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 & Motivation

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

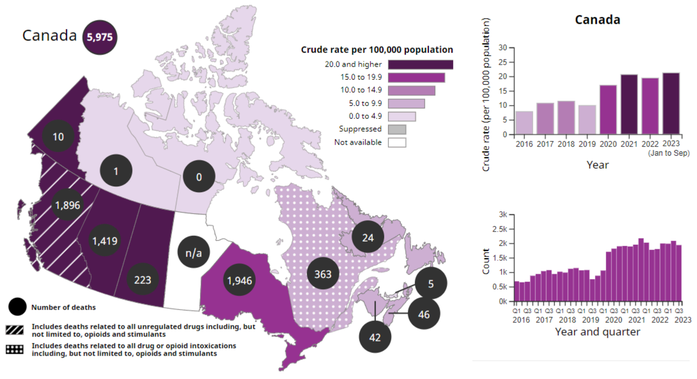


Figure 1: Opioid- and Stimulant-related Harms in Canada[1]

This work is motivated primarily by two facts:

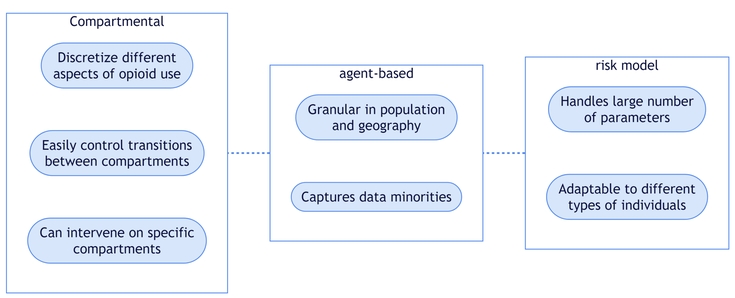
- Previously, Statistics Canada and the Public Health Agency of Canada have been involved in modelling outcomes only at the national or provincial level
- COVID-19 and the opioid crisis have demonstraded a necessity for policy-making and prevention efforts in smaller geogrpahic areas, as well as shedding light on the gap in modeling capacity and knowledge within the Federal Government

We are developing an open-source modelling tool aimed towards analyzing the impact of opioid use policies and interventions at the public health unit level in Canada.

II. Methods

We are developing a compartmental agent-based risk model which will simulate the frequency and outcomes of opioid use in a synthetic population. With this 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

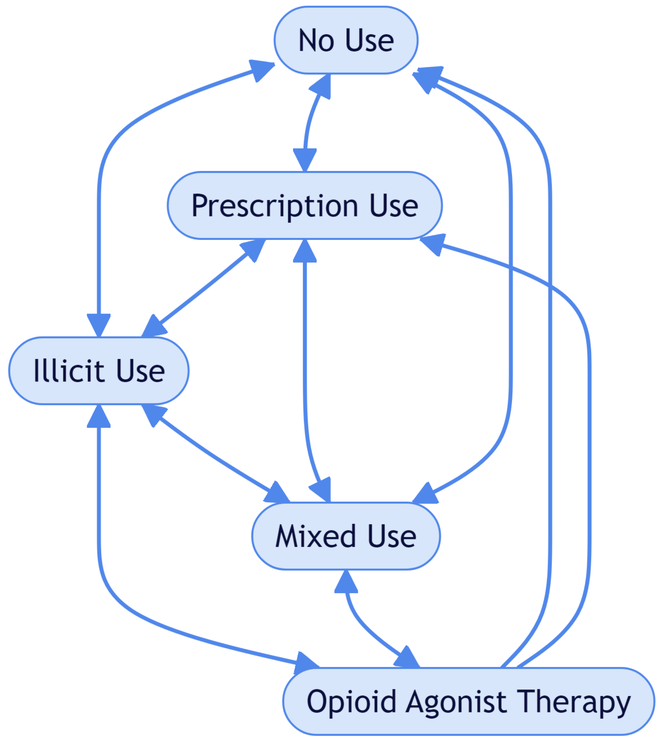
The model simulates opioid use and outcomes over a number of days, weeks or months for a synthetic population representative of a public health unit. The synthetic population is derived from the following:

- 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.