Endemicity

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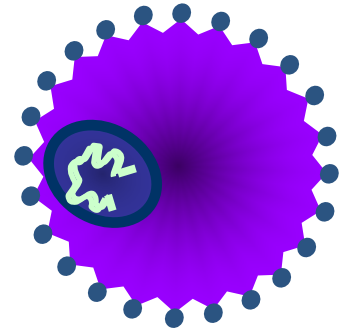
Centre for Disease Modelling

Modelling Infection and Immunity

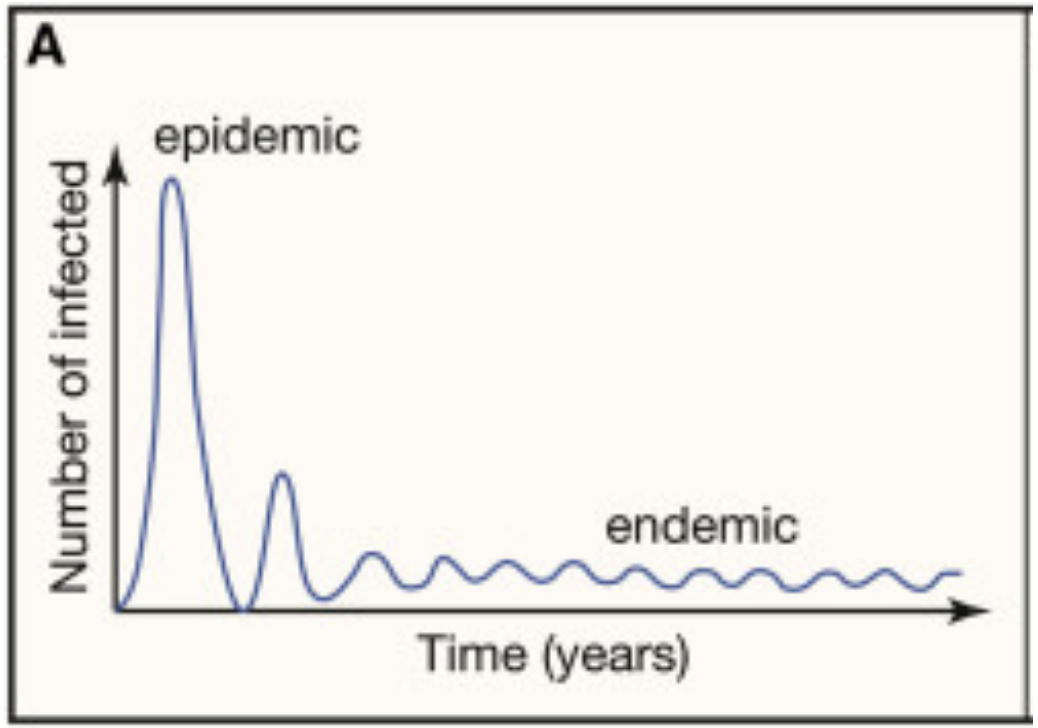
Mathematics & Statistics

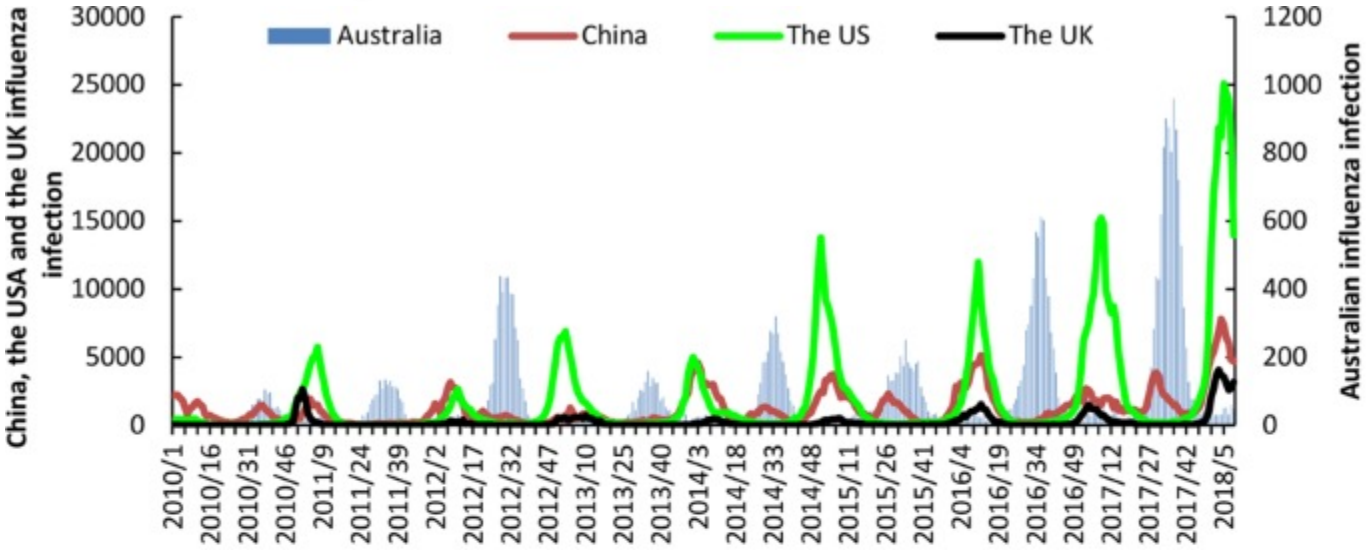
York University



Pathways

Endemicity


A
epidemic
endemic
Number of infected
Time (years)


Australia
China
The US
The UK
China, the USA and the UK influenza infection
Australian influenza infection
30000
25000
20000
15000
10000
5000
0
1200
1000
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600
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200
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2010/1
2010/16
2010/31
2010/46
2011/9
2011/24
2011/39
2012/2
2012/17
2012/32
2012/47
2013/10
2013/25
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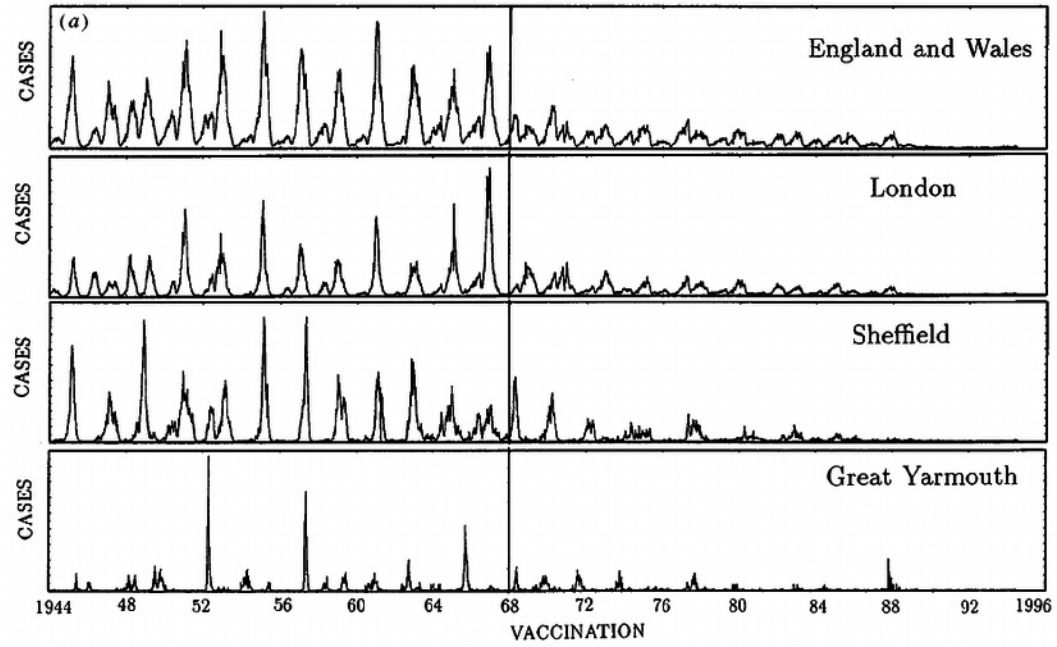
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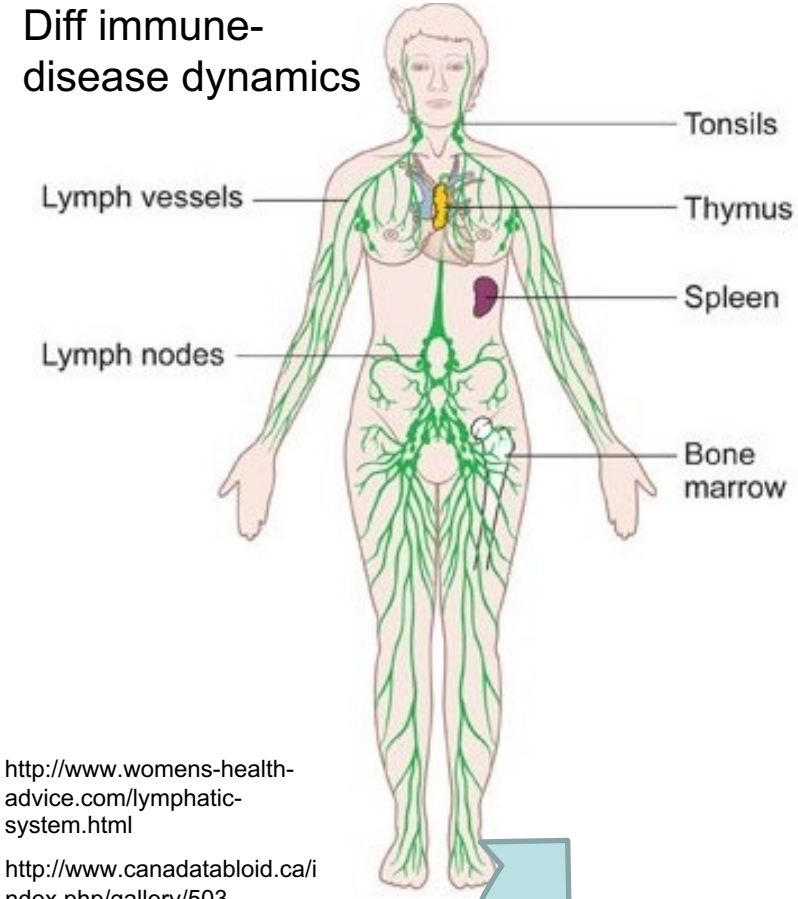
VACCINATION

Feedback

Diff immune-disease dynamics



http://www.womens-health-advice.com/lymphatic-system.html

http://www.canadatabloid.ca/index.php/gallery/503-canada-toronto

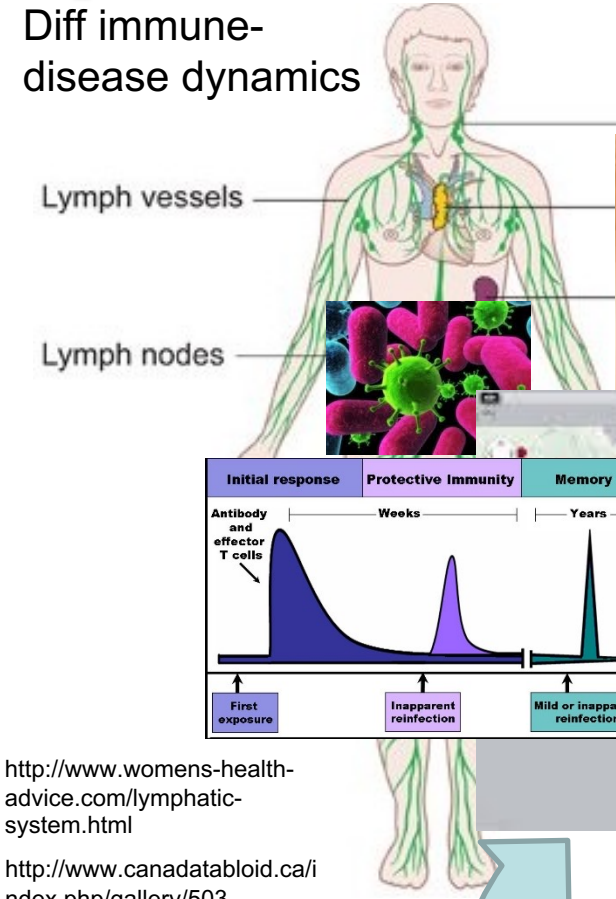
Transmission (transmissibility)

Diff disease dynamics (prevalence, incidence, etc)

Transmission (susceptibility)

A path to understanding endemicity

Diff immune-disease dynamics



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sease dynamics
lence,
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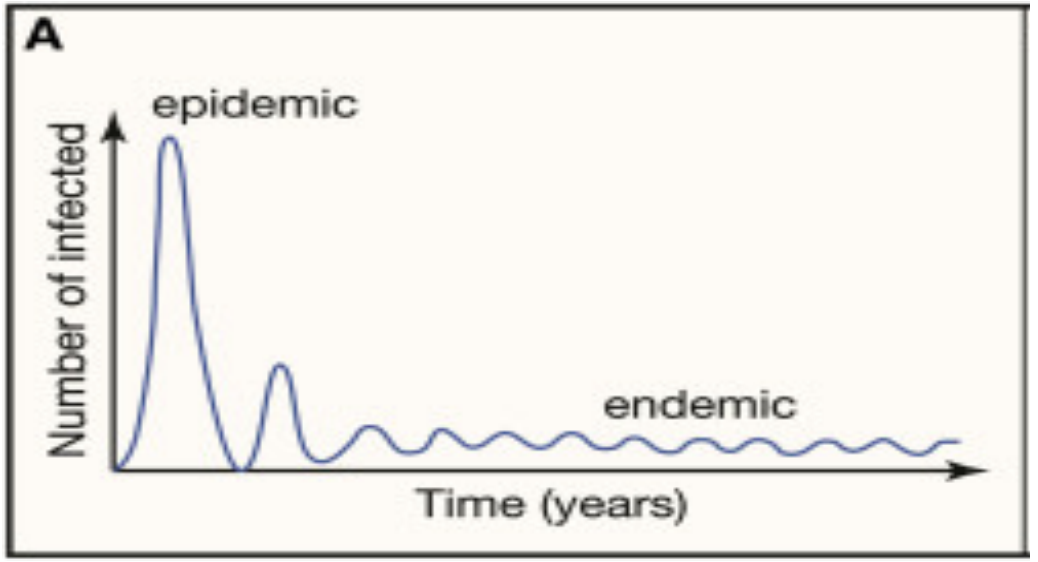
Transmission (susceptibility)

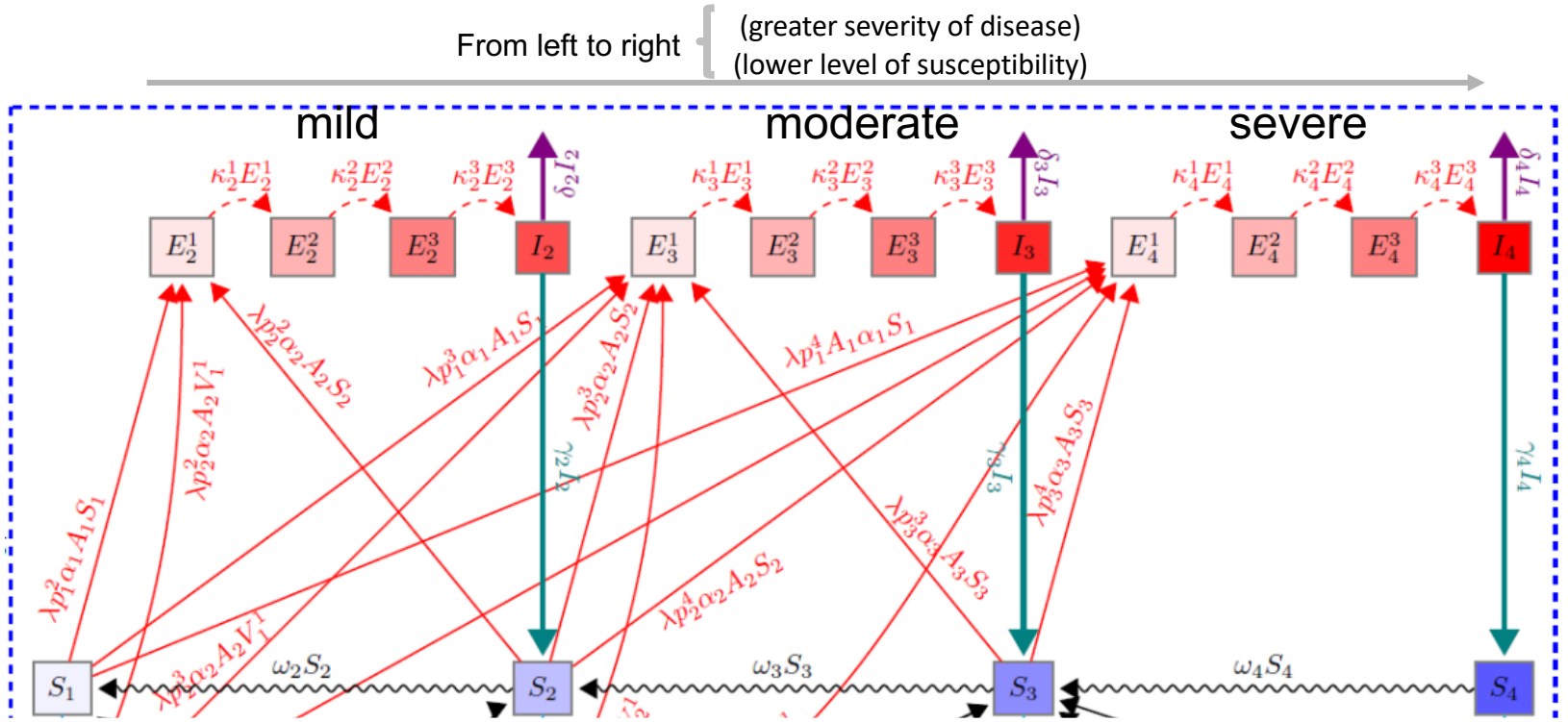
Endemicity

- Mathematical model
  - The number of new infection are equation to the number of infections leaving the infected class



- Add seasonality, behaviour, changes in public health activities and administration, changes in transmissibility of different variants
- Consider healthcare demand

Mathematical Model



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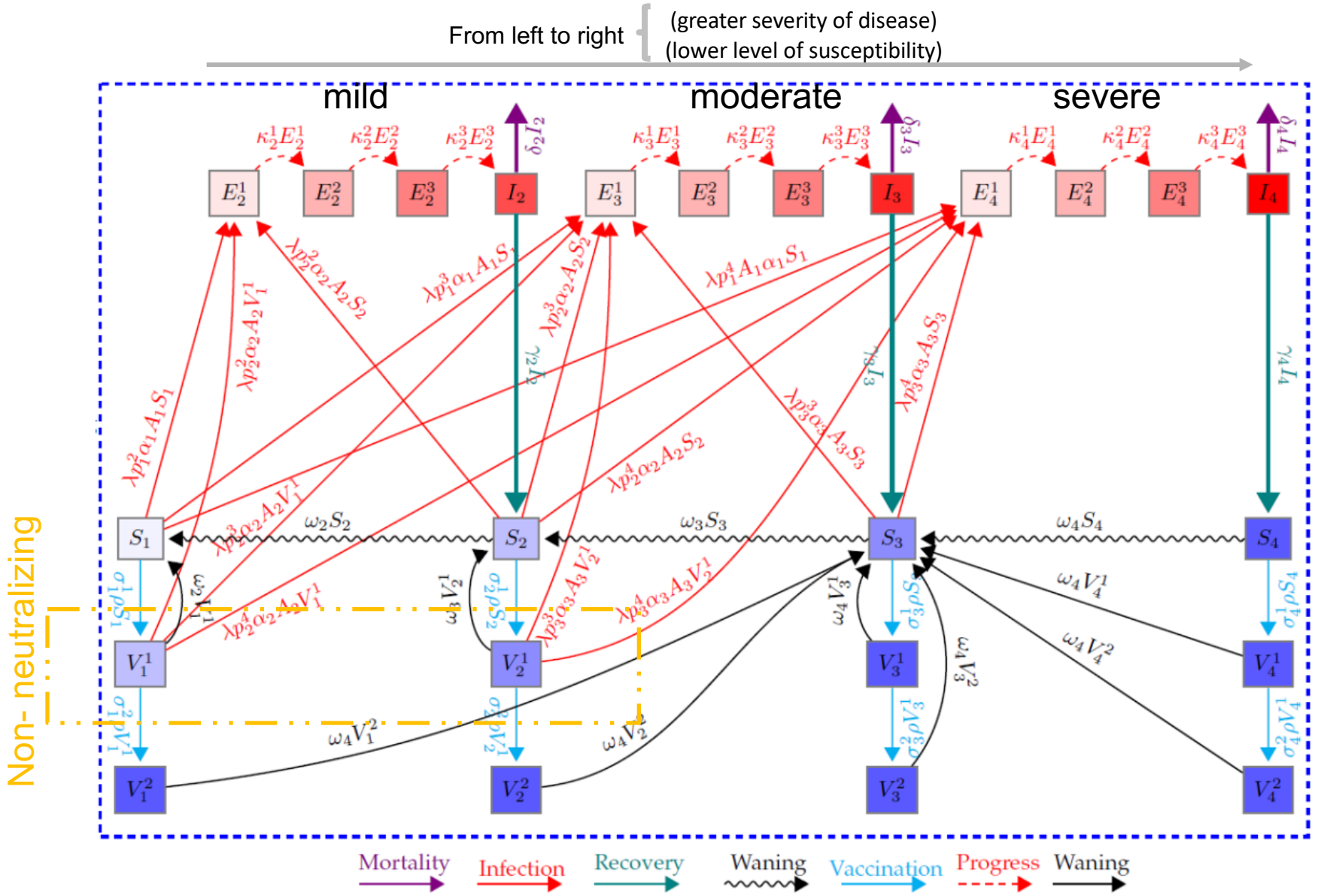
Carlsson et al. JTB (2020): 110265; Childs et al. *medRxiv* (2021) ; Dick et al. *medRxiv* (2021; Vignals et al, *medRxiv* (2021), accepted.

Mortality Infection Recovery Waning Vaccination Progress Waning

S – susceptible
V – vaccinated
E- infected, no symptoms, not infectious
I – infected, infectious, symptoms – mild (asymp), moderate, severe)

Mathematical Model



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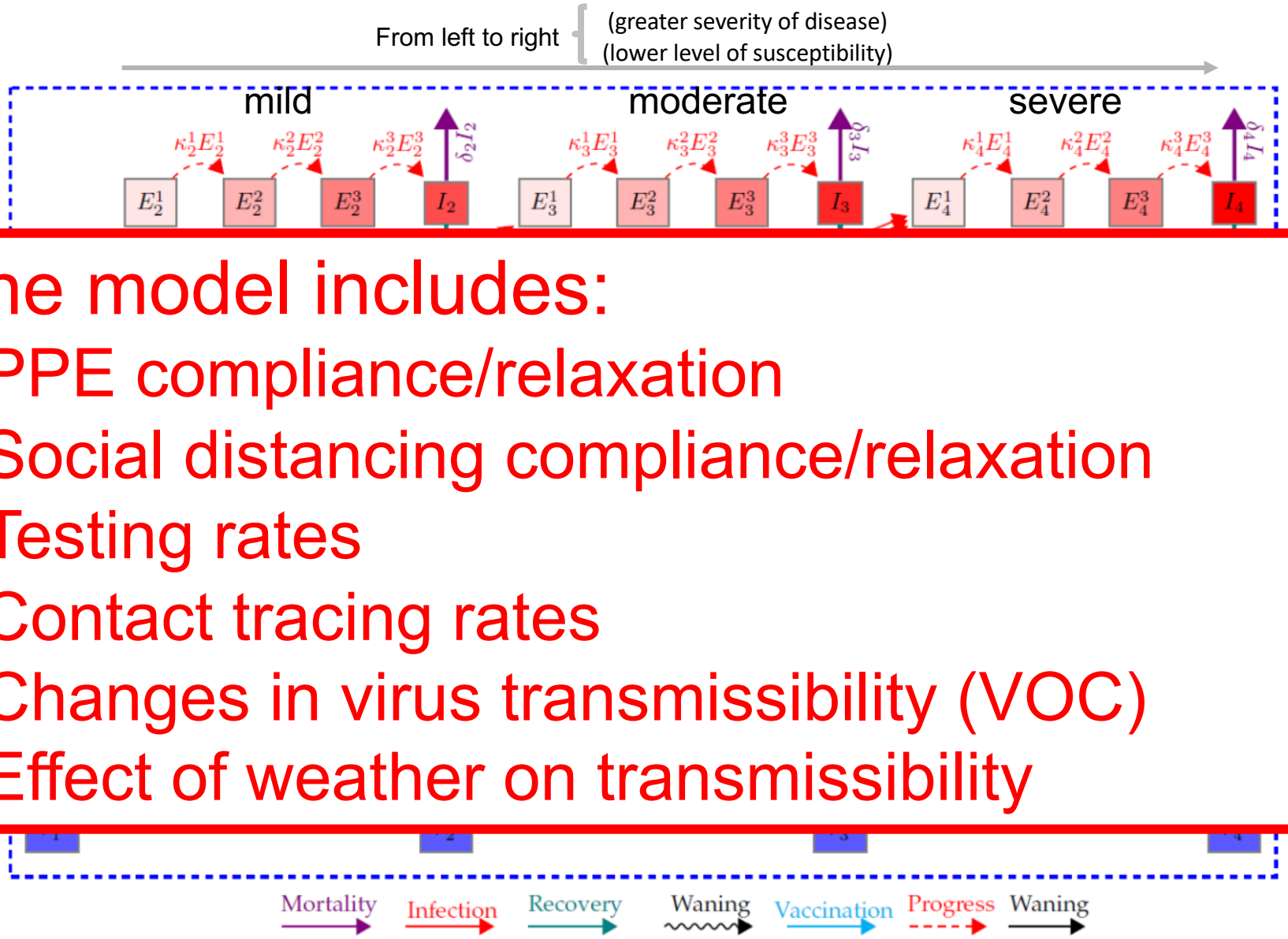

The model includes:

- PPE compliance/relaxation
- Social distancing compliance/relaxation
- Testing rates
- Contact tracing rates
- Changes in virus transmissibility (VOC)
- Effect of weather on transmissibility

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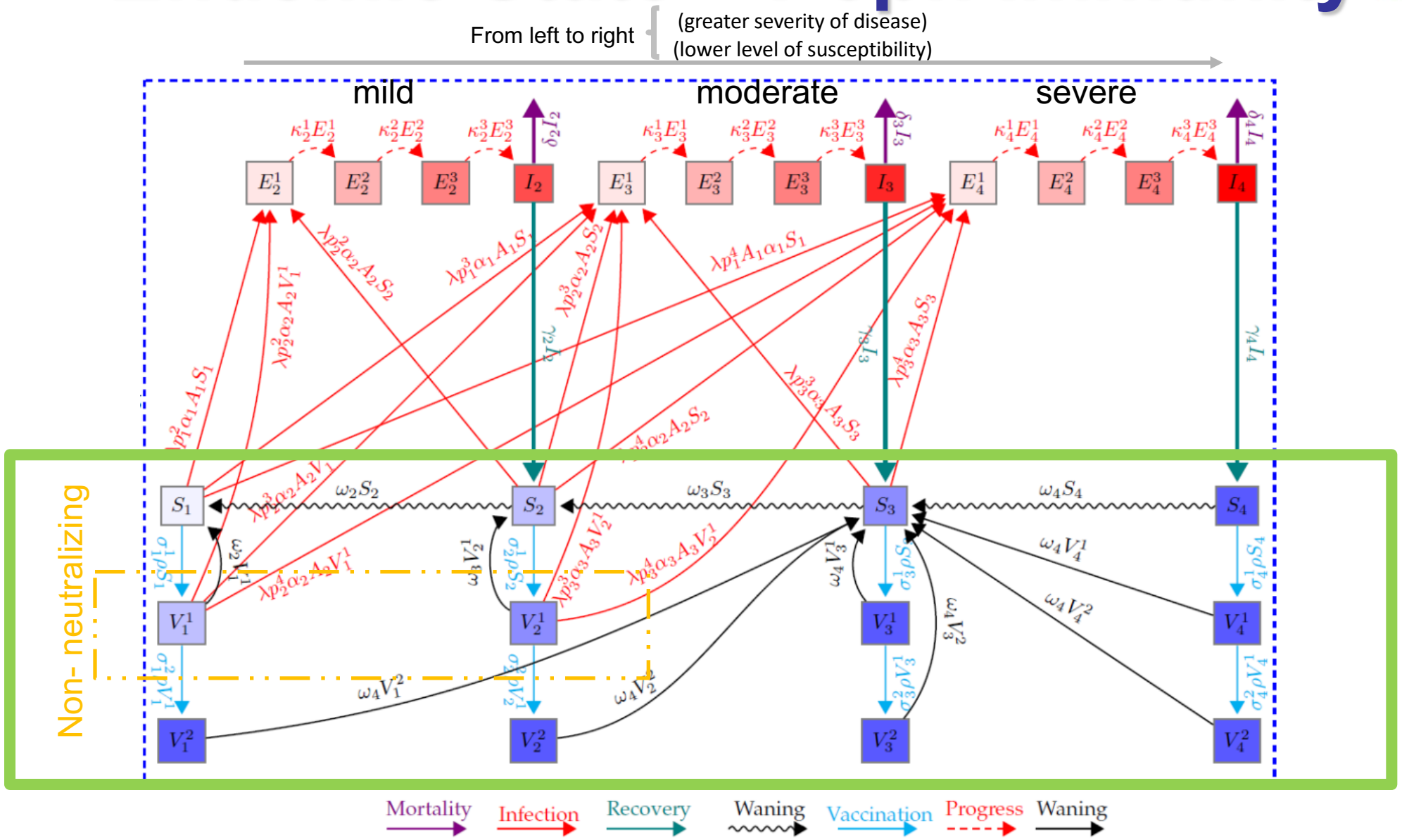
Endemic State – Popn Immunity



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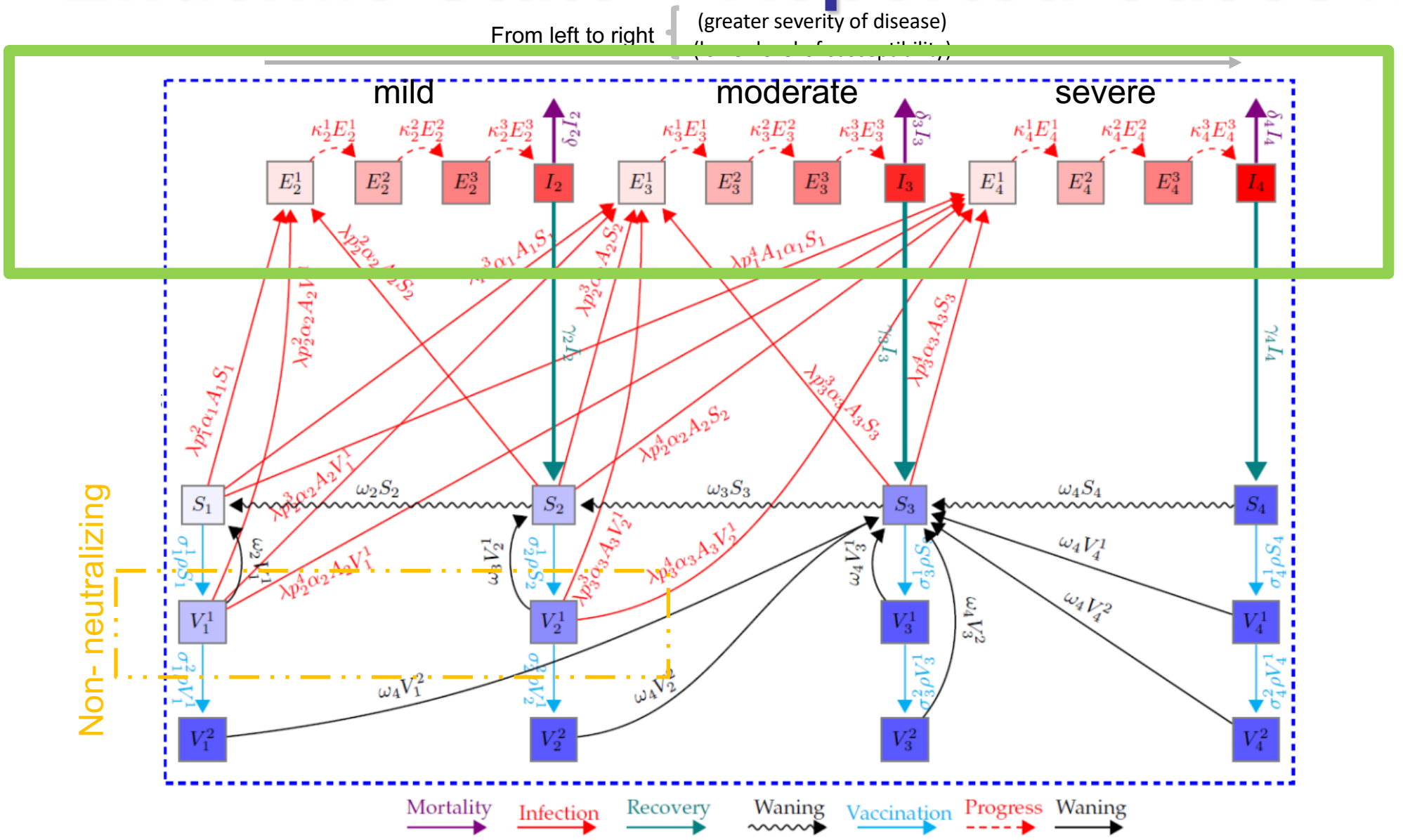
Endemic State – Reported Cases???



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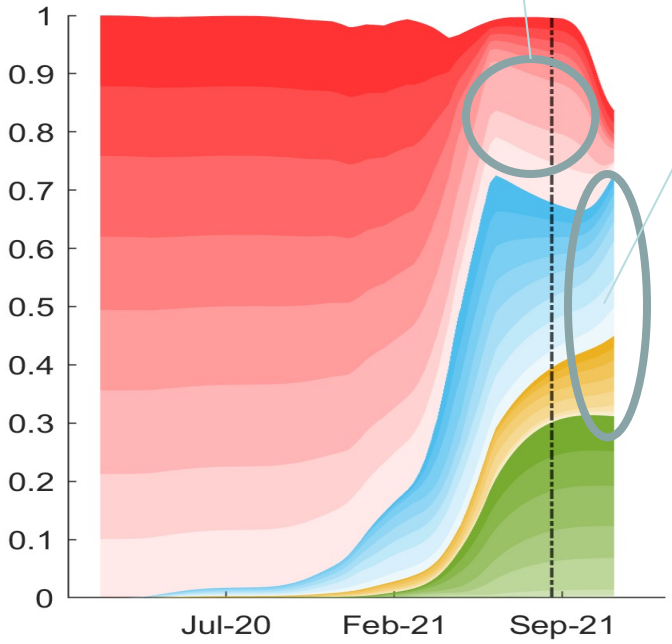
Ontario

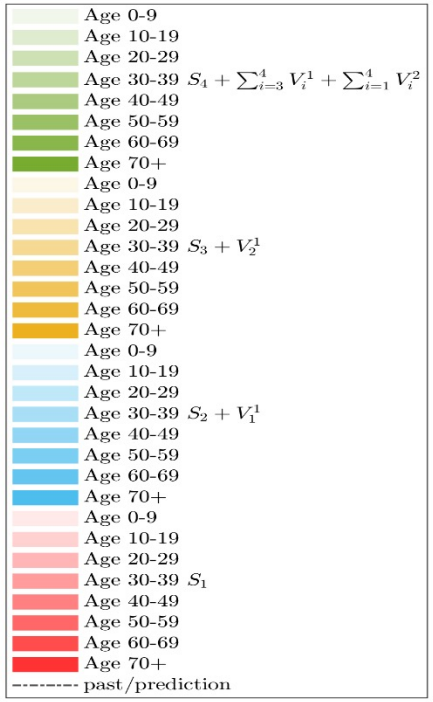
Need more 12-29 yr olds to be vaccinated

Most infections in resurgence are moderate and mild

When we look at severe infections we see that 50% of these infections are in ages 50+, so recommend a booster dose

Distribution of Immunity



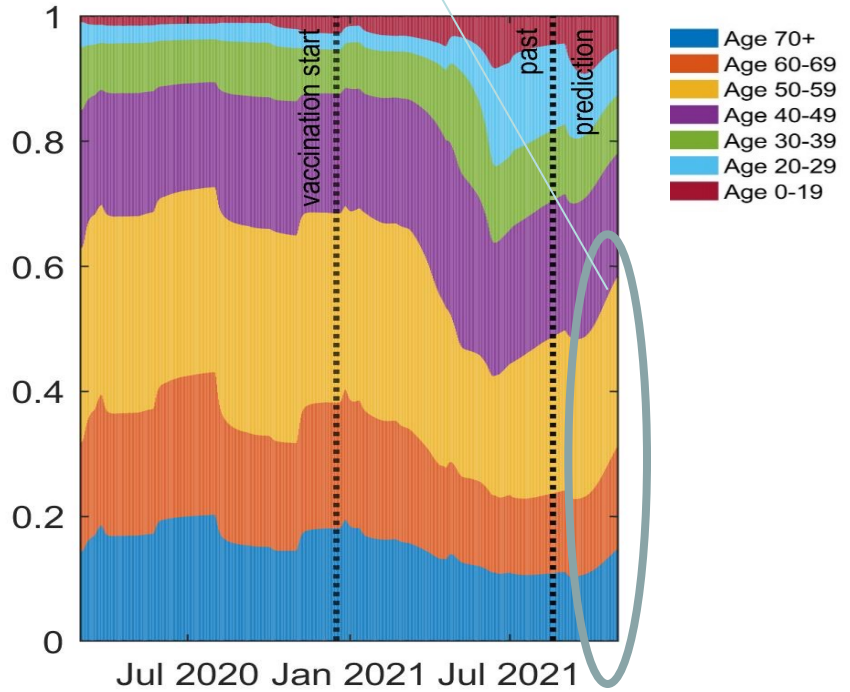


Neutralizing immunity

More immunity against infection and severe disease

Some immunity against infection and severe disease

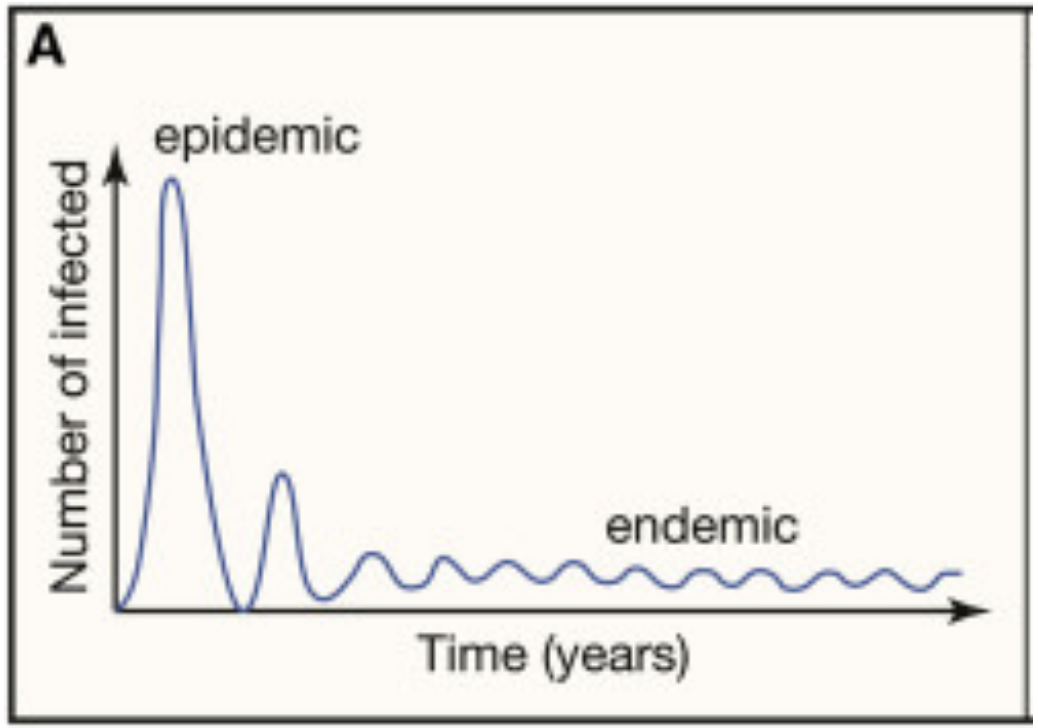
Full susceptibility, no immunity



Increases in blue show mild infections (asymptomatic, not many reported)
Increases in yellow show moderate infections (some symptoms, most will be reported)
Increase in green show severe infections (have symptoms, will be reported, some will need hospitalization.
While space is all infections and exposures at a particular time
We see increases in blue and yellow

Dick et al. , in prep

Endemicity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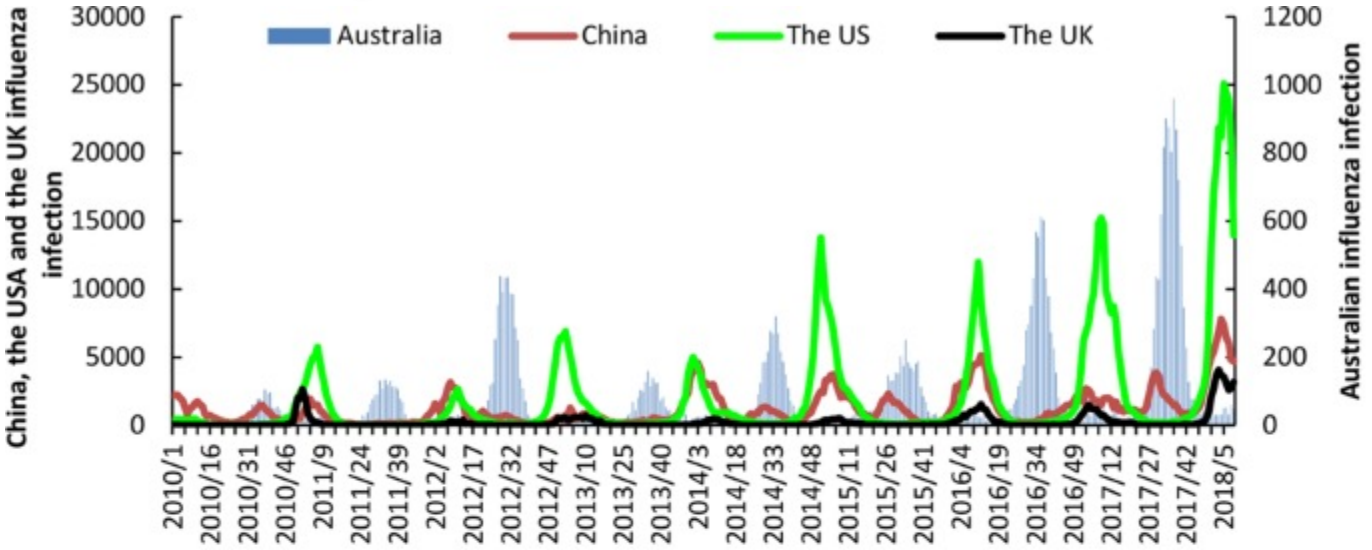
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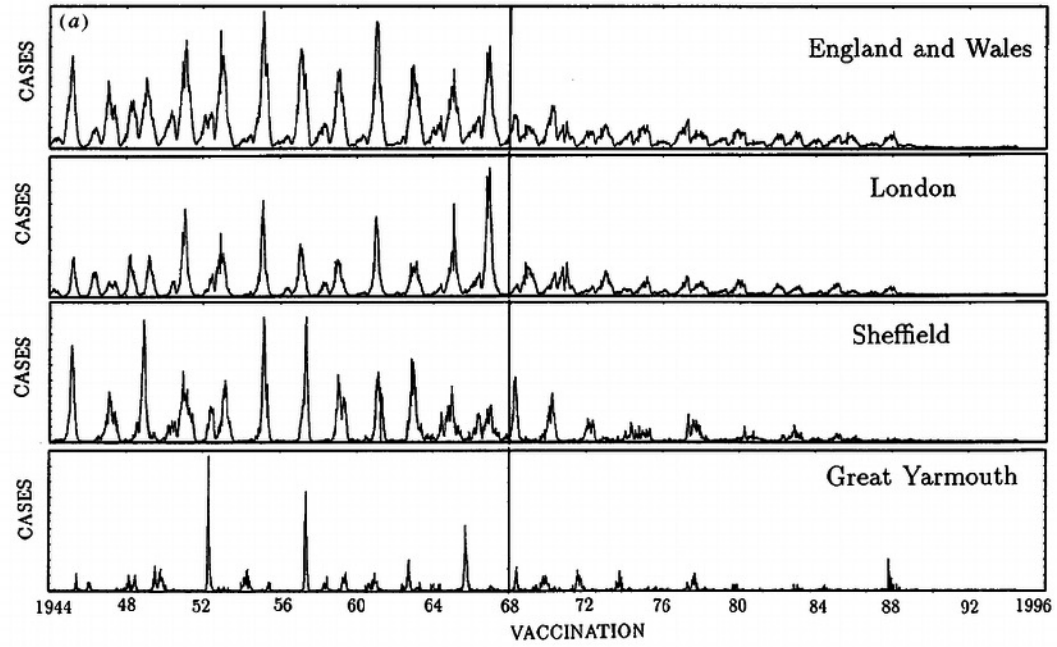
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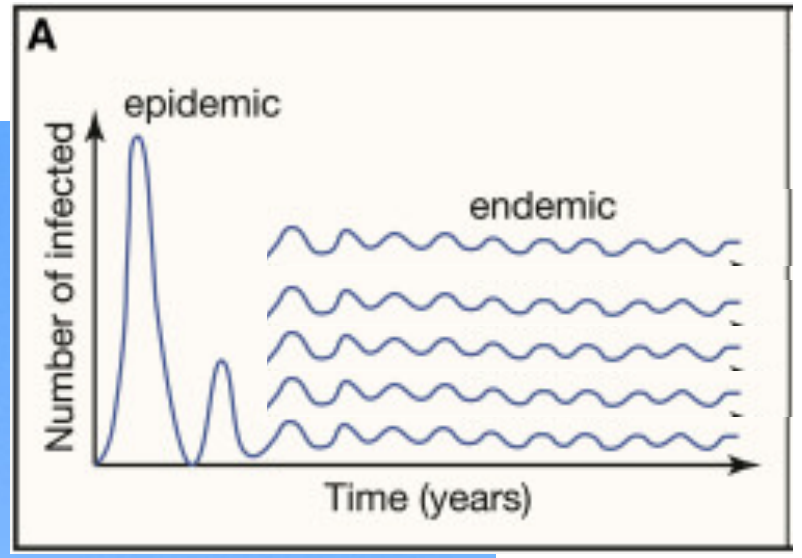
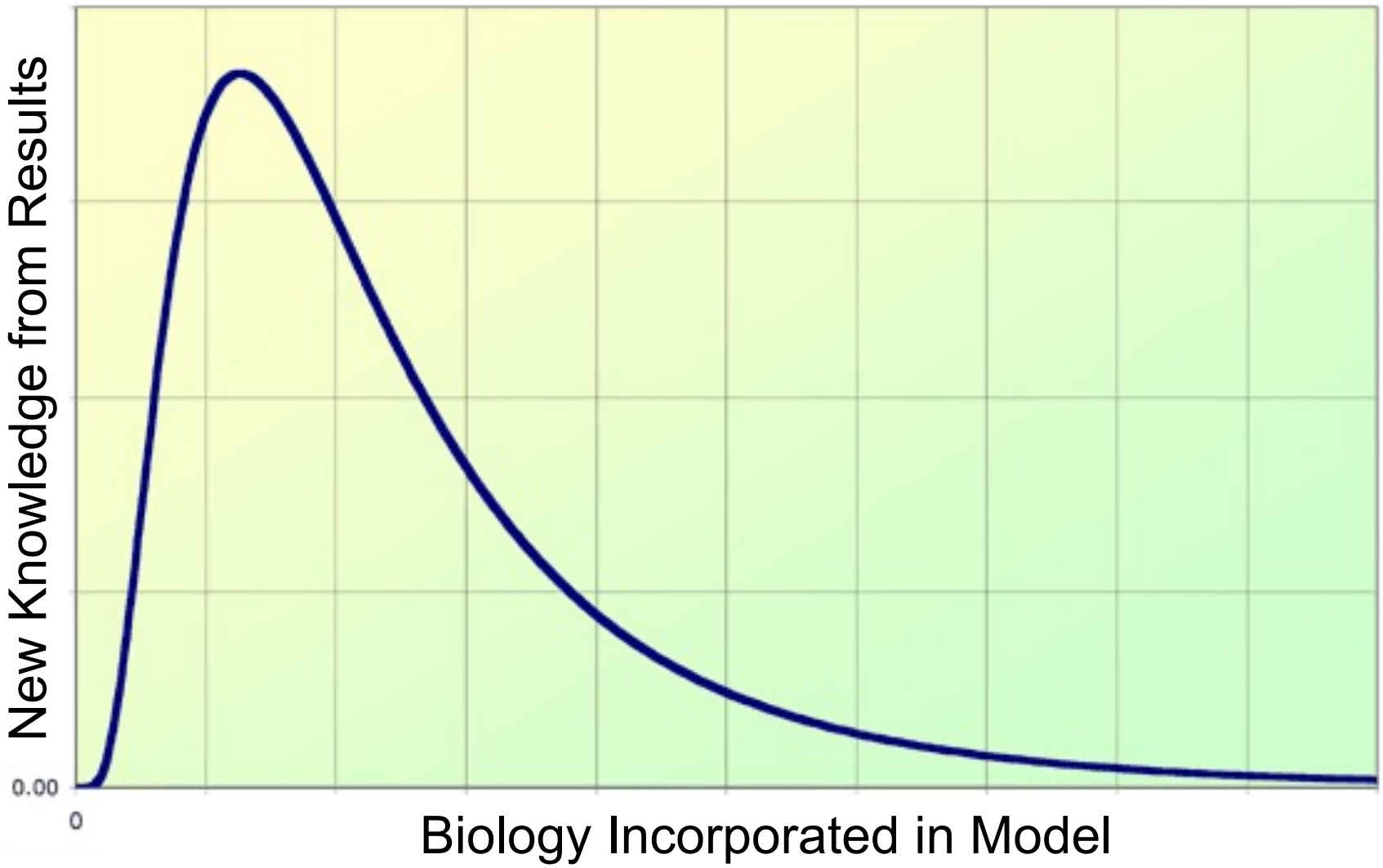


More vs. More


New Knowledge from Results
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Biology Incorporated in Model

Thank You!

- Lauren Childs (Virginia Tech)
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- Samaneh Gholami (York)
- Suzan Farhang Sardroodi (York)
- Jude Kong (York)
- Iain Moyles (York)

- In-host modelling group
- Centre for Disease Modelling