Counteracting the Canadian Opioid Crisis

Matthew Hagopian

Nicholas Rosewarne

Adam Spence

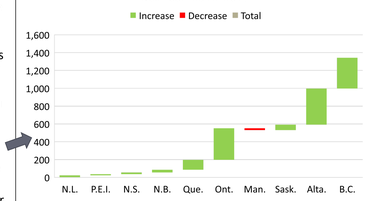
Problem

The opioid situation in Canada has reached a level of crisis to put Health Canada on full alert. There are various aspects to focus on when trying to solve this issue involving; but not limiting to: economic aspects, social demographics, external influences, causation, types of opioids, and geographical location. In order to identify trends and raise new insights on this issue, an analysis of each of these aspects must be carried out. After the deliberation of available and presented data, we chose to focus on the economic and social features of the crisis in order to understand where the issue is most predominant.

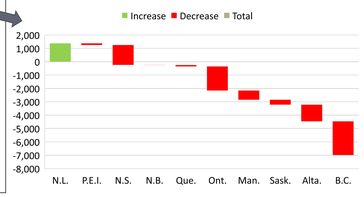
Background

Upon realizing that Canada was on the verge of an opioid-epidemic, one of the first steps to combatting this issue was to reduce the amount of prescriptions dispensed across the country. If you refer to the chart to the right, you will see how every province has been experiencing an increase in annual opioid-related hospitalizations. However, if you compare the findings from the first chart to the amount of prescriptions dispensed per province over the same span of years, you will find that the reduction in prescriptions dispensed across Canada has no relevant or beneficial effect on the reduction of opioid-related hospitalizations in Canada.

Differences in Opioid-Related Hospitalizations Between 2012-2017 [1]

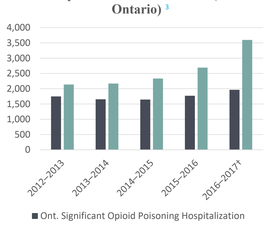


Differences in Opioid-Related Prescriptions Between 2012-2017 [4]

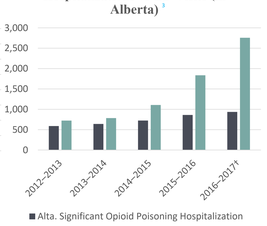


Among the various steps to tackling and solving the opioid crisis in Canada, we compared the number of opioid-related hospitalizations with the number of opioid-related emergency visits in two of the affected provinces: Ontario and Alberta over a five year span. The results showed that the number of opioid-related hospitalizations were remaining constant; however, there is a rising spike in emergency departments visits. This allows us to make the assumptions that Canada has the resources to ensure that low level opioid overdoses are being treated without the need of hospitalization, and that the public is becoming more aware of how to identify the signs of an overdose and further request assistance (i.e. admit a patient to the emergency department).

Hospitalizations vs ED Visits (in Ontario) [3]

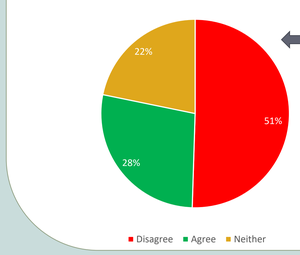


Hospitalizations vs ED Visits (in Alberta) [3]



In addition to the two assumptions that we made prevalent in the two charts above, we also found how aware the general public is regarding the awareness of opioid-related overdosing signs. It was found that 28% of Canada is aware of how to identify if someone is having an opioid-related overdose. However, with a quarter of the population knowing how to identify an opioid-related overdose, approximately half of the country has no recollection or knowledge on how to identify one.

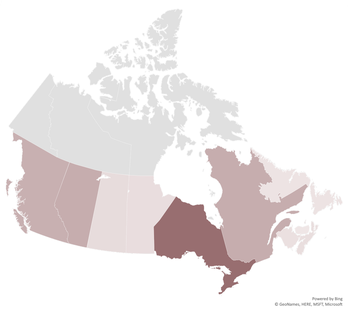
Average Percentage of Canadians Who Recognize the Signs of an Opioid Overdose in 2017 [7]



After making the assumption from the above bar charts regarding the raise in awareness leading to the increase in Emergency Department visits and the relative consistency in Hospitalization rates, it was found that more than half of the population remains unaware of how to recognize an opioid-related overdose. Therefore, there is a significant need to identify which demographic of the population to target in order to raise this form of awareness.

Economic Impact

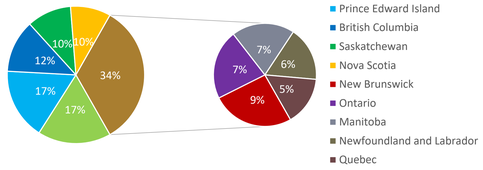
Total Cumulative Hospitalization Cost per Province 2012-2016 [1,3]



Total cost was determined as the product of the average cost per hospitalization and the total number of hospitalizations per year. The average cost used in this calculation refers to the average cost of a hospitalization in Canada due to all cause drug toxicity. Due to the various strengths of the different opioid sources we determined this method of cost estimation a good fit as it would encompass high and low severity opioid overdose cases. While exploring the total cumulative cost per province it was discovered that Ontario, Alberta, and British Columbia spent the most money over time.

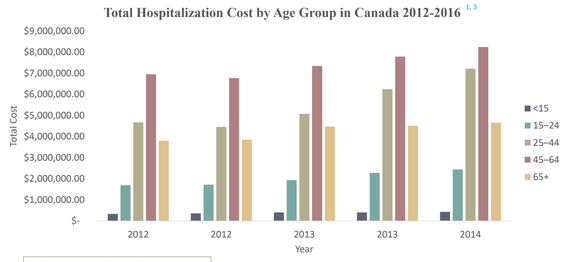
From the data, we created a plot of the cost per person for hospitalization due to opioids for each province for the year of 2016. It was discovered that Alberta and Prince Edward Island cost more for each person than any other province. It was also found that Ontario, Manitoba, New Brunswick, Newfoundland and Labrador, and Quebec had the lowest cost per person in the country.

Distribution of Provincial Per Capita Cost Due to Opioid Hospitalizations in 2016 [1,3]



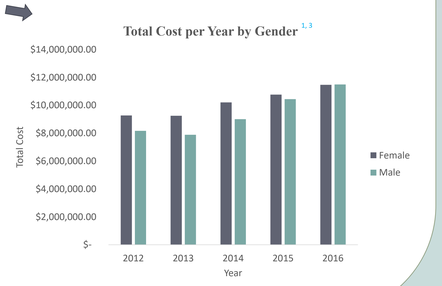
When comparing the age group and total cost of care of all hospitalization visits due to opioid toxicity the demographic which contributes the most across the entire time period is those between the ages of 45-64.

Total Hospitalization Cost by Age Group in Canada 2012-2016 [1,3]



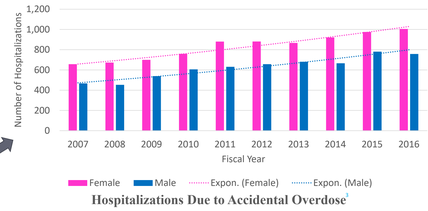
Highlighting the different total cost contributions between the genders we see that there was a larger cost due to female hospitalizations from 2012-2014. However, most recently in 2015 and 2016 there was no significant difference between the two genders in cost contributions.

Total Cost per Year by Gender [1,3]



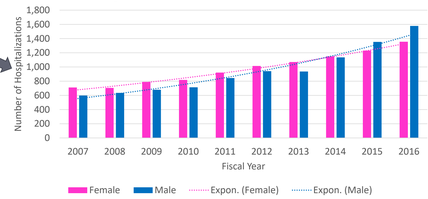
Social Impact

Hospitalizations Due to Intentional Overdose [1]

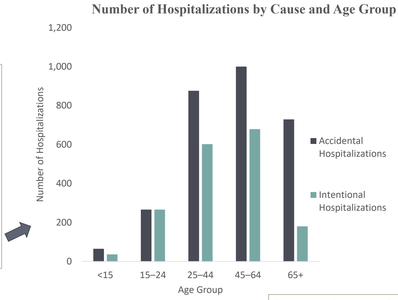


On the impact of gender it was discovered that female hospitalizations due to intentional overdoses was greater than the intentional rate for males consistently over the entire time period. We can also observe that males in recent years have seen a greater rate in change of accidental overdoses thereby surpassing that of the female accidental rate as of 2015.

Hospitalizations Due to Accidental Overdose [1]

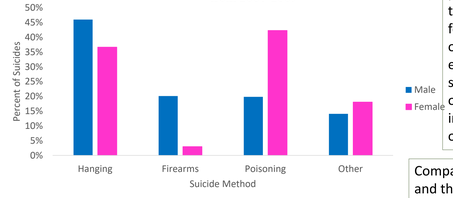


Number of Hospitalizations by Cause and Age Group [1]



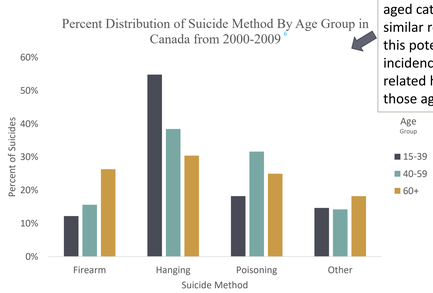
Analyzing the number of hospitalizations based on age groups of Canadians it was found that accidental overdoses were the leading cause of opioid related hospitalizations for all Canadians greater than 25 years of age.

Percent Distribution of Suicide Method by Gender in Canada from 2000-2009 [6]



Data published by Statistics Canada shows the gender specific rates of method of suicide in Canada from 2000-2009. It was found that poisoning was found to be the preferred method for females, as the cause of 42% of female suicides. This could explain the trend seen above showing greater female rates of hospitalization due to intentional overdoses of opioids relative to males.

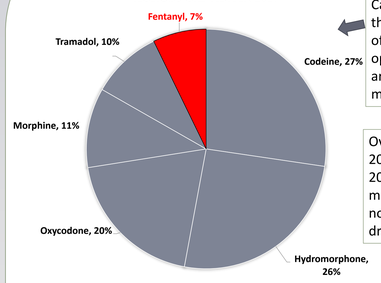
Percent Distribution of Suicide Method By Age Group in Canada from 2000-2009 [6]



Comparing the ages of Canadians and the distribution of suicide methods provided by Statistics Canada it was shown that the preferred method for the middle aged category was poisonings. With similar reasoning to the gender data, this potentially explains the highest incidence of intentional opioid related hospitalizations occurs within those age categories.

Opioid Prescriptions Across Canada

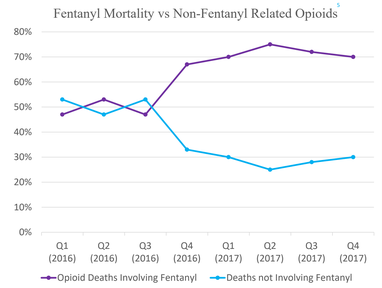
DISTRIBUTION OF TOP 6 OPIOIDS PRESCRIBED ACROSS CANADA IN 2017 [4]



Out of the top 6 opioids prescribed in Canada, it is shown in the diagram to the left that Fentanyl makes up only 7% of the nation's annual prescribed opioids. The other five opioids included are: codeine, hydromorphone, morphine, oxycodone, and tramadol.

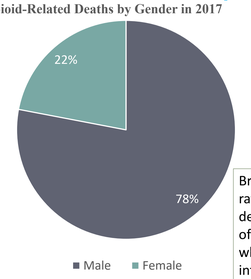
Over the span of two years (2016-2017), Fentanyl has been linked to a 20% increase in opioid-related mortality rate; while the decrease in non-fentanyl related opioids have dropped 20%.

Fentanyl Mortality vs Non-Fentanyl Related Opioids [2]

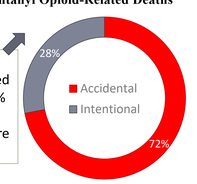


Referencing the pie chart below, it was identified that 78% of all opioid-related deaths were male and the remaining 22% percent were female.

Opioid-Related Deaths by Gender in 2017 [2]

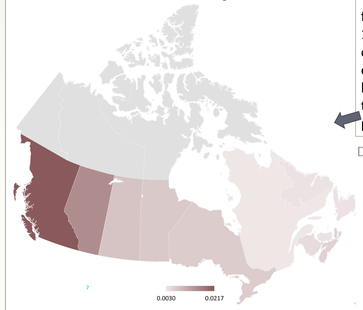


Percentage of Accidental vs Intentional Fentanyl Opioid-Related Deaths [2]



Breaking down the mortality rate of Fentanyl opioid-related deaths, it was found that 72% of deaths were accidental; while the remaining 28% were intentional.

Opioid-Related Deaths as Percent of Provincial Population 2016 [5]

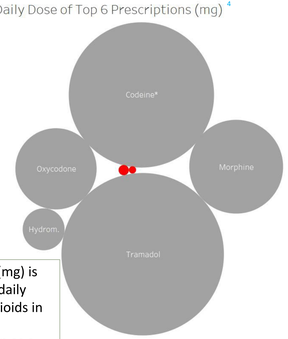


We compared the number of daily doses of fentanyl prescribed in each province per 1,000 population in 2017 with the percent of opioid-related deaths due to fentanyl across each province and found that there was a larger amount of deaths in the provinces that had lower amounts of fentanyl prescriptions.

Fentanyl Prescriptions per 1,000 Population in 2017 [4]

Provinces	
Saskatchewan	715.7
Quebec	610.4
Ontario	520.0
Manitoba	502.2
Prince Edward Is..	428.2
New Brunswick	417.2
Nova Scotia	373.9
Newfoundland a..	334.0
Alberta	320.8
British Columbia	277.3

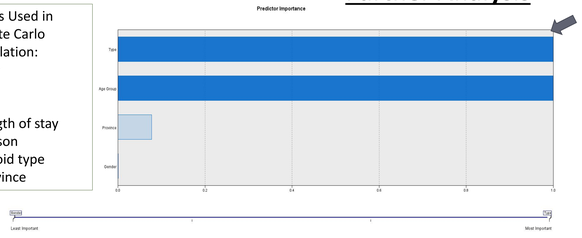
Daily Dose of Top 6 Prescriptions (mg) [4]



The daily dose of Fentanyl (mg) is roughly one percent of the daily dose of the other top six opioids in Canada. This visualization represents the amount given as a prescription in the form of a patch or tablet. This comparison shows how easily it may be to exceed the recommend daily dosage with regards to Fentanyl.

Further Analysis

Fields Used in Monte Carlo Simulation:
-Year
-Age
-Sex
-Length of stay
-Reason
-Opioid type
-Province



Since we have only been analysing summary data to this point we decided to perform a Monte Carlo Simulation with using weighted proportions for each field to generate a dataset for further analysis. From this generated dataset we performed a TwoStep analysis to determine predictor importance with the 'reason' field as a target. This analysis found type of opioid, and age group to be the two greatest predictors for opioid hospitalization reason.

Recommendations for Future Action

- In continued efforts to raise awareness around how to recognise an opioid overdose, it is most significantly important to target those individuals between the ages of 45-64 years old
- While important to reduce all opioid prescriptions across the country primary importance should be given to reduce the number of Fentanyl and other strong opioids being prescribed
- Increasing awareness of the severity of Fentanyl, and providing better access to Fentanyl testing kits to help reduce the number of accidental overdoses

References

[1] anon, (2019). https://www.cihi.ca/en/patient-cost-estimator.

[2] canada.ca. (2019). https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/infographic-federal-action-opioids-september-2018/infographic-federal-action-opioids-september-2018-en.pdf.

[3] Competition Dataset provided by Canadian Institute for Health Information.

[4] cihi.ca. (2019). *Amount of opioids prescribed dropping in Canada; prescriptions on the rise | CIHI*. https://www.cihi.ca/en/amount-of-opioids-prescribed-dropping-in-canada-prescriptions-on-the-rise.

[5] infobase.phac-aspc.gc.ca. (2019). *National Report: Apparent Opioid-related Deaths in Canada - Data Blog - Public Health Infobase | Public Health Agency of Canada*. https://infobase.phac-aspc.gc.ca/datalab/national-surveillance-opioid-mortality.html.

[6] www150.statcan.gc.ca. (2019). *Suicide rates: An overview*. https://www150.statcan.gc.ca/n1/pub/82-624-x/2012001/article/11696-eng.htm.

[7] www.150.statcan.gc.ca. (2019). *Opioid Awareness in* Canada. https://www150.statcan.gc.ca/n1/en/pub/11-627-m/11-627-m2018001-eng.pdf?st=BdPMgYkn