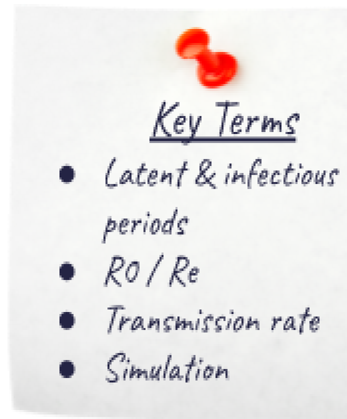
D4P Discussion Guide

Chloé Pasin and Sinead Morris present on using models and math to determine when to lift the rules of social distancing.



The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China: a modeling study · Kiesha Prem, Yang Liu, Timothy W Russel, Adam J Kucharski, Rosalind M Eggo, Nicholas Davies, Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, Mark Jit, Petra Klepac· Lancet Public Health · March 25, 2020 · PDF LINK · doi: https://doi.org/10.1016/S2468-2667(20)30073-6

The researchers used mathematical modeling 1) to predict what would happen when social distancing measures were lifted, and 2) to explore how transmission from children affected the progression of the COVID-19 epidemic in Wuhan, China. The researchers used these models to predict the impact that social distancing measures could have on the magnitude of the COVID-19 epidemic peak. This peak or curve represents the number of new infections per day. The researchers found that strict, careful social distancing measures could flatten the curve and delay the peak of the epidemic, both of which are crucial in order to avoid overwhelming health-care systems .

questions for learners	discussion points for educator
1. *What is R0, and how does that compare to Re? What are the limitations in establishing an R0 value for SARS-CoV-2?*	<u>R0</u> (basic reproduction number) is an estimation of how fast the disease can spread in a population at the *start* of an outbreak, as it estimates the number of people to whom each infected person can spread the disease, assuming that everyone in the population could become infected. The R0 for SARS-CoV-2 has been set to ~2.5, While helpful, R0 is only useful at the start of an outbreak when the majority of a population is thought to be susceptible. After an outbreak has started, researchers use <u>Re</u> (effective reproduction number). Re does not assume that everyone is susceptible (we know that some people have already been infected, and have recovered, making them “immune,” at least in the short term) and thus measures how the disease is actually spreading.
2. *What kind of model did the researchers use?*	The researchers used an SEIR model, which puts everyone in the population into one of four successive groups: susceptible → exposed → infectious → recovered. Susceptible=people not yet infected with the virus, but who could be infected. The <u>transmission rate</u>, the average number of people an infectious person can transmit the virus to each day that they are infectious, determines the frequency at which a person moves from the susceptible group to the exposed group. Exposed=people infected, but not yet infectious themselves. The <u>latent period</u> is the time it takes for a person to move from the exposed group to the infectious group. Infectious=people who are infected and can transmit the virus to others. The <u>infectious period</u> is the time it takes for a person to move from the infectious group to the recovered group.

	Recovered=people who have recovered (or, unfortunately died), so they cannot transmit the virus to anyone else, or become infected again (this model assumes reinfection could not occur within the relatively short timescale of the epidemic).
3. *What is the value of creating a model that takes into consideration both age and location for determining transmission of COVID-19?*	Current consensus around COVID-19 transmission suggests that person-to-person contact is the primary mechanism of disease spread. The mixing pattern for an individual is also *not random*, and influences transmission dynamics of the disease. Zeroing in on specific contact patterns for defined portions of the population would help establish a greater understanding of both *how* the disease can spread, and *by whom*. For example, understanding the impact of interactions between school children and older individuals in the population has important public health implications, as children might have high infection rates, but the elderly are more vulnerable to severe infections, with potentially fatal outcomes. The knowledge from these simulations is valuable because it pinpoints the best strategies for reopening specific locations, such as schools, workplaces, and other locations, to help delay and/or reduce the onset of a second peak in infections.
4. *How does the assumed infectiousness of children impact the outcome of the simulation using the described model?*	One of the assumptions given early data about the epidemic in Wuhan, was that children were more likely to be asymptomatic, and thus supposedly less infectious. To probe into how this assumed infectiousness of children could impact the strictest social distancing measures, the researchers made two categories of simulations: one where children were as infectious as adults, and one where children were less infectious. In the model where children were as infectious, infections were reduced by 50% in the young and the elderly. Where children were less infectious, infections were reduced by over 80%. The results of these two simulations demonstrate how much transmission from children influences the epidemic.
5. *Discuss the limitations of a "compartmentalized" model for transmission.*	The model created by the authors of this paper examines what happens when specific groups ("compartments"), such as school children, are allowed to engage in social mixing. A limitation of this model is that it assumes that people of the same age and disease status will all behave the same, in order to average the behavior of specific groups. This assumption means that the model does not take into consideration possible variability between individuals--for example, some people in their 20s might only interact with their coworkers, others might live with their elderly parents, and others might have kids who go to school These types of interactions could be important in super-spreading events, particularly early in an epidemic. This model is also not equipped to explicitly consider transmission within health-care institutions and households. More complex models, such as individual-based models with familial and health-care structures, are also being explored, in order to take into account local disparities
6. *Do you think*	This is an open-ended question, and there are no right or wrong

non-pharmaceutical interventions such as physical distancing will be completely effective at mitigating the spread of COVID-19? Why or why not?	answers. Students may draw from what we know from hypothetical models, such as the model presented in this paper, to comment on the effectiveness of social distancing on long-term outcomes. Students might also discuss the role of antivirals, vaccines, and other treatments that have relevance to COVID-19.