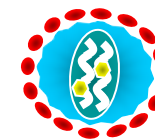




Disease Modelling: Incorporating Behaviour



Jane M Heffernan

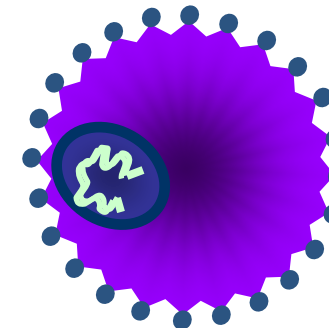
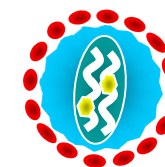
Member, Royal Society of Canada, College of New Scholars

Centre for Disease Modelling

Modelling Infection and Immunity

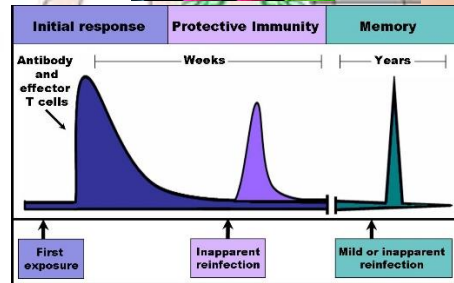
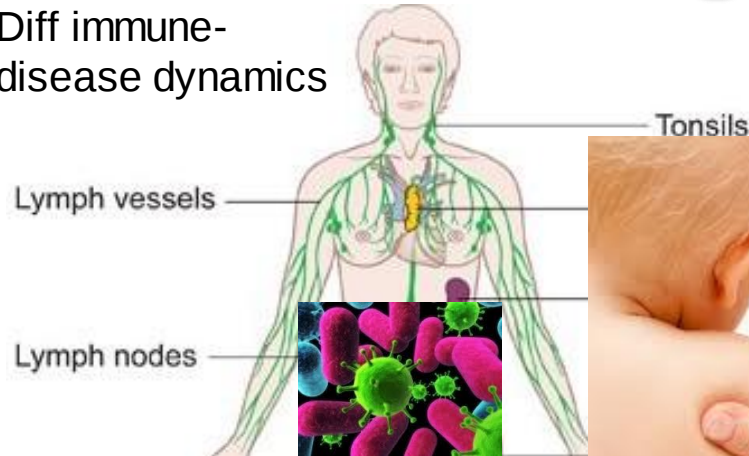
Mathematics & Statistics

York University



Understanding Infection/Pandemics

Diff immune-
disease dynamics



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

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

**Transmission
(susceptibility)**



ity)

sease dynamics
lence,
nce, etc)



Pandemic Waves

- Seasonality
- New variants
- Pub Health mitigation policies
- Changes in age groups infected
- Behaviour
 - Uptake and waning of public health mitigation (adherence)



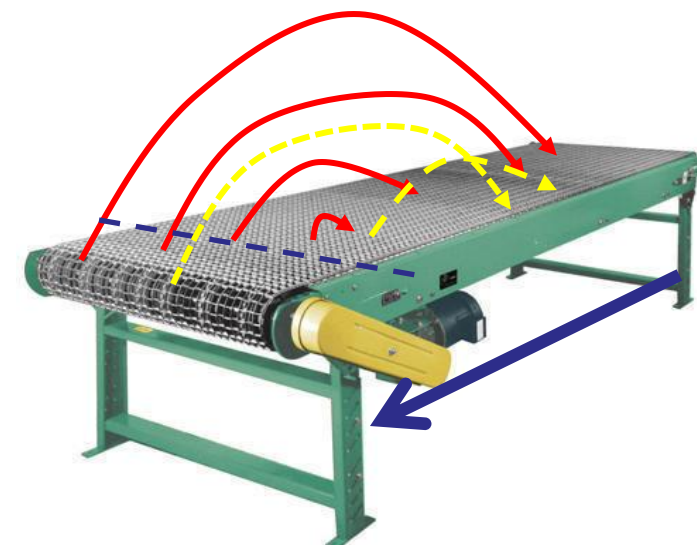
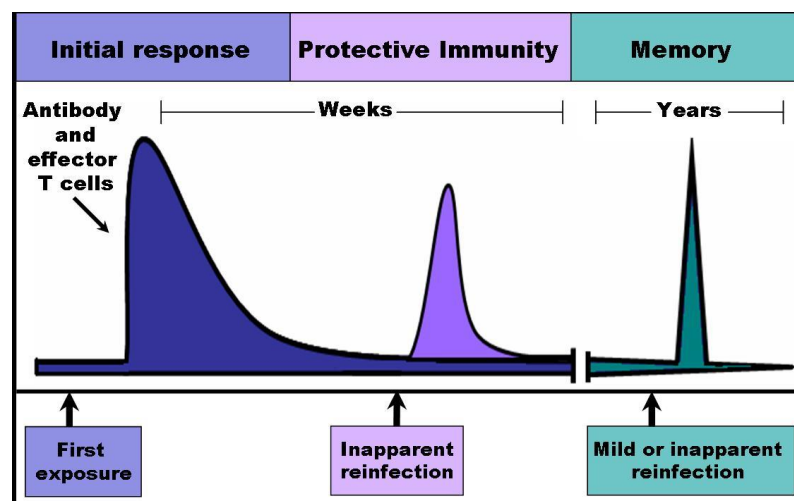
Behaviour Affects...

■ Public health and Medical care

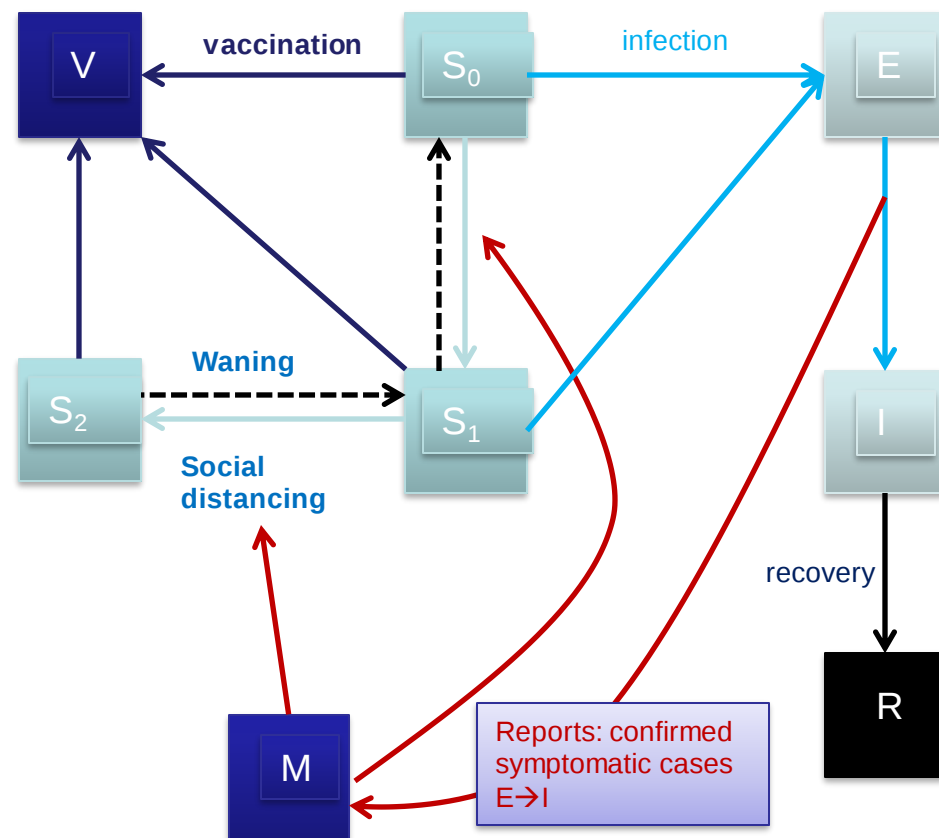


■ Immunity development and boosting

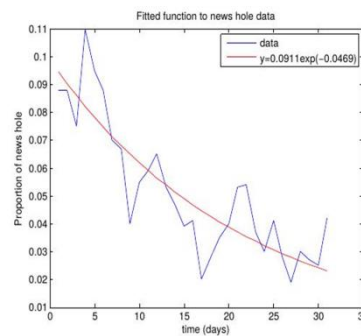
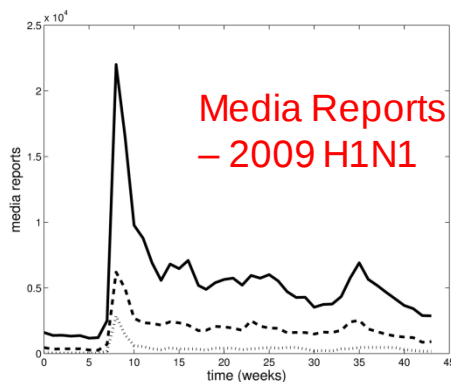
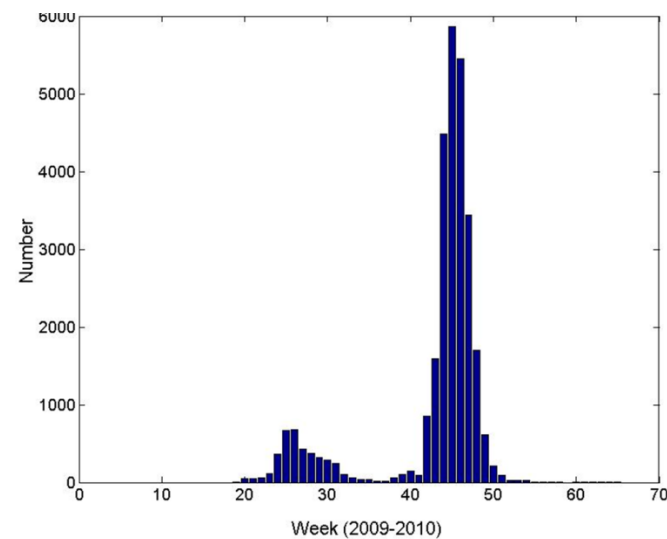
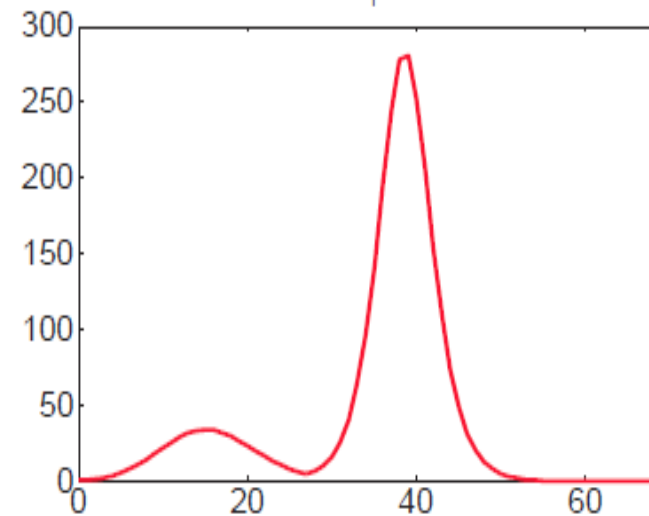
- Vaccine uptake
- Exposure to virus



Effects of Mass Media



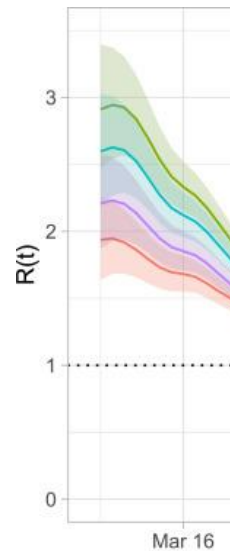
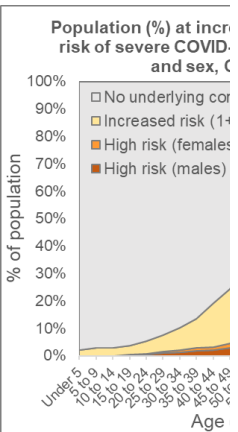
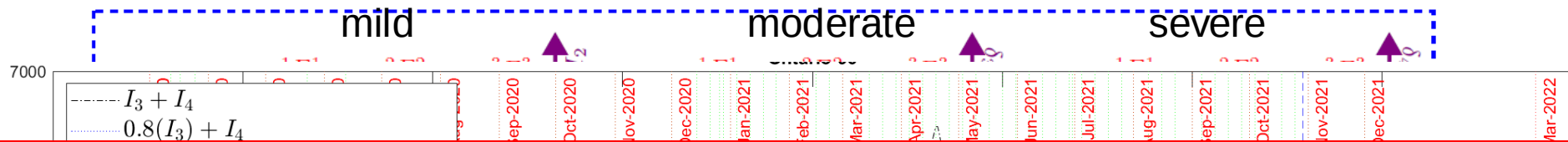
Infected vs time



Collinson MS, Khan K, Heffernan JM (2015)
Collinson MS, Heffernan JM (2014)

Model COVID-19 waves of infection

From left to right { (greater severity of disease)
(lower level of susceptibility)

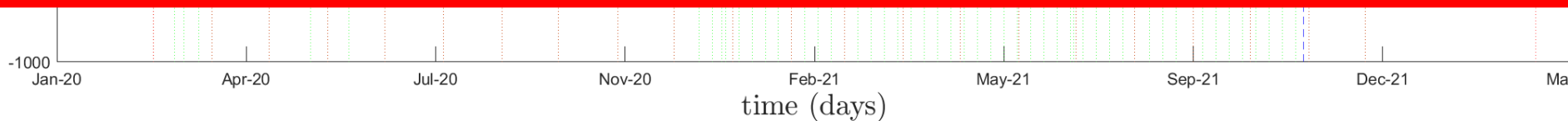


Daily incidence

$\kappa = \kappa_1 \kappa_2 \kappa_3 \kappa_4 \kappa_5 \kappa_6$ (*kappa*)

- κ_1 = PPE compliance/relaxation
- κ_2 = social distancing compliance/relaxation
- κ_3 = testing rates
- κ_4 = contact tracing rates
- κ_5 = changes in virus transmissibility (VOC)
- κ_6 = effect of weather on transmissibility

κ represents other factors that are not include in contact matrices
 κ is applied in a linearly on top of contact matrices fashion
 We fit κ to data.



S – susceptible
V – vaccinated

E – infected, no symptoms, not infectious
I – infected, infectious, symptoms – mild (asymptomatic), moderate, severe



n et al. JTB (2020):
 olds et
 v (2021); Dick
 xiv (2021);
 (2021),
 shra,
 disease
 rg/10.1016/j.
 0.009.
 ew, et al. The
 al
 2020):
 7.
 c, Jit. PLoS
 al
 17171.
 No mitigation

Team

- Iain Moyles (York)
- David Dick (York)
- Anna Akanteva (York)
- Angie Raad (York)
- Lauren Childs (Virginia Tech)
- Jing Li (CSUN)
- John Glasser (US CDC)
- Zhilan Feng (Purdue & NSF)
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- Nick Ogden (PHAC)
- Hanna Jankowski (York)
- Shannon Collinson (MOHLTC)
- Suzan Farhang-Sardroodi (York))
- Kamran Chan (BlueDot)
- GPHIN
- Centre for Disease Modelling

