Ogden NH, Fazil A, Arino J, Berthiaume P, Fisman DN, Greer AL, Ludwig A, Ng V, Tuite AR, Turgeon P, Waddell LA, Wu J.

Modelling scenarios of the epidemic of COVID-19 in Canada

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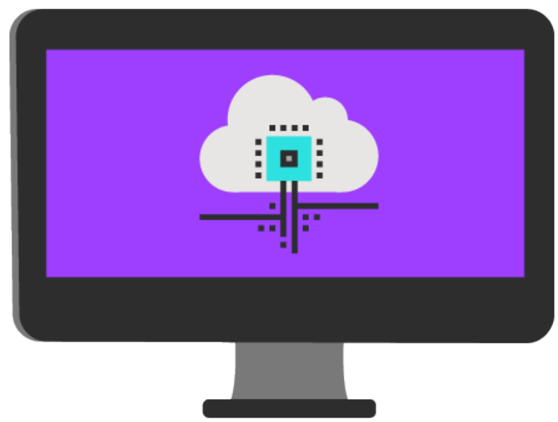
The article describes predictive modelling of COVID-19 in general, and efforts within the Public Health Agency of Canada to model the effects of non-pharmaceutical interventions (NPIs) on transmission of SARS-CoV-2 in the Canadian population to support public health decisions. The article describes and uses a deterministic model, developed in Analytica software[1] as the basis to provide a synopsis of results related to various NPIs. Finally, hospitalization and death rates are assessed using different scenarios for the total number of people infected with COVID-19 in Canada..



To set the context, prior to the COVID-19 outbreak, the Public Health Agency of Canada had developed experience in the modelling of infectious diseases. Upon knowledge of the newvirus, PHAC assembled a team of infectious disease modellers and epidemiologists who adapted previous models, and developed new ones, to assess the transmission of SARS-COV-2 and the impact of different NPIs. In addition, Public Health Agency of Canada brought together an Expert Modelling Group, comprising more than 50 federal, provincial, territorial and university-based modellers and epidemiologists, to develop a Canadian COVID-19 modelling network to support public health decisions. Modelling was used to explore the main public health measures available to control the COVID-19 epidemic in Canada:

- Physical distancing – measures such as closing schools, universities, meetings and meeting places, and teleworking, all of which aim to reduce the possibility that an infectious person will transmit the virus to another person;
- Case detection and isolation – identification of cases by surveillance and making sure they are isolated (at home or in hospital depending on how sick they are) so they cannot transmit the infection to someone else;
- Contact tracing and quarantine – identification of people who have had contact with a COVID-19 case, ensuring they undergo testing and making sure they remain in isolation for 14 days (or longer if they themselves start to show symptoms) so that they cannot transmit infection. This breaks the chains of transmission in the community.

Modelling results have helped identify which combinations of public health measures, applied with what intensity, are most likely to reinforce epidemic control. Key findings to date include:

- Without any effort to control the virus via public health measures, more than 70% of the Canadian population may acquire the disease.
- Public health measures are key to controlling the epidemic in Canada:
    - If public health measures are applied with an insufficient intensity to cause the epidemic to die out, the proportion of Canadians affected may be reduced to approximately 50%, and the epidemic will be longer with a lower peak.
- If public health measures are lifted too early, the epidemic may rebound, resulting in high percentages (more than 70%) of the population affected.
- If NPIs are applied with an intensity high enough, the attack rate can be reduced to between 1% and 25% of the population. That is, less of the population is affected.
- A gradual, phased approach to lifting public health measures will be important. Relaxing controls too quickly without appropriate safeguards could create risk of future epidemic waves.
    - Lifting disruptive public health measures, such as shut-downs, must be accompanied by enhancements to other public health measures to prevent new introductions and will have to be matched by increased efforts to detect cases by surveillance and to trace and quarantine contacts.

Modelling studies are not predictions, but they present plausible outcomes for different levels of non-pharmaceutical interventions, given our current knowledge of the virus and its transmission. They can be used to support planning, particularly when other evidence is limited, such as during emerging infectious disease epidemics. Our knowledge is constantly evolving, and the models and their outcomes will evolve accordingly.