# Multimorbidity and COVID-19 in Canada: How the Pandemic Has Highlighted a Key and Yet Underappreciated Risk Factor

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Multimorbidity, defined as having two or more chronic health conditions, is highly prevalent in Canada and is becoming a growing health concern as its population ages.(1) As an individual's chronic conditions tend to accumulate with age, so does multimorbidity and it is associated with an increased risk of short- and long-term mortality,(2) reduced function,(3) lower health-related quality of life,(4) and several other negative health outcomes.

Preliminary studies suggest multimorbidity is a substantial risk factor for COVID-19 incidence, morbidity, and mortality. A UK Biobank study of 428,199 participants aged 37–73 found multimorbidity to be associated with a 51% greater risk of SARS-CoV-2 infection compared to those without a comorbidity.(5) Another UK observational study of 360,283 participants aged 48–85 found multimorbidity to be associated with a 91% increased odds of severe COVID-19 compared to those without multimorbidity (one or no comorbidities).(6) To date, one Canadian study has examined the impact of multimorbidity on outcomes from COVID-19 in 167,500 persons diagnosed with COVID-19 in Ontario.(7) Compared to those without comorbidities, the risk of mortality from COVID-19 increased from 2.14 to 4.81 as number of comorbidities increased from one to five or greater.(7) When examining specific age strata, the risk of mortality in those with high multimorbidity (5+ conditions) compared to those without comorbidity was 395.4 times greater in those below 50 years of age, 35.9 times greater in those aged 50–59, and 12.3 times greater in those aged 60–69, while there was no significant association observed in Ontarians aged 70+.(7) With respect to the prevalence of those living with multimorbidity or multiple COVID-19 risk factors in Canada, a recent study found roughly one-third of Canadians lived with two or more established risk factors for severe COVID-19, which included a list of several common comorbidities.(8)

Despite the high and growing prevalence of multimorbidity in Canada, it remains an understudied health problem and it has received inadequate attention during the COVID-19 pandemic. While evidence points to multimorbidity as a risk factor for SARs-CoV-2 infection and poor COVID-19 outcomes, most of the focus in Canada has centred on individual risk factors—particularly age and individual conditions. Despite such factors being undoubtably strong risk factors for COVID-19 and have been paramount for public health planning, there has been little discussion on the inclusion of multimorbidity. In the Canadian COVID-19 response—from protecting settings such as long-term care (LTC), to increasing testing towards high-risk groups, to prioritizing various age groups, settings, and comorbidities for vaccination—most, if not all, elements failed to include multimorbidity as a condition for prioritization. This is similar to other jurisdictions, such as the UK, who used a strategy based on the QCOVID risk algorithm for individual high-risk conditions alongside age groups and other demographic variables.(9)

However, by using an approach that only included individual comorbidities, it is possible many Canadians with multimorbidity were not prioritized when this could have further reduced morbidity and mortality. For example, a Canadian who lives with diabetes, hypertension, and chronic kidney disease—three highly prevalent chronic conditions—would have been offered the same priority for vaccination as someone of the same age with any one of those three conditions, or others, despite evidence they are at greater risk of severe outcome from COVID-19 due to multimorbidity. While there is clear evidence for implementing age and comorbidity-based prioritization frameworks for COVID-19 vaccination and other health services, consideration of future frameworks that also include multimorbidity should be explored in Canada. Adding this further layer of granularity would allow prioritization of adults living with multimorbidity ahead of adults with only one or no long-term health conditions in the same age group. There are likely many settings that multimorbidity may help further provide risk stratification for COVID-19 responses. While the ubiquity of multimorbidity in LTC (estimated at 97% of residents in Ontario)(10) leaves little room for improving COVID-19 response prioritization, it is likely other settings, such as home care, group homes, or the general

population, could benefit from including multimorbidity in prioritization frameworks.

The reasons underlying the lack of awareness, understanding, and impact of multimorbidity on COVID-19 in Canada are multifaceted and complex, and are related to issues surrounding multimorbidity that predate the pandemic. First, health-care delivery and planning in Canada has traditionally been focused, and continues to have an emphasis, on the treatment of individual conditions. This is the result of a long history of public health strategies targeting single diseases, physician practices, and fee codes traditionally focused on treatment/management of one disease,[11,12] alongside the epidemiological transition and modern health-care advances that have drastically increased the number of patients living longer with multiple conditions.[13] Second, multimorbidity research is still in the early stages, and research into multimorbidity must become a bigger priority—both in Canada and worldwide. Today, much remains unknown as to why various combinations of diseases predispose individuals to negative outcomes, often over and above the additive effect of either condition alone. Further, the pervasive lack of standard definitions in multimorbidity research, along with the plethora of combinations of chronic diseases seen in clinical practice, provide a complex public health problem, yet multimorbidity rarely becomes incorporated into clinical practice guidelines.[14]

Multimorbidity and COVID-19 are two different, yet intertwined, health challenges that Canadian public health programs will face for years to come. With respect to tackling the intersection of such challenges, we suggest the following:

1. First, as the COVID-19 pandemic continues, existing research suggests there should be greater consideration of including multimorbidity into public health decision-making. While age and comorbidity-based risk algorithms have a key role in prioritization of vaccination and other health services, the addition of multimorbidity to frameworks in Canada should be further explored. Based on the currently available evidence that suggests multimorbidity predicts poor outcome from COVID-19, more emphasis should be placed on multimorbidity for COVID-19 response programs, including the administration of booster vaccinations. Canadians with multiple comorbidities that are known COVID-19 risk factors should be considered for prioritization over Canadians with single comorbidities within the same age group, where possible.
2. Second, while the current body of evidence suggests a need to presently include multimorbidity in COVID-19 public health policies, further research on this topic is still needed. While multimorbidity has been found to predict poor outcome from COVID-19, which warrants immediate inclusion of multimorbidity into COVID-19 policies, there is limited mechanistic and etiological understanding as to why multimorbidity is associated with excess risk from COVID-19. As a comprehensive retrospective examination of the COVID-19 pandemic in Canada begins, multimorbidity should be explored further in detail to understand better why multimorbidity influenced outcomes from COVID-19, both globally and in Canada. While preliminary research has found that multimorbidity comprising certain common conditions increased risk of severe COVID/death,[5,6] there remains little understanding as to why multimorbidity is associated with heightened risk of poor COVID-19 outcomes over and above the additive impact of individual comorbidities. Further, research that aims to understand underlying mechanisms that caused age to be such a strong risk factor for COVID-19 should explore the role of multimorbidity. Globally, there is a need for a more nuanced understanding of the role of multimorbidity on the risk of SARs-CoV-2 infection, morbidity, and mortality from COVID-19, along with incidence and outcomes of post COVID-19 condition (aka "long COVID"). Research organizations and funding bodies should prioritize research into multimorbidity and COVID-19. This will help inform ongoing COVID-19 vaccine rollouts, clinical practice, and future pandemic preparedness worldwide.

   While associations between multimorbidity and poor outcomes from COVID-19 are likely robust across settings, future research in Canada should explore how multimorbidity contributed to COVID-19 outcomes across the country. For instance, Canadian research should explore whether multimorbidity was a key confounder underlying the excess risk of mortality in Canadian LTC during COVID-19.[15] There is a need to understand better which combinations of chronic health conditions placed Canadians at the greatest risk of severe COVID-19 outcomes. When conducting a post-mortem analysis of the COVID-19 pandemic and the Canadian response, this may help better understand how case-mix and multimorbidity in Canada contributed to variations in COVID outcomes nationwide.
3. Third, health-care systems and health informatics infrastructure in Canada must place greater emphasis on multimorbidity. As the Canadian population continues to age rapidly, improving routinely collected data on multimorbidity could be a key tool to understand and address this public health issue moving forward. A shift towards expanding data-linkage across disciplines and specialty centres should be encouraged to improve the quality and amount of routinely collected data surrounding multimorbidity across jurisdictions in Canada.

In the wake of the pandemic, Canada must aim to further include, understand, and emphasize the impact of multimorbidity on COVID-19 in this country. This could help further prioritize ongoing vaccination and health-care service delivery during the COVID-19 pandemic and improve understanding of COVID-19 outcomes in Canada. Beyond the pandemic, this will also help address the needs of many Canadians living with multimorbidity moving forward.

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## REFERENCES

1. Steffler M, Li Y, Weir S, *et al*. Trends in prevalence of chronic disease and multimorbidity in Ontario, Canada. CMAJ. 2021; 193(8):E270–E27.
2. Nunes BP, Flores TR, Mielke GI, Thumé E, Facchini LA. Multimorbidity and mortality in older adults: a systematic review and meta-analysis. *Arch Gerontol Geriatr*. 2016;67:130–38.
3. Calderón-Larrañaga A, Vetrano DL, Ferrucci L, *et al*. Multimorbidity and functional impairment-bidirectional interplay, synergistic effects and common pathways. *J Intern Med.* 2019; 285(3):255–71.
4. Fortin M, Bravo G, Hudon C, *et al*. Relationship Between Multimorbidity and Health-Related Quality of Life of Patients in Primary Care. *Qual Life Res*. 2006;15(1):83–91.
5. McQueenie R, Foster HM, Jani BD, *et al*. Multimorbidity, polypharmacy, and COVID-19 infection within the UK Biobank cohort. *PLoS One*. 2020;15(8):e0238091.
6. Chudasama YV, Zaccardi F, Gillies CL, *et al*. Patterns of multimorbidity and risk of severe SARS-CoV-2 infection: an observational study in the UK. *BMC Infect Dis*. 2021;21(1):908.
7. Ge E, Li Y, Wu S, Candido E, Wei X. Association of pre-existing comorbidities with mortality and disease severity among 167,500 individuals with COVID-19 in Canada: a population-based cohort study. *PLoS One*. 2021;16(10):e0258154.
8. McAlister FA, Bushnik T, Leung AA, Saxinger L. Informing COVID-19 vaccination priorities based on the prevalence of risk factors among adults in Canada. *CMAJ*. 2021;193(17):E617–E21.
9. Clift AK, Coupland CA, Keogh RH, *et al*. Living risk prediction algorithm (QCOVID) for risk of hospital admission and mortality from coronavirus 19 in adults: national derivation and validation cohort study. *BMJ*. 2020;371:m3731.
10. Ontario Long-term Care Association. This is Long-Term Care 2016 [Internet]. Toronto, ON: Ontario Long-term Care Association; 2016 [cited 2021 Sept 17]. Available from: https://www.oltca.com/oltca/documents/reports/tiltc2016.pdf
11. Nicholson K, Terry AL, Fortin M, Williamson T, Thind A. Understanding multimorbidity in primary health care. *Can Fam Physician*. 2015;61(10):918.
12. Moffat K, Mercer SW. Challenges of managing people with multimorbidity in today's healthcare systems. *BMC Fam Pract*. 2015;16(1):129.
13. Pearson-Stuttard J, Ezzati M, Gregg EW. Multimorbidity: a defining challenge for health systems. *The Lancet Public Health*. 2019;4(12):e599–e600.
14. Uhlig K, Leff B, Kent D, *et al*. A framework for crafting clinical practice guidelines that are relevant to the care and management of people with multimorbidity. *J Gen Intern Med*. 2014;29(4):670–79.
15. Fisman DN, Bogoch I, Lapointe-Shaw L, McCready J, Tuite AR. Risk factors associated with mortality among residents with coronavirus disease 2019 (COVID-19) in long-term care facilities in Ontario, Canada. *JAMA Network Open*. 2020;3(7):e2015957.

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