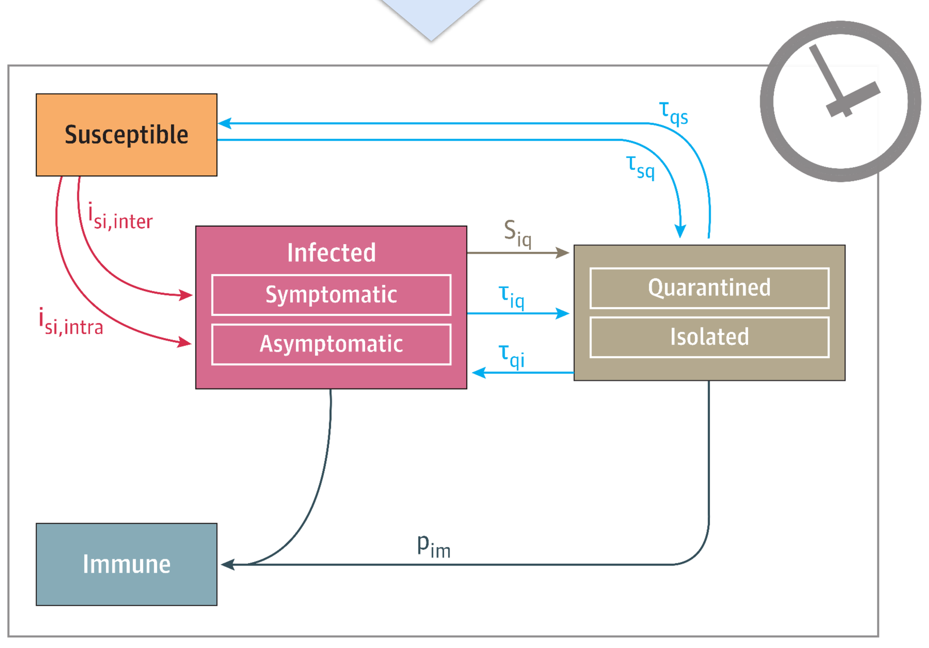


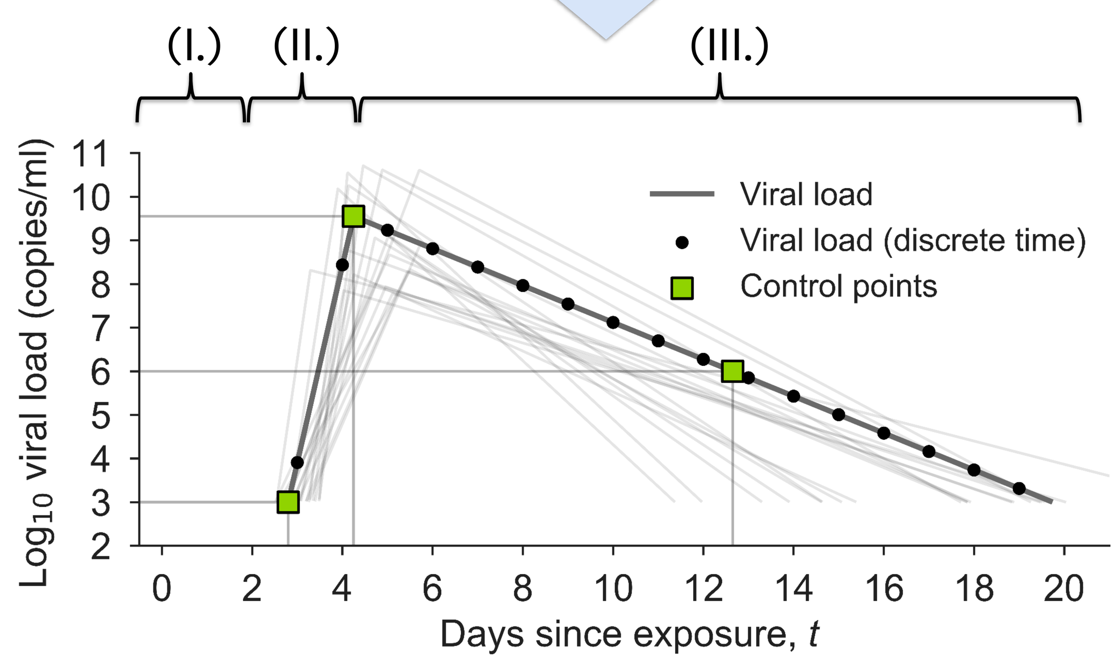
Viral load dynamics



Individual-based model

- day care centers are described by a modified **stochastic individual-based model** [3] based on an SIR model [4]
- through repeated simulations we can capture
  1. **random events** of a small population size
  2. effects of **surveillance strategies**
- the probability of a state transition depends on viral load
- the **viral load kinetic model** [5] is designed through a piecewise linear function with a
  - I. variable **latent** phase
  - II. rapid **growth** phase
  - III. slow **decay** phase



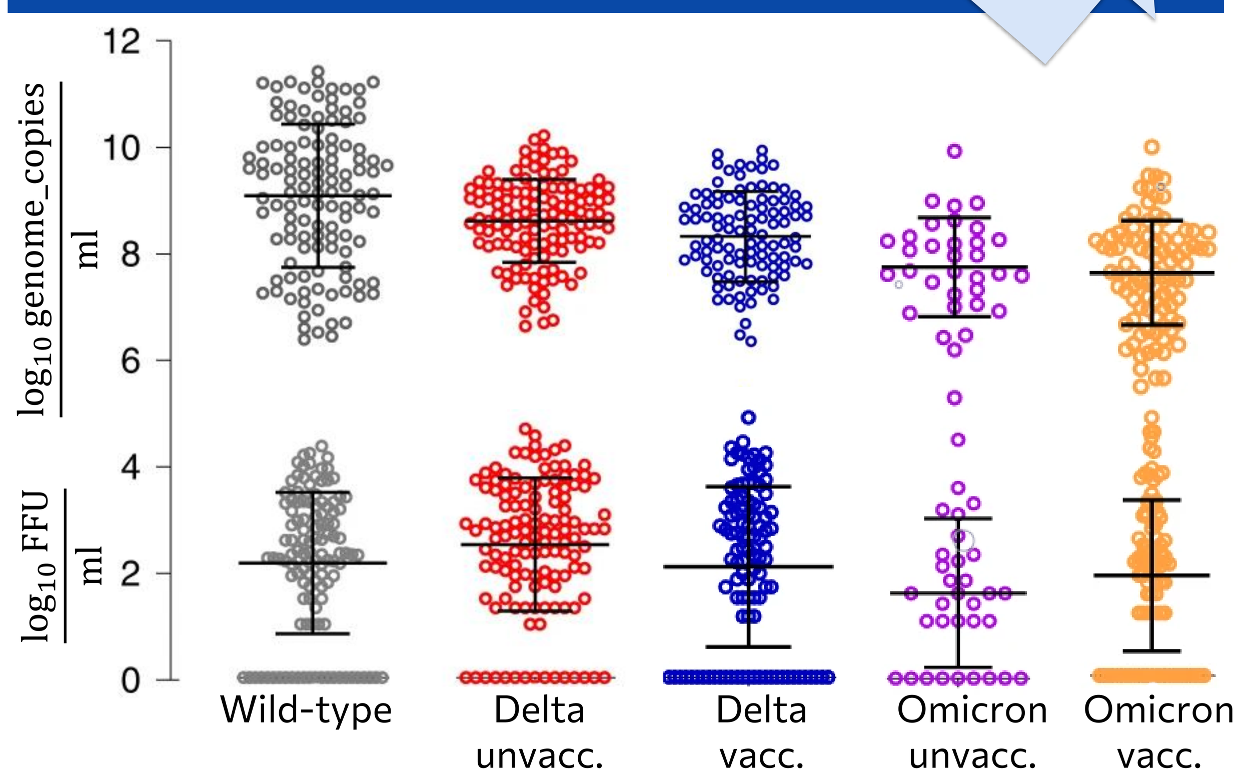


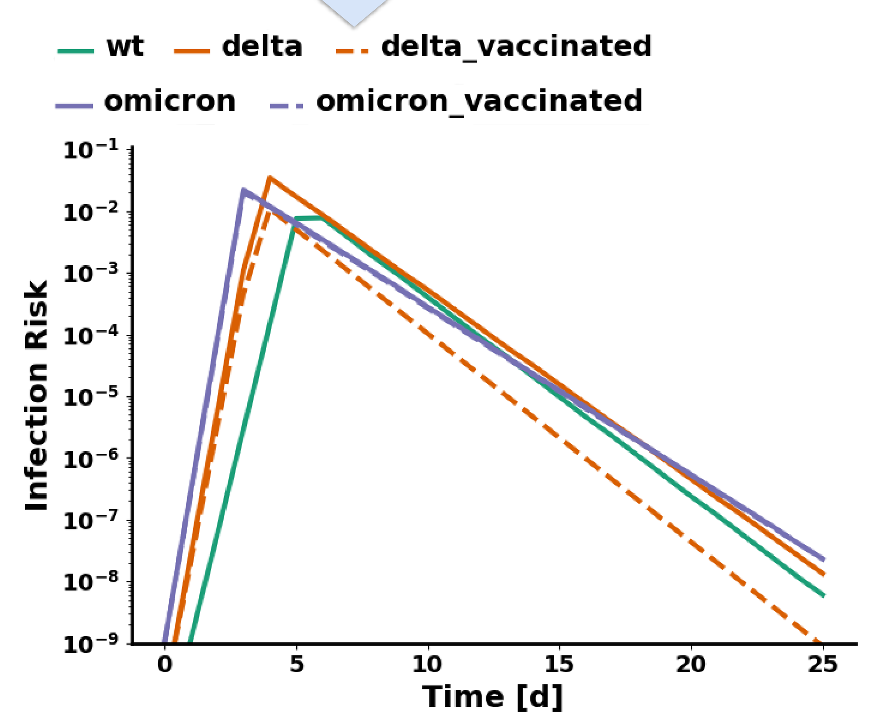
Experimental data & Infection Risk

- **viral load** represents the **total** amount of viral particles
- **viral titre** represents the amount of **infectious** viral particles

1) piecewise linear functions are generated by sampling from **viral load posterior distributions** for key parameters [6]
2) the infectivity is described by the D50 value that is inferred from the **viral titre posterior distributions**
3) the infection risk probability is calculated using the **infection risk calculator** [7]

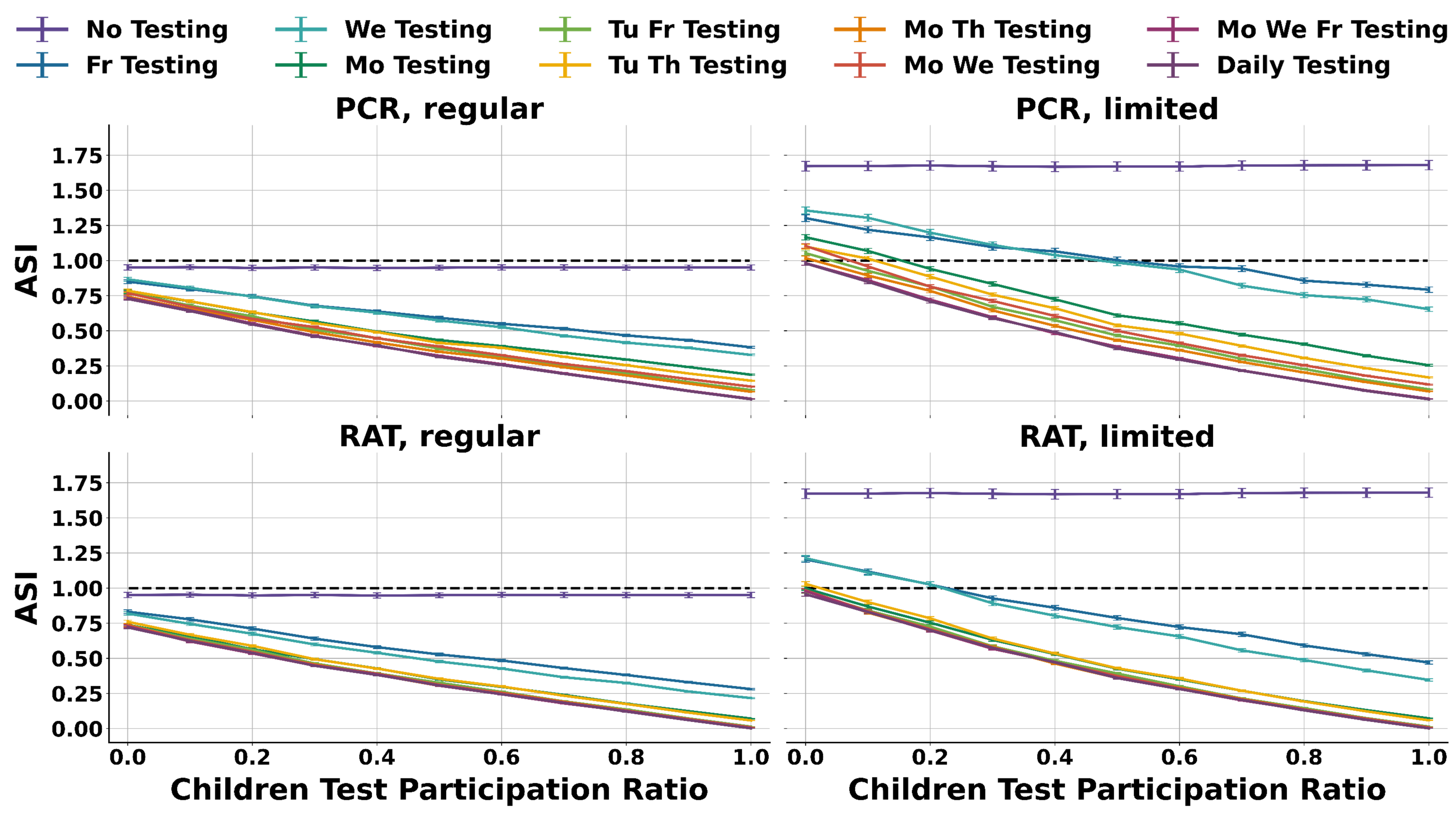
$$P_{infection\_risk} = 1 - \left(10^{\frac{1}{D_{50}}}\right)^{genome\_copies}$$



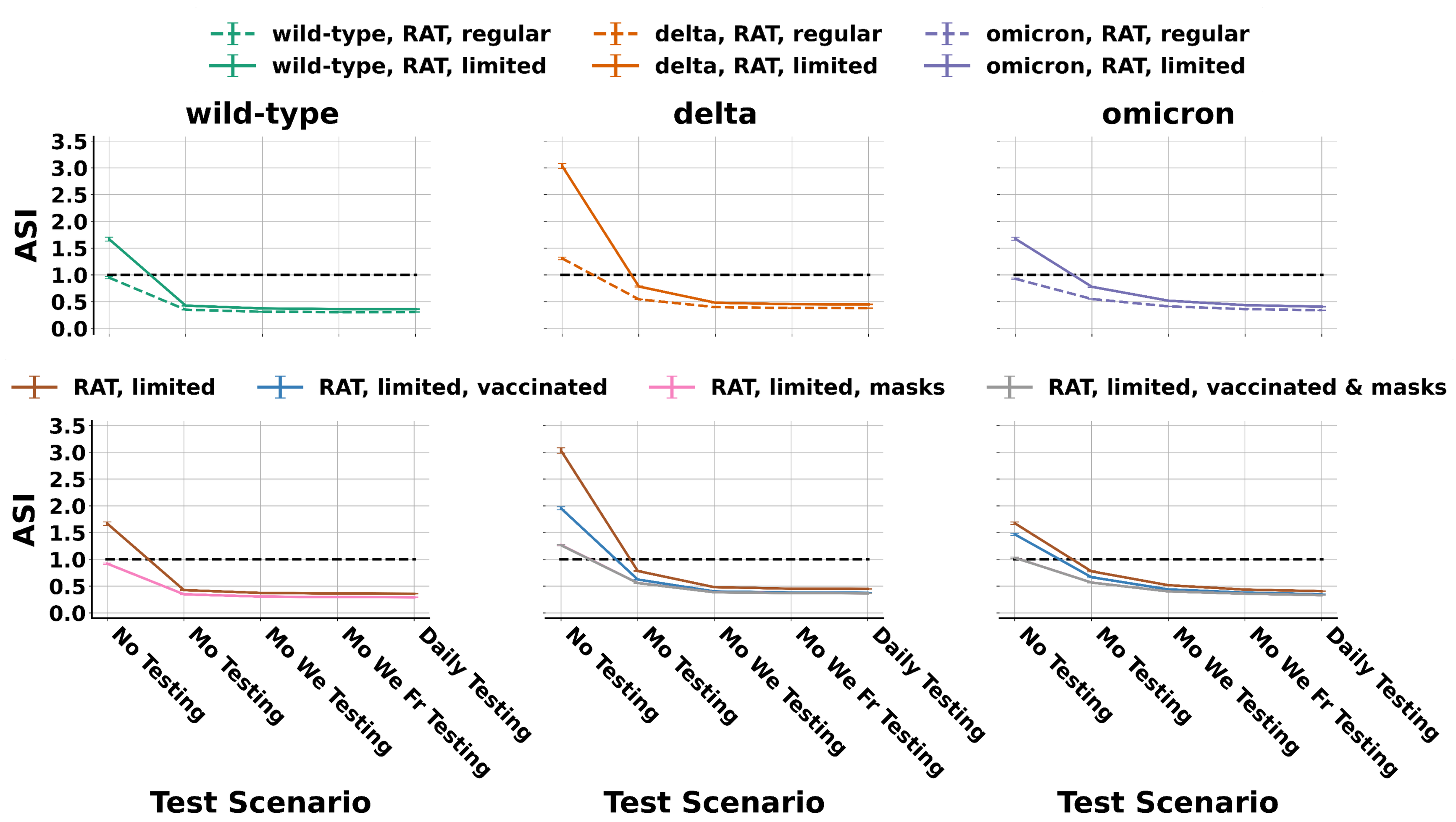


Results

- **rapid antigen test** outperforms PCR test due to receiving **test result fast**
- **limited** policy **as efficient** as regular policy with at least **1x/week** testing
- **monday** is the best **1x/week** test scenario



- **delta** and **omicron** variants lead to an **increase** in **average secondary infections (ASI)**
- **masks** are the most **efficient** infection prevention measure



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References
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