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Modeling the spread and impact of COVID-19 in contact networks

In the early phase of the COVID-19 pandemic, efforts to mitigate and control the spread of the virus focused on non-pharmaceutical interventions (NPI) while research into vaccine development and anti-viral treatments were ongoing. The most common NPI were physical distancing and the closure of in-person schools and workplaces where possible. However, these interventions are not without their cost. Targeted interventions such as the closure of schools results in lost in-person school days for children. Mechanistic models in networks can be used to model the potential impact of targeted strategies while exploring different transmission scenarios. Here we performed analysis using Covasim (covasim.org), an open-source agent-based model of disease transmission in networks to investigate the dynamics of the COVID-19 pandemic in Seattle, Washington and explore the impact of diagnostic testing, scheduling, and structural interventions to mitigate transmission in schools and the greater community. Complex models aimed at evaluating targeted interventions also call for increased realism and accuracy of the descriptions of how people are in contact in their everyday lives. We use data-driven multi-layered networks generated by the SynthPops model (synthpops.org) to model the population of Seattle with realistic age distributions, age mixing patterns, and network structure. We found that no scenario of reopening schools is without risk of transmission or many days spent learning at home for children, however a focus on in-person learning for children in the youngest age groups presented the lowest risk scenario, provided sufficient countermeasures are implemented in schools such as diagnostic testing and screening.