Go Masked or Go Home: Why Face Masks Could Prevent Another Lockdown

Peter Winkelstein, MS, MD, MBA

Sarah Mullin, MS

Gabriel Anaya, MS, MD

Matthew Bonner, PhD, MPH

For the UB COVID-19 Analytics Model Workgroup

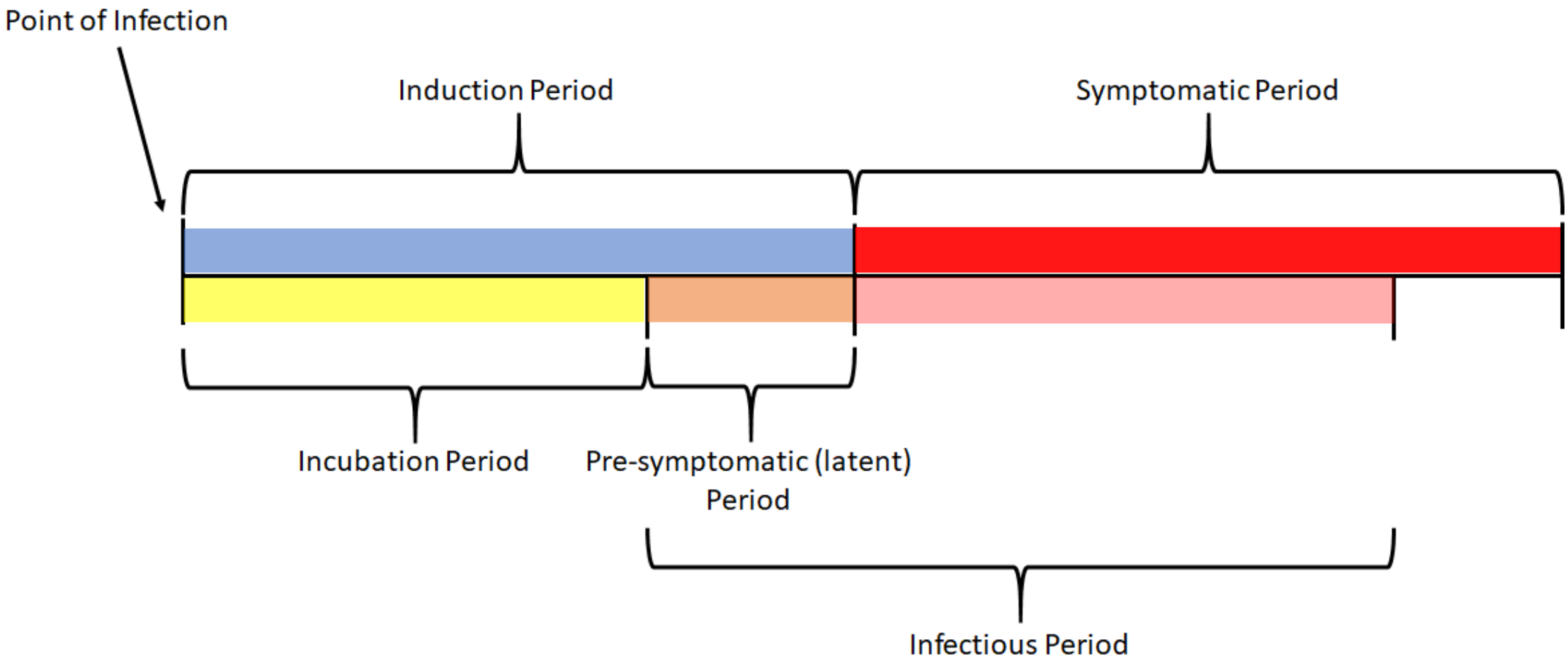
Key points

- The fundamental public health goal is to avoid overwhelming the hospitals
  - And to open schools this Fall
- We do this by reducing transmission
- Transmission will inevitably increase as we reopen unless we put in place transmission reduction measures
- Facemasks are an effective way to reduce transmission and may be our best tool right now

Outline

- Epidemiology of Transmission – Matthew Bonner
- Compartmental Models – Sarah Mullin
- Erie County Disease Model – Gabriel Anaya

Natural History of Infectious Disease



Source: modified from Rothman *AJE*(1981)

Infectious Dose and Wearing a Mask

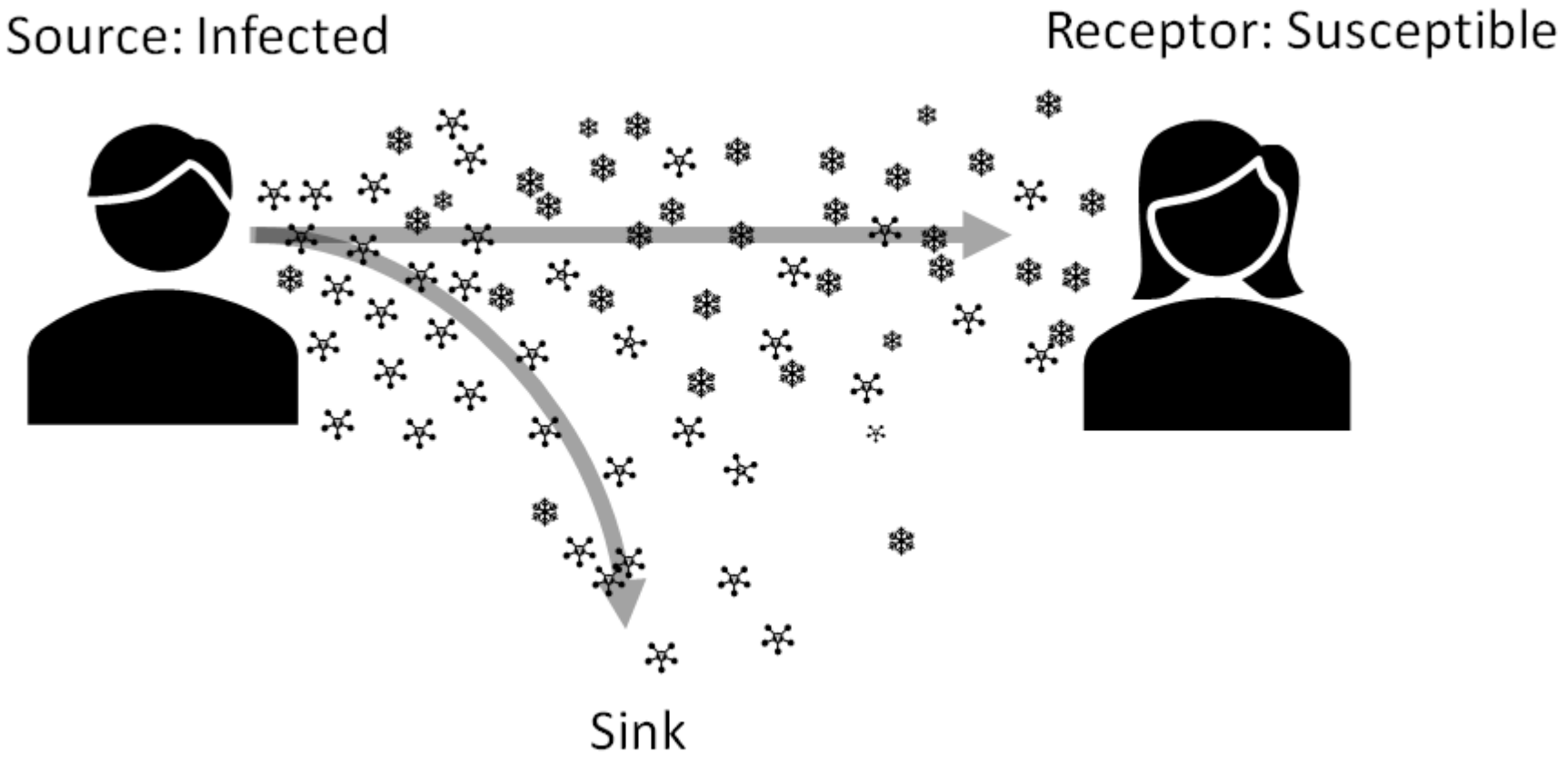
- Infectious Dose: The amount of viral particles taken into the body needed to produce and infection.

$$Infectious\ dose = \boldsymbol{intensity} \times frequency \times duration$$

If a pre- or asymptomatic person wears a mask, then the intensity of dose acquired by a susceptible would be decreased

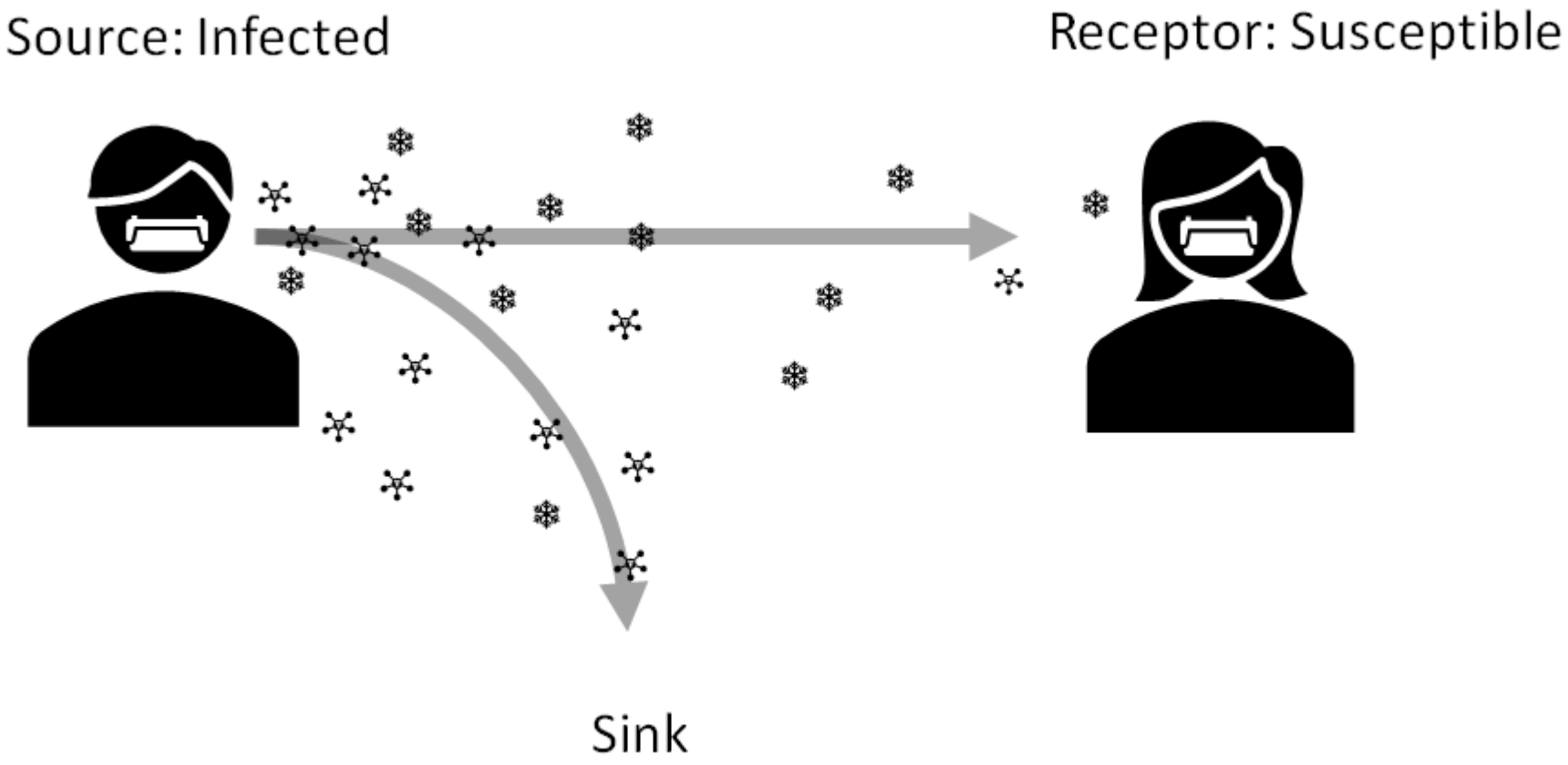
Source Receptor Model

Source Control: None

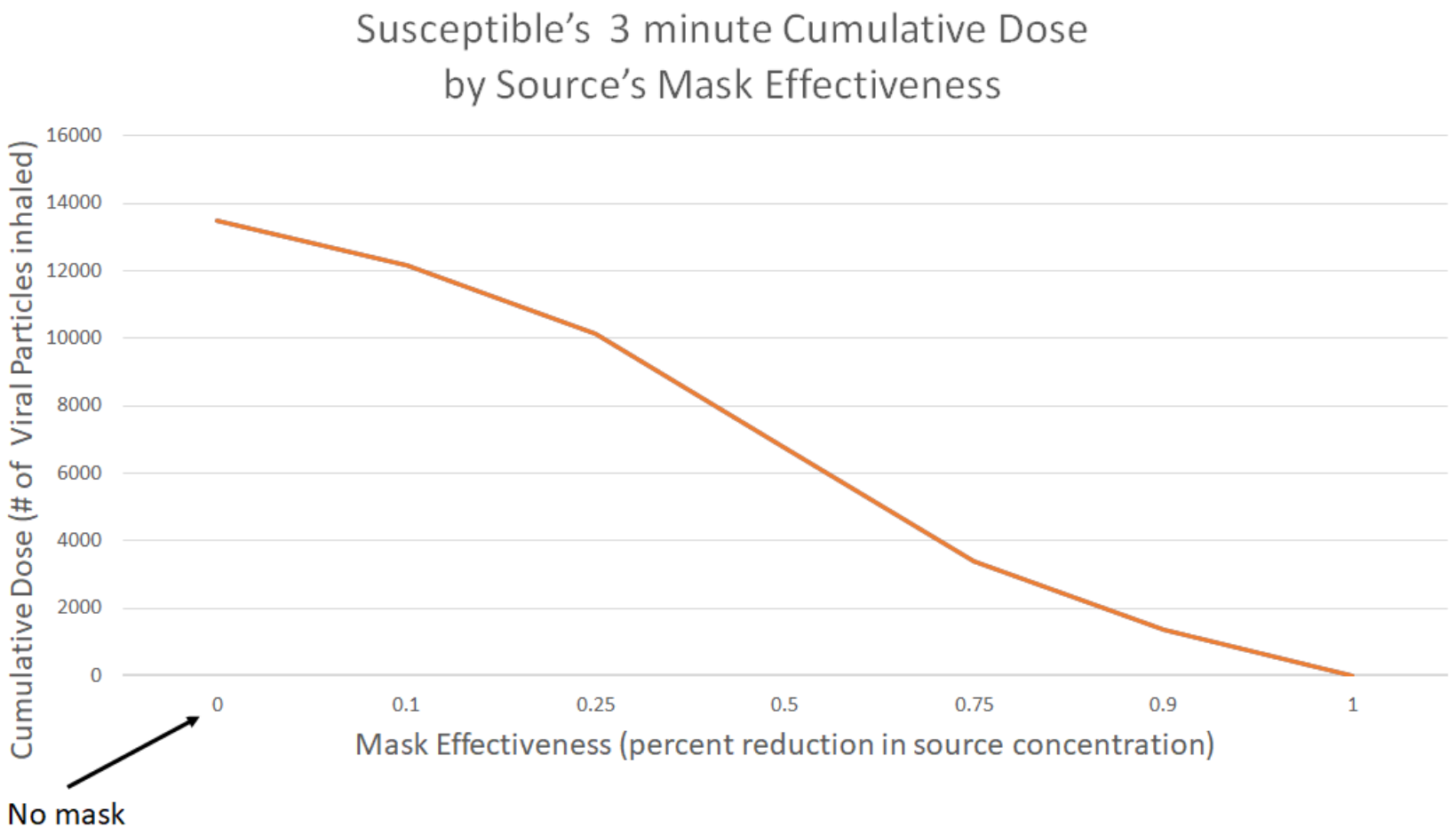


Source Receptor Model

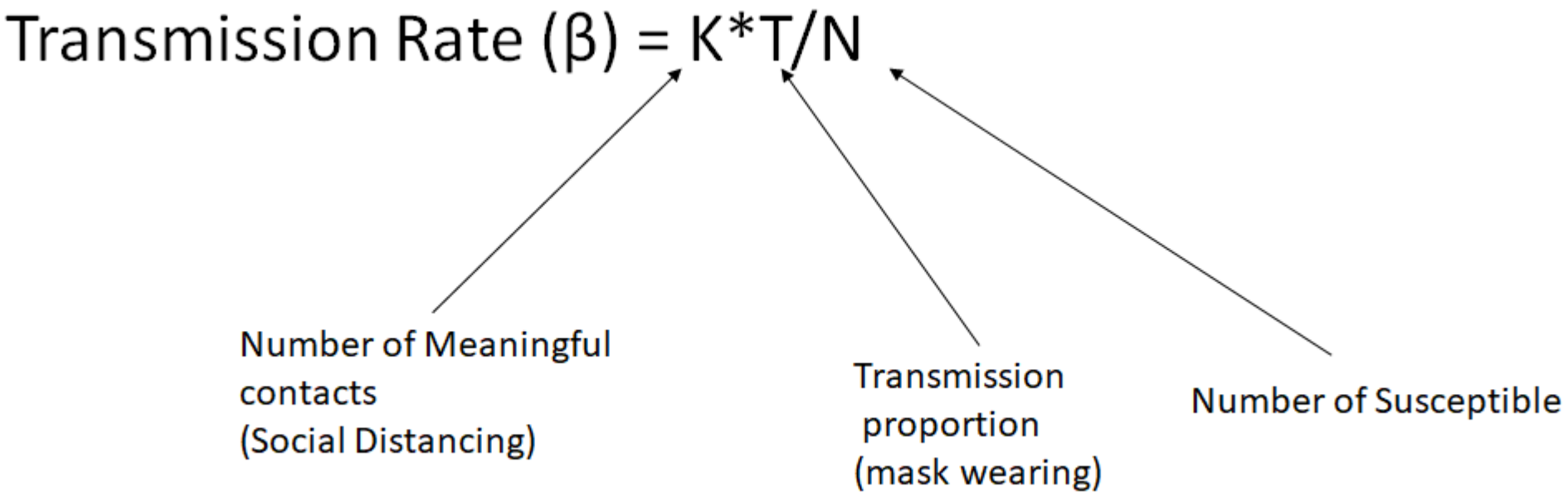
Source Control: Asymmetric Mask Protection



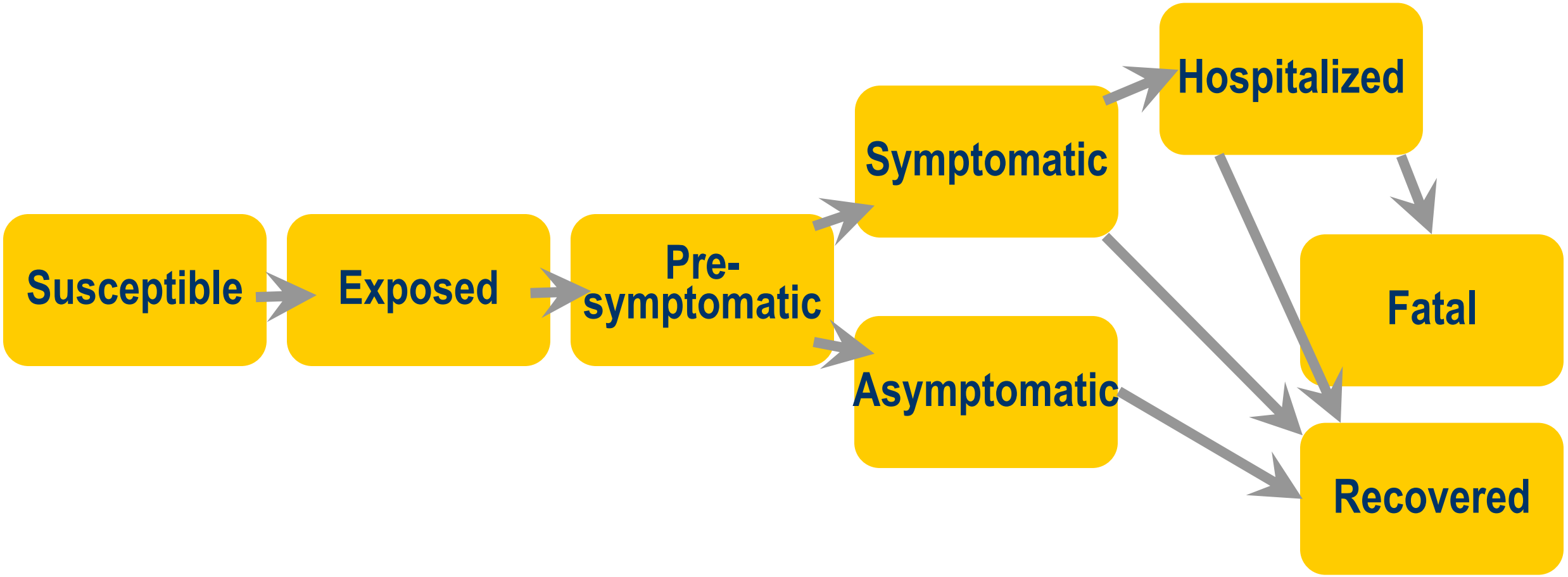
Mask Effectiveness



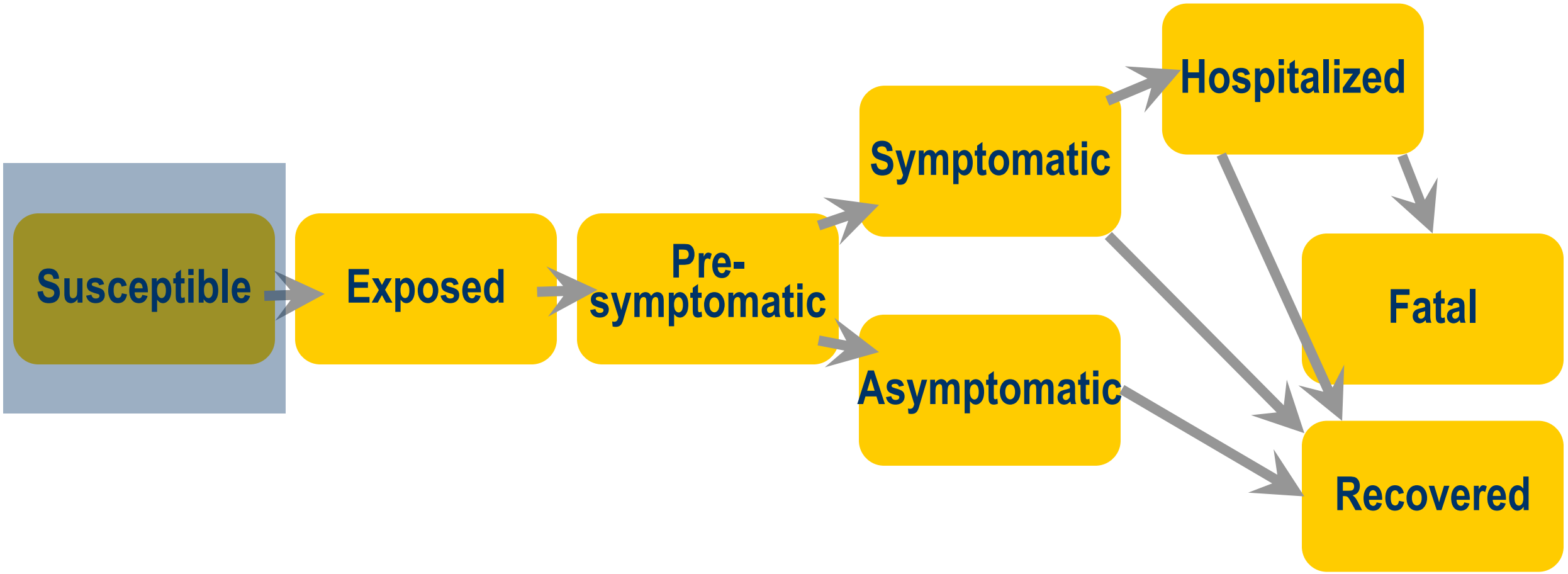
Compartmental Models of Transmission Dynamics and Mask Use



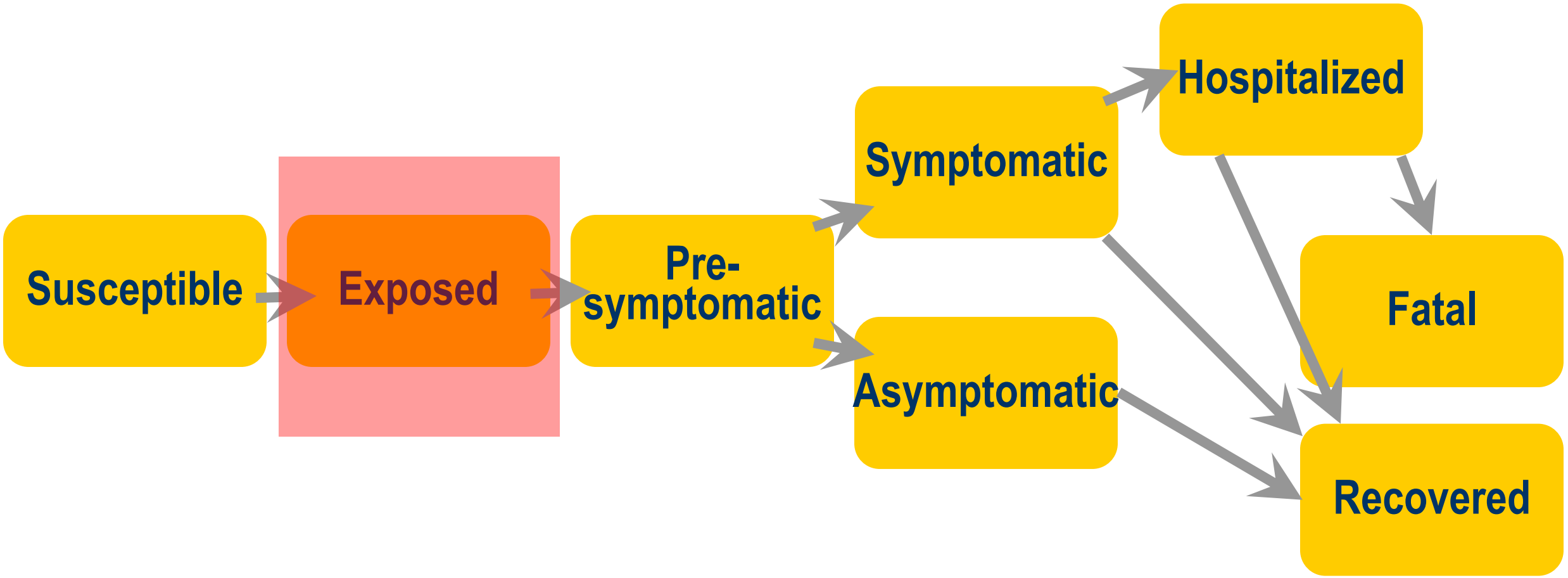
Compartmental Models In Epidemiology



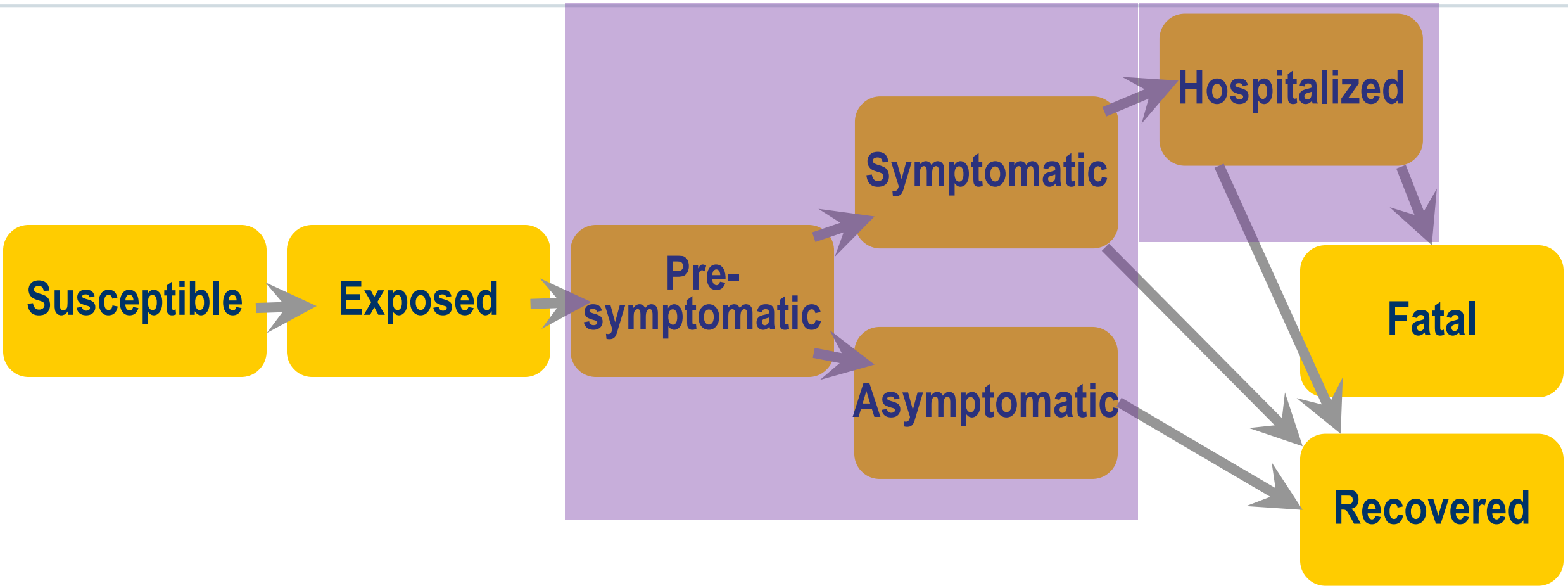
Compartmental Models In Epidemiology



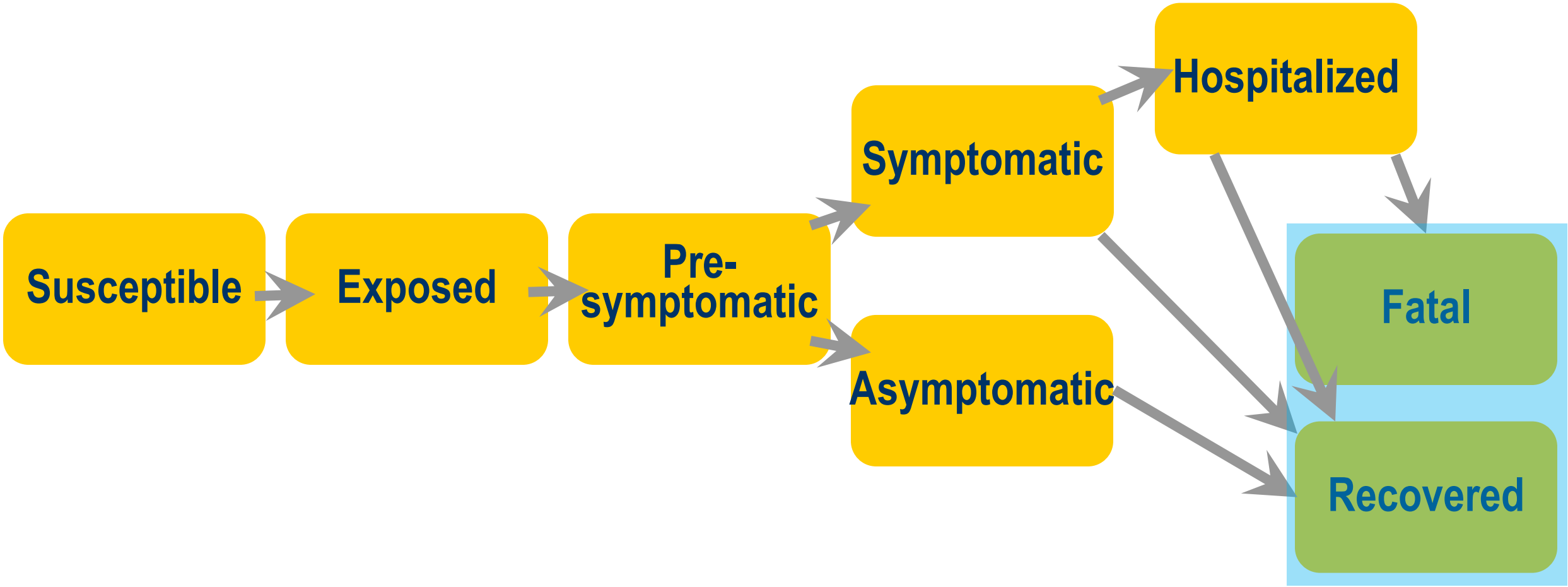
Compartmental Models In Epidemiology



Compartmental Models In Epidemiology



Compartmental Models In Epidemiology



Compartmental Models In Epidemiology

Susceptible → Exposed → Pre-symptomatic → Symptomatic → Hospitalized → Fatal

Pre-symptomatic → Asymptomatic

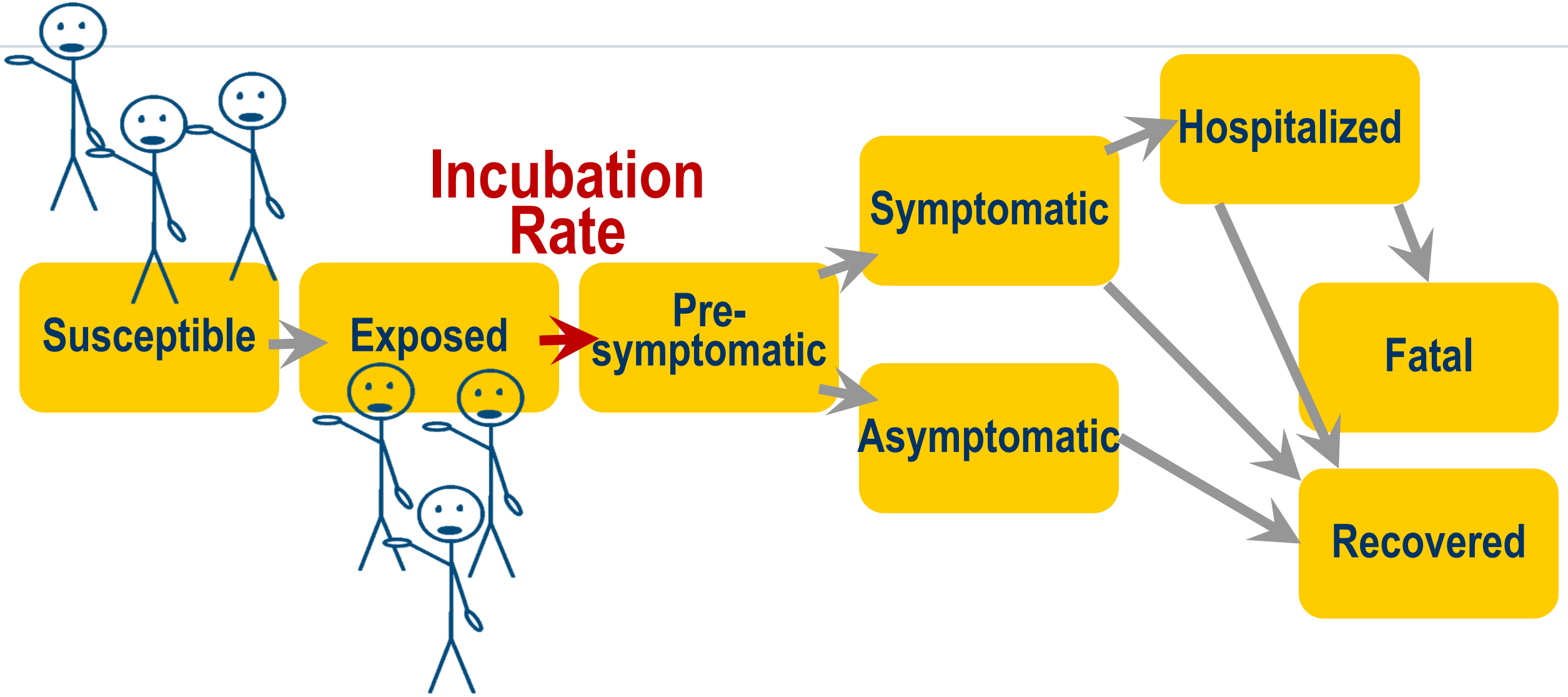
Symptomatic → Recovered

Asymptomatic → Recovered

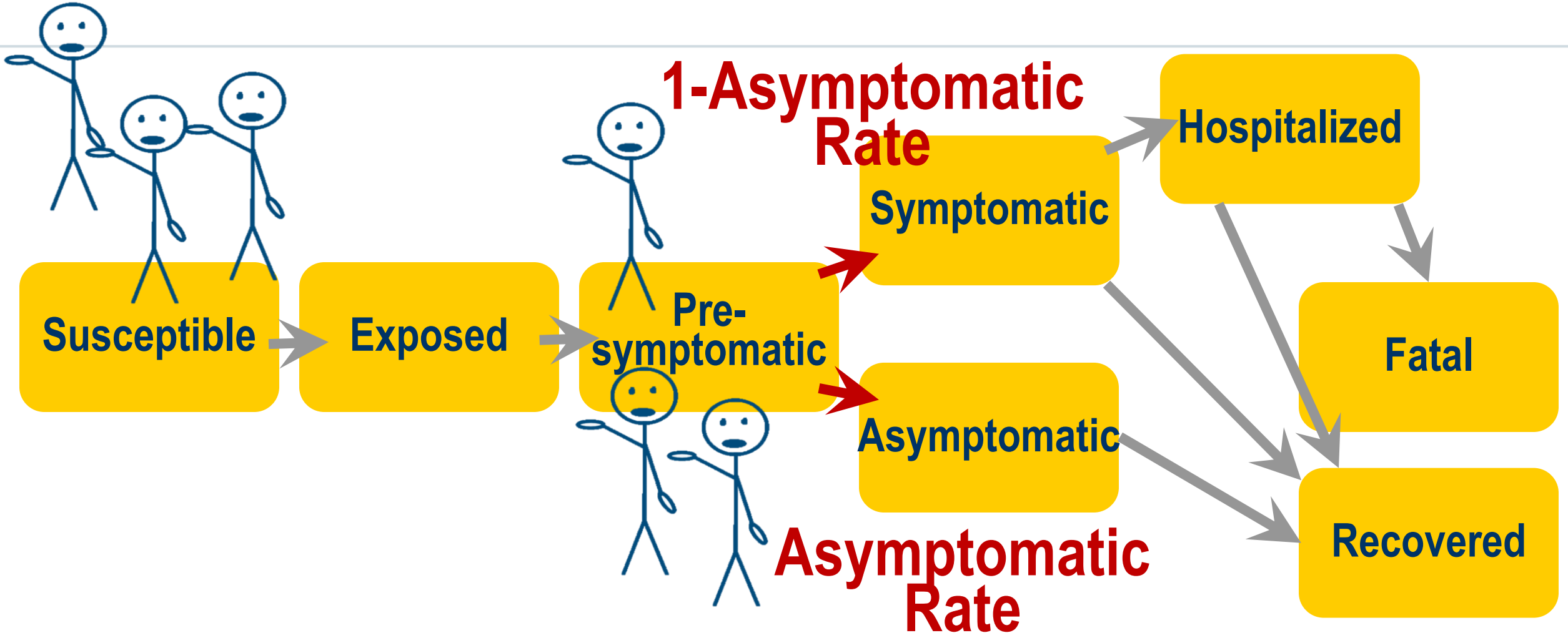
Hospitalized → Recovered

Transmission Rate(β)

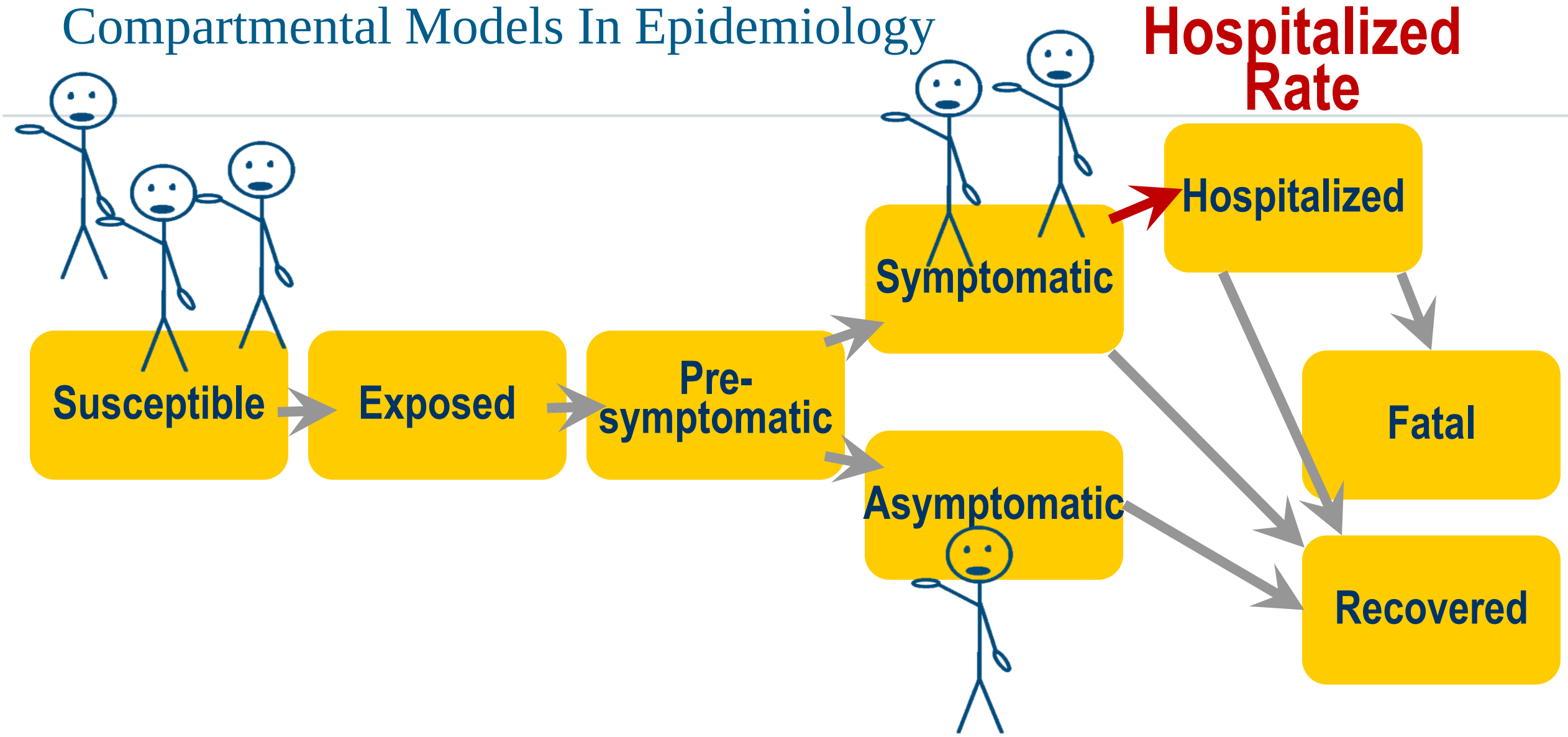
Compartmental Models In Epidemiology



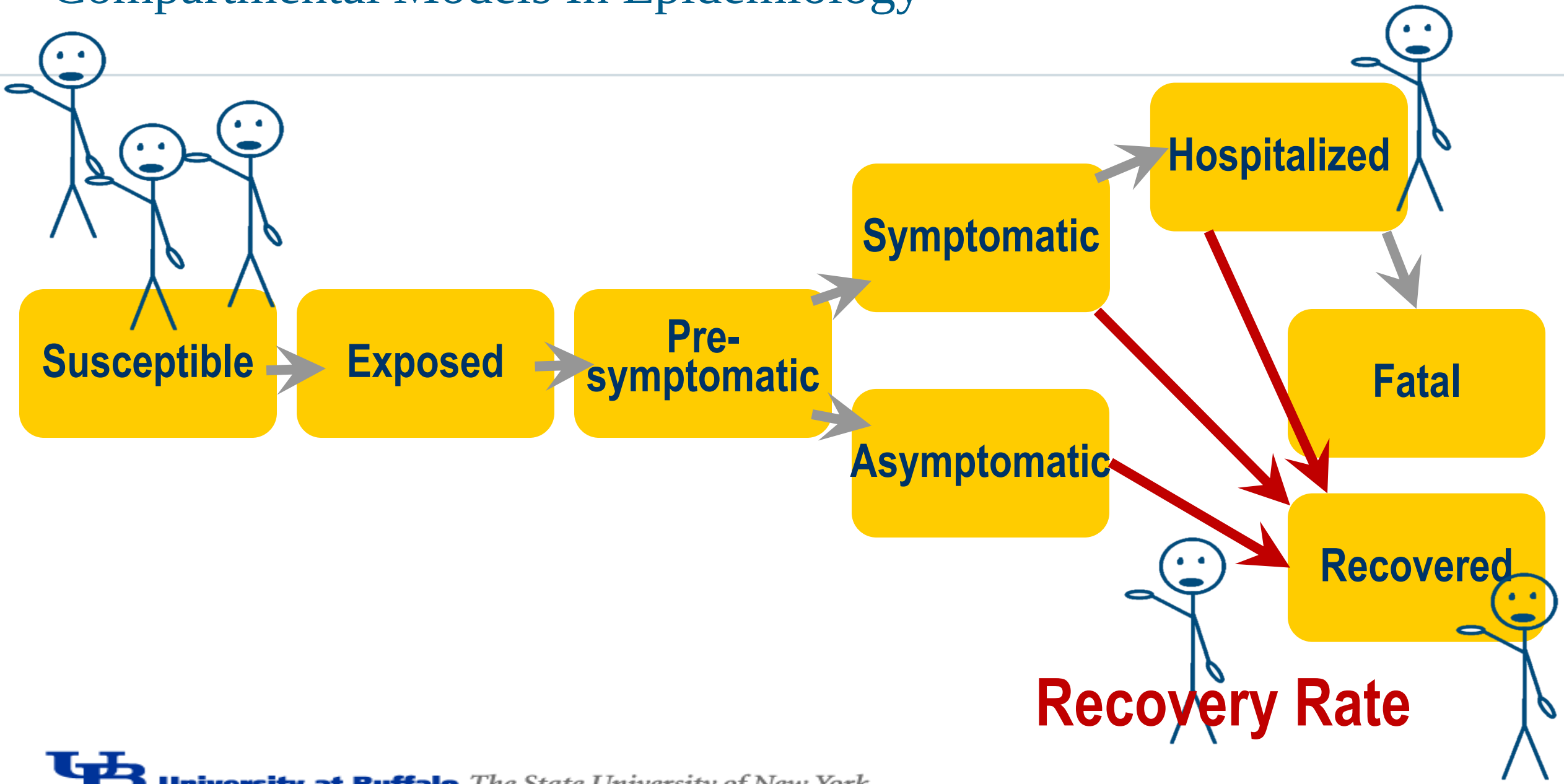
Compartmental Models In Epidemiology



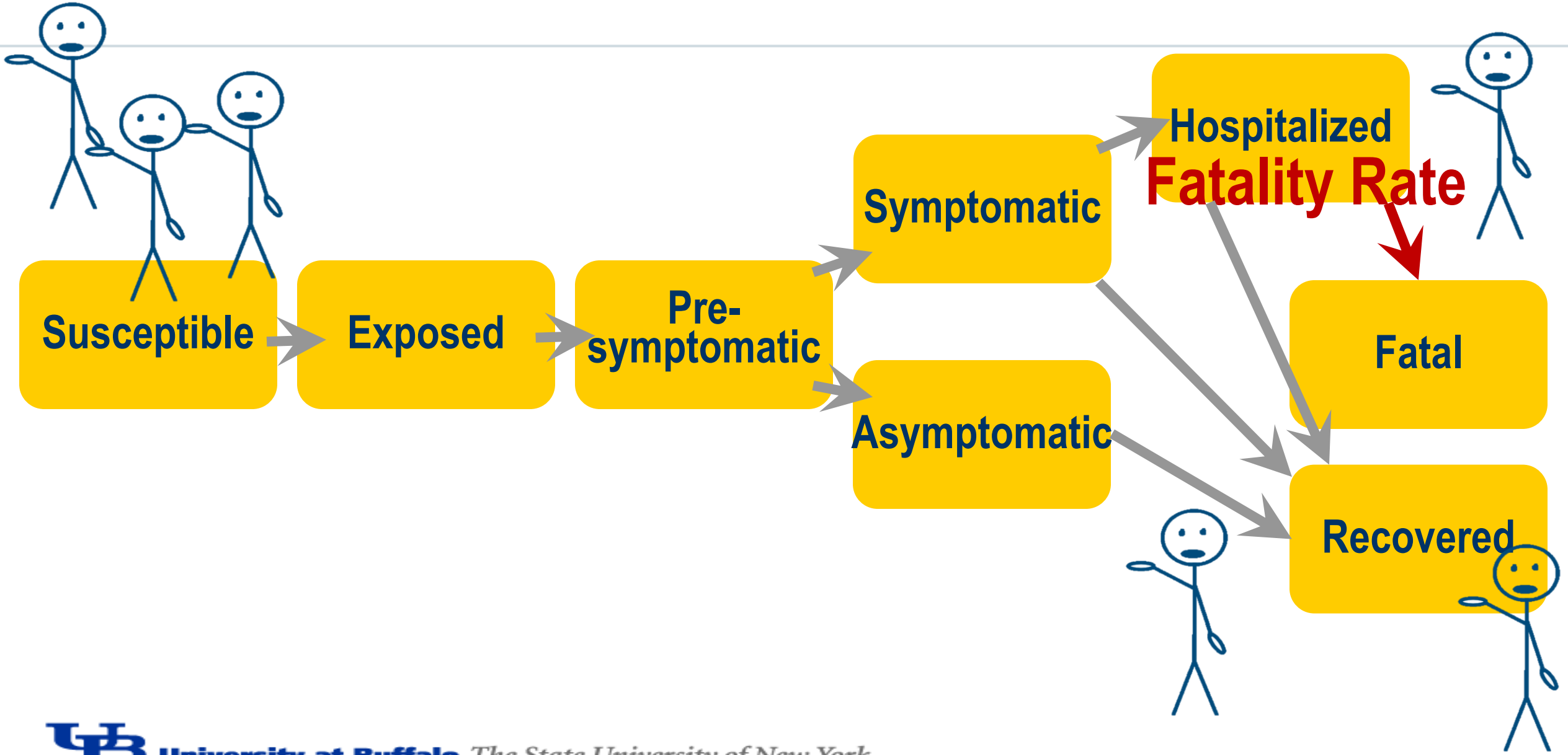
Compartmental Models In Epidemiology



Compartmental Models In Epidemiology



Compartmental Models In Epidemiology



How do we reduce the force of the infection?

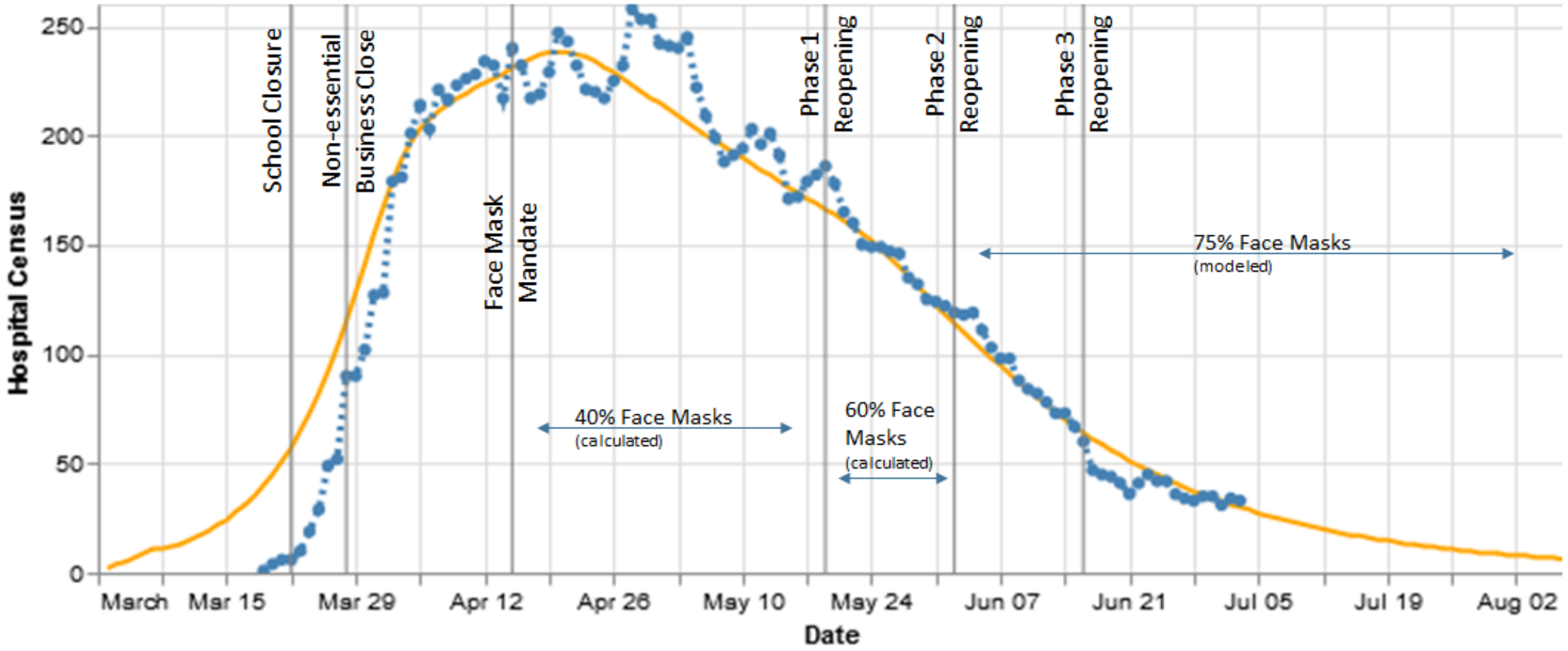
- For a susceptible person, the rate of coming in contact with infected persons depends on their density in the population

$$\textbf{Force of Infection} = \frac{\boldsymbol{\beta}}{\boldsymbol{N}} * (\boldsymbol{Presymptomatic} + \boldsymbol{Asymptomatic} + \boldsymbol{Symptomatic} + \boldsymbol{Hospitalized})$$

- We can reduce the force of infection by reducing the transmission rate (β) through intervention strategies: government mitigation, face masks, standing 6 ft. apart

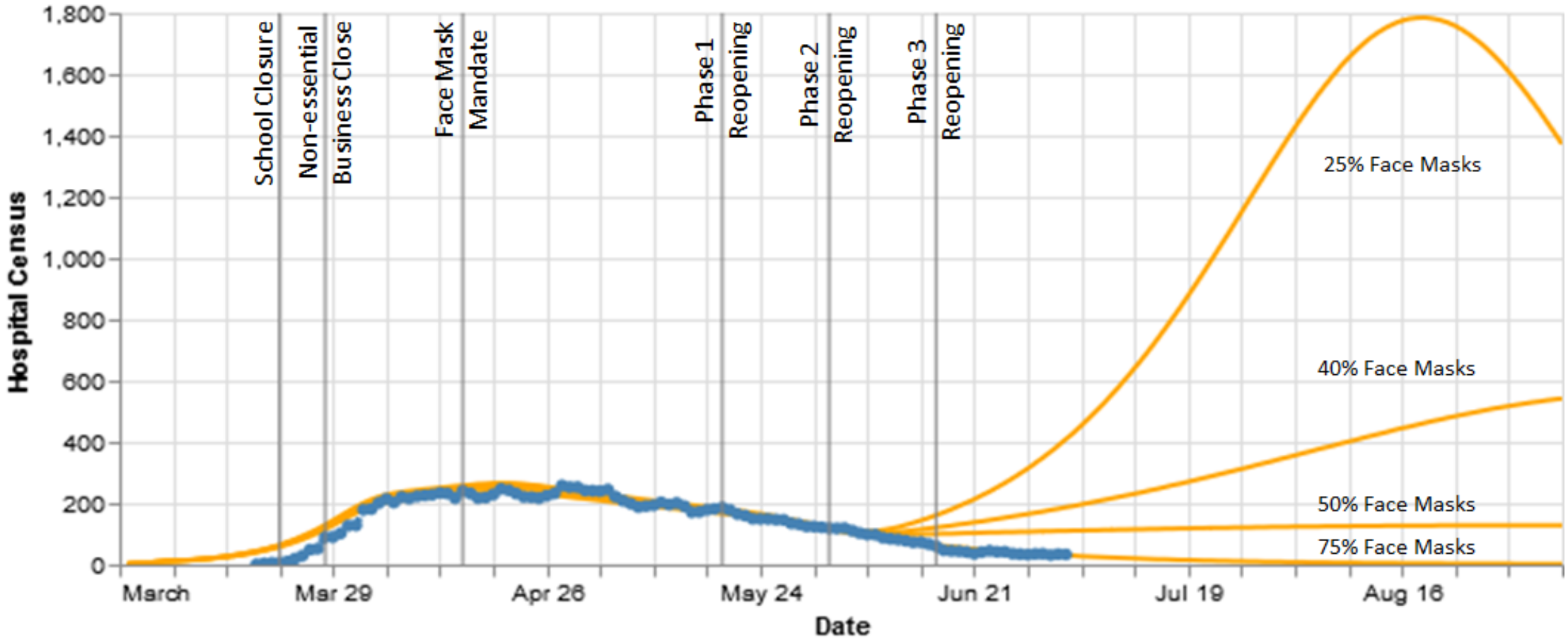
Erie County COVID-19 Disease Model

Disease Model with Compartments, Stepwise Social Distancing and Facemask Effect



Erie County COVID-19 Disease Model

Effect of Facemasks



Summary

- The key to controlling the spread of COVID-19 is to control the transmission rate (β)
- If we don't control the spread, we will wind up with overwhelmed hospitals, closed schools and/or another lockdown
- Facemasks are an effective method to reduce transmission rate
  - They must be used properly!
- **They are so effective that mask use will be critical to preventing a lockdown this Fall**

References

- Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet (London, England)*. 2020;395(10223):497-506. doi:10.1016/S0140-6736(20)30183-5
- Verity R, Okell LC, Dorigatti I, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. *Lancet Infect Dis*. April 2020. doi:10.1016/S1473-3099(20)30243-7
- KRR G, KVR M, SSP PR, Casella F. Non-Pharmaceutical Interventions (NPIs) to Reduce COVID-19 Mortality. *SSRN Electron J*. 2020:1-9. doi:10.2139/ssrn.3560688
- Howard J, Huang A, Li Z, et al. Face Masks Against COVID-19: An Evidence Review. April 2020. doi:10.20944/PREPRINTS202004.0203.V1
- Rajgor DD, Lee MH, Archuleta S, Bagdasarian N, Quek SC. The many estimates of the COVID-19 case fatality rate. *Lancet Infect Dis*. 2020;20(7):776-777. doi:10.1016/S1473-3099(20)30244-9
- Neil M Ferguson et al. COVID-19 reports | Faculty of Medicine | Imperial College London. 2020;(March). https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/news--wuhan-coronavirus/.
- Jewell NP, Lewnard JA, Jewell BL. Predictive Mathematical Models of the COVID-19 Pandemic: Underlying Principles and Value of Projections. *JAMA*. April 2020. doi:10.1001/jama.2020.6585
- Bayham J, Fenichel EP. Impact of school closures for COVID-19 on the US health-care workforce and net mortality: a modelling study. *Lancet Public Heal*. April 2020. doi:10.1016/S2468-2667(20)30082-7
- Ma J. Estimating epidemic exponential growth rate and basic reproduction number. *Infect Dis Model*. 2020;5:129-141. doi:https://doi.org/10.1016/j.idm.2019.12.009

University at Buffalo COVID-19 Analytics Model Workgroup

Gabriel Anaya

Jonathan Blaisure

Matthew Bonner

Arlen Brickman

JinWei Hu

Brianne Mackenzie

Sarah Mullin

Greg Wilding

Peter Winkelstein

Contact: pwink@buffalo.edu

https://medicine.buffalo.edu/news_and_events/news/2020/05/winkelstein-hospitalization-data-11363.html

http://medicine.buffalo.edu/news_and_events/news/2020/05/anaya-mullin-model-11258.html