
A discrete-event, simulated social agent-based network transmission model for communicable diseases

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Evidence Review

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Summary

Imagine a computer system that can model the outbreak of any disease in great detail. Gold Coast Hospital and Health Service (GCHHS) has created such a software platform, called the Discrete-

Event, Simulated Social Agent-based Network Transmission (DESSABNeT), that can model the spread of any communicable disease, in any city or region. DESSABNeT was used to accurately model the 2020 COVID-19 outbreaks in Sydney, Melbourne and the Gold Coast and are now using this platform to model vaccination strategies and the impact of social restrictions along with vaccination.

Key dates

Apr 2020

Implementation sites

Gold Coast Health, Central Queensland Health

Partnerships

Gold Coast Health, Central Queensland Hospital and Health Service, Bond University Faculty of Health Sciences & Medicine, the Melbourne School of Population and Global Health, University of Melbourne and the National Centre for Immunisation Research and S

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Aim

Our aim was to develop a new agent-based model (ABM) called DESSABNeT and demonstrate its ability to model the spread of COVID-19 in large cities like Sydney, Melbourne and Gold Coast. Our further aim was to validate the model with its disease dynamics and underlying social network and then apply it to inform public health outcomes.

Benefits

The model has been validated, rigorously peer reviewed and published. The model has received interest in Queensland as well as nationally, such as the National Centre for Immunisation Research and Surveillance (NCIRS). It has been used to inform the potential impact on hospital and intensive care unit (ICU) admissions and predict resource utilisation for Gold Coast Health and Central Queensland Hospital and Health Service during a potential COVID-19 outbreak. It is currently being used to explore different COVID-19 vaccination strategies and their interaction with social restrictions.

Background

With the outbreak of COVID-19 and its potential impact on society, a great opportunity existed for the development of systems that can model such an impact.

Solutions Implemented

An agent-based model applying demographic data which is very detailed and flexible was implemented. DESSABNeT can model different combinations of social restrictions, can model contact tracing, can assist to predict and plan for the impact on hospital and ICU admissions and deaths, and also the rollout of COVID-19 vaccines and optimal social restrictions during vaccination. DESSABNeT can fluidly implement different combinations of social restrictions and then remove restrictions again within the same simulation run. We are not aware of other platforms with this degree of flexibility.

Evaluation and Results

The mean predicted daily incidence of COVID-19 cases was compared to real case incidence data for COVID-19 outbreaks in Sydney, Melbourne, and Gold Coast. The effective reproduction number and health service utilisation outputs were compared to the literature, or for the Gold Coast, with daily incidence of hospitalisation data. This work was published in the peer-reviewed scientific literature.

Lessons Learnt

The COVID-19 pandemic and its spread through different communities is very complex but is substantially reliant on social networks. Many detailed aspects of an outbreak can be modelled, including the implementation and lifting of different social restrictions and the impact of vaccination. We are also very interested to model disease spread in rural communities which, while geographically spread out, are still connected by social and occupational networks.

References

"All our references are listed in our recently published paper:

Stapelberg, N. J., Smoll, N. R., Randall, M., Palipana, D., Bui, B., Macartney, K., ... & Wattiaux, A. (2021). A Discrete-Event, Simulated Social Agent-Based Network Transmission (DESSABNeT) model for communicable diseases: Method and validation using SARS-CoV-2 data in three large Australian cities. *Plos one*, 16(5), e0251737.

DESSABNeT is freely available at:

<https://github.com/NicolasStapelberg/DESSABNeT>"