Creating an open-source tool to model opioid overdoses and deaths

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Scan me to read more about this project!

I. Background

Canada has seen an increasing number of opioid-related harms and deaths between January 2016 and June 2023, with an estimated:

- 39,435 opioid-related hospitalizations
- 40,462 apparent opioid toxicity deaths

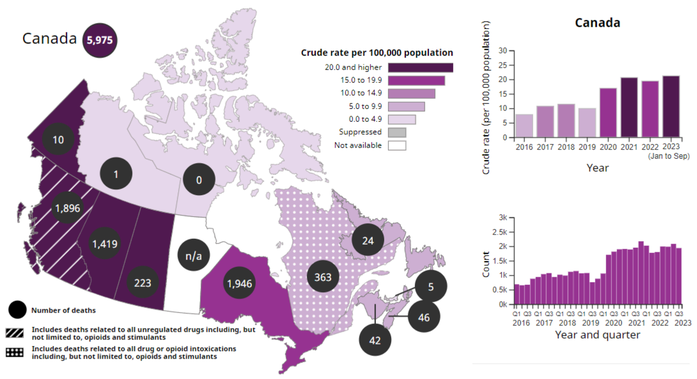


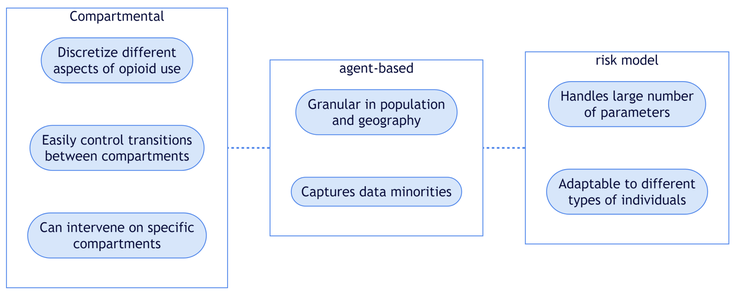
Figure 1: Opioid- and Stimulant-related Harms in Canada[1]

We are developing an open-source modelling tool aimed to provide insight into the opioid epidemic at multiple levels of health administration across Canada. In particular, the model will be directed towards analyzing the impact of policies and intervantions at the public health unit level.

II. Methods

We are developing a compartmental agent-based risk model which will leverage detailed socio-demographic and other data to simulate the frequency and locations of opioid use as well as fatality of overdoses.
With our modelling approach, we aim to achieve the following:

- Simulate counterfactual scenarios via policies and interventions
- Asses impacts of these scenarios on a synthetic population
- Produce outputs at lower-level geographies, e.g., the public health unit
- Support policy makers and reaserchers with an easy-to-use tool
- Adapt an open-science approach (publically available and free to use)



[1]Federal, provincial, and territorial Special Advisory Committee on the Epidemic of Opioid Overdoses. Opioid- and Stimulant-related Harms in Canada. Ottawa: Public Health Agency of Canada; March 2024. https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/

III. The Model

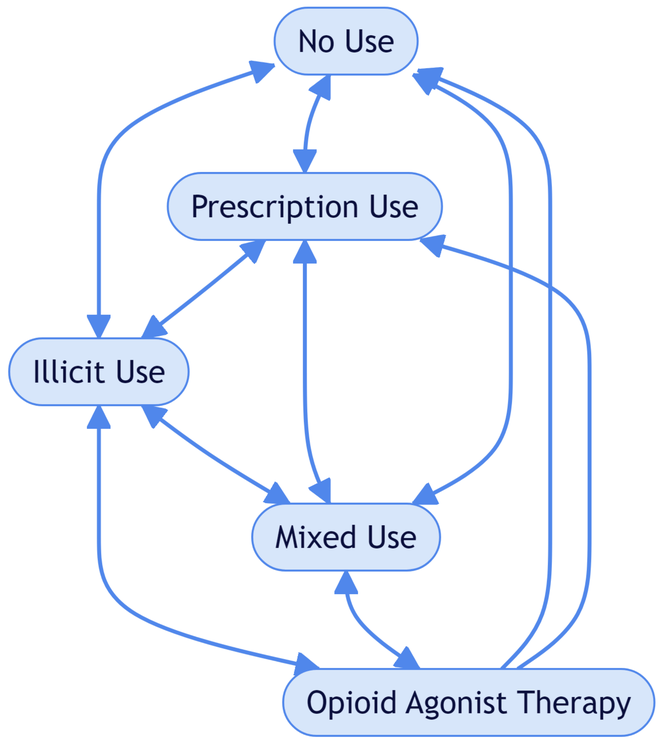
The model simulates opioid use and outcomes over a number of days, weeks or months for a synthetic population representative of a public health unit. The synthetic population is derived from the following:

- Statistics Canada internal data + local population characteristics
- Population profile is represented as a set of probability distributions
- Large number of indidividual characteristics, e.g., socio-demographic, socio-economic, geographic, health conditions

IV. Opioid Use State

These states compartmentalize the ways in which a model individual may use opioids. Directed arrows represent possible transitions between use states, with transition rates dependant on any of the following:

- An individual's personal characteristics
- Location of opioid use
- Events that have occured for the individual or in the world
- Interventions or policies that have been applied to the simulation
- Transition multipliers specific to the health care system of the public health unit



V. Locations

These states include the location in which the agent is currently using opioids:

1. Housing status
2. Hospital
3. Prison
4. Safe site
5. Other

VI. Events

Certain events may have an impact on opioid-related outcomes, on a personal or global level:

1. Supply contamination
2. Injuries
3. Social assitance cheques
4. Overdoses
5. Compartment changes

VII. What-If Decision Making

A key feature of a modeling approach is the ability to simulate counterfactual ('what-if') scenarios. For example:

- What if there are more take-home naloxone kits available in the community?
- Do supervised safe consumption sites reduce the burden of opioid-related harms?

Our model can be adapted to include a number of policies or interventions related to opioid use and outcomes in order to explore different scenarios and their impact on the community. The model includes the following:

i Take-home naloxone kit availability
Determines the number of naloxone kits available to take home at each moment in time.

i Opioid prescription alteration
Affects the rate at which opioid prescriptions are administered

i OAT prescription alteration
Affects the rate at which Opioid Agonist Therapy (OAT) is prescribed.

i Point-of-contact interventions
This intervention represents a broad class of interventions which may occur when an opioid-using actor comes into contact with some form of system. For example, visits to the hospital, emergency room/department, prison, or supervised safe consumption sites.

VIII. Implementation

The implementation of the model will follow an open-science approach to research and dissemination:

- Written completely in the Python
- Accompanied by Dash/Plotly user interface
- Pre-packed datasets tailored for public use
- Publically available on the Statistics Canada Github page

IX. Acknowledgements

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This poster is made in Quarto, using a typst poster template made by Christophe Dervieux of Posit. The methods and opioid use state diagrams are made using the Mermaid Diagramming and charting tool.