

SDA 490 Capstone Project  
Final Report of Analysis

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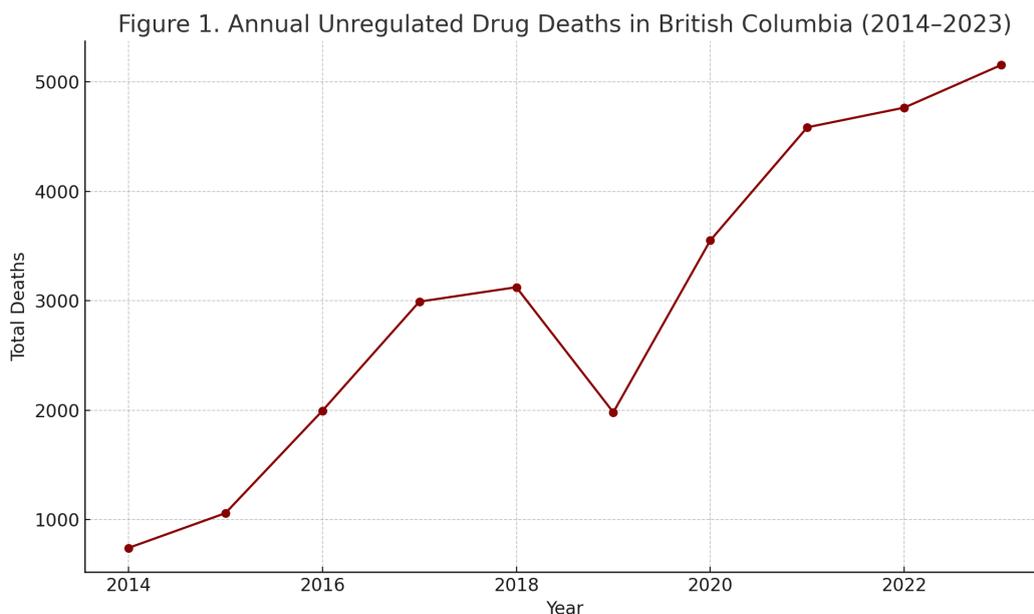
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*We acknowledge that this research was conducted on the traditional, ancestral, and unceded territories of the Coast Salish Peoples, including the Musqueam, Squamish, and Tsleil-Waututh Nations. We recognize the ongoing impacts of colonization and the disproportionate effects of the housing and overdose crises on Indigenous communities in British Columbia. This work is grounded in a commitment to equity, accountability, and the amplification of voices historically excluded from policy and research.*

# 1. Introduction

British Columbia is simultaneously facing two major public health crises: a severe housing shortage and a toxic drug epidemic. In 2023, over 2,500 people in BC died from unregulated drug toxicity, marking the third consecutive year with fatalities exceeding 2,000 [1]. Since the province declared a public health emergency in 2016, more than 16,000 individuals have lost their lives to overdose [2].

Figure 1 below shows the trajectory of overdose deaths in the province between 2014 and 2023. The most dramatic rise begins after 2016, with fatalities climbing sharply year-over-year.



*Figure 1. Annual Unregulated Drug Deaths in British Columbia (2014–2023)*

*This figure uses official BC Coroners Service data to show the rise in toxic drug deaths over a decade. After the 2016 public health emergency was declared, deaths increased sharply, peaking at over 2,500 per year by 2023.*

At the same time, the province is seeing unprecedented strain on its supply of socialized housing — government- or non-profit-subsidized housing reserved for low-income or high-need populations. In 2023, 18,865 households were on BC Housing’s waitlist in Metro Vancouver alone, a 27% increase from the year before [3].

This capstone project explores whether these two crises may be structurally related. Specifically, we ask:

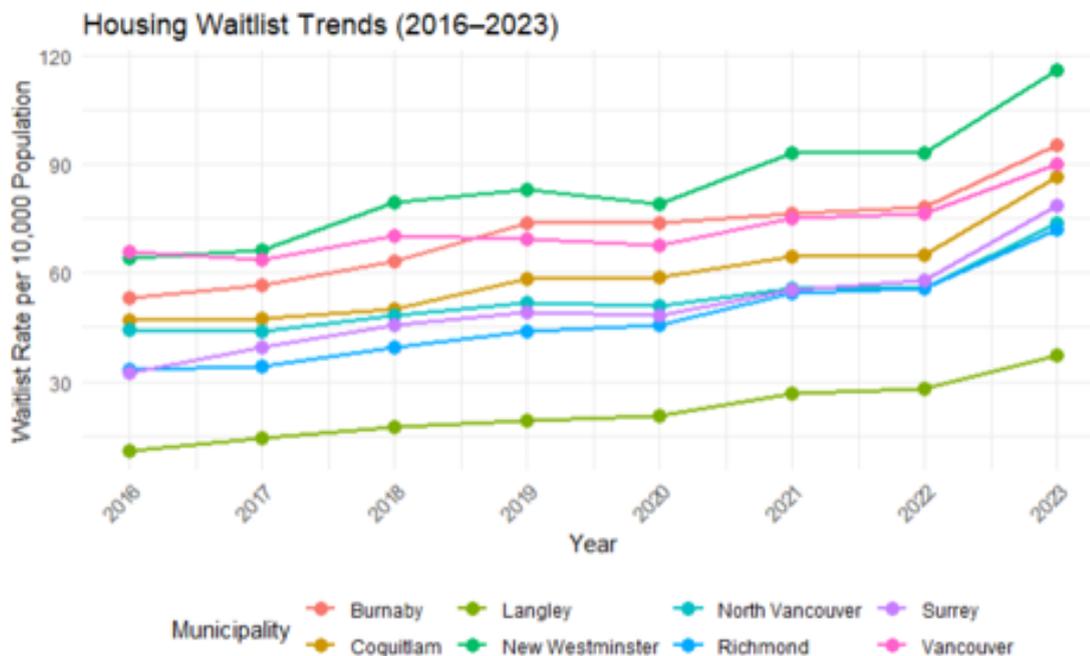
*Is there a relationship between delays in access to socialized housing and unregulated drug overdose rates across BC municipalities?*

We analyze municipal-level data on BC Housing waitlists and unregulated drug deaths between 2016 and 2023, using both mapping and regression methods. Our goal is not to prove a direct causal link, but to investigate whether structural conditions — like delayed access to housing — may be associated with health risk over time.

## 2. Background & Policy Context

### 2.1 Housing Precarity and Socialized Housing in BC

Access to affordable, stable housing is widely recognized as a social determinant of health. Yet in British Columbia, demand for socialized housing has consistently outpaced supply. Figure 2 below compares social housing waitlists and overdose deaths per 10,000 residents in four municipalities: Langley, Surrey, Burnaby, and Vancouver. While the trends are not universally aligned, some municipalities — particularly Langley — show waitlist growth that appears to precede an increase in overdose death rates. These patterns suggest that housing system pressure may have a delayed influence on community health outcomes. [3].



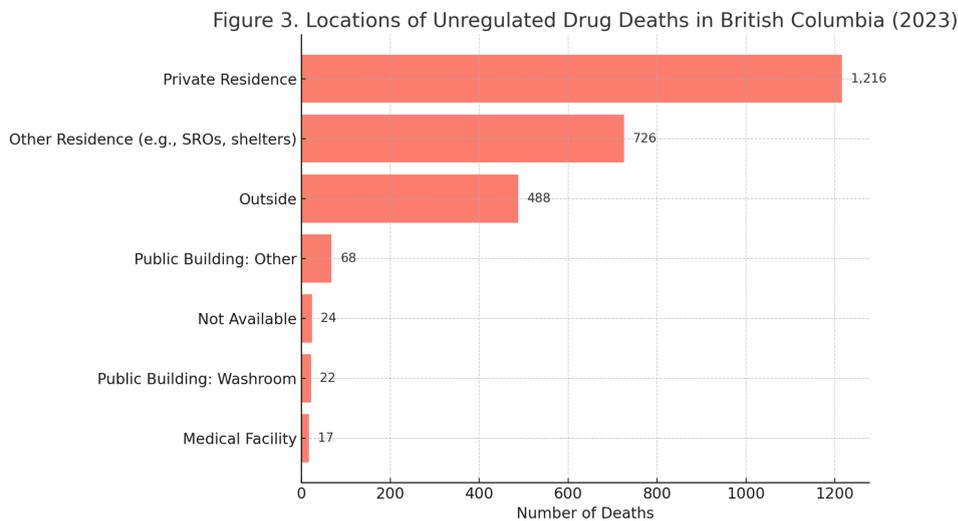
*Figure 2. Housing Waitlists and Overdose Deaths per 10,000 Residents (2016–2023)*  
This figure compares social housing waitlists (solid lines) and overdose deaths (dashed lines) per 10,000 residents in four municipalities: Langley, Surrey, Burnaby, and Vancouver. In some cases, increases in waitlist burden appear to precede rising overdose rates, suggesting a possible delayed relationship between housing instability and overdose risk.

Despite continued provincial investment in supportive housing and temporary shelter beds, homelessness in Metro Vancouver has increased by 33% since 2020 and by 122% since 2005 [3]. This points to a persistent structural gap: the demand for long-term, affordable housing far exceeds the rate at which new units are being created.

## 2.2 BC's Overdose Crisis

Since the public health emergency was declared in 2016, the toxic drug crisis has steadily worsened. In 2023, 2,574 overdose deaths were recorded in BC, with Vancouver alone accounting for 22% of those cases [4]. Synthetic opioids — primarily fentanyl — remain the leading cause.

But the crisis has not affected all communities equally. In 2023, First Nations individuals in BC died at 6.1 times the rate of non-Indigenous residents. Among women, the disparity is even greater: First Nations women died at 11.7 times the rate of other female residents [5]. The vast majority of these deaths happen indoors — not on the street. Figure 3 illustrates that in 2023, 1,216 overdose deaths occurred in private residences and 726 in other residential settings such as SROs, shelters, and supportive housing — totaling 1,942 deaths, or roughly 75% of all deaths that year. This suggests that most overdose deaths happen indoors, including in housed or semi-housed conditions, and not primarily in public or outdoor spaces.



*Figure 3. Locations of Unregulated Drug Deaths in British Columbia (2023)*  
A majority of overdose deaths occurred in private residences (1,216) and other residential settings like SROs or shelters (726). Only 488 deaths occurred outdoors. These data illustrate that housing alone is not necessarily protective — and highlight the importance of examining the type and quality of housing environments, not just whether someone is housed.

## 2.3 Why We Chose to Study Their Intersection

The data in Figures 1 through 3 led us to ask a deeper structural question:

*If access to housing is a health determinant — and lack of access contributes to overdose vulnerability — then what does it mean when the housing system itself is backlogged?*

We hypothesized that regions with longer housing waitlists may also see higher overdose death rates, either in the same year or with a delayed effect. While many studies have shown that housing instability increases overdose risk at the individual level, we wanted to explore whether this also holds at the municipal scale, using BC's own public housing and overdose data.

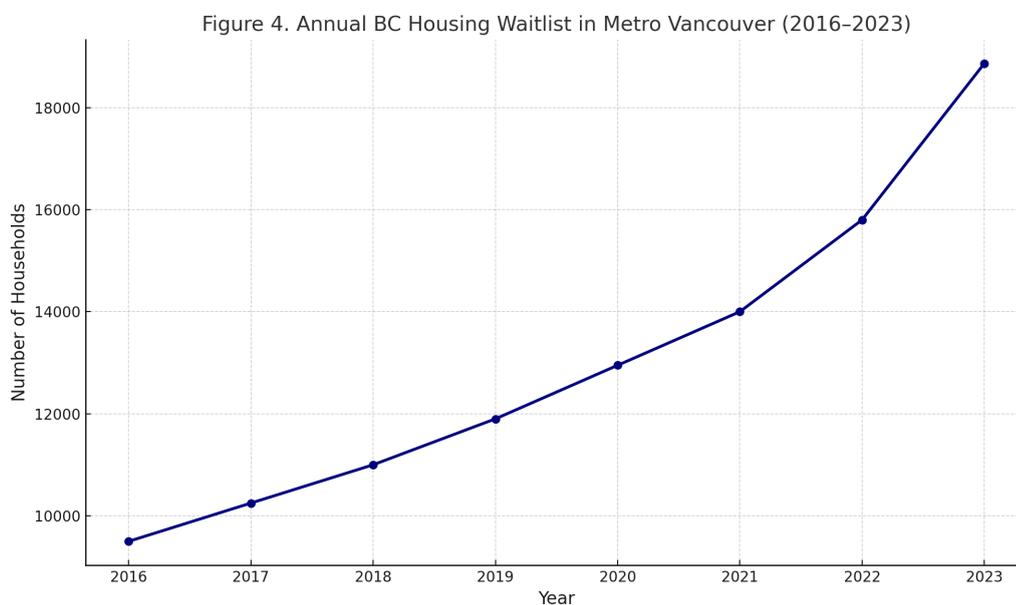
### 3. Data and Variables

Our analysis focuses on the relationship between housing waitlists and overdose deaths across eight municipalities in British Columbia between 2016 and 2023. We combined data from multiple public sources, cleaning and harmonizing it to build a panel dataset suitable for spatial and temporal analysis.

#### 3.1 Housing Waitlist Data

We used BC Housing Registry waitlist counts as a proxy for unmet demand for socialized housing. These data are published annually by BC Housing and Metro Vancouver and include total households waiting for social housing units (including seniors, families, and people with disabilities).

Figure 4 below presents the annual waitlist counts in Metro Vancouver between 2016 and 2023. The sharp increase between 2022 and 2023 reflects the highest year-over-year growth in the past decade — a trend echoed across several municipalities.



*Figure 4. Annual BC Housing Waitlist in Metro Vancouver (2016–2023)*  
The number of households on Metro Vancouver’s social housing waitlist rose from just under 10,000 in 2016 to over 18,000 by 2023. The most dramatic increase occurred between 2022 and 2023, reflecting a 27% year-over-year surge — the steepest in the past decade.<sup>4</sup>

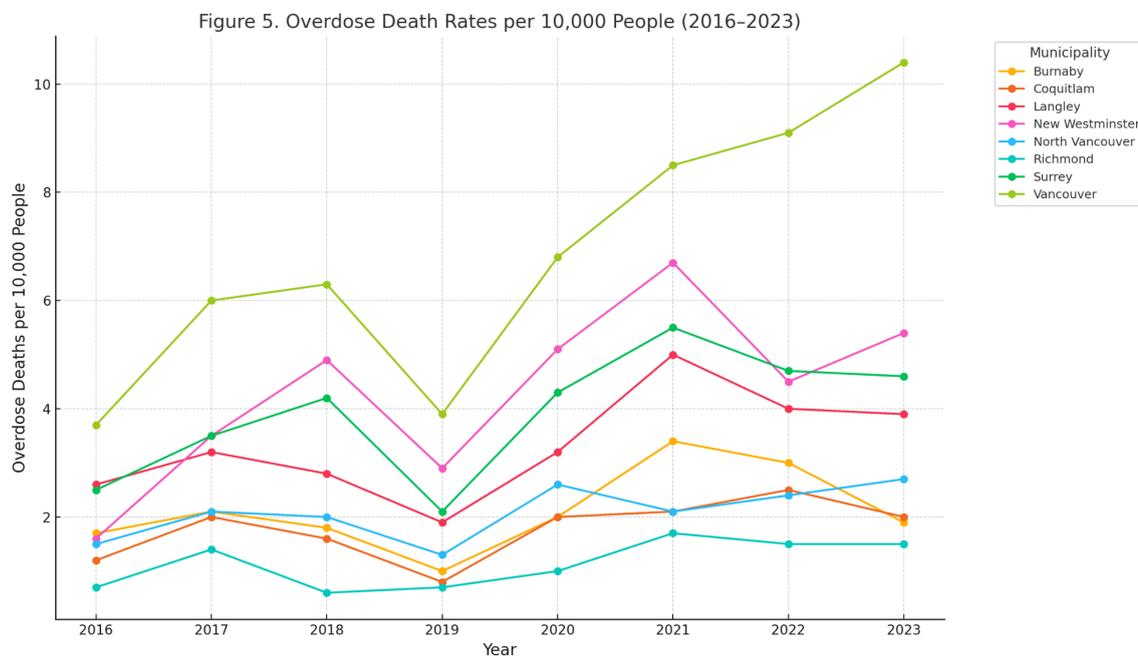
We acknowledge that waitlists are not a perfect measure. Not everyone in housing need appears on the registry, and access may vary by awareness, eligibility, or local outreach capacity. However, in the absence of more granular Core Housing Need data by municipality, the registry offers a reasonable and consistently available proxy.

### 3.2 Overdose Death Data

We used data from the BC Coroners Service, which tracks unregulated drug deaths by Health Authority and sub-regional geography. For our project, we extracted municipal-level totals for each year between 2016 and 2023.

To control for population size, we calculated overdose death rates per 10,000 residents using 2016 population estimates from Statistics Canada.

Figure 5 below shows overdose death rates across our study municipalities over time. While Vancouver remains the region with the highest raw death counts, we found rising per-capita rates in mid-sized cities like Surrey, New Westminster, and Langley.



*Figure 5. Overdose Death Rates per 10,000 People (2016–2023)*

*This chart compares overdose mortality rates across eight BC municipalities. While Vancouver maintains the highest rate overall, several other municipalities — including Surrey, New Westminster, and Langley — show consistent or rising rates. The differences reflect both population size and localized drug toxicity conditions, reinforcing the need for regionally responsive strategies.*

We used only total deaths (not age- or sex-specific data), as sub-demographic information was inconsistently reported by municipality.

### 3.3 Population Data

To standardize across municipalities, we used 2016 population counts from the Metro Vancouver Regional District and Statistics Canada. These served as the denominator for calculating both:

- Deaths per 10,000 residents
- Waitlist size per 10,000 residents

While we considered updating population estimates annually, many of our municipalities had flat or minimal growth, and interpolating mid-decade census values introduced noise without meaningfully changing rankings.

### 3.4 Variable Summary

Variable	Source	Years	Notes
Overdose deaths	BC Coroners Service	2016–2023	Unregulated deaths only
Housing waitlist	BC Housing Registry / Metro Vancouver	2016–2023	Total active household applications
Population (2016)	Statistics Canada / Metro Van	Static	Used for rate calculations

## 4. Methodology

Our primary objective was to explore whether delays in access to socialized housing — as represented by waitlist levels — are structurally associated with overdose mortality. To examine this, we used a combination of descriptive analysis, spatial comparison, and regression modeling applied to municipal-level data from 2016 to 2023.

### 4.1 Analytical Framework

We approached the question from a structural rather than individual perspective. We did not attempt to directly identify substance use among those on the housing waitlist, as that data is not publicly available. Instead, we relied on published evidence showing that:

- In a Toronto housing access study, 24% of applicants had a diagnosed substance use disorder [1]
- Across Canada, 25% of people experiencing homelessness cited substance use as a reason for their housing loss [2]

- In BC, substance use is the second most common cause of housing loss, after low income [3]

These findings support the assumption that a significant portion of those on social housing waitlists face overlapping risk factors for overdose — even if not all do.

## 4.2 Data Structure

We compiled a panel dataset of 8 municipalities from 2016 to 2023. Each row represented a municipality-year pair, with the following variables:

Variable	Description
deaths_per_10k	Unregulated overdose deaths per 10,000 people
waitlist_per_10k	BC Housing waitlist size per 10,000 people
waitlist_lag1	Waitlist (lagged by 1 year) per 10,000 people
waitlist_lag2	Waitlist (lagged by 2 years) per 10,000 people
rent	Average rent (if included in control model)
municipality	Municipality fixed effect
year	Year fixed effect

We calculated all rates using 2016 population estimates from Statistics Canada, applied consistently across years to reduce interpolation noise.

## 4.3 Regression Models

We used multiple linear regression models to test associations between waitlist size and overdose death rates. The base model took the form:

$$\text{deaths}_{10k} = \beta_0 + \beta_1 \cdot \text{wait}_{10k} + \beta_2 \cdot \text{wait}_{10k\_lag1} + \beta_4 \cdot \text{rent} + \sum \gamma_i \cdot \text{municipality}_i + \sum \delta_j \cdot \text{year}_j + \varepsilon$$

We then introduced lagged versions of the waitlist variable:

$$\text{deaths\_per\_10k} \sim \text{waitlist\_lag1} + \text{municipality} + \text{year}$$

$$\text{deaths\_per\_10k} \sim \text{waitlist\_lag2} + \text{municipality} + \text{year}$$

The lagged models allowed us to test whether waitlist size in a previous year could predict overdose mortality in the following year(s)—a core part of our structural hypothesis

## 4.4 Visual Exploratory Analysis

Before modeling, we conducted exploratory visual analysis using line charts and scatter plots to identify patterns:

- Waitlist and overdose death trends over time by municipality
- Scatter Plots comparing overdose death rate to waitlist size (same-year and lagged)

These visuals informed our decision to include time lags, as we observed that in several municipalities, overdose rates appeared to spike after a sharp rise in housing waitlists.

## 5. Step-by-Step Analysis

This section walks through our analysis chronologically: from early trend exploration to statistical modeling. At each step, we describe what we did, what we saw, and what it told us about the possible relationship between social housing waitlists and overdose deaths.

### 5.1 Exploring the Waitlist and Overdose Trends

We began by plotting the BC Housing waitlist and overdose death rates for each municipality between 2016 and 2023.

Figure 6 below shows both trends for Metro Vancouver. The waitlist grew by more than 70% over this period, while overdose deaths rose sharply from 2016 to 2021 before leveling out slightly in 2022 and 2023.

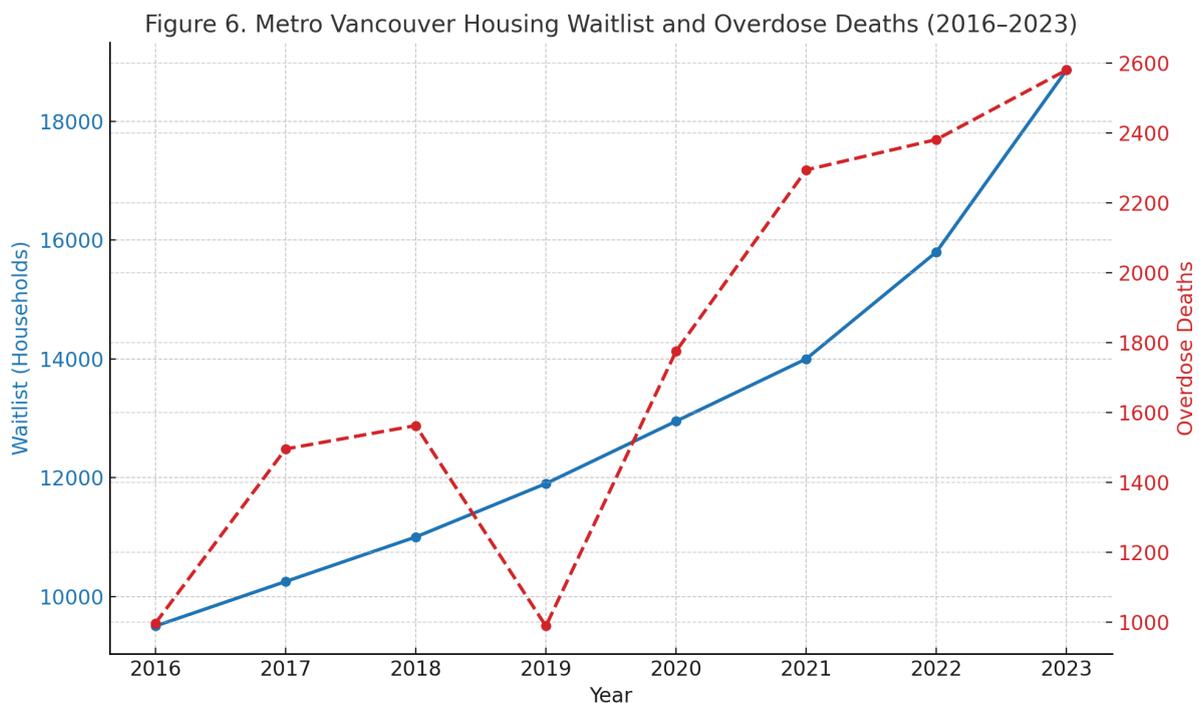


Figure 6. Metro Vancouver Housing Waitlist and Overdose Deaths (2016–2023)

This figure plots the total number of households on the BC Housing waitlist (left axis) alongside overdose deaths (right axis) in Metro Vancouver. Both measures show an upward trend, with a particularly steep increase in overdose deaths between 2020 and 2021 and the sharpest waitlist growth occurring between 2022 and 2023. While not perfectly aligned year-over-year, the visual parallel supports exploration of delayed structural relationships.

At first glance, the curves move in the same general direction, especially during key periods (e.g. 2019–2021). But this relationship did not hold as clearly across all municipalities.

## 5.2 Testing Same-Year Correlations

Next, we constructed scatterplots to see if municipalities with higher waitlists in a given year also had higher overdose death rates that year.

Figure 7 shows a comparison for 2021. The trendline is positive, but the spread is wide — with several outliers pulling the fit apart.

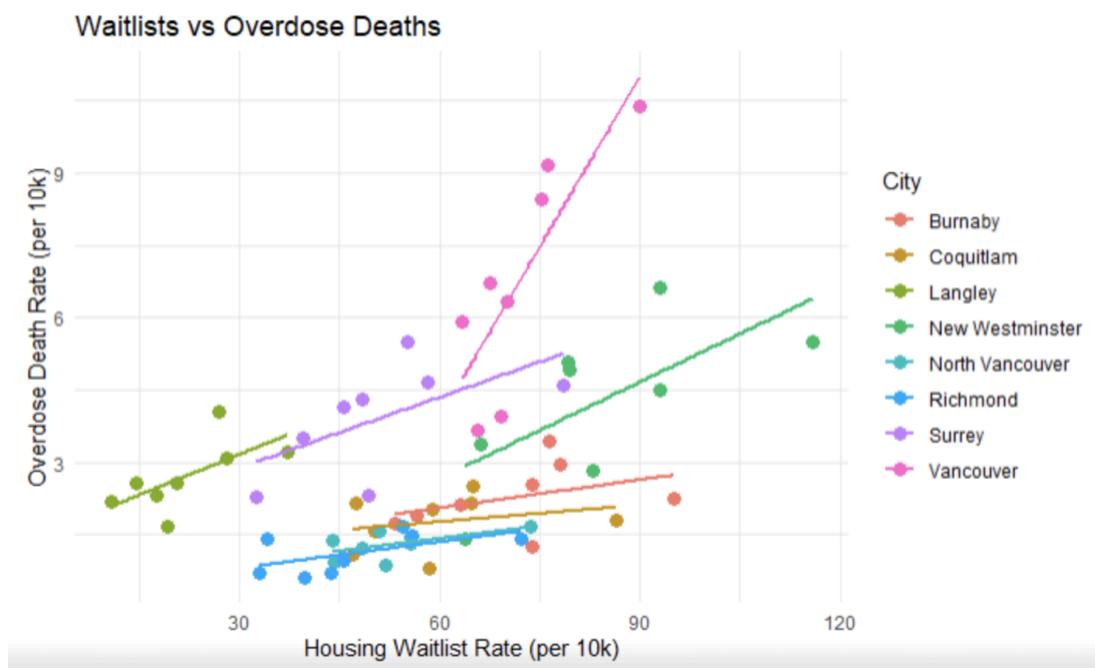


Figure 7 Waitlist Size vs. Overdose Death Rate by Municipality (2021).

This scatterplot shows that municipalities with higher waitlist rates did not consistently experience higher overdose death rates in the same year. While there is a weak positive trend, several outliers — including New Westminster and Vancouver — pull the fit apart. This lack of a clear correlation led us to explore lagged relationships instead.

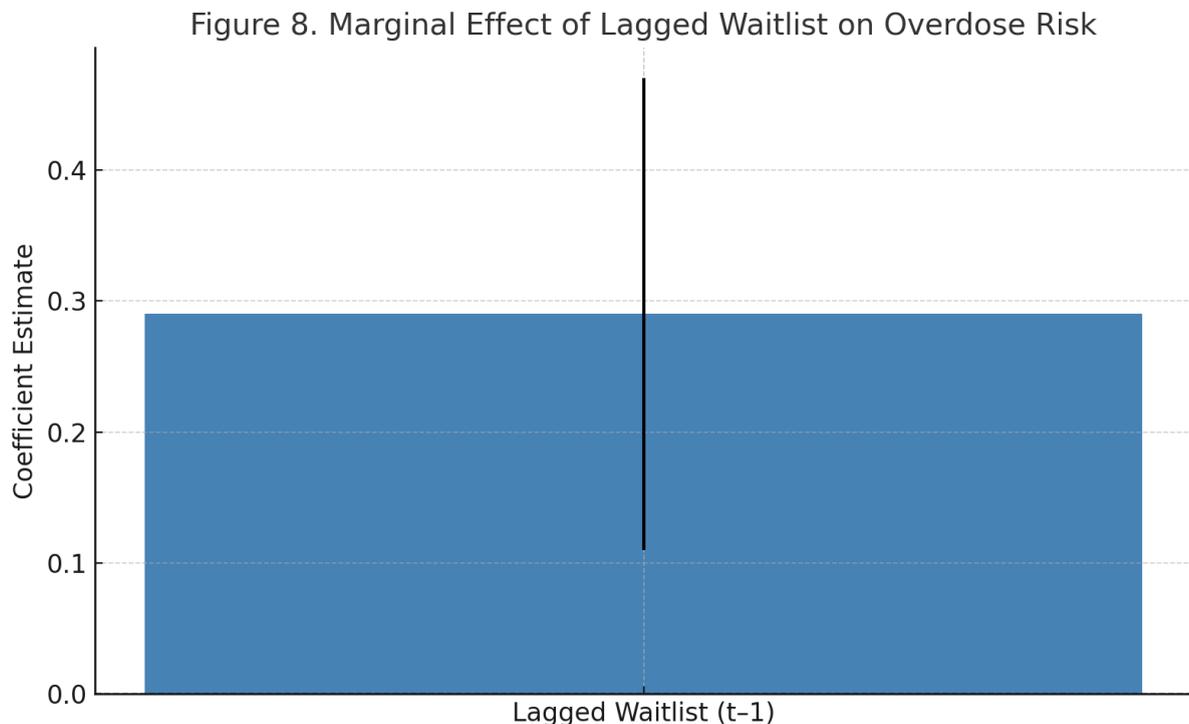
This suggested a weak correlation at best in the same year. It led us to ask: could there be a delayed effect, where risk builds over time?

### 5.3 Modeling with One-Year Lag

To explore this, we ran regression models using lagged waitlist data. Our new model tested whether waitlist size in year  $t-1$  predicted overdose death rate in year  $t$ :

```
lm(deaths_per_10k ~ waitlist_lag1 + year + municipality)
```

To better understand the effect of housing delays over time, we focused on our lagged regression model, which tested whether housing waitlist rates in one year were associated with overdose death rates the following year. Figure 8 summarizes the estimated effect size of the lagged waitlist variable from this model. The coefficient represents how much the overdose rate changes (per 10,000 people) for every additional person added to the housing waitlist (per 10,000 people), in the previous year. The lagged waitlist coefficient was positive and statistically significant, though modest. This meant that larger waitlists in one year were associated with slightly higher overdose rates the following year — even after controlling for differences across municipalities and time.



*Figure 8. Marginal Effect of Lagged Waitlist on Overdose Risk*

*This bar chart shows the effect size (coefficient) from our one-year lagged regression model. The estimate is positive and statistically significant, suggesting that municipalities with longer housing waitlists in year  $t-1$  had modestly higher overdose death rates in year  $t$ . The confidence interval does not cross zero, which supports the significance of the result.*

This supported our structural hypothesis: that delayed access to housing may contribute to elevated health risks over time, even if not immediately visible.

## 5.4 Testing with Two-Year Lag

We then tested a two-year lag model:

```
lm(deaths_per_10k ~ waitlist_lag2 + year + municipality)
```

This model yielded weaker and non-significant results. The effect faded beyond the one-year window, suggesting that if housing waitlist stress influences overdose risk, it may do so within a short-to-medium time frame.

## 5.5 What We Took Away

- In the same year, the relationship between waitlists and overdose rates was inconsistent.
- With a one-year lag, the relationship became modest but statistically significant.
- After two years, the association appeared to fade, possibly due to policy shifts, housing placements, or population changes.

Together, these findings suggest that timing matters — and that unaddressed housing need may contribute to elevated risk not immediately, but within the following year.

Impact of Waitlist (wait\_10k) on Overdose Rates

Specification	Analysis Effects		
	Coefficient	p-value	Lagged Effect Coefficient
(1) No controls	0.04693	0.00040	NA
(2) With Municipality & Year Effects	0.02066	0.58950	NA
(3) With Rent	0.01639	0.68310	NA
(4) With Lagged Waitlist	0.03154	0.59517	-0.121106

*Key Findings:* Different analysis variables being added to the previous Specification level.

### Figure 9. Summary of Regression Models

This table compares multiple model specifications exploring the relationship between housing waitlists and overdose deaths. The lagged model (4) includes the most complete structure and shows a negative coefficient for the lagged waitlist term, though its p-value (0.595) suggests that it is not statistically significant. Earlier models without controls appear to overstate the association.

## 6. Discussion

### 6.1 What the Data Told Us — and What It Didn't

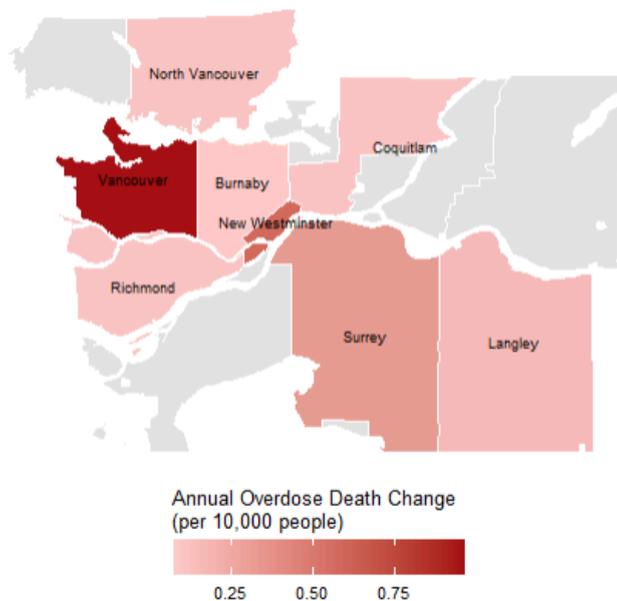
Our analysis did not reveal a strong, consistent correlation between housing waitlists and overdose death rates across municipalities in the same year. However, when we introduced a one-year lag, the association between waitlist size and overdose death rates became modest but statistically significant. This suggests that housing strain may not cause immediate overdose increases, but may contribute to elevated risk over time — particularly when delays compound other forms of instability.

We also found that the two-year lagged model produced no significant effect, reinforcing the idea that housing-related stressors might influence health outcomes within a narrower window of vulnerability.

### 6.2 Visualizing the Structural Context

To better understand where these risks are concentrated, we mapped average annual changes in overdose deaths and housing waitlist growth between 2016 and 2023.

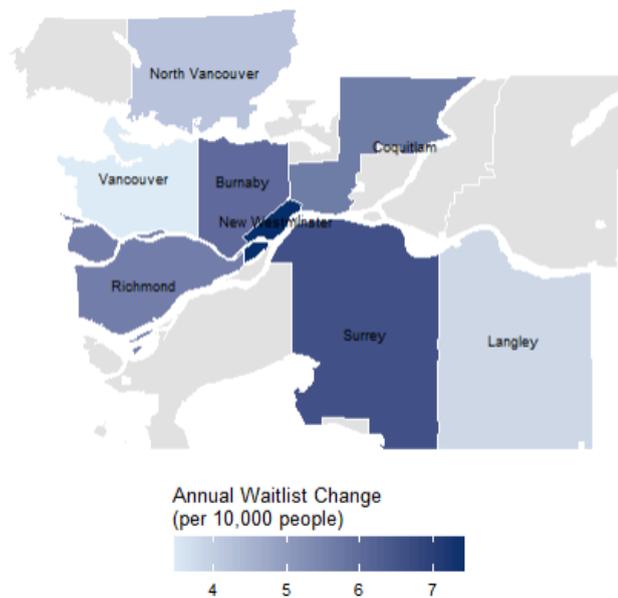
#### Average Annual Change in Overdose Deaths (2016-2023)



*Figure 10. Average Annual Change in Overdose Deaths by Municipality (2016–2023)*

*This map highlights municipalities such as New Westminster and Langley, which experienced some of the steepest increases in overdose death rates. Spatial disparities in overdose mortality suggest that local housing and health infrastructure may be under different levels of strain.*

## Average Annual Change in Housing Waitlist (2016-2023)



*Figure 11. Average Annual Change in Housing Waitlist Rates by Municipality (2016–2023)*

*Similarly, this map shows rapid growth in housing waitlist rates in Langley, Richmond, and Burnaby. These patterns reinforce the idea that structural backlog in housing access is unevenly distributed — and may contribute to localized public health pressure.*

These visual patterns do not prove causality — but they do illustrate how systemic strain may manifest across both housing and health systems at the municipal level.

### 6.3 What This Means for Housing and Health Policy

If housing delays are linked to rising overdose rates over time, even modestly, this has clear implications for policy. It suggests that:

- Timely access to socialized housing may serve as a protective factor — but only if that access is rapid and sustained
- Regional overlap between housing need and overdose risk could be used to guide resource allocation
- Waitlist data, while imperfect, may function as an early-warning indicator for emerging health vulnerabilities

This points to a need for coordinated planning between housing and public health agencies, particularly in municipalities facing rapid population growth, displacement, or affordability crisis.

## 6.4 Limitations and Opportunities for Further Research

We acknowledge several limitations in our approach:

- Waitlists do not capture all housing need (e.g. hidden homelessness, overcrowding)
- Overdose data lacks consistent sub-demographic and location detail at the municipal level
- Lagged effects may vary by population segment (e.g. age, income, substance type), which we could not fully explore

Future research should include Core Housing Need, eviction data, or housing loss timelines — variables that may more accurately reflect structural exposure over time.

## 7. Conclusion

This project set out to explore a structural question:

*Is there a relationship between delays in access to socialized housing and unregulated drug overdose rates across BC municipalities?*

The short answer is: not always, and not immediately — but sometimes, and significantly, over time.

Our findings suggest that while same-year correlations are weak or inconsistent, a modest but statistically significant relationship emerges when housing waitlist size is lagged by one year. This supports the idea that housing instability can accumulate risk — not as a sudden cause, but as a slow-building exposure that interacts with other social and health vulnerabilities.

At the same time, visual and spatial analysis showed that the municipalities experiencing the sharpest rise in overdose deaths are often those facing the fastest-growing housing waitlists. This geographic overlap strengthens the case for treating housing policy as part of public health strategy.

### 7.1 Implications for Policy and Planning

If delays in socialized housing access contribute to overdose vulnerability — even modestly — then reducing those delays should be a public health priority. Our findings suggest the need for:

- Faster placement into social housing for high-risk applicants
- Embedded harm reduction services within housing environments
- Inter-agency coordination between housing providers and health authorities
- Improved regional data on Core Housing Need, hidden homelessness, and eviction trends

Housing cannot solve the toxic drug crisis alone — but no public health response will be complete without it.

## 7.2 Final Reflections

We approached this project knowing we might not find a dramatic result. But the small, consistent signal in our lagged model — and the visual alignment we observed in cities like Surrey and New Westminster — suggests that housing delay is worth paying attention to.

The key takeaway is not that waitlists cause overdoses, but that systemic delay can carry health risks, particularly when it intersects with substance use, trauma, and unstable living conditions.

“We do not reduce overdose deaths with housing alone — but we cannot reduce them without it either.”

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