Integrating COVID Models at Different Scales for Infection Risk Estimation

SARS-COV-2 infections result from interactions at fine spatial and temporal scales; however, outbreaks occurr within a larger scale epidemiological context. Appropriately integrating the interactions between processes that occur across spatial and temporal scales is essential for simulating systems of disease transmission and understanding infection risk. Here we present a simulation engine that places a fine scale network based infection model within the broader epidemiological context of the study population. Using this system we are able to simulate seeding events and fully explore the control strategy space

We have developed a simulation engine that is capable of integrating a spatially explicit COVID-19 case estimation technique at the county scale with institution level disease transmission at a “building” scale. The case estimation technique takes into account location specific factors around infection control and population level movement to estimate disease burden in a given location. **meta population model** The institution level model uses a multigraph to integrate social and spatial contact networks under various hazard reduction strategies at two different time scales. This allows us to model individual level interactions in the local context of the COVID-19 pandemic **expand on this idea, formalize**. **we know that people have lives outside of work, and we need to be able to model disease transmission outside of work, as well as what as happening in the office setting. the meta popuation model allows us to capture that population level uncertainity and incorporate it into the.**

Using our model, we were able to recover outbreak behavior in multiple systems**Validation** and discover novel control strategies. Need examples of known infection networks - summer camps, cruise ship, uss theo rosevelt, nba, nfl?, schools?, hospitals? **Validation** . - need to be able to implement interventions at a specific time point

We have demonstrated that our model provides realistic estimates of the COVID-19 outbreaks as well novel control strategies. By integrating models at multiple scales, our simulation engine empowers decision makers to develop location specific preparedness policies based on realistic estimates of how COVID will spread through their institutions. Because our framework is highly extensible, we plan to add vaccination modules as that information becomes available.

– creating a closed system – meta pop model can generalize but doesnt have the specificity of the network model – combining the two to get closed system model – meta pop model allows us to approximate an open system

validation – model is capable of describing outbreaks at small scales - contstrained literature search for outbreaks with certain parameters. - population description - contact matrix, age structure, hometown, total number of individuals at the camp - closed or mostly closed system - well described NPI’s - If we can show that our tool is able to capture behavior in multiple settings/context, it may indicate that our model is representative of general covid transmission systems and not simply recreating inputs.

* provide what if scenarios and optimize strategy for return to work.

extensions – what if scenarios

prove and demonstrate that solutions can be found via this tool that could not be found in other strategy exploration methods

we can model external forces, bring those into what was a closed system. Bringing you closer to a realistic tool for decision makers.

## [1] "infected" "recovered" "susceptible" "leave"

