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Evaluating optimal lockdown and testing strategies for COVID-19 using multi-agent social simulation

P. M. Dunuwila[*] and C. Rajapakse

Department of Industrial Management, Faculty of Science, University of Kelaniya, Sri Lanka
praboddunuwila@gmail.com*

COVID-19 pandemic has become a major concern due to its rapid spread throughout the world. We can observe some countries are successful in formulating strategies effectively for managing the transmission of the pandemic, while some countries like USA, India and Mexico are struggling to identify effective policies. Recently, we can observe an increasing trend for COVID-19, surging in the Asian region. The study is based on the question of formulating effective policies for curbing the surge in COVID-19 pandemic by reducing community transmission. While many countries are suffering from the pandemic, it is a critical issue that the policymakers should be concerned with formulating effective policies to address the problem. Computational methods are used to foresee the future by creating a simulation model based on multi-agent methodology since statistical methods require the collection of large amounts of accurate data to train the model which is a challenge, currently. Multi-agent simulation helps in studying macro-level emerging patterns in a complex adaptive system such as a society, by simulating the micro-level interactions of individual entities in the system. A survey and literature review are carried out to collect data on people behaviour, responses for different policies, and social composition. When the model runs, simulated agents such as children, parents, and grandparents will engage in their daily tasks. They will have states of susceptible, infected, or recovered. Based on the testing rate and lockdown day parameters, it identifies different zones as contaminated, buffer, and sterile based on whether any infected people live in that area. The implementation of the model follows an iterative process for improving the validity of the model by comparing simulation results with real-world observations. The validated model can be used for exploring and analysing possible emerging patterns related to community transmission of COVID-19 in the society based on different lockdown and testing strategies such as closing schools and universities, reducing visits to supermarkets by the community, use of public transportation and using aggressive testing and lockdown strategies. The results show that when there are no policy measures taken, the pandemic spreads quickly in the community. When the schools and universities are closed, there is a delay in the pandemic, but eventually, most of the community will get infected. When there are policy measures taken to restrict visits to public places, closing schools / universities and a high percentage of people using private transport, show a slight improvement in controlling the pandemic. However, when aggressive testing and lockdown policies are implemented and carried out, the authorities will be able to control the pandemic within a reasonable period compared to other policies. Further, the implications of the study could be used as a decision support tool for analysing lockdown and testing strategies for controlling community transmission of COVID-19 pandemic.

Keywords: Complex adaptive systems, Multi-agent, Policymaking, Simulation