Mathematical Modeling of COVID-19 Transmission in Sonoma County - Phase 2

April 28, 2020
In its initial modeling output, The Imperial College of London adopted conservative assumptions for the effect of Shelter-in-Place orders in Sonoma County, in the absence of data. Those models were not intended to predict what would happen, but rather to illustrate the minimum effectiveness that SIP would need to have, in order for hospital capacity in Sonoma County not to be overwhelmed.
Phase 2 of Modeling Summary

- The Phase 2 Report from The Imperial College of London demonstrates that Sonoma County’s Shelter-in-Place (SIP) order combined with other interventions that include contact tracing, targeted testing, face covering, social distancing, congregate living guidelines, among others have suppressed the virus transmission to a greater degree than originally estimated in the Phase 1 report.
- Based on actual data, the anticipated transmission rate of $R_0=2.5$ (where every case infects 2.5 people) has been reduced by 75%.
Phase 2 of Modeling Summary

• Had Sonoma County not instituted the various mitigation strategies, the Phase 1 modeling predicted the need for 10,000 hospital beds within 4 months of the county’s first case. Phase 2 modeling affirms the success of Sonoma County’s interventions with 222 reported cases -to-date and 23 hospitalizations as of today.

• All county residents are to be commended for their adherence to these mitigation measures and for helping us to “flatten the curve” and prevent overwhelming existing capacity in Sonoma County hospitals.
Phase 2 of Modeling Summary

- The timing of Shelter-in-Place hugely impacts the amount of hospitalizations and deaths resulting from Coronavirus. Sonoma County introduced Shelter-in-Place when it had fewer cases than neighboring counties, and so we are seeing far fewer hospitalizations and deaths.

- Upon lifting Shelter-in-Place, intensive test-and-isolate strategies can be a valuable means of protecting the population from a resurgent wave of infection.

- Such a strategy can have some impact if we test just people with symptoms and isolate these people rapidly as possible. However, in order to keep any 'second wave' within levels manageable by the health system, we should also identify and isolate people who are asymptomatic.
Phase 2 of Modeling Summary

- Asymptomatic infections could be reached through tracing of all contacts of known cases, regardless of symptom status, as well as making testing more widely accessible in the community. These measures could be facilitated by approaches such as testing pooled samples.
- Absent a vaccine, herd immunity will be difficult to achieve without allowing transmission to spread through the community. Consequently, intensive testing efforts may need to be maintained until a vaccine becomes available.
Sonoma County: testing strategies for lifting SIP

The figure to the right illustrates expected hospitalizations under three different epidemic trajectories based on different assumptions for the effectiveness of SIP where the transmission rate is $R_0 = 2.5$ (one case will infect two and a half other people). The blue curve (representing 75% transmission rate reduction) is most consistent with evidence observed in the County to date that reflect how our efforts “flatten-the-curve.”
Modelled Hospitalisations with intensive contact tracing, isolation of cases, contact quarantine

The figure to the right shows model projections for the peak hospitalisations following the lifting of SIP, under a range of scenarios for: a) the proportion of *asymptomatics* being identified and isolated (horizontal axis) and, b) among symptomatic cases, the delay from symptom onset to isolation (vertical axis).

- Isoclines in white show hospital bed capacity.
- The two points labelled P1 and P2 are used as illustrative examples only.
Modeled Hospitalizations without SIP with intensive contact tracing

The figure to the right is a model of hospitalization projections after lifting the SIP order under each of the contact tracing scenarios.
Conclusion & Next Steps

- Sonoma County is gradually increasing testing capacity now and we have a goal of testing 600-800 people per day in the coming weeks.
- As of April 28, the County is prioritizing testing healthcare workers in this first wave of expanded testing. A reminder that if you are a healthcare worker, you can call 707-565-4667 to make an appointment to be tested.
- Boosting testing and contact tracing capacity coupled with continued observance of all Health Orders and related guidance will create the conditions to systematically begin to relax Shelter-in-Place in line with the Governor’s direction.