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# SIMULATING THE ACTIVE CASES AND HOSPITALIZATION CASES OF COVID-19.

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## ABSTRACT

Simulating and predicting the active COVID-19 cases and hospitalization cases in advance can be helpful to minimize the catastrophe of this persistent outbreak. This study proposed a novel Agent-based modelling (ABM) framework based on various temporal and non-pharmaceuticals parameters to predict active cases and hospitalization cases. We evaluated the model's performance based on COVID-19 data of Windsor-Essex county region of Ontario, Canada, and achieved satisfactory results in predicting active cases and hospitalization cases. Experimental results have demonstrated that the simulations provide helpful information that could help take advanced steps to cover up for the shortage in hospital resources and take necessary steps to reduce the number of infections.

## 1 INTRODUCTION

The ongoing COVID-19 pandemic is caused by a new strain of coronavirus: Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). In this work, we have proposed an extended SEIR-based model. As a result of diverse social dynamics, it is tough to simulate the disease propagation more precisely using a simple model. To the best of our knowledge, this is the first work simulating the active COVID-19 cases of the Windsor-Essex County region of Canada. Due to its geographical location as a border city, the area has a tremendous economic impact on the United States, Canada, and North America as a continent. Also, we have incorporated the duration-based variable parameters during various stages of the simulation period, which also enhances the novelty of our work.

## 2 PROPOSED MODEL

All the training to obtain necessary parameters is performed using the built-in calibration techniques of the AnyLogic 8.7.3 University Researcher simulation platform and adjusted based on that. We have considered day(s) as the unit of our model simulation. The model primarily consists of agents and their associated parameters. Both components work together to generate an artificial simulation environment to produce an outcome similar to real-life scenarios. Agents can have different epidemiological states depending on different COVID-19 related situations, as depicted in Figure 1. The simulation model uses various parameters to simulate the transition between different states of the model. Our agent-based model is an age-stratified simulation model, as representing each agent with a particular age value helps decide the transition among various epidemiological states of an agent (Ng et al. 2020; Shuvo et al. 2020; PHAC 2020). Besides, we have used various temporal parameters related to COVID-19 disease data to make the simulation as realistic as possible, for example, Latent Period, Hospitalization Period etc., as shown in Figure 1. We have used probabilistic distribution values for these parameters from different existing literature (Li et al. 2020, Ng. et al. 2020). Instead of using a fixed contact ratio to simulate the direct or indirect physical contact, we have introduced a novel approach of using three different contact rates to represent the first wave and second wave of the outbreak more precisely. And later, it will be simply easier only to tweak between these parameters to represent and simulate even any future outbreak without changing a lot of other parameters as need, unlike different traditional approaches.

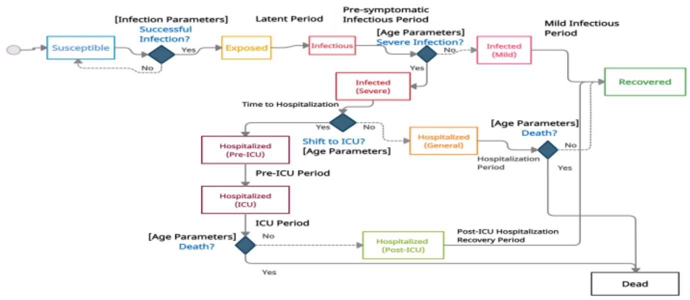


Figure 1: State diagram of various epidemiological stages of the agent.

## 3 EXPERIMENTAL RESULT AND CONCLUSION

Each incremental step in the simulation has been counted as a natural-day unit for the total number of agents, 391,000 (Statistics Canada 2017). Our model's performance in simulating and predicting active COVID-19 patients and comparing actual data has been depicted in Figure 2, where the orange lines and blue lines represented the ground truth values and predicted values, respectively.

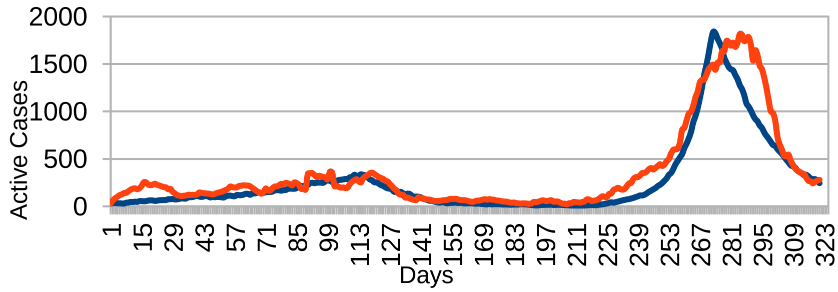


Figure 2: Active cases prediction (Historical Data vs. Simulation Data).

The aforementioned proposed framework and experimental study can significantly reduce the knowledge gap in the existing literature of agent-based simulation modelling that validates the second wave of the COVID-19 outbreak. We emphasized predicting active cases rather than only predicting newly infected patients, as the active cases' projection can play vital roles in making decisions related to various pharmaceutical interventions.

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