

Excess mortality, COVID-19 and health care systems in Canada

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During the first year of the COVID-19 pandemic through early 2021, international comparisons showed a wide variation in patterns of mortality across countries.¹ Although some countries saw no change in mortality or even fewer deaths than expected, others saw marked increases, such as a 19% increase in Italy, 18% in the United Kingdom and 22% in the United States.¹ In Canada, a 5% increase was reported during this early pandemic period.¹ A report from the Public Health Agency of Canada suggested differential mortality rates among older adults across Canada's provinces in 2020.² An analysis of data from the first few months of the pandemic showed a twofold variation in excess mortality rates across regions of England and Wales,³ whereby excess mortality refers to the degree to which observed deaths exceed expected deaths (based on modelling of previous years of age-specific mortality).^{4,5} Excess mortality is a useful indicator of the population-wide effects of the COVID-19 pandemic.

Given the observed variation across and within other countries, variation across provinces and territories in Canada is likely. This analysis uses publicly available data to explore excess mortality related to COVID-19 in the Canadian provinces from the start of the pandemic in March 2020 through October 2021 to shed light on the population-wide effects of the pandemic and variations across the country.

What do publicly available data show?

Overall patterns

This analysis considers data only from Canada's provinces because of small case numbers and limited COVID-19 deaths in the territories before the Omicron wave. Weekly data on total (observed) deaths were obtained from Statistics Canada, as reported by provincial vital statistics agencies. The numbers are adjusted by Statistics Canada to "... account for the incomplete nature of the counts."⁴ The process of adjustment accommodated how the pandemic itself likely affected reporting.⁵ Data on expected deaths were also from Statistics Canada. These estimates are produced through province-specific statistical modelling, using age and sex groupings to estimate the number of deaths that would have occurred in the absence of the pandemic, accounting for year-over-year population growth and aging.⁵ Excess deaths (provided by Statistics Canada) are the difference between the observed and expected

Key points

- Excess mortality rates in Canada during 2020 and 2021 varied widely by province, according to publicly available data.
- Deaths attributed to COVID-19 also varied across provinces, as did COVID-19 deaths as a percentage of excess deaths.
- Potential explanations for these variations include differences in data reporting and in pandemic responses across provinces, as well as compounding effects of other public health crises.
- An effective system response to health threats requires more consistent and more comprehensive reporting of data across jurisdictions, and a collective forensic analysis of reasons for observed variations.

numbers. Data on COVID-19 deaths were from the "COVID-19 in Canada" dashboard, which collects daily reporting by public health agencies in each province of deaths attributed to COVID-19.⁶ These were aggregated to weekly numbers for consistency with data from Statistics Canada.

Excess mortality was calculated as a percentage of total observed mortality, to help make comparisons across provinces with very different population sizes. Similarly, COVID-19 deaths were calculated as a percentage of total excess deaths. Excess and COVID-19 mortality rates were also calculated per 100 000 population by province, overall and by week.

Table 1 shows observed (adjusted), expected and excess deaths from the start of the pandemic in March 2020 through October 2021. A wide range in excess and COVID-19 deaths across provinces is evident. The Eastern provinces had the lowest number of excess deaths (and excess deaths as a proportion of expected deaths were negative in 2 provinces, meaning mortality was lower than expected) and the 3 westernmost provinces had the highest number of deaths as of Oct. 23, 2021, before the Omicron wave. Deaths attributed to COVID-19, as a percentage of total excess deaths, also showed large variations.

Week-by-week patterns

The overall figures mask week-by-week trends in both excess and COVID-19 mortality rates. Week-by-week mortality rates, and 2-week rolling averages for excess and COVID-19-related

Table 1: Observed, expected, excess and COVID-19 deaths by province, Mar. 14, 2020, to Oct. 23, 2021*

Province	No. of deaths†				Proportion of excess deaths of observed deaths, %	Proportion of COVID-19 deaths of excess deaths, %
	Observed	Expected	Excess	COVID-19		
Newfoundland and Labrador	8928	8707	221	15	2.5	6.8
Prince Edward Island	2149	2297	-148	0	-6.9	0
Nova Scotia	15 985	16 202	-217	98	-1.4	-45.2
New Brunswick	13 366	12 736	630	107	4.7	17.0
Quebec	115 440	111 407	4033	11 470	3.5	284.4
Ontario	189 025	177 687	11 338	9804	6.0	86.5
Manitoba	11 185	10 508	677	842	6.1	124.4
Saskatchewan	17 251	15 525	1726	814	10.0	47.2
Alberta	58 963	52 420	6543	3026	11.1	46.2
British Columbia	83 592	74 096	9496	2109	11.4	22.2

*All provinces reported data to Oct. 23, 2021, except Manitoba, which is to Feb. 13, 2021.

†Observed (adjusted), expected and excess deaths from Statistics Canada (<https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1310078401>). COVID-19 deaths from <https://art-bd.shinyapps.io/covid19canada/>. All numbers are estimates and should be interpreted accordingly.

mortality were calculated; the overall patterns observed were similar, but the rolling averages are the focus because they smoothed some trends for provinces with smaller populations.

Figure 1 shows excess and COVID-19 mortality rates for 6 provinces (Nova Scotia, Ontario, Quebec, Saskatchewan, Alberta and British Columbia) that appeared to have different experiences of the early pandemic, based on Table 1. Quebec and Nova Scotia had periods during which excess deaths exceeded COVID-19 deaths, but also substantial periods during which mortality rates were lower than expected (where the “excess” dipped below 0). Ontario and Saskatchewan each had a small number of weeks during which excess mortality rates were lower than expected, whereas Alberta and British Columbia saw consistently increased excess mortality rates. Ontario appeared to have the most consistent tracking between COVID-19 and excess mortality rates, though some divergence in the summer and fall of 2021 is apparent. In BC, Alberta and Saskatchewan, periods early in the pandemic and at the end of the reported period saw excess mortality rates far higher than those for COVID-19. In particular, BC saw a notable, sustained divergence after the spike in deaths related to the 2021 “heat dome.”⁷

Figure 2 shows excess and COVID-19 deaths per 100 000 population aggregated over the whole period under analysis. Prince Edward Island and Nova Scotia had low (to no) COVID-19 mortality rates and negative excess mortality rates, whereas Quebec, Newfoundland and Labrador and Manitoba (over a truncated period) had moderate excess mortality rates. Quebec, however, stands out for having had the highest COVID-19 mortality rate. Alberta, BC and Saskatchewan stand out for having had excess mortality rates nearly double (or more) those of other provinces.

What is the meaning of the different mortality patterns across provinces?

These remarkably diverse patterns of mortality over the course of the COVID-19 pandemic may have several explanations. These explanations are not mutually exclusive, and their relative importance is likely to vary by province.

COVID-19 reporting practices

The accuracy with which COVID-19 deaths were captured may have varied across jurisdictions. For example, some people with COVID-19 were never tested, particularly at the beginning of the pandemic when criteria for testing were limited. Furthermore, in subsequent waves, some jurisdictions may have had limited testing capacity. Deaths from COVID-19 that occurred in the community rather than in hospital may not have been reported as COVID-19 deaths. Reporting practices by provincial public health agencies were likely affected by decisions regarding whether or not to classify deaths of both people whose primary cause of death was COVID-19 (those who died “from” COVID-19) and people who were infected with SARS-CoV-2 whose primary cause of death was other than COVID-19 (those who died “with” COVID-19) as being related to COVID-19. This distinction may be addressed when vital statistics data are available, but underlying cause-of-death assessments take time to process. Having confidence in the accuracy of data on COVID-19 deaths is key to understanding different provincial experiences of the pandemic and to distinguishing whether provinces had a “COVID-19 problem,” a broader mortality problem or both. In particular, a clear understanding of the distinction in the Western provinces is required, since their excess mortality was calculated to be high despite relatively low COVID-19 mortality rates. Differential

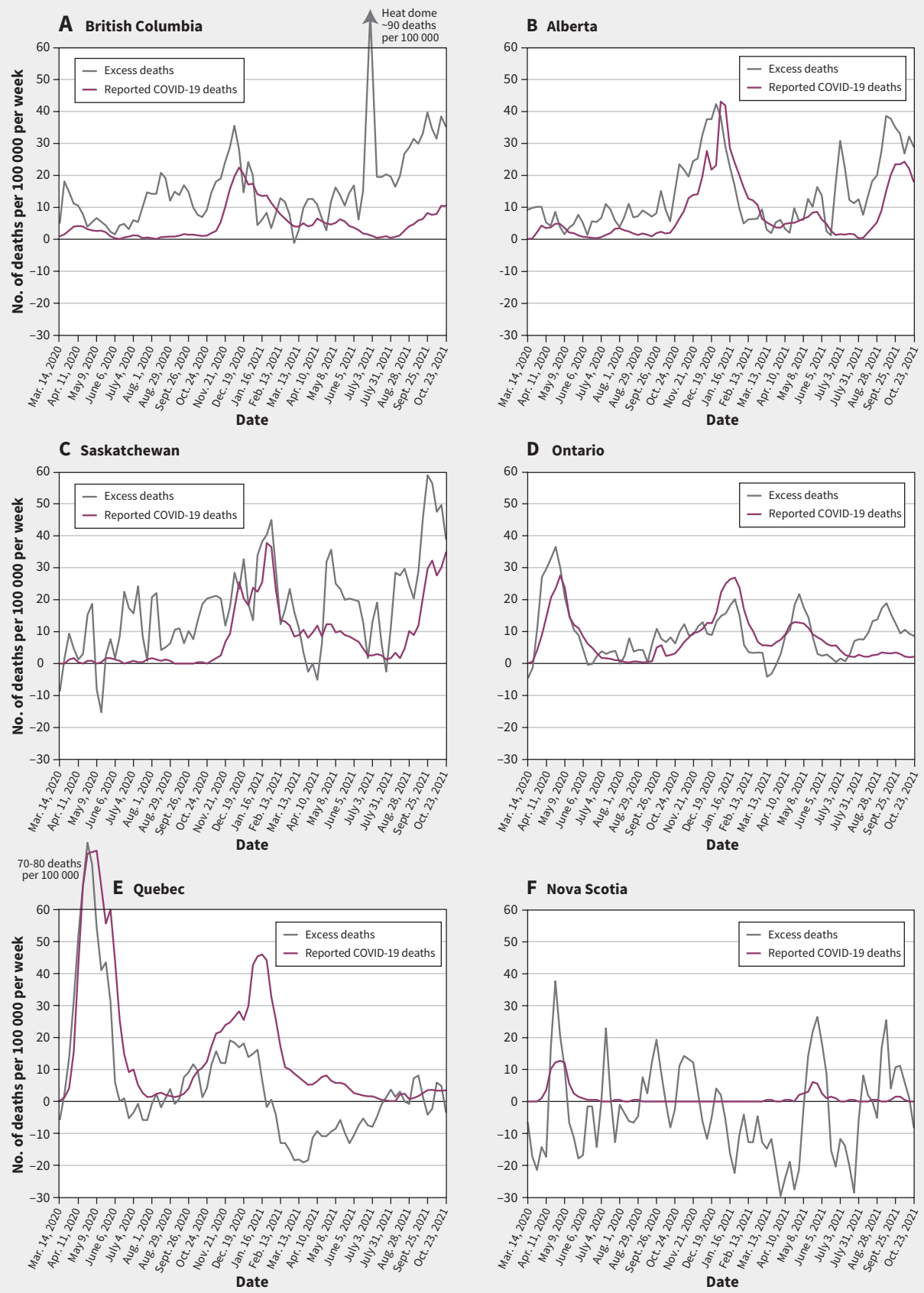


Figure 1: Two-week rolling averages of excess and COVID-19 mortality rates, for (A) British Columbia, (B) Alberta, (C) Saskatchewan, (D) Ontario, (E) Quebec and (F) Nova Scotia from Mar. 14, 2020, to Oct. 23, 2021.

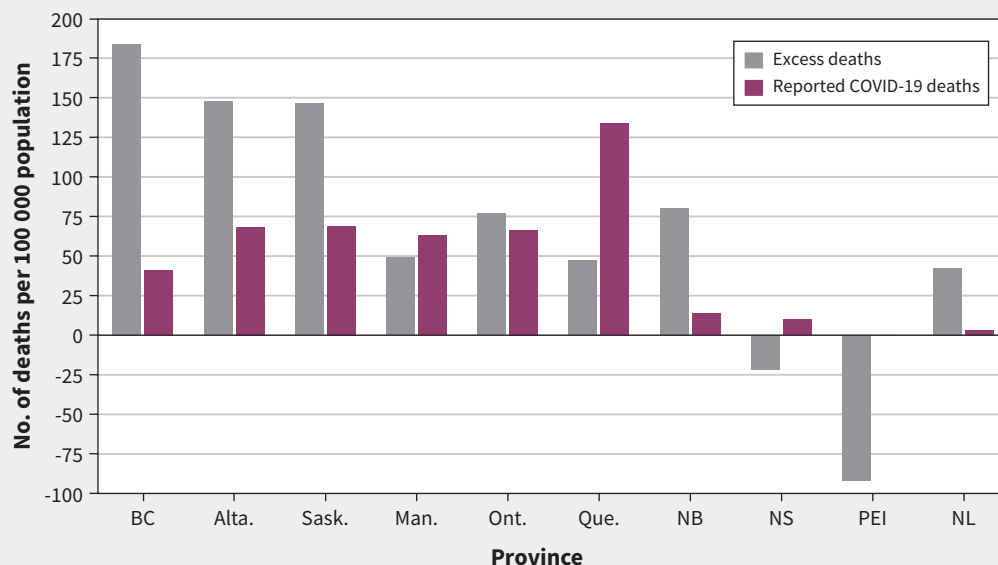


Figure 2: Excess and COVID-19 mortality rates, Mar. 14, 2020, to Oct. 23, 2021 (Mar. 14, 2020, to Feb. 13, 2021, for Manitoba).

COVID-19 reporting practices should be ruled out as a primary explanation for the observed trends seen before other possible explanations for interprovincial differences (or differences over time) are considered.

Provincial control measures in response to COVID-19

The Canadian provinces took quite different approaches to pandemic control,⁸ such as the timing and frequency of business and school closures, focus on marginalized communities, and approaches to vaccine rollouts.⁹ These elements may have affected outcomes, including mortality rates, and, once clearer data on “true” COVID-19 case counts become available, it may be possible to better estimate to what extent the type and timing of pandemic response mattered to provinces’ overall mortality rates.

Additional public health events

The ongoing public health crisis of tainted drug supply and related overdose emergencies grew worse in Canada in 2020 and 2021. To some degree this would be captured in the Statistics Canada data, given the approach the organization uses to calculate expected (and thus excess) deaths. Some provinces, especially BC, had an unexpected heat dome in June and July 2021, which, as noted, was associated with a spike in deaths. Human Rights Watch concluded that an inadequate policy response contributed to heat-related deaths in BC,¹⁰ and that these deaths were highly associated with social and material deprivation,⁷ which may have been related to the COVID-19 pandemic. Pandemic policies and border shutdowns likely also contributed to an unsafe drug supply, more people using alone and other social factors that contributed to higher rates of opioid-related deaths.¹¹

Broader implications of COVID-19

Pandemic-control measures contributed to a decline in motor vehicle accidents¹² and vastly reduced influenza-related deaths.¹³ The Canadian Institute for Health Information reported 560 000 fewer surgeries than usual from the start of the pandemic to the end of 2021;¹⁴ however, it is difficult to quantify the effect that this and other missed, altered or delayed health care interactions had on overall mortality.

Inaccuracies in modelling of expected deaths

Modelling of expected deaths is complicated under usual circumstances, and even more so during a pandemic. For example, it is debatable whether avoided deaths (e.g., because of reduced motor vehicle accidents) should be accounted for, as not doing so would lower the assessed impact of COVID-19.¹⁵ The method used by Statistics Canada did not account for avoided deaths. Some may argue that this choice makes it difficult to account for how different population groups (e.g., high v. low socioeconomic status) benefitted from avoided deaths. In addition, modelling of expected deaths may misstate an excess if a province had an anomalous trend in mortality in the years before the pandemic. In this case, the modelling would represent a counterfactual that would never have come to pass, even in the absence of the pandemic.

How should Canada’s health systems respond?

Other reviews have pointed to the need for health care systems to be attentive to social determinants of health and issues of equity,¹⁶ as well as to health system workforce, communications and governance factors,¹⁷ as the pandemic continues or recedes.

This analysis suggests a need both for health care systems to generate better and more consistent data, and for a forensic analysis of factors contributing to mortality, such as the possible explanations outlined here.

All provinces and territories should use consistently applied definitions for collection and reporting of data on deaths, as is the focus here, but also ideally extending to other outcomes, since deaths are only one of the many population impacts of COVID-19. In addition to consistent definitions across every jurisdiction in Canada for how COVID-19 deaths and morbidity variables are counted and tracked, up-to-date reporting on overall mortality, and immediate and publicly available analysis of any changes in overall mortality, are needed. Timely reporting is critical. Canada is notoriously slow when it comes to the availability of mortality data; an international analysis found that Canada is 3–4 months behind its peers in reporting.¹⁸ Consistent definitions for the wider impacts of COVID-19, including mental health, delayed surgeries, delayed diagnostics and progress on responding to all of these issues, should also be developed as soon as possible.

The forensic analysis of the reasons for variations in excess mortality would ideally be a joint project of health care systems across all provinces. Such collective assessment and learning is key to help ensure preparedness for another SARS-CoV-2 variant, another weather event or an entirely new health threat. It will take the collective efforts of all stakeholders, including the public, to be ready and willing to respond to the next crisis. Conversations that support that preparedness should start now.

References

- Karlinsky A, Kobak D. Tracking excess mortality across countries during the COVID-19 pandemic with the world mortality dataset. *eLife* 2021 Jun 30;10:e69336.
- COVID-19 and deaths in older Canadians: excess mortality and the impacts of age and comorbidity. Ottawa: Public Health Agency of Canada; 2021.
- Kontopantelis E, Springate DA, Ashworth M, et al. Investigating the relationship between quality of primary care and premature mortality in England: a spatial whole-population study. *BMJ* 2015;350:h904.
- Provisional deaths and excess mortality in Canada dashboard*. Ottawa: Statistics Canada; 2020. Cat no 71-607-X. Available: <https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021028-eng.htm> (accessed 2022 Feb. 25).
- Estimation of excess mortality*. Ottawa: Statistics Canada; 2020. Available: https://www.statcan.gc.ca/en/statistical-programs/document/3233_D5_V1 (accessed 2022 Feb. 25).
- Berry I, Soucy JPR, Tuite A, et al. Open access epidemiologic data and an interactive dashboard to monitor the COVID-19 outbreak in Canada. *CMAJ* 2020;192:E420.
- Henderson SB, McLean KE, Lee MJ, et al. Analysis of community deaths during the catastrophic 2021 heat dome. *Environ Epidemiol* 2022;6:e189.
- COVID-19 Intervention Scan. Ottawa: Canadian Institute for Health Information; 2021. Available: <https://www.cihi.ca/en/covid-19-intervention-scan> (accessed 2022 Feb. 27).
- Mishra S, Stall NM, Ma H, et al. A vaccination strategy for Ontario COVID-19 hotspots and essential workers. *Science Briefs of the Ontario COVID-19 Science Advisory Table*. 2021 Apr. 23:1-11.
- Canada: disastrous impact of extreme heat. New York: Human Rights Watch; 2021. Available: <https://www.hrw.org/news/2021/10/05/canada-disastrous-impact-extreme-heat> (accessed 2022 Feb. 27).
- Norton A, Kerr T. Applying the lessons of COVID-19 response to Canada's worsening opioid epidemic. *EClinicalMedicine* 2020 Dec;29:100633.
- Yasin YJ, Grivna M, Abu-Zidan FM. Global impact of COVID-19 pandemic on road traffic collisions. *World J Emerg Surg* 2021;16:51.
- Peek K. Flu has disappeared for more than a year. *Scientific American* 2021 Apr. 29. Available: <https://www.scientificamerican.com/article/flu-has-disappeared-worldwide-during-the-covid-pandemic1/> (accessed 2022 Feb. 27).
- Over half a million fewer surgeries have been performed in Canada since the start of the pandemic. Ottawa: Canadian Institute for Health Information; 2021 Dec. 9. Available: <https://www.cihi.ca/en/over-half-a-million-fewer-surgeries-have-been-performed-in-canada-since-the-start-of-the-pandemic> (accessed 2022 Feb. 27).
- Moriarty TJ, Boczula AE, Thind EK, et al. Excess all-cause mortality during the COVID-19 epidemic in Canada. Ottawa: Royal Society of Canada; 2021:52. Available: https://rsc-src.ca/sites/default/files/EM%20PB_EN.pdf (accessed 2022 Apr. 25).
- Persaud N, Woods H, Workentin A, et al. Recommendations for equitable COVID-19 pandemic recovery in Canada. *CMAJ* 2021;193:E1878-88.
- Alami H, Lehoux P, Fleet R, et al. How can health systems better prepare for the next pandemic? Lessons learned from the management of COVID-19 in Quebec (Canada). *Front Public Health* 2021;9:671833.
- Tracking covid-19 excess deaths across countries. *The Economist* 2021 Oct. 20. Available: <https://www.economist.com/graphic-detail/coronavirus-excess-deaths-tracker> (accessed 2022 Apr. 25).

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