The Application of Machine Learning and Predictive Modelling to Understand Risk of Overdose

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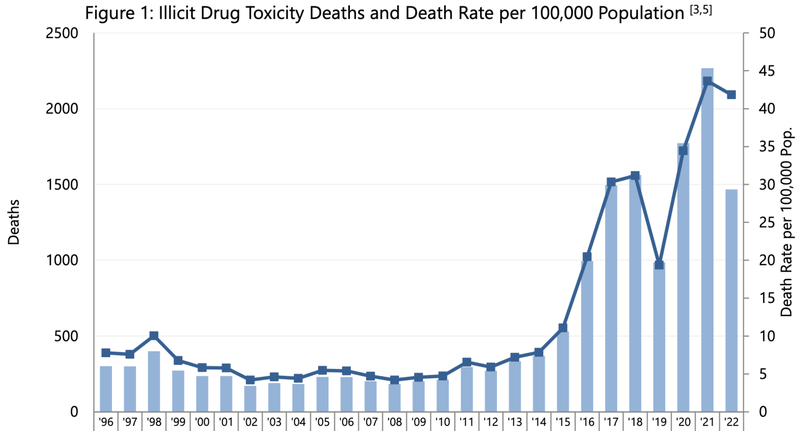
BACKGROUND

- In April 2016, British Columbia declared a public health emergency under the Public Health Act in response to increasing non-fatal and fatal overdose events in the province [1].
- Overdose remains a significant public health challenge. In 2020, 5.5 people died from illicit drug overdoses every day [2].
- Currently in BC the care for patients with addictions is siloed, and wait times to see psychiatrists are often very long , In 2021 this wait time for patients was an average of 19 weeks[3].
- This is also not due to a lack of spending, as for 2022, the net operating costs for addictions and mental health services will be close to $2 billion [4]
- Additionally, the problem is compounded by expert opinions that is focused on harm reduction instead of providing a continuum of care that includes treatment.
- Despite previous research identifying risk factors for overdose, there is limited knowledge on their potential to predict fatal opioid overdose events [5].
- In this poster, we will describe the application of these ML methods to create a cross-sectional (3 years) model to predict fatal overdose using data from the BC Provincial Overdose Cohort.

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



	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
Deaths	301	300	400	272	236	236	172	190	183	230	229	202	183	201	211	295	270	334	369	529	994	1495	1562	986	1773	2267	1468
Rate	7.8	7.6	10.0	6.8	5.8	5.8	4.2	4.6	4.4	5.5	5.4	4.7	4.2	4.6	4.7	6.6	5.9	7.2	7.8	11.1	20.5	30.3	31.2	19.4	34.4	43.6	41.8

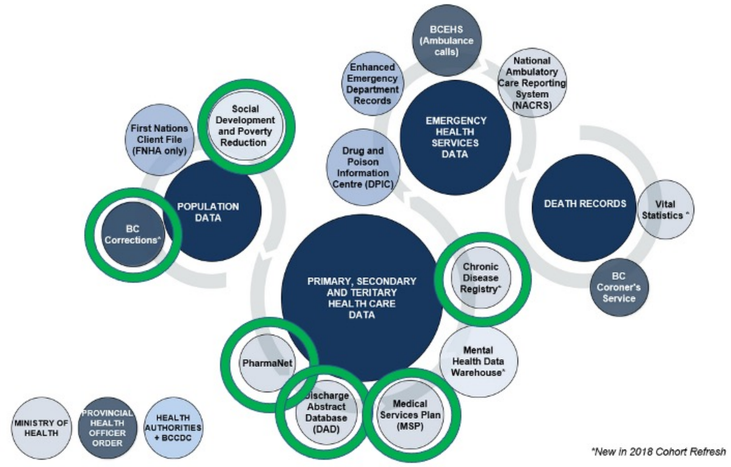
Hypothesis

- We hypothesize that our machine learning model will identify the most critical risk factors such as substance use and other related comorbidities for fatal overdose using existing cohort data on overdose fatalities. In addition, the machine learning model will predict the likelihood of a fatal overdose.

- To test this hypothesis, we will execute the following aims:
- 1) Find and create a suitable dataset for the purpose of describing opioid overdose
- 2) Utilize a feature selection methodology to find top risk factors
- 3) Create different machine learning models to predict or explain the risk of fatal overdose

METHODS

- The data utilized from The BC Provincial Overdose Cohort includes many different databases [6, 7, 8, 9]. We utilized data from the Chronic Disease Registries, Medical Service Plan (MSP), Discharge Abstract Database (DAD), PharmaNet, Social Development and Poverty Reduction (SDPR), and BC Corrections.
- There were upwards of 0-20% missing data. Data was cleaned by having continuous variables replaced by mean, and categorical variable replaced by mode.
- Data was either under sampled or oversampled using Multiple Imputations Chain Equations (MICE).
- Utilizing machine learning: XGBoost algorithm and the Boruta wrapper algorithm paired with the Random Forest algorithm was utilized to create two preliminary models.
- A confusion matrix used to determine how the model performed.



RESULTS & CONCLUSION

Table 1. Sample Size

	Train 70%	Test 30%	Total
Case = 1 People who have non-fatally overdosed	**17824**	**7639**	**25463**
Case = 2 People who have fatally overdosed	**17778**	**7619**	**25397**

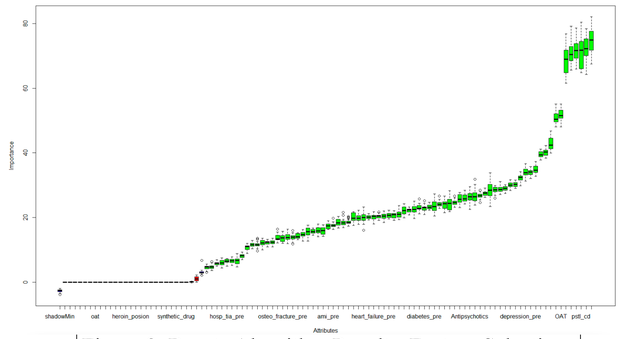


Figure 2. Boruta Algorithm Results, Feature Selection

Table 2. Results

Algorithms	Accuracy	Sensitivity	Specificity	Prevalence (Class Balance)	P- Value
Top 10 variables	52%	65%	38%	0.5	< 0.05
Top 44 variables	75%	68%	83%	0.5	< 0.05
Top 76 variables	76%	70%	83%	0.5	< 0.05

- Top 10 variables from pharamnet did not peform well, and included prescription drug.
- Top 44 variables included variables such as distance to services, SPDR data, derived variables such as IDU, DU, and other relevant comorbitities.
- Top 77 variables only slightly increased the model's performance, with data introduced from the chronic mental warehouse.
- Clinically, my model can assist with the education, prevention, treatment and recovery.
- There is missing ethnicity and gender data. Without data, tools developed to address the opioid crisis are in the dark and cannot address these issues,
- In conclusion, the next steps include finding a better class balanced data set that would introduce less bias within the BC Provincial Overdose Cohort.
- My model will test the difference between the HRA (knowledgebase method) and my model (nonknowledge base method). It will also be able to test specific interventions.

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