**Supplement File**

**Appendix 1**: CHEERS 2022 Checklist

|  |  |  |  |
| --- | --- | --- | --- |
| Topic | No. | Item | Location where the item is reported |
| **Title** |  |  |  |
| 1 | Identify the study as an economic evaluation and specify the interventions being compared. | Healthcare and Labour Impacts of Post COVID-19 Condition in Canada: A Health Economic Costing Model, page 1 |
| **Abstract** |  |  |  |
| 2 | Provide a structured summary that highlights context, key methods, results, and alternative analyses. | Abstract, Page 2 |
| **Introduction** |  |  |  |
| **Background and objectives** | 3 | Give the context for the study, the study question, and its practical relevance for decision making in policy or practice. | Introduction, Paragraph 1 and 2 |
| **Methods** |  |  |  |
| **Health economic analysis plan** | 4 | Indicate whether a health economic analysis plan was developed and where available. | Methods, Paragraph 1 |
| **Study population** | 5 | Describe characteristics of the study population (such as age range, demographics, socioeconomic, or clinical characteristics). | Methods, Design and Setting section |
| **Setting and location** | 6 | Provide relevant contextual information that may influence findings. | Methods, Design and Setting section |
| **Comparators** | 7 | Describe the interventions or strategies being compared and why chosen. | Not applicable |
| **Perspective** | 8 | State the perspective(s) adopted by the study and why chosen. | Methods, Design and Setting section |
| **Time horizon** | 9 | State the time horizon for the study and why appropriate. | Methods, Design and Setting section |
| **Discount rate** | 10 | Report the discount rate(s) and reason chosen. | No discounting was used. |
| **Selection of outcomes** | 11 | Describe what outcomes were used as the measure(s) of benefit(s) and harm(s). | Methods, Sixth Paragraph |
| **Measurement of outcomes** | 12 | Describe how outcomes used to capture benefit(s) and harm(s) were measured. | Methods, Sixth Paragraph |
| **Valuation of outcomes** | 13 | Describe the population and methods used to measure and value outcomes. | Methods, Modelled Events and Costs |
| **Measurement and valuation of resources and costs** | 14 | Describe how costs were valued. | Methods, Modelled Events and Costs |
| **Currency, price date, and conversion** | 15 | Report the dates of the estimated resource quantities and unit costs, plus the currency and year of conversion. | Not applicable |
| **Rationale and description of model** | 16 | If modelling is used, describe in detail and why used. Report if the model is publicly available and where it can be accessed. | Methods, Analysis |
| **Analytics and assumptions** | 17 | Describe any methods for analysing or statistically transforming data, any extrapolation methods, and approaches for validating any model used. | Methods, Analysis; Table 1; Appendix 3 |
| **Characterising heterogeneity** | 18 | Describe any methods used for estimating how the results of the study vary for subgroups. | Methods, Analysis |
| **Characterising distributional effects** | 19 | Describe how impacts are distributed across different individuals or adjustments made to reflect priority populations. | Not applicable |
| **Characterising uncertainty** | 20 | Describe methods to characterise any sources of uncertainty in the analysis. | Methods, Analysis |
| **Approach to engagement with patients and others affected by the study** | 21 | Describe any approaches to engage patients or service recipients, the general public, communities, or stakeholders (such as clinicians or payers) in the design of the study. | Not reported / not applicable |
| **Results** |  |  |  |
| **Study parameters** | 22 | Report all analytic inputs (such as values, ranges, references) including uncertainty or distributional assumptions. | Results, first paragraph; Table 1; Appendix 3 |
| **Summary of main results** | 23 | Report the mean values for the main categories of costs and outcomes of interest and summarise them in the most appropriate overall measure. | Results, second paragraph |
| **Effect of uncertainty** | 24 | Describe how uncertainty about analytic judgments, inputs, or projections affect findings. Report the effect of choice of discount rate and time horizon, if applicable. | Not reported / not applicable |
| **Effect of engagement with patients and others affected by the study** | 25 | Report on any difference patient/service recipient, general public, community, or stakeholder involvement made to the approach or findings of the study | Not reported / not applicable |
| **Discussion** |  |  |  |
| **Study findings, limitations, generalisability, and current knowledge** | 26 | Report key findings, limitations, ethical or equity considerations not captured, and how these could affect patients, policy, or practice. | Discussion, first paragraph |
| **Other relevant information** |  |  |  |
| **Source of funding** | 27 | Describe how the study was funded and any role of the funder in the identification, design, conduct, and reporting of the analysis | End of manuscript |
| **Conflicts of interest** | 28 | Report authors conflicts of interest according to journal or International Committee of Medical Journal Editors requirements. | End of manuscript |

*From:* Husereau D, Drummond M, Augustovski F, et al. Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022) Explanation and Elaboration: A Report of the ISPOR CHEERS II Good Practices Task Force. Value Health 2022;25. <doi:10.1016/j.jval.2021.10.008>

**Appendix 2**: Parameter estimates used for the economic costing model over an average 9-month PCC symptom duration.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Entire Cohort | | Sex | | | | | | Vaccination Status | | | | | |
| **Males** | | | **Females** | | | **0 doses** | | | **2+ doses** | | |
| Healthcare related estimates | | | | | | | | | | | | | | |
| Number SARS-CoV-2 cases | * Appendix 7 | | Appendix 7 | | | Appendix 7 | | | Appendix 7 | | | Appendix 7 | | |
| Prevalence of post-COVID-19 condition | * Normal \*\* * µ: 0.174 * SE: 0.024 | | * Normal \*\* * µ: 0.124 * SE: 0.009 | | | * Normal \*\* * µ: 0.221 * SE: 0.012 | | | * Normal \*\* * µ: 0.248 * SE: 0.016 | | | * Normal \*\* * µ: 0.13 * SE: 0.008 | | |
| Emergency department rate | * ΩTrapezoidal * Appendix 8 | | * ΩTrapezoidal * Appendix 8 | | | * ΩTrapezoidal * Appendix 8 | | | * ΩTrapezoidal * Appendix 8 | | | * ΩTrapezoidal * Appendix 8 | | |
| Hospitalization rate | * ΩTrapezoidal * Appendix 9 | | * ΩTrapezoidal * Appendix 9 | | | * ΩTrapezoidal * Appendix 9 | | | * ΩTrapezoidal * Appendix 9 | | | * ΩTrapezoidal * Appendix 9 | | |
| Mean GP visits per case | * ΩTrapezoidal * LB: 0 * LM: 2 * UM: 3 * UB: 15 | | * ΩTrapezoidal * LB: 0 * LM: 2 * UM: 3 * UB: 15 | | | * ΩTrapezoidal * LB: 0 * LM: 2 * UM: 3 * UB: 15 | | | * ΩTrapezoidal * LB: 0 * LM: 2 * UM: 3 * UB: 15 | | | * ΩTrapezoidal * LB: 0 * LM: 2 * UM: 3 * UB: 15 | | |
| Mean outpatient specialist visits per case | * Uniform * LB: 0 * UB: 2 | | * Uniform * LB: 0 * UB: 2 | | | * Uniform * LB: 0 * UB: 2 | | | * Uniform * LB: 0 * UB: 2 | | | * Uniform * LB: 0 * UB: 2 | | |
| School/Labour related parameters | | | | | | | | | | | | | | | |
| Proportion that left work permanently | | * ΩTrapezoidal * LB: 0.01 * LM: 0.03 * UM: 0.05 * UB: 0.13 | | * ΩTrapezoidal * LB: 0.01 * LM: 0.03 * UM: 0.05 * UB: 0.13 | | | * ΩTrapezoidal * LB: 0.01 * LM: 0.03 * UM: 0.05 * UB: 0.13 | | | * ΩTrapezoidal * LB: 0.01 * LM: 0.03 * UM: 0.05 * UB: 0.13 | | | * ΩTrapezoidal * LB: 0.01 * LM: 0.03 * UM: 0.05 * UB: 0.13 | | |
| Mean PCC Symptom Duration (days) | | * Normal \*\*   µ: 265; SE: 12 | | * Normal \*\*   µ: 245; SE: 18 | | | * Normal \*\*   µ: 276; SE: 15 | | | * Normal \*\*   µ: 400; SE: 21 | | | * Normal \*\*   µ: 133; SE: 3 | | |
| Proportion of full-time equivalent work lost due to PCC symptoms, Ɵ | | * ΩTrapezoidal * LB: 0.00 * LM: 0.05 * UM: 0.10 * UB: 0.25 | | * ΩTrapezoidal * LB: 0.00 * LM: 0.05 * UM: 0.10 * UB: 0.25 | | | * ΩTrapezoidal * LB: 0.00 * LM: 0.05 * UM: 0.10 * UB: 0.25 | | | * ΩTrapezoidal * LB: 0.00 * LM: 0.05 * UM: 0.10 * UB: 0.25 | | | * ΩTrapezoidal * LB: 0.00 * LM: 0.05 * UM: 0.10 * UB: 0.25 | | |
| Proportion that missed at least one school or work day | | * Normal \*\* * µ: 0.7494 * SE: 0.024 | | * Normal \*\* * µ: 0.741 * SE: 0.045 | | | * Normal \*\* * µ: 0.754 * SE: 0.028 | | | * Normal \*\* * µ: 0.736 * SE: 0.039 | | | * Normal \*\* * µ: 0.772 * SE: 0.031 | | |
| Missed school or work days per case | | * Normal \*\* * µ: 19.874 * SE: 2.666 | | * Normal \*\* * µ: 25.173 * SE: 4.603 | | | * Normal \*\* * µ: 17.013 * SE: 3.071 | | | * Normal \*\* * µ: 25.909 * SE: 4.862 | | | * Normal \*\* * µ: 13.236 * SE: 2.447 | | |
| Economic Costs | | | | | | | | | | | | | | | | | |
| National daily average income in 2021 | | * Appendix 10 | | | | Appendix 10 | | | Appendix 10 | | | Appendix 10 | | | Appendix 10 | | |
| Inflation factor to convert the costs in 2023 Canadian dollars.(Government of Canada, 2024b, 2024a) | | - Constant  - 1.0995 | | | | - Constant  - 1.0995 | | | - Constant  - 1.0995 | | | - Constant  - 1.0995 | | | - Constant  - 1.0995 | | |
| Emergency department visit | | * ΩTrapezoidal * LB: 300 * LM: 450 * UM: 550 * UB: 750 | | | | * ΩTrapezoidal * LB: 300 * LM: 450 * UM: 550 * UB: 750 | | | * ΩTrapezoidal * LB: 300 * LM: 450 * UM: 550 * UB: 750 | | | * ΩTrapezoidal * LB: 300 * LM: 450 * UM: 550 * UB: 750 | | | * ΩTrapezoidal * LB: 300 * LM: 450 * UM: 550 * UB: 750 | | |
| Inpatient hospital visit | | * ΩTrapezoidal * LB: 5000 * LM: 5000 * UM: 7500 * UB: 50000 | | | | * ΩTrapezoidal * LB: 5000 * LM: 5000 * UM: 7500 * UB: 50000 | | | * ΩTrapezoidal * LB: 5000 * LM: 5000 * UM: 7500 * UB: 50000 | | | * ΩTrapezoidal * LB: 5000 * LM: 5000 * UM: 7500 * UB: 50000 | | | * ΩTrapezoidal * LB: 5000 * LM: 5000 * UM: 7500 * UB: 50000 | | |
| General practitioner visit | | * Uniform * LB: $44 * UB: $64 | | | | * Uniform * LB: $44 * UB: $64 | | | * Uniform * LB: $44 * UB: $64 | | | * Uniform * LB: $44 * UB: $64 | | | * Uniform * LB: $44 * UB: $64 | | |
| Specialist visit | | * Uniform * LB: $70 * UB: $90 | | | | * Uniform * LB: $70 * UB: $90 | | | * Uniform * LB: $70 * UB: $90 | | | * Uniform * LB: $70 * UB: $90 | | | * Uniform * LB: $70 * UB: $90 | | |

**Note**: For some parameters (e.g. proportion that left work permanently), we had limited or no data to indicate any differences between subgroups (e.g., male vs. female or vaccinated vs. unvaccinated.) As such, we kept these parameters the same for all subgroups.

Ɵ This parameter includes post-COVID-19 conditions related to reduced work hours, the need for modified work, etc. It does not include missed work due to PCC symptoms.

£ This represents the Canadian full-time average income assuming 260 workdays over a 12-month calendar period.

¥ Estimates include hospital-only costs (i.e., not including physician costs) for PCC patients with ICD-10 code U07.4 (PCC) from January 2021 to March 2022.

Ω Trapezoidal distributions are characterized by a quadrilateral shape with two parallel and two non-parallel sides. This distribution is a good fit when parameters exhibit an initial increase, a subsequent stabilization phase, and a decline in the probability distribution. Four points specify the trapezoidal distribution: the lower (LB) and upper (UB) bounds and the lower (LM) and upper (UM) modes between which the density is flat and equal to these modes; this flat region is the zone of indifference (Fox et al., 2005).

\*\* The parameter mean was estimated using sampling weights provided by Statistics Canada, and the variance was calculated using a balanced repeated replication method to account for the complex survey design with 1000 replicate weights.

Abbreviations: µ= mean of the parameter; SE = standard error of the mean; CAD = Canadian dollar; PCC = Post-covid condition.

**Appendix 3**: Several R packages were utilized for data manipulation, statistical analysis, visualization, and interactive application development during the analyses conducted as part of this study. Below is a list of the R packages employed, along with a brief description of their functionality:

* glue: Simplifies the interpolation of strings to enhance data manipulation and reporting.
* scales: Provides tools for visually appealing and meaningful data scaling in graphics.
* flextable: Enables the creation of tables for reporting that can be easily formatted and adjusted.
* lubridate: Facilitates working with dates and times, simplifying time-based data management.
* forcats: Designed to handle categorical variables and their associated challenges more effectively.
* stringr: This program offers simple, consistent tools for working with strings, particularly for string manipulation.
* dplyr: Aims at simplifying and speeding up data manipulation tasks.
* purrr: Enhances R's functional programming capabilities by providing a complete approach to working with functions and vectors.
* readr: Utilized for fast and efficient reading of tabular data into R.
* tidyr: Helps in tidying data, making it more suitable for analysis.
* tibble: Provides a modern rethinking of data frames, improving the user experience and performance.
* ggplot2: A system for declaratively creating graphics based on the grammar of graphics.
* tidyverse: An ecosystem of packages designed to work together to make data science fast, fluid, and fun.
* shinyjs: Allows the user to enhance the interactivity of Shiny applications with JavaScript functionalities.
* shinythemes: Provides additional themes to customize the appearance of Shiny applications.
* shiny: Enables the creation of interactive web applications directly from R.

**GITHUB LINK FOR R CODE:** [PHMUphac/PCC\_Costing: Healthcare and Labour Impacts of Post COVID-19 Condition in Canada: A Health Economic Costing Model (github.com)](https://github.com/PHMUphac/PCC_Costing)

**Appendix 4:** Estimated national and provincial level costs (Millions, 2023 CAD $) among participants reporting post-COVID-19 conditions in the Canadian COVID-19 Antibody and Health Survey (CCAHS-2).Values in brackets are the 95% simulation intervals representing the uncertainty of input model parameters.

The numbers in the first column represent the assumption condition for emergency department and inpatient hospitalization rates for those reporting PCC symptoms. These include: (#1) rates are the same as the 2019 to 2021 rates observed for the general population over 20 years; (#2) rates are 1.5 times higher than 2019 to 2021 observed rate for the general population over 20 years; (#3) rates are 2.0 times higher than 2019 to 2021 observed rate for the general population over 20 years; and (#4) rates are 3.0 times higher than 2019 to 2021 observed rate for the general population over 20 years. The estimated number of SARS-CoV-2 infections is shown in **Appendix 7**. The emergency visit and hospitalization rates are presented in **Appendix 8** and **9**.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| # | Region | PCC cases | ED visits | Inpatient stays | Outpatient GP visits | Specialist visits | Missed School or Work | Productivity Loss | Total |
| 1 | National | 1329281  (1152085, 1510682) | 210  (154, 277) | 2016  (1076, 3324) | 453  (224, 749) | 117  (52, 185) | 8663  (6759, 10881) | 10100  (4605, 15976) | 21559  (15306, 28379) |
| 2 | National | 1329281  (1152085, 1510682) | 313  (230, 414) | 2981  (1591, 4923) | 453  (224, 749) | 117  (52, 185) | 8663  (6759, 10881) | 10100  (4605, 15976) | 22627  (16134, 29663) |
| 3 | National | 1329281  (1152085, 1510682) | 418  (307, 552) | 3962  (2110, 6565) | 453  (224, 749) | 117  (52, 185) | 8663  (6759, 10881) | 10100  (4605, 15976) | 23712  (16997, 31005) |
| 4 | National | 1329281  (1152085, 1510682) | 626  (460, 828) | 5963  (3183, 9847) | 453  (224, 749) | 117  (52, 185) | 8663  (6759, 10881) | 10100  (4605, 15976) | 25921  (18774, 33894) |
| 1 | British Columbia | 186591  (134753, 239919) | 29  (15, 50) | 284  (69, 684) | 64  (9, 152) | 16  (1, 35) | 1215  (709, 1905) | 1420  (70, 3025) | 3028  (1400, 5005) |
| 2 | British Columbia | 186591  (134753, 239919) | 44  (22, 74) | 419  (102, 1016) | 64  (9, 152) | 16  (1, 35) | 1215  (709, 1905) | 1420  (70, 3025) | 3178  (1494, 5228) |
| 3 | British Columbia | 186591  (134753, 239919) | 59  (29, 99) | 557  (135, 1354) | 64  (9, 152) | 16  (1, 35) | 1215  (709, 1905) | 1420  (70, 3025) | 3331  (1587, 5461) |
| 4 | British Columbia | 186591  (134753, 239919) | 88  (44, 149) | 839  (204, 2031) | 64  (9, 152) | 16  (1, 35) | 1215  (709, 1905) | 1420  (70, 3025) | 3642  (1756, 5971) |
| 1 | Alberta | 170175  (122364, 218796) | 27  (14, 45) | 261  (62, 624) | 58  (9, 139) | 15  (1, 32) | 1105  (647, 1734) | 1290  (58, 2777) | 2756  (1252, 4555) |
| 2 | Alberta | 170175  (122364, 218796) | 40  (21, 67) | 385  (92, 927) | 58  (9, 139) | 15  (1, 32) | 1105  (647, 1734) | 1290  (58, 2777) | 2894  (1348, 4760) |
| 3 | Alberta | 170175  (122364, 218796) | 54  (28, 90) | 512  (121, 1237) | 58  (9, 139) | 15  (1, 32) | 1105  (647, 1734) | 1290  (58, 2777) | 3034  (1427, 4973) |
| 4 | Alberta | 170175  (122364, 218796) | 80  (42, 135) | 771  (184, 1854) | 58  (9, 139) | 15  (1, 32) | 1105  (647, 1734) | 1290  (58, 2777) | 3319  (1583, 5446) |
| 1 | Manitoba | 40614  (29264, 52438) | 6  (3, 11) | 61  (15, 147) | 14  (2, 33) | 4  (0, 8) | 265  (154, 417) | 308  (17, 659) | 658  (307, 1079) |
| 2 | Manitoba | 40614  (29264, 52438) | 10  (5, 16) | 91  (22, 218) | 14  (2, 33) | 4  (0, 8) | 265  (154, 417) | 308  (17, 659) | 690  (326, 1128) |
| 3 | Manitoba | 40614  (29264, 52438) | 13  (7, 21) | 121  (29, 293) | 14  (2, 33) | 4  (0, 8) | 265  (154, 417) | 308  (17, 659) | 723  (345, 1180) |
| 4 | Manitoba | 40614  (29264, 52438) | 19  (10, 32) | 182  (44, 436) | 14  (2, 33) | 4  (0, 8) | 265  (154, 417) | 308  (17, 659) | 791  (382, 1292) |
| 1 | Saskatchewan | 41504  (30118, 53500) | 7  (3, 11) | 62  (15, 152) | 14  (2, 34) | 4  (0, 8) | 269  (157, 420) | 315  (16, 674) | 671  (307, 1109) |
| 2 | Saskatchewan | 41504  (30118, 53500) | 10  (5, 16) | 92  (23, 226) | 14  (2, 34) | 4  (0, 8) | 269  (157, 420) | 315  (16, 674) | 704  (327, 1158) |
| 3 | Saskatchewan | 41504  (30118, 53500) | 13  (7, 22) | 123  (30, 302) | 14  (2, 34) | 4  (0, 8) | 269  (157, 420) | 315  (16, 674) | 738  (348, 1217) |
| 4 | Saskatchewan | 41504  (30118, 53500) | 20  (10, 33) | 185  (45, 451) | 14  (2, 34) | 4  (0, 8) | 269  (157, 420) | 315  (16, 674) | 806  (381, 1337) |
| 1 | Ontario | 489978  (353340, 627976) | 77  (40, 130) | 742  (181, 1779) | 167  (25, 400) | 43  (2, 92) | 3198  (1880, 4942) | 3703  (168, 7936) | 7931  (3672, 13117) |
| 2 | Ontario | 489978  (353340, 627976) | 115  (60, 194) | 1097  (266, 2642) | 167  (25, 400) | 43  (2, 92) | 3198  (1880, 4942) | 3703  (168, 7936) | 8324  (3909, 13651) |
| 3 | Ontario | 489978  (353340, 627976) | 154  (81, 259) | 1458  (351, 3536) | 167  (25, 400) | 43  (2, 92) | 3198  (1880, 4942) | 3703  (168, 7936) | 8724  (4144, 14231) |
| 4 | Ontario | 489978  (353340, 627976) | 231  (120, 389) | 2195  (532, 5284) | 167  (25, 400) | 43  (2, 92) | 3198  (1880, 4942) | 3703  (168, 7936) | 9537  (4593, 15608) |
| 1 | Quebec | 327852  (238598, 418865) | 52  (27, 87) | 496  (122, 1198) | 111  (17, 269) | 29  (1, 62) | 2138  (1258, 3331) | 2507  (120, 5334) | 5333  (2461, 8798) |
| 2 | Quebec | 327852  (238598, 418865) | 77  (40, 129) | 734  (179, 1775) | 111  (17, 269) | 29  (1, 62) | 2138  (1258, 3331) | 2507  (120, 5334) | 5596  (2652, 9181) |
| 3 | Quebec | 327852  (238598, 418865) | 103  (53, 173) | 975  (237, 2382) | 111  (17, 269) | 29  (1, 62) | 2138  (1258, 3331) | 2507  (120, 5334) | 5863  (2798, 9608) |
| 4 | Quebec | 327852  (238598, 418865) | 155  (79, 259) | 1468  (358, 3551) | 111  (17, 269) | 29  (1, 62) | 2138  (1258, 3331) | 2507  (120, 5334) | 6407  (3120, 10502) |
| 1 | Atlantic Provinces | 72567  (52650, 92871) | 11  (6, 19) | 110  (27, 266) | 25  (4, 60) | 6  (0, 14) | 472  (275, 738) | 557  (28, 1176) | 1182  (544, 1919) |
| 2 | Atlantic Provinces | 72567  (52650, 92871) | 17  (9, 28) | 162  (40, 394) | 25  (4, 60) | 6  (0, 14) | 472  (275, 738) | 557  (28, 1176) | 1240  (578, 2006) |
| 3 | Atlantic Provinces | 72567  (52650, 92871) | 23  (12, 38) | 216  (52, 527) | 25  (4, 60) | 6  (0, 14) | 472  (275, 738) | 557  (28, 1176) | 1299  (614, 2108) |
| 4 | Atlantic Provinces | 72567  (52650, 92871) | 34  (17, 57) | 324  (79, 789) | 25  (4, 60) | 6  (0, 14) | 472  (275, 738) | 557  (28, 1176) | 1419  (675, 2310) |

1. The Canadian COVID-19 Antibody and Health Survey (CCAHS) included SARS-COV-2 infections between January 2020 and May 2022. Post-COVID-19 conditions (PCC) were defined as the continuation or development of new symptoms at least 84 days after the initial SARS-CoV-2 infection. The values presented above are population-level estimates that used sampling and bootstrap weights provided by Statistics Canada.
2. The CCAHS-2 included adults aged 18+ living in 10 provinces. It did not include persons living in the Territories, on reserves, Canadian Forces personnel living on base, persons living in institutions, or residents of certain remote regions.
3. The number of PCC cases in this Table is estimated using the average and 95% interval from Monte Carlo simulations accounting for the uncertainty of input parameters. Thus, the average values in this table do not match the “weighted population average” in Figure 1 and Table 2.

**Appendix 5:** Estimated costs (Millions, 2023 CAD $) among subgroups reporting post-COVID-19 conditions in the Canadian COVID-19 Antibody and Health Survey.Values in brackets are the 95% simulation intervals representing the uncertainty of input model parameters.

The numbers in the first column represent the assumption condition for emergency department and inpatient hospitalization rates for those reporting PCC symptoms. These include: (#1) rates are the same as the 2019 to 2021 rates observed for the general population over 20 years; (#2) rates are1.5 times higher than the 2019 to 2021 observed rate for the general population over 20 years; (#3) rates are 2.0 times higher than the 2019 to 2021 observed rate for the general population over 20 years; and (#4) rates are 3.0 times higher than the 2019 to 2021 observed rate for the general population over 20 years. The estimated number of SARS-CoV-2 infections is shown in **Appendix 7**. The emergency visit and hospitalization rates are presented in **Appendix 8** and **9**.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| # | Subgroup | Estimated number of PCC Cases | Healthcare Costs  (95% SI) | Productivity Losses  (95% SI) | Total  (95% SI) |
| 1 | Full cohort | 1329281  (1152085, 1510682) | 2796  (1784, 4163) | 18763  (12776, 25235) | 21559  (15306, 28379) |
| 2 | Full cohort | 1329281  (1152085, 1510682) | 3864  (2404, 5869) | 18763  (12776, 25235) | 22627  (16134, 29663) |
| 3 | Full cohort | 1329281  (1152085, 1510682) | 4949  (3042, 7614) | 18763  (12776, 25235) | 23712  (16997, 31005) |
| 4 | Full cohort | 1329281  (1152085, 1510682) | 7159  (4315, 11112) | 18763  (12776, 25235) | 25921  (18774, 33894) |
| 1 | Males | 470646  (431867, 510611) | 844  (555, 1227) | 8121  (5755, 10568) | 8965  (6542, 11497) |
| 2 | Males | 470646  (431867, 510611) | 1152  (743, 1692) | 8121  (5755, 10568) | 9272  (6802, 11817) |
| 3 | Males | 470646  (431867, 510611) | 1482  (939, 2207) | 8121  (5755, 10568) | 9603  (7083, 12212) |
| 4 | Males | 470646  (431867, 510611) | 2143  (1327, 3244) | 8121  (5755, 10568) | 10264  (7636, 13027) |
| 1 | Females | 829093  (773373, 886310) | 1925  (1233, 2852) | 9629  (6574, 12744) | 11554  (8333, 14830) |
| 2 | Females | 829093  (773373, 886310) | 2714  (1697, 4086) | 9629  (6574, 12744) | 12343  (8967, 15780) |
| 3 | Females | 829093  (773373, 886310) | 3494  (2151, 5315) | 9629  (6574, 12744) | 13123  (9593, 16780) |
| 4 | Females | 829093  (773373, 886310) | 5064  (3050, 7791) | 9629  (6574, 12744) | 14693  (10799, 18933) |
| 1 | 0 Vaccines | 589143  (535828, 645415) | 1927  (1193, 2921) | 9772  (6971, 12694) | 11699  (8681, 14858) |
| 2 | 0 Vaccines | 589143  (535828, 645415) | 2835  (1717, 4360) | 9772  (6971, 12694) | 12607  (9434, 15995) |
| 3 | 0 Vaccines | 589143  (535828, 645415) | 3659  (2198, 5650) | 9772  (6971, 12694) | 13431  (10066, 17096) |
| 4 | 0 Vaccines | 589143  (535828, 645415) | 5332  (3150, 8310) | 9772  (6971, 12694) | 15104  (11300, 19437) |
| 1 | 2+ Vaccines | 636900  (591167, 684231) | 720  (490, 1000) | 7364  (4731, 10089) | 8084  (5433, 10825) |
| 2 | 2+ Vaccines | 636900  (591167, 684231) | 960  (641, 1363) | 7364  (4731, 10089) | 8324  (5657, 11078) |
| 3 | 2+ Vaccines | 636900  (591167, 684231) | 1169  (770, 1683) | 7364  (4731, 10089) | 8532  (5832, 11305) |
| 4 | 2+ Vaccines | 636900  (591167, 684231) | 1630  (1050, 2392) | 7364  (4731, 10089) | 8994  (6221, 11813) |

1. The Canadian COVID-19 Antibody and Health Survey (CCAHS) included SARS-COV-2 infections between January 2020 and May 2022. Post-COVID-19 conditions (PCC) were defined as the continuation or development of new symptoms at least 84 days after the initial SARS-CoV-2 infection, lasting at least eight weeks without explanation. The values presented above are population-level estimates that used sampling and bootstrap weights provided by Statistics Canada.
2. The CCAHS-2 included adults aged 18+ living in 10 provinces. It did not include persons living in the Territories, on reserves, Canadian Forces personnel living on base, persons living in institutions, or residents of certain remote regions.
3. The number of PCC cases in this Table is estimated using the average and 95% interval from Monte Carlo simulations accounting for the uncertainty of input parameters. Thus, the average values in this table do not match the “weighted population average” in Figure 1 and Table 2.

**Appendix 6:** Additional modellingassumptions for costs that would have been observed in the absence of a COVID-19 vaccine program.

Assumption 1**:** We would have observed the same infection rate for vaccinated (2+ vaccine doses) and unvaccinated (0 vaccine doses) individuals.

* This assumption is unlikely to hold true because those with 0 vaccine doses were more likely to have been infected by earlier strains (e.g., Wave 1 and 2) of the SARS-CoV-2 virus compared to vaccinated respondents.

Assumption 2**:** In the absence of COVID-19 vaccination, we would have observed similar outcome rates (e.g., PCC prevalence, missed work days, health care utilization, symptom duration, etc.) as the unvaccinated group.

This assumption is unlikely to hold because those with 0 vaccine doses were more likely to have been infected by earlier strains (e.g., Wave 1 and 2) of the SARS-CoV-2 virus, which elicited different COVID-19 disease severity (i.e., virulence).

**Appendix 7:** Estimated number of SARS-CoV-2 infections from CCAHS-2 by geographic region.(Statistics Canada, 2022)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Region | Entire cohort  (Standard error) | Males  (Standard error) | Females  (Standard error) | 0 vaccine doses  (Standard error) | 2+ vaccine doses  (Standard error) |
| British Columbia | 1,073,008 (43466) | 551,681 (32846) | 502,674 (28003) | 310,513 (26383) | 714,302 (39211) |
| Alberta | 977,713 (39668) | 505,832 (28927) | 468,568 (26965) | 355,546 (27561) | 567,366 (32891) |
| Saskatchewan | 238,118 (10216) | 118,182 (7746) | 110,284 (6883) | 69,898 (6503) | 153,757 (9218) |
| Manitoba | 233,350 (11109) | 112,148 (8291) | 119,948 (7627) | 62,524 (6303) | 158,435 (10001) |
| Ontario | 2,818,860 (94039) | 1,323,045 (69721) | 1,44,6879 (63530) | 941,067 (65425) | 1,714,089 (83596) |
| Quebec | 1,888,729 (54346) | 978,000 (42377) | 899,530 (34726) | 536,288 (33513) | 1,294,022 (49306) |
| Atlantic Provinces | 418,486 (12254) | 207,687 (9653) | 204,166 (7585) | 99,670 (7080) | 298,312 (10633) |

1. The Canadian COVID-19 Antibody and Health Survey (CCAHS) included SARS-COV-2 infections between January 2020 and May 2022. Post-COVID-19 conditions (PCC) were defined as the continuation or development of new symptoms at least 84 days after the initial SARS-CoV-2 infection, lasting at least eight weeks without explanation. The values presented above are population-level estimates that used sampling and bootstrap weights provided by Statistics Canada.
2. The CCAHS-2 included adults aged 18+ living in 10 provinces. It did not include persons living in the Territories, on reserves, Canadian Forces personnel living on base, persons living in institutions, or residents of certain remote regions.
3. The number of SARS-CoV-2 infections was estimated using sampling weights provided by Statistics Canada, and the variance was calculated using a balanced repeated replication method to account for the complex survey design with 1000 replicate weights.

**Appendix 8:** Distribution of monthly per person emergency department rates among those with PCC symptoms for different assumptions about the relative increase in emergency department visit rates compared to the general population over 20 years in 2019 to 2021 (24 months). For example

\*\* The rates in column 1 are based on the observed all-cause emergency department visits between Jan 1, 2019, and Dec 31, 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | The assumption about the relative increase in ED visit rate for those reporting PCC symptoms | | | |
| Group | **Bounds** | **#1**  **No difference \*\*** | **#2**  **1.5x** | **#3**  **2x** | **#4**  **3x** |
| Both | **LB** | 0.019 | 0.028 | 0.038 | 0.056 |
| **LM** | 0.025 | 0.038 | 0.05 | 0.075 |
| **UM** | 0.038 | 0.056 | 0.075 | 0.113 |
| **UB** | 0.044 | 0.066 | 0.088 | 0.132 |
| Males | **LB** | 0.018 | 0.028 | 0.037 | 0.055 |
| **LM** | 0.025 | 0.037 | 0.049 | 0.074 |
| **UM** | 0.037 | 0.055 | 0.074 | 0.111 |
| **UB** | 0.043 | 0.065 | 0.086 | 0.129 |
| Females | **LB** | 0.019 | 0.029 | 0.038 | 0.057 |
| **LM** | 0.026 | 0.038 | 0.051 | 0.077 |
| **UM** | 0.038 | 0.057 | 0.077 | 0.115 |
| **UB** | 0.045 | 0.067 | 0.089 | 0.134 |
| 0 Vaccines | **LB** | 0.022 | 0.032 | 0.043 | 0.065 |
| **LM** | 0.029 | 0.043 | 0.058 | 0.087 |
| **UM** | 0.043 | 0.065 | 0.087 | 0.13 |
| **UB** | 0.05 | 0.076 | 0.101 | 0.151 |
| 2+ Vaccines | **LB** | 0.016 | 0.024 | 0.032 | 0.048 |
| **LM** | 0.021 | 0.032 | 0.043 | 0.064 |
| **UM** | 0.032 | 0.048 | 0.064 | 0.096 |
| **UB** | 0.037 | 0.056 | 0.075 | 0.112 |

**Appendix 9:** Distribution of monthly per person hospitalization rates among those with PCC symptoms for different assumptions about the relative increase in hospitalization rates compared to the general population over 20 years in 2019 to 2021 (24 months).

\*\* The rates in column 1 are based on the observed all-cause hospitalization rate between Jan 1, 2019, and Dec 31, 2021. We included all-cause hospitalizations, including childbirths (the most frequent hospitalization type for females).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Bounds | The assumption about the relative increase in hospitalization rate for those reporting PCC symptoms | | | |
| **No difference \*\*** | **1.5x** | **2x** | **3x** |
| Both | **LB** | 0.005 | 0.007 | 0.009 | 0.014 |
| **LM** | 0.006 | 0.009 | 0.012 | 0.018 |
| **UM** | 0.009 | 0.014 | 0.018 | 0.028 |
| **UB** | 0.011 | 0.016 | 0.022 | 0.032 |
| Males | **LB** | 0.004 | 0.006 | 0.008 | 0.012 |
| **LM** | 0.005 | 0.008 | 0.011 | 0.016 |
| **UM** | 0.008 | 0.012 | 0.016 | 0.025 |
| **UB** | 0.01 | 0.014 | 0.019 | 0.029 |
| Females | **LB** | 0.005 | 0.008 | 0.01 | 0.015 |
| **LM** | 0.007 | 0.01 | 0.014 | 0.02 |
| **UM** | 0.01 | 0.015 | 0.02 | 0.031 |
| **UB** | 0.012 | 0.018 | 0.024 | 0.036 |
| 0 Vaccines | **LB** | 0.005 | 0.008 | 0.011 | 0.016 |
| **LM** | 0.007 | 0.011 | 0.014 | 0.021 |
| **UM** | 0.011 | 0.016 | 0.021 | 0.032 |
| **UB** | 0.012 | 0.019 | 0.025 | 0.037 |
| 2+ Vaccines | **LB** | 0.004 | 0.006 | 0.008 | 0.012 |
| **LM** | 0.005 | 0.008 | 0.01 | 0.016 |
| **UM** | 0.008 | 0.012 | 0.016 | 0.024 |
| **UB** | 0.009 | 0.014 | 0.018 | 0.027 |

**Appendix 10:** Distribution of 2021 Canadian tax filers and dependants with income by total income, sex and age.

|  |  |  |  |
| --- | --- | --- | --- |
| Income Band \*\* | Both Sexes | Males | Females |
| $0 to $5,000 | 4.6% | 4.2% | 5.0% |
| $5,000 to $9999 | 3.9% | 3.1% | 4.6% |
| $10,000 to $14999 | 5.4% | 4.2% | 6.6% |
| $15,000 to $19999 | 6.6% | 6.0% | 7.1% |
| $20,000 to $24999 | 8.8% | 7.7% | 9.8% |
| $25,000 to $34999 | 13.0% | 11.5% | 14.4% |
| $35,000 to $49999 | 16.6% | 15.6% | 17.6% |
| $50,000 to $74999 | 18.7% | 19.5% | 18.0% |
| $75,000 to $99999 | 10.3% | 12.0% | 8.7% |
| $100,000 to $149999 | 7.9% | 10.1% | 5.8% |
| $150,000 to $199999 | 2.1% | 3.0% | 1.3% |
| $200,000 to $249999 | 0.8% | 1.2% | 0.5% |
| $250,000 to $1000000 | 1.2% | 1.8% | 0.6% |
| All persons with income | 28,931,530 | 14,030,430 | 14,901,100 |
| Mean (calculated) | $59107 | $68397 | $49791 |
| Median (calculated) | $41991 | $47663 | $37087 |
| Median (provided by SC) | $41650 | $47710 | $36900 |

SC=Statistics Cannada. Data were retrieved in March 2024.(Government of Canada, 2023)

Source: Statistics Canada. [Table 11-10-0008-01  Tax filers and dependants with income by total income, sex and age](https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110000801)

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