

# A predictive model for overdose

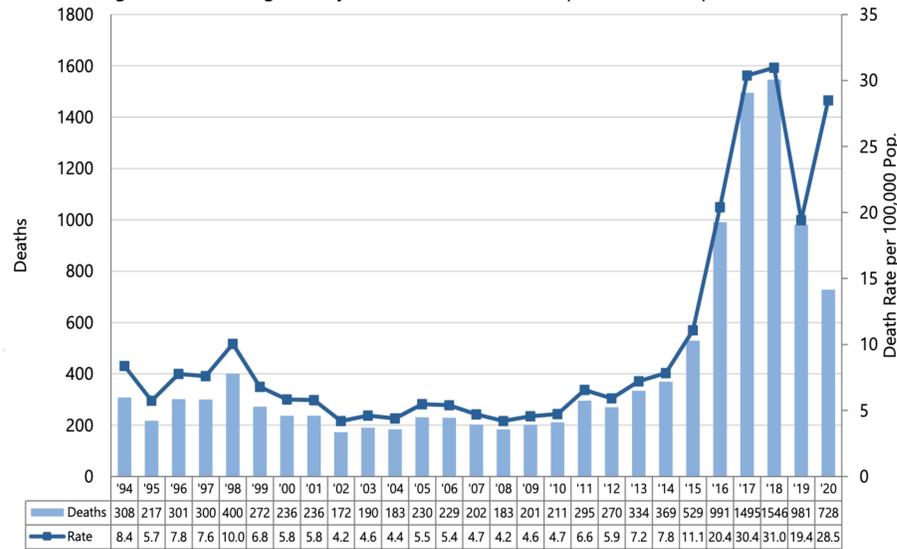


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## BACKGROUND & AIM

- Death toll due to overdose rapidly increased since 2014 resulting in a state of public health emergency in 2016. However, despite all the efforts the number continued to increase from 2017 and 2018.
- One meaningful area for research in the crisis is to identify the risks of fatal and non-fatal overdose at the individuals' level based on the documented health data and registries.
- British Columbia Center for Disease Control (BCCDC) has collected longitudinal overdose data across the province to better understand the factors that may contribute or cause overdose.
- The BC Provincial Overdose Cohort is a population-level cohort of all identified persons who have experienced a drug-related overdose event in British Columbia (BC), Canada, between January 1st, 2015 and December 31st, 2018.
- As a first step, the Addictions and Concurrent Disorders (ACD) group has created a survey tool based on series of expert panels (Delphi technique) who weighted different relevant risk factors for overdose for a high risk assessment (HRA).

Figure 1: Illicit Drug Toxicity Deaths and Death Rate per 100,000 Population [3,5]



Our Aim is by utilizing the BCCDC dataset, to employ the use of machine learning methods to:

- Identify risk factors of fatal and non-fatal overdose.
- Create and validate a model to predict the likelihood of overdose
- Compare and contrast the differences between risk factors from the HRA and the CDC

## Methods

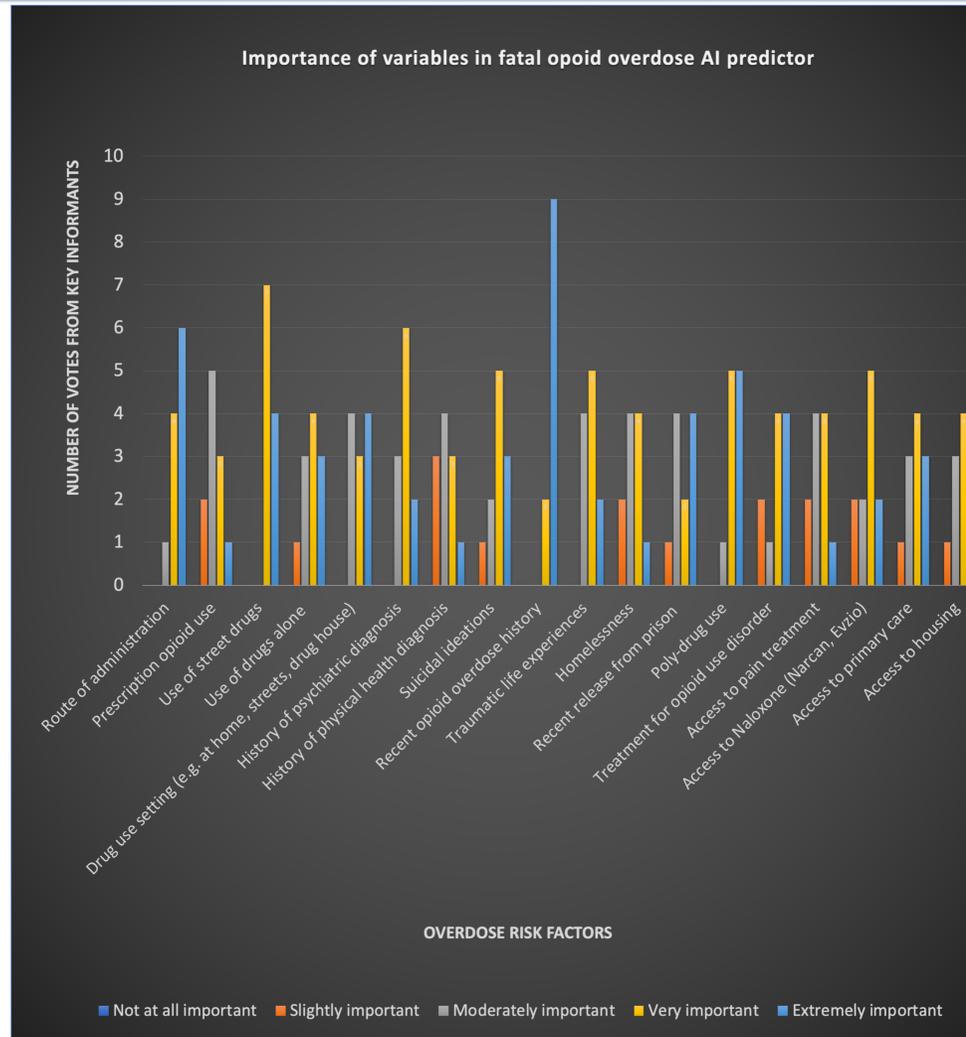


Figure 2. Key informant opinions from a Key Informant Survey of Psychiatrists and Family Physicians

### Feature selection:

#### Comparison of risk factors collected via RAMP Survey and BCCDC dataset

In order to have a more holistic view of the overdose risk factors and to select the most relevant factors contributing to overdose, we have compared the risk factors that were identified as part of a survey tool that was designed to gather information about overdose from SROs with the risk factors collected via BCCDC cohort dataset. Most of the factors were similar however, there were some differences that are summarized below. Factors that appeared on both in addition to important factors that were projected on BCCDC dataset will be used as our input for feature selection and model creation.

#### Projected risk factors from the BCCDC data set

**Overdose data:**  
Narcan, naloxone administered and dose, Indicator of OD, Previous overdose event, Overdose episodes first and last, Total number of overdoses, Participation in opioid agonist treatment, Recent rehabilitation program and participation, Date OD episode, Date of fatal overdose, Total amount of overdoses

**Geographic data:**  
Local health area, Distance to overdose Provision site, Shelter and single room occupancy, Location

#### Factors from Both

Socio-demographic: Age, Gender, Death date, Ethnicity

**Mental Health:** Mental health comorbidities such as depression, Mood and anxiety Disorder, Medical outcome

**Physical Health:** Outcome and prevalence of physical health comorbidities, Pain, Abuse, Multiple sclerosis, Osteoporosis with fracture, Arthritis, Chronic obstructive pulmonary disease, Parkinson's.

**Resilience factors:** Social assistance data, Education, Employment

**Substance use:** Substance used, Drug consumed, Incarceration information, Drug use history (non-injection), Mode of drug use, Fentanyl detection, Benzo use, Alcohol use

**Treatment history:** Treatment category, Discharge disposition, Rehabilitation program

#### Risk factors from the Delphi survey utilized in the High Risk Assessment for RAMP

**Substance use:**  
Injection drug use

**Risk awareness and behavior:** high impulsivity, witnessed OD

## Methods

### 1. Data Access and Familiarization of Provincial Overdose Cohort Data

### 2. Data preprocessing (Preparing the BCCDC Provincial Overdose Cohort Data for modelling)

- Missing value handling and data cleansing (handling missing values, cleaning data and normalizing independent variables)
- Feature Scaling (will ensure all features and independent variables are scaled properly)
- Data Sampling (over-sampling vs. under-sampling to deal with imbalanced data)
- Data Splitting into subset (Splitting data into training, testing and evaluating data sets)
- Feature Selection** (using ML techniques to select risk factors contributing to fatal and non-fatal overdose)

### 3. Model selection (Finding the best fitting ML method and algorithm)

### 4. Hyper parameter tuning (Optimising the performance of the model by tuning parameters such as learning rate, depth, and number of layers)

## Future steps & Conclusions

### 1. Software/Web application

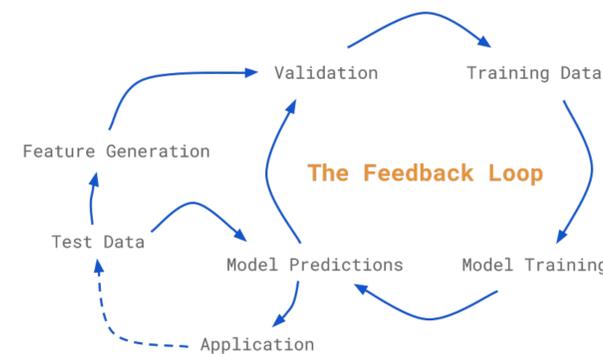
- This algorithm will be embedded within RAMP's web application

### 2. Test in the real environment

- Testing of this algorithm embed within RAMP's web application in real world vulnerable populations (SROs, Hospitals etc.)

### 3. Real world updating (Autofeedback)

- Creation of a real time feedback loop. Real time results of overdose fatalities will update the algorithm



In conclusion

- In this study we would like to examine the ability for the machine learning methods and algorithms to appropriately select factors contributing to overdose and to predict the likelihood of having an overdose
- We hope by completing this project, we can show that utilization of ML methods can help bridge the gap of providing hard to analysis data.

## REFERENCES

- Kerr, T., Fairbairn, N., Tyndall, M., Marsh, D., Li, K., Montaner, J., & Wood, E. (2007). Predictors of non-fatal overdose among a cohort of polysubstance-using injection drug users. *Drug and alcohol dependence*, 87(1), 39-45.
- González, G., Ash, S. Y., Vegas-Sánchez-Ferrero, G., Onieva Onieva, J., Rahaghi, F. N., Ross, J. C., ... & Washko, G. R. (2018). Disease staging and prognosis in smokers using deep learning in chest computed tomography. *American journal of respiratory and critical care medicine*, 197(2), 193-203.
- Krausz, M. (2016). Addiction component walk along working towards a new app. *European Psychiatry*, 33, S66.