Machine Learning Applications in Public Health Management During Healthcare Crises

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Time: 9 am - 11 am on Thursday 5/30/2024

Zoom Link: https://binghamton.zoom.us/j/99969003702

Abstract

Machine learning technologies are becoming increasingly prevalent and having a significant impact on the future of healthcare by enabling better solutions and computational approaches to be created. The COVID-19 pandemic has underscored the critical role of different mitigation strategies in public health management. These measures play a key role in the early detection and control of infectious diseases, resulting in the reduction of spread and impact of them. In this dissertation, several machine learning techniques were modeled to address several real-life problems in public health crises management, specifically during COVID-19 pandemic. **First**, we evaluated the impact of different testing programs in controlling the spread of COVID-19 in schools. During the initial reopening phase of schools and with the initiation of TTS programs, one concern was that students exposed to the virus would have an increased risk of spreading the disease in schools if they continue in-person activities. So, there is a need to assess the impact of in-school mitigation programs and immunity on COVID-19 case rates in students. **Second**, the impact of removing in-school masking policy on increasing the county-level COVID-19 cases was evaluated. Studies showed that schools can be the major source of infection transmission in the community. So, school-aged children are at low risk of having severe conditions however, they can spread the virus to their adult contacts who are at a higher risk of having serious consequences. Therefore, there is a need to evaluate county-level COVID-19 case, hospitalization, and death rates considering masking policy variations in schools. **Third,** we analyzed how different stages of COVID-19 pandemic, variation in physical exercising and diet have affected mental distress in men and women. **Fourth,** we proposed a reinforcement learning-based method to allocate tests to schools within each town. At the beginning stages of pandemics, resources are scarce while organizations require a way to control the spread of disease. So, we proposed a reinforcement learning-based testing allocation method that allocate tests to each town based on COVID-19 prevalence of the corresponding town. **Fifth,** we evaluated the behavior of people on getting vaccinated based on the number of implemented COVID-19 mitigation policies. COVID-19 mitigation policies have been found to be successful in controlling the spread of the disease. But there is a need for evaluating the impact on these policies on people's tendency for being vaccinated. Overall, this dissertation emphasizes the importance of public health management to control the spread of infectious diseases during healthcare crises.