

January 2023 Thematic Committee Briefing

Theme #2: Modeling the Impact of Intervention Policies for Disease Prediction

In Theme 2 of the PIPP Phase I PILOT (Predictive Intelligence for Limiting Outbreak Threats) project, we aim to identify and evaluate models and tools that predict the effectiveness of and prioritize intervention policies for disease prevention at both the individual and community levels. To achieve this goal, we are currently focusing on two main research topics that consider social and behavioral factors in the context of pandemic-related interventions. Specifically, we are studying the following research questions:

1. How can we model the problem of designing a step-by-step plan of policies that accounts for emerging behavior in pandemics? In other words, how do we optimize for policies that reduce the future amount of infections while assuming the general population is adapting to those policies?
2. How can we incorporate bounded rationality into epidemic models to help researchers better capture the complexities of disease spread in outbreaks?

For both questions, we have conducted a literature review on existing modeling approaches for predicting the impact of pandemic-related interventions through the lens of agent-based modeling and game-theoretic modeling.

Regarding the first question, we are currently working on methods to design sequential intervention policies that take into account real-world factors and the emerging behavior of the population throughout the course of the pandemic. These factors and behaviors have been shown to be critical in this COVID-19 pandemic and have greatly influenced the choice of intervention policies.

For the second question, we are currently exploring the use of agent-based models to optimize pandemic interventions that take into account the bounded rationality of the population in complying with health mandates. In the past, Markov Decision Processes (MDP) and Restless Multi-Armed Bandit (RMAB) frameworks have been used for various sequential decision-making and resource allocation problems. We are working on building upon these techniques to create a more realistic model of disease outbreak dynamics.

We are also organizing a workshop—entitled *Modeling the Impact of Intervention Policies for Disease Prediction*—in January 2023, which will be a hybrid event with in-person attendance at Carnegie Mellon University and at Harvard Medical School. The workshop will be an excellent opportunity for people to share their expertise related to the topic, brainstorm new ideas, and foster potential collaborations.