Determinants of post-COVID ill-health in a cohort of Canadian health care workers

by

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Abstract

Background:

During the COVID-19 pandemic, health care workers (HCW) were at risk of SARS-CoV-2 infection and of developing a post-COVID condition (PCC). Post-COVID conditions are generally defined to occur following the onset of COVID-19, be present after 3 months, and persist for at least 2 months. The objectives of this study were to determine health complaints by HCW attributed to COVID-19, examine the prevalence of a post-COVID condition among HCW and attempt to identify pre-pandemic factors and factors associated with experiences during the pandemic that increase or decrease risk of post-COVID symptoms among HCW.

Methods:

A prospective cohort of Canadian HCW was recruited at the beginning of the pandemic in March 2020. Questionnaires were distributed online four times to those who consented, from the start of the pandemic to summer 2022. Questionnaires collected data on demographics, pre-pandemic medical history, COVID-19 infections, symptoms and severity, vaccination status, work-related factors, and mental health. The 2022 questionnaire additionally asked participants if they have had a condition they believed to be a result of, or made worse by, their COVID-19 infection. From the full cohort, we selected a sub-cohort that included all those with only one positive COVID-19 test who had completed the 2022 questionnaire. Test dates for Alberta, British Columbia and Quebec participants were validated with provincial health records. Within this sub-cohort, the proportion with a PCC was estimated for those with a case date at least 90 days before completion of the questionnaire. Binary logistic regression was used to evaluate the relationship between PCC and risk factors in a model allowing for gender, age, and HCW job type.

Results:

The full cohort comprised 4964 HCW. In our sub-cohort (N=1653), 967 had a positive COVID-19 test at least 90 days before completing the questionnaire. Among these HCW, we estimated a post-COVID condition prevalence of 27%. (n=263). In our final model, a PCC was least likely to be reported by physicians and was not related to gender or age. The following factors increased the likelihood of a PCC in the multivariable model: higher pre-infection anxiety (OR=1.06, 95% CI: 1.02-1.10), a pre-existing mental health condition other than anxiety or depression (OR=4.55, 95% CI: 1.29-16.02), a pre-existing chronic condition other than respiratory or mental health (OR=1.90, 95% CI: 1.35- 2.67) and perception of being infected at work (OR= 1.52, 95% CI: 1.09-2.12). Number of vaccines received prior to infection reduced the likelihood of a PCC (OR=0.77, 95% CI: 0.66-0.89). When stratified by vaccination status, unvaccinated HCW infected later in the pandemic, compared to earlier, were less likely to develop a PCC (OR= 0.84, 95% CI: 0.74 to 0.95). Symptom severity from initial infection increased risk, specifically from chest pain (OR=1.49, 95% CI: 1.22-1.81), shortness of breath (OR=1.22, 95% CI: 1.04-1.44) and trouble thinking (OR=1.75, 95% CI: 1.45-2.11). HCWs rated functional limitation due to a PCC at a median of 31% and 27% for classic and non-classic symptoms respectively, and 98% of all HCW working at the time of their infection returned to work in 30 days or less. A severe PCC (n=57) was more likely among nurses and those with higher pre-infection anxiety and was reduced as number of vaccines increased.

Conclusion:

Certain pre-existing factors and factors experienced during the pandemic predisposed HCW to a PCC. Overall, HCWs generally did not report a severe PCC, with almost all HCW returning to work quickly after infection. As HCW continue to face potential new waves and increased risk of infection and of developing a post-COVID condition, it is important to identify vulnerable groups

and modifiable factors to help mitigate the deleterious long-term effects, both at a personal and occupational level.

Preface

This thesis is an original work by Tanis Zadunayski. It is part of a larger research project led by Dr. Nicola Cherry at the University of Alberta, that is investigating the impact of COVID-19 on the health of Canadian physicians, nurses, and other health care workers. It has received research ethics approval from the Health Research Ethics Board at the University of Alberta (Pro00099700).

Dedication

I dedicate this thesis to my family, who have provided unconditional support and encouragement throughout my academic career. Thank you for your continuous motivation as I strive to achieve my goals.

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Table of Contents

Abstract ii

Preface v

Dedication vi

Acknowledgements vii

List of Tables xii

List of Figures xiv

List of Abbreviations xv

Chapter 1: Introduction 1

1.1 Background 1

Chapter 2: Literature Review 4

2.1 Categorizing Long Term Sequelae of COVID-19 6

2.1.1 Defining Long COVID and Post-COVID Conditions 6

2.2 The Epidemiology of Post-COVID Condition 6

2.2.1 Prevalence 6

2.2.2 Etiology and potential causal factors 7

2.2.3 Diagnosis 8

2.2.4 Symptoms 10

2.3 Literature Review of a Post-COVID Condition in HCW 10

2.3.1 Prevalence of a post-COVID Condition in HCW 15

2.3.2 Characteristics 17

2.3.3 Identified Risk Factors 22

2.3.4 Association of COVID-19 Vaccination and a Post-COVID Condition 28

2.4 Conclusion 29

2.5 Objective of Thesis 30

Chapter 3: Methods 32

3.1 Study Design/Setting 32

3.2 Study Population and Recruitment 32

3.3 Data Collection 33

3.4 Sub-Cohort Selection for the study of post-covid conditions 35

3.5 Classification of Post-COVID Symptoms and Conditions 35

3.6 Outcome Measure 37

3.6.1 Report of a Post-COVID Condition 37

3.6.2 Post-COVID Ill-Health Variables 38

3.7 Variables for Analysis: 40

3.7.1 General Characteristic Variables (potential confounders) 40

3.7.2 Potential Risk Factors 42

3.7.3 Time periods 51

3.8 Health Record Linkage 51

3.8.1 Alberta Administrative Health Database Linkage: Pre-pandemic Mental Health & Respiratory conditions 51

3.9 Statistical Methods 52

3.10 Subgroup Analyses 53

3.10.1 Vaccination Status and Infection Period 53

3.10.2 Perception of Being Infected at Work 54

3.10.3 Severity of Infection 54

3.10.4 Post-COVID Severity 55

3.10.5 Alberta Administrative Health Database Linkage: Pre-pandemic Mental Health & Respiratory conditions Sub-Analysis 56

3.11 Ethical Considerations 56

Chapter 4: Results **57**

4.1 Characteristics of Post-COVID Ill-Health 57

4.1.1 Post-COVID Symptoms 57

4.1.2 Consultation with a Health Professional 61

4.2 Baseline Characteristics and Pre-Existing Conditions 63

4.2.1 Baseline Characteristics 63

4.2.2 Work Role 64

4.2.3 Pre-Infection Substance Use 66

4.2.4 Pre-existing Mental Health 68

4.2.5 Pre-existing Mental Health: Other Conditions 70

4.2.6 Pre-existing conditions other than mental health 70

4.3 Association with Vaccination 78

4.4 Association with Work Factors 81

4.4.1. 1-on-1 Contact with COVID-19 Patients & Role Setting 81

4.5 Association of Work, Time and Severity Factors with PCC 83

4.5.1 Work Factors Related to Infection Episode 83

4.5.2 Infection Period During the Pandemic 86

4.5.3 Severity of infection: Symptoms 88

4.6 Sub-Analysis using Alberta Health Records 94

4.7 Final Model 96

Chapter 5: Discussion **106**

Bibliography **114**

Appendices 124

Appendix A. *Questionnaires* 124

A.1 Phase 1 Questionnaire for Alberta Registered Nurses (RNs).....124

A.2 Phase 2 Questionnaire for Alberta Healthcare Aides (HCAs) 160

A.3 Phase 3 Questionnaire for Ontario Personal Support Workers (PSWs).....205

A.4 Phase 4 Questionnaire for Alberta Physicians (MDs) 262

Appendix B*. Details of other chronic conditions listed by participants by ICD-10 Chapter*.319

Appendix C*. Sub-Analysis: Factors Associated With Developing a Severe post-COVID Condition* 321

List of Tables

Table 1. *Characteristics of the 5 studies on post-COVID ill health in HCW selected for detailed critical review* 5
Table 2. *Characteristics of eligible studies on post-COVID ill health in HCW* 11
Table 3. *Characteristics of eligible studies on post-COVID ill health in HCW* 12
Table 4*. Characteristics of eligible studies on post-COVID ill health in HCW* 13
Table 5. *Most common symptoms among eligible studies on post-COVID ill health in HCW* 18
Table 6. *Observational HCW studies: Demographic and health-related risk factors for developing long COVID or post-COVID* 23
Table 7*. Observational HCW studies: Occupation and acute infection-related risk factors for developing long COVID or post-COVID* 24
Table 8. *Categorization of self-reported post-COVID symptoms and conditions attributed to COVID-19* 36
Table 9*. Defining post-COVID variables* 39
Table 10. *Defining general characteristic variables* 41
Table 11*. Defining potential predictive variables* 46
Table 12. *Characteristics of reported post-COVID conditions in HCW (N=263)* 60
Table 13*. Severity (daily limitation) of reported post-COVID condition in HCW* 61
Table 14. *Discussion of post-COVID condition with a health professional (N=263)* 62
Table 15. *Suggestions given by a health professional for post-COVID condition. N=263* 63
Table 16. *Association between explanatory factors and developing a post-COVID condition* 65
Table 17. *Association between substance use and developing a post-COVID condition* 67
Table 18. *Association between previous mental health and developing a post-COVID condition* 69
Table 19. *Self-report of other mental health conditions listed (n=11)* 70
Table 20. *Association between previous chronic conditions and developing a post-COVID condition* 72
Table 21. *Self-report of other respiratory conditions listed (n=8)* 73
Table 22. *Self-report of other chronic conditions (ICD-10 Chapter) and developing a post-COVID condition (PCC). (n=97)** 74
Table 23. *Association between previous auto-immune conditions and developing a post-COVID condition* 77

Table 24. *Association between vaccination and developing a post-COVID condition* 79
Table 25. *Association between most recent work setting and type of patient contact prior to infection and developing a post-COVID condition* 82
Table 26. *Association between work factors related to infection episode and developing a post-COVID condition*.....84
Table 27. *Association between time of infection during the pandemic and developing a post-COVID condition*.....87
Table 28. *Derivation of severity score. Distribution of symptom responses (N=705)** 89
Table 29. *Association between reporting a post-COVID condition and total severity of infection symptoms (at most recent questionnaire following infection). (N=967)*.....91
Table 30. *Derivation of a final model for the association between reporting a post-COVID condition and severity of infection symptoms (at most recent questionnaire following infection). (N=967)*.....92
Table 31. *Final model of the association between reporting a post-COVID condition and severity of infection symptoms (at most recent questionnaire following infection). (N=967)*.....93
Table 32. *Association of a post-COVID condition and pre-existing conditions (billing codes) in Alberta HCW based on Alberta Health Data (35 months pre-pandemic). (n=614)* 95
Table 33. *Derivation of a multivariable model from factors found to be associated with a post-COVID condition*.....97
Table 34. *Final Model of associations with developing a post-COVID condition* 98
Table 35. *Effect of months since the start of the pandemic at time of infection on the final model* 99
Table 36. *Final Model among unvaccinated participants only (includes months since start of pandemic at time of infection). (N=122)*.....101
Table 37. *Final Model among vaccinated participants only (includes months since start of pandemic at time of infection). (N=845)*.....102
Table 38. *Effect of total symptom severity on the final model* 103
Table 39. Final Model investigating the risk of developing a severe PCC (classic+>50% limitation).....105

List of Figures

Figure 1. *Timeline of Study Phases and Questionnaire Distribution* 35

Figure 2. Flow chart of sub-cohort and final sample selection 58

Figure 3. *Self-report of other chronic conditions (ICD-10 Chapter) and developing a post-COVID condition (PCC). (n=97)* 76

Figure 4. *Vaccination status and developing a post-COVID condition* 80

Figure 5. *Changes in the perception of being infected at work with a post-COVID condition (PCC) over time.* 85

List of Abbreviations

AHDB	Alberta Administrative Health Database
BC	British Columbia
BMI	Body Mass Index
CCAHS	Canadian COVID-19 Antibody and Health Survey
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
COVID-19	Coronavirus Disease 2019
DASS21	Depression Anxiety Stress Scale-21
DF	Degrees Freedom
GI	Gastrointestinal
GUTS	Growing Up Today Study
HADS	Hospital Anxiety and Depression Scale
HCA	Health Care Aide
HCW	Health Care Workers
IBD	Irritable Bowel Disease
ICD-9	International Classification of Diseases, Ninth Revision
ICD-10	International Classification of Diseases, Tenth Revision
ICU	Intensive Care Unit
IQR	Interquartile Range
K6	Kessler Psychological Distress Scale 6
LPN	Licensed Practical Nurse
LRT	Likelihood Ratio Test
ME/CFS	Myalgic Encephalomyelitis/Chronic Fatigue Syndrome
MD	Medical Doctor (physician)
MH	Mental Health
NHS2	Nurses' Health Study 2
NHS3	Nurses' Health Study 3
OR	Odds Ratio
PASC	Post-acute Sequelae of SARS-CoV-2 Infection

PCC	Post-COVID Condition
PCR	Polymerase Chain Reaction
PHQ-4	Patient Health Questionnaire-4
PSW	Personal Support Worker
RN	Registered Nurse
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus-2
VR-12	Veterans Rand 12 Item Health Survey
WAI	Work Ability Index
WCB	Workers' Compensation Board
WHO	World Health Organization
12m	12 Months

Chapter 1: Introduction

1.1 Background

During the coronavirus disease 2019 (COVID-19) pandemic, the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infected approximately 770 million individuals globally and led to the death of nearly 7 million[1]. According to the World Health Organization (WHO), as of January 21st 2024 Canada has reached approximately 4.7 million cases[2], with a death toll of 54,000.[3]

Some individuals who have been infected with the SARS-CoV-2 virus have continued to develop crippling long-term effects or symptoms from their COVID-19 illness, often known as long COVID or post-COVID condition. Since September 2020, this long-term sequela of COVID-19 is listed in the International Classification of Diseases (ICD) published by the World Health Organization, with post-COVID-19 condition coded as U09.9 in the 10th edition and RA02 in the 11th edition under the chapter for codes for special purposes and sub-category for provisional assignment of new diseases of uncertain etiology or emergency use.[4-6] Long-term COVID-19 effects may also be referred as post-COVID conditions (PCC), chronic COVID, post-acute COVID-19, long-haul COVID, or post-acute sequelae of SARS-CoV-2 infection (PASC).[7] For clarity on the heterogenous nature of this condition, the World Health Organization (WHO) defined a post-COVID condition, in October 2021, as symptoms which occur following the onset of COVID-19, be present after 3 months, and persist for at least 2 months without an alternate diagnosis.[4,8] This definition is generally accepted and used globally among institutions and parliament, such as the government of Canada.[9] Symptoms of a post-COVID condition can range from physical to neurocognitive impairment, with an extensive array of heterogeneity and severity. Some of the most common symptoms among adults, according to the Government of

Canada, include fatigue, trouble sleeping, shortness of breath (dyspnea), general pain and discomfort, cognitive problems such as memory loss and difficulty thinking or concentrating, and mental health symptoms such as anxiety and depression.[9] According to results from the Canadian COVID-19 Antibody and Health Survey (CCAHS), as of August 2022 the prevalence of a post-COVID condition in Canadian adults was 14.8%, with 47.3% of those affected experiencing symptoms for a year or more.[10] Among those with a post-COVID condition, 74.1% missed work or school due to persisting symptoms, with an average of 20 missed days.[10] Risk factors for post-COVID among those who had a COVID-19 infection include female sex (22.0%), number of pre-existing chronic conditions (≥4, 37.4%), chronic heart disease (39.3%), chronic lung condition (38.8%), chronic neurological disorder (38.6%), obesity (27.0%), living with a disability (28.3%), severity of initial symptoms (44.7% of those hospitalized), an earlier infection period (26.0% prior to July 2021), and being unvaccinated prior to infection (25.0%).[11] Compared to those unvaccinated, individuals who received 2 to 3 doses were half as likely to report persisting symptoms.[11]

During the COVID-19 pandemic, health care workers (HCW) were at risk of SARS-CoV-2 infection and so were at risk of developing a post-COVID condition. The impact of SARS-CoV-2 infection and lingering post-COVID ill-health on HCW may lead to detrimental effects on work performance, including absenteeism and presenteeism[12], fitness to work[13] and healthcare delivery.[13] The struggle for HCW to return to work at the same ability as their pre-infection self may be influenced by the outcome of a post-COVID condition, such as lingering fatigue, cognitive symptoms (memory and concentration), psychological symptoms, and inadequate sources for rehabilitation.[14] As HCW continue to face potential new waves and increased risk of infection and of developing a post-COVID condition, it is important to identify vulnerable groups

and modifiable factors to help mitigate the deleterious long-term effects, both at a personal and occupational level. Due to the relative novelty of long term COVID-19 effects, the prevalence and risk factors associated with a post-COVID condition are still not well understood. The objectives of this study were to determine health complaints by HCW attributed to COVID-19, examine the prevalence of a post-COVID condition among HCW related to the WHO definition of a post-COVID condition, and attempt to identify pre-pandemic factors and factors associated with experiences during the pandemic that increase or decrease risk of post-COVID symptoms among HCW.

Chapter 2: Literature Review

This review serves to provide a summary of current knowledge of the topics explored in this thesis and to critically assess gaps in the definition, categorization, epidemiology, diagnosis, and symptoms of a post-COVID condition. It considers the available literature focusing on identifying and characterizing a post-COVID condition in the HCW population.

Search protocol: Literature for identifying observational studies focused on a post-COVID condition in HCW was searched using PubMed. Relevant literature was searched for using a combination of keywords related to HCW and post-COVID. Relevant and original peer-reviewed study articles, which explored post-COVID ill health in HCW, were selected and examined. Review articles and studies focusing on serological findings were excluded. In addition to peer-reviewed articles, grey literature relevant to post-COVID was examined from Statistics Canada, Government of Canada, Centers for Disease Control and Prevention (CDC), and the World Health Organization (WHO). For this literature review, findings from the five best HCW studies have been selected for a detailed critical review and provide focus to the rationale of this thesis. These studies were selected based on their large sample sizes, internal validity, the type of risk factors investigated, and having strong evidence for their findings. The studies were also chosen for their potential inclusivity across various workplace settings and locations. Details of these 5 selected studies are explored further in the chapter, with their characteristics outlined in Table 1.

Table 1. *Characteristics of the 5 studies on post-COVID ill health in HCW selected for detailed critical review*

Reference	Country	Study Time Period	Infection Period	Study Design	Study Population, Setting	Sample Size	Outcome Condition*:	LC/PC Prevalence (%)
Carazo et al., 2022[33]	Quebec, Canada	July 2020-May 2021	July 2020-May 2021	Retrospective cohort & case-control	HCW, Selection: Invited all Quebec HCW with positive Provincial PCR Results, Workplace N/A	6061	Both	LC: 46.8% PC: 11.2%
Kahlert et al., 2023[34]	Switzerland	May 2020-June 2022	May 2020-May 2022	Cross-sectional & case-control	HCW, 9 healthcare networks	2912	Long COVID	23.9%
Peters et al., 2022[21]	Germany	Jan 2020-April 2021	Jan 2020-Dec 2020	Cross-sectional	HCW, non-governmental & welfare institutions (selected via employment insurance: job related infection claim)	2053	Both	LC: 74.2% PC: 72.8%
Shukla et al., 2023[35]	India	July 2021-Oct 2021	<Oct 2021	Multicenter cross-sectional	HCW, 8 tertiary care hospitals	679	Post COVID	30.3%
Wang et al., 2022[36]	USA	April 2020-Nov 2021	<Nov 2021	Prospective cohort	HCW and non-HCW, 3 large ongoing longitudinal studies: 1. NHS2 (nurses' health study 2) 2. NHS3 (nurses' health study 3) 3. GUTS (growing up today study), Workplace N/A	3193	Long COVID	43.9%

*Both: Long COVID and Post COVID

2.1 Categorizing Long Term Sequelae of COVID-19

2.1.1 Defining Long COVID and Post-COVID Conditions

As the pandemic progressed from the beginning of 2020, new definitions for long-term effects of COVID-19 were developed and utilized. The variability and interchangeability of these definitions was due to the heterogeneity and scarce, yet developing, knowledge on these long-term effects and symptoms as the pandemic evolved. These long-term effects may be referred to as long COVID, post-COVID-19, post-COVID conditions (PCC), chronic COVID, post-acute COVID-19, long-haul COVID, or post-acute sequelae of SARS-CoV-2 infection (PASC).[7] However, since September 2020, ICD-10 and ICD-11 classified long term sequelae of COVID-19 as post-COVID-19 condition (U09; RA02), followed by the WHO, which further defined a post-COVID condition in October 2021, as symptoms which occur following the onset of COVID-19, be present after 3 months, and persist for at least 2 months without an alternate diagnosis.[4,8] The variability of definitions over time has led to studies with differing and overlapping long term sequelae of COVID-19 classifications. To simplify review and comparison, we categorized the peer-reviewed articles examined into three categories based on the time window long term symptoms were presented after infection: long COVID (≥4 weeks), post-COVID (≥12 weeks or 3 months), or both long COVID and post-COVID.

2.2 The Epidemiology of Post-COVID Condition

2.2.1 Prevalence

Recent estimates suggest that, among those who have tested positive for COVID-19, there are approximately 200 million cases globally of a post-COVID condition[15], with a prevalence of 19% among adults ever infected in Canada (June 2023)[16], and 28.8% among those ever infected

in the United States (June 2023)[17]. When comparing prevalence between regions, there is a slight increase in self-reporting in Canada for the province of Prince Edward Island (24.6%)[11], and in Montana (20.2%) for the United States.[17] Some studies have suggested a prevalence in their study population of up to 50-80%, however most of these findings are based on small sample sizes or are limited to populations from a single medicentre, hospital, or region, which may generate an overrepresentation of the disease and may not be generalizable.[18–20] The prevalence of a post-covid condition is difficult to assess and varies as it may depend on the method of assessment, definition, temporal criteria, and population.[21,22]

2.2.2 Etiology and potential causal factors

The etiology of a post-COVID condition is still unclear and poses constraints in identifying and treating the condition.[23] Some authors have proposed the underlying pathophysiology may be virus driven cellular alterations or a dysregulated immune reaction to the initial infection or viral persistence, causing autoimmune dysregulation and an increase of inflammatory mechanisms, leading to inflammation and organ damage.[24,25] However, a major limitation of most of these studies is the very small sample size of subjects, with many limiting their samples to a single medicentre or hospital and excluding those who were either an initial asymptomatic or mild case, focusing only on severe or hospitalized cases.[26]

Evidence is still evolving regarding risk factors for developing a post-COVID condition, but suggests some groups are more prone to developing long term effects. At risk groups may include females,[11,15,23,27,28] those who experienced greater severity of initial SARS-CoV-2 infection,[11,27] those who did not receive two or more vaccine doses prior to infection or are unvaccinated,[11] those with underlying chronic conditions and increasing number of chronic

conditions,[11] those with previous poor mental health,[11,28] having a disability,[11] chronic lung condition,[11,27] heart disease,[11,27] or neurological disorder,[11] and those with a previous cancer diagnosis.[11] BMI (obesity) has also been shown in some studies[11,28] but not in others[27] to be associated with increased risk of developing a post-COVID condition. Varying virulence has also been postulated to pose as a risk factor in the CCAHS study, with 27.3% and 26.7% of those infected in 2020 and early 2021, respectively, reported lingering symptoms, compared to only 14.5% in the second half of 2021, and 12.7% between December 2021 and May 2022.[11] This may be due to the presence of higher virulent strains at the start of the pandemic. Serological studies have also suggested that viral persistence and variation in immune response may also pose as a risk factor for developing post-COVID.[18,23,29,30] While there are a range of potential at risk groups and causal factors for developing a post-COVID condition, the interplay of other factors is often overlooked, such as the effect of multiple infections, variants, environmental exposures, vaccination, and genetics, which may influence the susceptibility for the disease to occur.

2.2.3 Diagnosis

According to the CDC, a post-COVID condition can be clinically diagnosed based on findings during a physical examination and history,[7] followed by certain diagnostic testing methods to determine characteristics of the condition.[22] Testing methods to evaluate post-COVID conditions may include taking standard vital signs, body mass index, ambulatory pulse-oximetry, orthostatic vital signs, and diagnostic imaging.[22] Basic and specialized laboratory testing methods may also be considered and should be selected based on patient history, physical examination, and clinical findings.[22] Basic laboratory testing may include complete blood count and metabolic panels, liver function tests, urinalysis, tests for inflammatory markers such as C-reactive protein,

erythrocyte sedimentation rate, ferritin, tests on thyroid function (TSH and free T4), and vitamin deficiencies.[22] Specialized laboratory tests may include those to test for rheumatological conditions, coagulation disorders and myocardial injury.[22] Other types of assessments and tools to evaluate post-COVID conditions may include tests for Functional status or quality of life using the Post-Covid-19 Functional Status Scale (PCFS), tests for respiratory conditions, neurological conditions, psychiatric conditions, and other tools to evaluate changes to exercise capacity, balance and fall risk.[22] Findings based on these evaluations help characterize the illness and may suggest a route of treatment for post-COVID conditions at an individual level.[22] Conversely, the Government of Canada states there are currently no diagnostic tests for a post-COVID condition.[9]

Diagnosis of a post-COVID condition may be difficult as many of the persisting symptoms overlap with the chronic medical condition myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), which is illustrated by persistent fatigue and exhaustion for at least 6 months, usually following an infectious event.[26,31] Currently the World Health Organization classifies ME/CFS in ICD-11 under post-viral fatigue syndrome.[32] A systemic review comparing long COVID and ME/CFS symptomatology found that among 21 long COVID studies, 25/29 known ME/CFS symptoms were reported at least once among the studies, with fatigue being the most reported symptom.[26] However, only 3 of these studies reported a symptom duration of 6 months or longer and were conducted in the early stages of the pandemic, well before any consensus definitions of long COVID were accepted.[26] Long COVID or a post-COVID condition may also present symptoms which fall outside ME/CFS and are unique to post-COVID, such as changes in smell or taste, rash, menstrual changes, and hair loss.[26] Thus, those with a diagnosis of long COVID or post-COVID may develop ME/CFS if post-COVID symptoms such as fatigue continue for more

than 6 months, and demonstrate how the overlap of symptoms may be due to similar underlying pathological processes.[26,31]

2.2.4 Symptoms

A post-COVID condition may present an extensive array of new or ongoing symptoms, ranging in severity and impact on daily life.[22] Some of the most typical symptoms among adults include fatigue, trouble sleeping, shortness of breath (dyspnea), general pain and discomfort, cognitive problems such as memory loss and difficulty thinking or concentrating, and mental health symptoms such as anxiety and depression.[9] Some other symptoms recognized by the CDC include cough, chest pain, headache, palpitations, GI issues, fever, hair loss, and menstrual cycle irregularities.[22] Many other symptoms may present themselves on a case by case basis and may fluctuate or relapse over time.[8]

2.3 Literature Review of a Post-COVID Condition in HCW

A total of 28 studies were found to be eligible for this literature review. After examining and assessing each study individually, 13 focused on post-COVID, 9 focused on long COVID, and 6 focused on both long COVID and post-COVID. Characteristics of each study are shown in Tables 2-4. For this literature review, findings from the five best of the 28 have been selected for a detailed critical review. Characteristics of each study are outlined in Table 1 and are described in detail below.

Table 2. *Characteristics of eligible studies on post-COVID ill health in HCW*

Reference	Country	Study Time Period	Infection Period	Study Design	Study Population, Setting	Sample Size	Outcome Condition*:	LC/PC Prevalence (%)
AlBahrani et al., 2023[37]	Saudi Arabia	May 2022-Aug 2022	<Aug 2022	Cross-sectional	HCW, 2 medicentres	243	Post COVID	26.2%
Azzolini et al., 2022[38]	Italy	Mar 2020-April 2022	Mar 2020-April 2022	Longitudinal cohort	HCW, 9 health care facilities/ hospitals	739	Long COVID	31%
Carazo et al., 2022[33]	Quebec, Canada	July 2020-May 2021	July 2020-May 2021	Retrospective cohort & case-control	HCW, Selection: Invited all Quebec HCW with positive Provincial PCR Results, Workplace N/A	6061	Both	LC: 46.8% PC: 11.2%
da Costa E Silva et al., 2023[39]	Central Brazil	July 2020-July 2021	July 2020-Aug 2020	Prospective cohort	HCW, safety workers, administrative workers, Workplace N/A	147 (110/147 HCW)	Both	LC: 70.3% PC: 48.1%
D'Ávila et al., 2022[40]	Brazil	Jan 2021-Dec 2021	Jan 2021-June 2021	Prospective cohort	HCW, General tertiary care university hospital	174	Post COVID	36.2%
El Otmani et al., 2022[41]	Morocco	Feb 2021-April 2021	Feb 2021-April 2021	Cross-Sectional & case-control	HCW, Ibn Rochd University Hospital	118	Both	LC:13.6% PC: 33.9%
Fouad et al., 2022[12]	Egypt	May 2020-Sept 2020	May 2020-Sept 2020	Cross-Sectional & case-control	HCW, Cairo University Hospitals (same clinical departments)	69	Both	LC: 75.4% PC: 24.6%
Gaber et al., 2021[42]	NW England, UK	June 2020-Aug 2020	<June 2020	Cross-sectional	HCW, Wrightington, Wigan & Leigh NHS Teaching Trust (WWL: English teaching NHS Hospital)	138	Long COVID	45%
Havervall et al., 2021[43]	Sweden	April 2020-Jan 2021	<Jan 2021	Longitudinal cohort	HCW, Danderyd Hospital	1395	Both	LC:12.9% PC: 5.52%

*Both: Long COVID and Post COVID

Table 3. *Characteristics of eligible studies on post-COVID ill health in HCW*

Reference	Country	Study Time Period	Infection Period	Study Design	Study Population, Setting	Sample Size	Outcome Condition:	LC/PC Prevalence (%)
Hyassat et al., 2023[44]	Jordan	Mar 2020-Feb 2022	Mar 2020-Feb 2022	Longitudinal cohort	HCW, National Center for Diabetes, Endocrinology & Genetics	140	Post COVID	59.3%
Izadi et al., 2023[45]	Iran	July 2020-Sept 2020	July 2020-Sept 2020	Cross-sectional	HCW, Imam-Khomeini hospital complex (IKHC)	445	Long COVID	9.44%
Kahlert et al., 2023[34]	Switzerland	May 2020-June 2022	May 2020-May 2022	Cross-sectional & case-control	HCW, 9 healthcare networks	2912	Long COVID	23.9%
Kaspersen et al., 2020[46]	Denmark	May 2020-Aug 2020	<June 2020	Cross-sectional	HCW, hospital, prehospital services, and specialist practitioner clinics	10,776	Long COVID	13.8%
Kisiel et al., 2022[47]	Sweden	Mar 2020-July 2021	Mar 2020-July 2020	Cross-sectional	HCW, Uppsala University Hospital	336	Post COVID	47%
Lulli et al., 2023[13]	Italy	Oct 2020-June 2021	Oct 2020-April 2021	Cross-sectional	HCW, Tertiary referral hospital	318	Long COVID	57.2%
Marques et al., 2023[48]	Portugal	Oct 2020-June 2021	Oct 2020-April 2021	Cross-sectional & case-control	HCW, District hospital	326 (Cases: 174; Controls: 152)	Post COVID	Cases: 78.2% Controls: 55.3%
Martinez et al., 2021[49]	Switzerland	Mar 2020-June 2021	Mar 2020-April 2021	Retrospective cohort	HCW, University Hospital (tertiary care)	260	Post COVID	17.3%
Nielsen et al., 2021[50]	Denmark	Mar 2020-June 2020	Mar 2020-June 2020	Prospective cohort	HCW, Hospitals in Central Denmark	840 (Cases: 210; Controls: 630)	Long COVID	Cases: 38.5% Controls: 14.7%
Pereira et al., 2021[51]	London, UK	Mar 2020-Dec 2020	Mar 2020-May 2020	Longitudinal cohort	HCW, Hospital in NW London	38	Post COVID	55%

***Table 4**. Characteristics of eligible studies on post-COVID ill health in HCW*

Reference	Country	Study Time Period	Infection Period	Study Design	Study Population, Setting	Sample Size	Outcome Condition:	LC/PC Prevalence (%)
Peters et al., 2022[21]	Germany	Jan 2020-April 2021	Jan 2020-Dec 2020	Cross-sectional	HCW, non-governmental & welfare institutions (selected via employment insurance: job related infection claim)	2053	Both	LC: 74.2% PC: 72.8%
Pop-Vicas et al., 2022[52]	USA	Mar 2020-April 2021	Mar 2020-Jan 2021	Cross-sectional	HCW, 3 healthcare systems (medical college, a university hospital, clinics)	1012	Long COVID	LC: 67.1% PC: 15.8%
Rao et al., 2021[53]	India	Jan 2021-Mar 2021	<Mar 2021	Cross-sectional	HCW, single medical center	163	Post COVID	66%
Shukla et al., 2023[35]	India	July 2021-Oct 2021	<Oct 2021	Multicenter cross-sectional	HCW, 8 tertiary care hospitals	679	Post COVID	30.3%
Štěpánek et al., 2022[54]	Czech Republic	Nov 2020-Sept 2021	<Sept 2021	Cross-sectional	HCW, Selection: examined to have COVID-19 recognized as an occupational disease, Workplace N/A	305	Post COVID	59.3%
Strahm et al., 2022[55]	Switzerland	Aug 2020-Mar 2021	<Mar 2021	Prospective multicenter cohort	HCW, 23 healthcare institutions (hospitals)	3334 (Cases: 556; Controls: 2550; Sero+ only: 228)	Post COVID	Case: 73% Control: 52% Sero+: 58%
Tempany et al., 2021[56]	Ireland	Nov 2020	<Nov 2020	Cross sectional	HCW, Tallaght University Hospital	217	Post COVID	53.5%
Wang et al., 2022[36]	USA	April 2020-Nov 2021	<Nov 2021	Prospective cohort	HCW and non-HCW, 3 large ongoing longitudinal studies: 1. NHS2 (nurses' health study 2) 2. NHS3 (nurses' health study 3) 3. GUTS (growing up today study), Workplace N/A	3193	Long COVID	43.9%
Wose Kinge et al., 2022[57]	South Africa	Jan 2020-April 2021	Jan 2020-Feb 2021	Cross-sectional	HCW, non-profit providing health services	62	Post COVID	24.2%

For this literature review, findings from the five best of the 28 have been selected for a detailed critical review. Characteristics of each study are outlined in Table 1 and are described in detail below.

The first study by Carazo et al. (2022) is a Canadian study on HCW from Quebec. It includes a subset of all Quebec HCW who received a positive PCR test due to COVID-19 compatible symptoms between July 2020 and May 2021.[33] The study included a total of 6061 HCW who tested positive, consisting of physicians, nurses, nurse assistants, healthcare assistants, housekeeping, admin/managers, psychosocial workers, and other HCW.

The second study used in the review by Kahlert et al. (2023) is a cross-sectional Switzerland study involving 2912 HCW from north-eastern Switzerland from 9 healthcare networks, consisting of physicians, nurses, and other healthcare personnel. The original cohort was followed from May 2020 to June 2022, with newly recruited participants added for the cross-sectional study in May and June 2022.[34] The period for positive infections spanned between May 2020 to May 2022.

A third study conducted by Peters et al. (2022) involved 2053 workers from 2 regional administrative regions in eastern and western Germany from non-governmental health and welfare institutions. Subjects were selected through employment insurance (BGW) data based on making an occupational related claim due to a suspected job-related COVID-19 infection.[21] The majority of subjects were HCW consisting of nursing, medical, and therapeutic staff. Other workers included housekeeping, social service employees, administrative staff, and other personnel. Since most of the subjects were healthcare professionals, the authors use the term

health workers. The included subjects had a COVID-19 infection prior to December 21 2020, and completed a questionnaire between February and April 2021.

The fourth study included in this review is by Shukla et al. (2023) and is a study from India based on 679 HCW from 8 tertiary care hospitals, consisting of physicians, nurses and other hospital workers (hospital staff, lab technician, administrative and research staff, hospital attendant, security, and housekeeping). The cross-sectional study was conducted between July and October 2021 with the conduction of a structured interview, where positive COVID-19 infections ranged 12 to 52 weeks prior.[35]

The fifth study included in this critical review is by Wang et al. (2022) which included a total of 3193 healthcare workers and non-healthcare workers in the USA. Subjects were originally drawn from 3 large ongoing longitudinal studies: nurses' health study 2 (NHS2); nurses' health study 3 (NHS3); growing up today study (GUTS).[36] Subjects were a subset of participants who tested positive for COVID-19 at the time of a baseline questionnaire administered between April and August 2020, followed by completing at least 1 follow-up questionnaire between August 2020 and March 2021, and completed a final questionnaire asking about Long COVID between April and November 2021.

2.3.1 Prevalence of a post-COVID Condition in HCW

The prevalence of long COVID ranged from 23.9%[34] to 74.2%,[21] while a post-COVID condition ranged from 11.2%[33] to 72.8%.[21] In their Canadian study of 6061 HCW, Carazo et al. (2022) reported a 46.8% prevalence of long COVID and 11.2% of post-COVID among physicians, nurses, and other personnel from Quebec,[33] while the cross-sectional German study by Peters et al. (2022) found a much higher prevalence for both long and post-COVID of 74.2% and 72.8%,

respectively.[21] These high numbers are based on a cohort of 2053 German workers in health and social services but may be subject to bias in selection due to the nature of recruitment, where workers were invited to participate if they had made an insurance claim for a job-related COVID-19 infection.[21] These HCW may be more prone to report persisting symptoms due to the nature of the claim, and therefore may not be a true representation of the prevalence of HCW with a post-COVID condition. Unlike Peters et al. (2022), Carazo invited all Quebec HCW who had a positive polymerase chain reaction (PCR) test against SARS-CoV-2, which may be more inclusive and demonstrate a higher generalizability among Canadian HCW.[33] The cross-sectional multicenter studies of similar HCW personnel reported by Kahlert et al. (2023) found the prevalence of long COVID in 2912 Swiss HCW to be about 24%,[34] whereas Shukla et al. (2023) found a slightly higher post-COVID prevalence of 30% among 679 hospital HCW from India.[35] Shukla however excluded those with any serious comorbidities, mental health conditions, or were pregnant at time of the study.[35] Interestingly, the American prospective cohort including 3193 subjects from 3 large ongoing longitudinal studies of nurses and their children (NHS2, NHS3, GUTS) found a much higher long COVID prevalence of 44%, but was based on a 58% response rate, which may be subject to bias as those with persistent symptoms may be more willing to participate and answer the survey if they were impacted by their COVID-19 infection.[36] In studies investigating both long COVID and post-COVID,[21,33] a post-COVID condition tended to have a reduced prevalence, likely due to the more stringent criteria for a case, such as the requirement for longer duration since the onset of illness. These findings underscore the variability in reported cases across diverse healthcare contexts and regions, emphasizing the need for more comprehensive investigations into factors influencing the prevalence of post-

COVID ill health in HCW while using similar inclusion and exclusion criteria and definitions for what constitutes long COVID and post-COVID conditions.

2.3.2 Characteristics

Analysis of reported symptoms in HCW experiencing post-COVID ill health reveals a spectrum of manifestations. A total of 26 symptoms were commonly reported by the 28 eligible HCW studies (Table 5). Among the five studies we focused on, the most common post-COVID symptoms were impaired taste or smell (5/5 studies), fatigue (4/5 studies), dyspnea (3/5 studies) and headache (3/5 studies). Brain fog (2/5 studies), and concentration problems (2/5 studies) were the next most reported symptoms. Other common symptoms include hair loss, memory problems, muscle/joint pain, sleep problems and tiredness/weakness (Table 5). However, variability and limitedness in symptom reporting across studies was evident due to exclusivity, where most studies only allowed participants to report from a pre-defined symptom list. [21,33,34,36] Although these symptoms were identified as one of the most common, each study differed in the prevalence of each symptom.

Table 5. *Most common symptoms among eligible studies on post-COVID ill health in HCW*

	Studies looking at Long-COVID (≥4 weeks)	**Studies looking at Post-COVID (≥3 months)**	**Studies looking at both Long COVID and Post-COVID**		
Most Common Symptoms	Long COVID	Post-COVID	Both*	Both: Long COVID	Both: Post-COVID
Anxiety	3 Studies [42,45,52]	2 Studies [56,57]		1 Study [12]	1 Study [12]
Attention Problems		1 Study [48]			
Brain Fog	2 Studies[34,36]	1 Study [44]	1 Study [41]		
Cardiovascular	1 Study [45]				
Chest Pain	1 Study [52]				
Concentration Problems	1 Study [52]	3 Studies [47,51,56]	1 Study [33]	1 Study [21]	1 Study [21]
Coryza			1 Study [39]		
Cough	1 Study [46]	2 Studies [37,40]	1 Study [39]		
Diarrhea		1 Study [37]			
Depression	1 Study [52]			1 Study [12]	
Dyspnea	6 Studies [13,36,42,46,50,52]	3 Studies [40,47,54]	1 Study [33]	2 Studies [21,43]	2 Studies [12,21]
Fatigue	5 Studies [13,36,42,46,52]	11 Studies [35,37,40,44,47,49,51,53,54,56,57]	1 Study [33]	3 Studies [12,21,43]	2 Studies [12,21]
GI Issues	1 Study [45]				
Hair Loss	1 Study[34]	2 Studies [37,55]	1 Study [39]		
Headache	2 Studies [46,50]	5 Studies [35,37,48,53,54]	3 Studies[33,39,41]		1 Study [21]
Impaired Taste/Smell	5 Studies [34,36,46,50,52]	6 Studies [35,47,49,53-55]	1 Study [33]	1 Study [43]	1 Study [21]
Memory Problems	2 Studies[36,52]	2 Studies [47,48]		1 Study [21]	1 Study [21]
Menstrual Cycle Changes		1 Study [44]			
Nasal Congestion			1 Study [39]		
Muscle/Joint Pain	1 Study [46]	4 Studies [35,44,54,57]		1 Study [12]	1 Study [12]
Musculoskeletal Pain	1 Study [13]				
Myalgia	1 Study [52]	1 Study [53]	2 Studies [39,41]		
Palpitations	1 Study [52]	1 Study [49]			1 Study [12]
Sleep Problems	1 Study [42]	6 Studies[35,40,47,54,56,57]	1 Study [41]	1 Study [12]	
Sore Throat	1 Study [46]				
Tiredness/Weakness	1 Study [34]	2 Studies [49,55]			
Total (N)	**28**				

*Studies which look at both Long and Post COVID, but does not distinguish symptoms between each group

Temporal variations in symptoms were found in some studies, such as the waning or increasing of symptoms over time. The research by Shukla et al. (2023) highlighted variations in HCW reporting symptoms at 12-24 weeks versus >24 weeks post infection, where HCW with a longer post-infection timeframe reported lower amounts of trouble concentrating and fatigue, but did report higher levels in memory difficulty, difficulty thinking, depression, stress, and anxiety.[35] Likewise, the Canadian study from Carazo et al. (2023) involving HCW of similar job roles, also found a decrease in persisting symptoms over a duration of 28 weeks, but additionally found that the proportion of those with at least 1 severe symptom remained relatively steady.[33] However, although Shukla et al. (2023) did not measure severity of persisting symptoms, almost all participants were vaccinated at time of infection,[35] whereas only 4% were vaccinated in the Canadian study. These findings demonstrate the difficulties in comparison of results based on variation in infection timelines, as well as the timeframe of when the COVID-19 vaccine became available for HCW in different countries.

Distinctive neurological manifestations such as cognitive dysfunction, including concentration and memory problems, headaches, and brain fog, were a common pattern among most studies. Fatigue, mental health, and psychological distress were also a common result in those experiencing post-COVID ill health. Following infection at the time of survey completion, Peters et al. (2022) found reports of poorer physical and mental health, such as higher psychological stress, anxiety and depression (PHQ-4), lower quality of life (VR-12), and lower health status and work ability (WAI) using validated questionnaire tools among HCW with post-COVID compared to those without symptoms.[21] Assessment of work ability and health status (WAI) pre-infection among both groups were similar, but post-infection scores of subjective work ability and current health condition were distinctly reduced for those who developed a post-COVID

condition.[21] Conversely, Carazo et al. (2022) used the Kessler Psychological Distress Scale (K6) and found no difference in high psychological distress between cases and negative controls, demonstrating that the impact of the pandemic may have posed a burden on the psychological health of all HCW, regardless of COVID-19 infection, and not necessarily a symptom of a post-COVID condition.[33] Shukla et al. (2023) also investigated mental health symptoms using the depression, anxiety and stress scale-21 (DASS21), but found extremely low reports of such persisting symptoms (prevalence <2%).[35] The prevalence of fatigue as one of the most prominent symptoms in post-COVID ill health among HCW is also consistently reported across studies. Peters et al. (2022), Shukla et al. (2023), and Kahlert et al. (2023) find high levels of fatigue in their respective cohorts of HCW.[21,34,35] Interestingly, Carazo et al. (2022) found that although fatigue was one of the highest reported post-COVID symptoms, it was also reported pre-pandemic in 99% of those with post-COVID.[33] Additionally, Kahlert et al. (2023) found that fatigue was not more common in those infected later in the pandemic compared to uninfected controls.[34] These findings may suggest fatigue being a result of other underlying causes, such as work conditions (high workload and lack of staff), stressful environments, other chronic conditions, such as ME/CFS, or other external factors.[33,34] However, it is noteworthy that the assessment of fatigue varied among studies, with Peters employing the multidimensional fatigue inventory scale (MFI),[21] Kahlert using the 9-item fatigue severity scale (FSS),[34] and Shukla and Carazo relying solely on self-reporting.[33,35] The discrepancy in methodological measurements raises questions about the comparability of findings and underscores the importance of standardizing assessment tools for ensuring uniform judgement of fatigue, as well as other symptoms, as a clinical manifestation in HCW experiencing a post-COVID condition.

The severity of a post-COVID condition was investigated in a few studies and varied depending on methods used to measure severity. Measures of severity include duration of persisting symptoms, severity of symptoms, functional limitation, and struggling to cope with symptoms. Carazo (2022) found the prevalence of post-COVID symptoms decreased over time, but severe symptoms remained elevated and stable.[33] Similarly, Peters (2022) found that acute type symptoms decreased over time while chronic symptoms increased, but that infection period did not play a role in developing persisting symptoms.[21] Conversely, Kahlert (2023) found the prevalence of symptoms to increase for those infected later on in the pandemic but noted higher fatigue and depression scores for those infected earlier in the pandemic.[34] While these are interesting findings, it is important to note that the infection period among these studies ranged from January 2020 to August 2022, with the majority of the studies conducted prior to the emergence of Omicron. Although Peters (2022) found that infection period did not make a significant impact on the prevalence of post-COVID, the results were based on only infections occurring prior to December 2020,[21] whereas Kahlert (2023) included infections ranging from May 2020 to May 2022, providing a much broader and generalizable range for findings on post-COVID ill-health.[34]

In conclusion, the current literature on post-COVID in HCW exhibits complexities characterized by variations in types of reported symptoms, measurement methodologies, and observed infection timeframes. Diversity in assessment tools, standardized questionnaires, and self-reporting add difficulties in interpreting results, along with the heterogeneity of long COVID and post-COVID definitions throughout the pandemic as research was conducted. It is important to address these differences to be able to establish a cohesive understanding of the impact of post-

COVID ill health on HCW, emphasizing the need for standardized definitions, methodologies, and criteria for symptom assessment and duration in future research.

2.3.3 Identified Risk Factors

In the investigation of risk factors contributing to post-COVID ill health in HCW, many studies highlighted a diverse range of determinants such as demographics, health history, occupational factors, and infection-related factors (Tables 6 & 7).

Table 6. *Observational HCW studies: Demographic and health-related risk factors for developing long COVID or post-COVID*

Factors	**Total # of Studies with risk factor**	**Studies looking at Long-COVID (≥4 weeks)**	**Studies looking at Post-COVID (≥3 months)**	**Studies looking at both Long COVID and Post-COVID**		
		Long COVID	Post-COVID	Both*	Both: Long COVID	Both: Post-COVID
Demographics						
Older age	5	3 Studies [38,45,13]	2 Studies [54,57]			
Younger age	1		1 Study [55]			
Age >40	5	1 Study [50]	2 Studies [35,49]		1 Study [33]	2 Studies [21,33]
Gender: Female	9	2 Studies [50,52]	4 Studies [35,44,54,55]		1 Study [33]	2 Studies [21,33]
Unvaccinated	2	1 Study [38]			1 Study [33]	
Non-birth/ethnic origin country	1		1 Study [47]			
Lower education level	1		1 Study [47]			
Health-Related						
Higher BMI	7	3 Studies [13,34,38]	3 Studies [47,54,55]			1 Study [21]
Any Comorbidity	5	1 Study [34]	3 Studies [35,54,55]			1 Study [21]
# of comorbidities	1	1 Study [38]				
Allergies	1	1 Study [38]				
Obstructive lung disease	4	1 Study [38]	3 Studies [47,49,54]			
Asthma	1		1 Study [35]			
Hypertension	2		2 Studies [47,49]			
Chronic pain	1		1 Study [47]			
Poor physical fitness	1		1 Study [47]			
Depression History	1		1 Study [49]			
Distress pre-infection: Depression, anxiety, worry, perceived stress	1	1 Study [36]				
# of distress types (D, A, W, PS)	1	1 Study [36]				
Any Medication (baseline)	2	1 Study [34]	1 Study [25]			
Total (N)	–	**28**				

*Studies which look at both Long and Post COVID, but does not distinguish symptoms between each group

Table 7. *Observational HCW studies: Occupation and acute infection-related risk factors for developing long COVID or post-COVID*

	Total # of Studies with risk factor	**Long COVID (≥4 weeks)**	**Post-COVID (≥3 months)**	**Studies looking at both Long COVID and Post-COVID**		
		Long COVID	Post-COVID	Both*	Both: Long COVID	Both: Post-COVID
Occupation-Related						
COVID-19 patient contact	1	1 Study [34]				
Job (non-physician or non-Nurse)	1		1 Study [35]			
Job (nurse vs other)	1		1 Study [55]			
Less N95 Use	1	1 Study [45]				
Less Respiratory Protection Use	1	1 Study [45]				
Pre-pandemic sick leave	1		1 Study [47]			
Acute Infection-Related						
Variant Type (Wildtype)	2	2 Studies [34,38]				
Variant Type (Alpha/Delta)	1	1 Study [34]				
Duration of acute phase	1		1 Study [54]			
Acute symptom number	8	3 Studies [13,34,52]	4 Studies [47,51,54,55]			1 Study [21]
Acute symptom severity	4		2 Studies [35,54]	1 Study [12]		1 Study [21]
Severity of Pulmonary Involvement (chest CT)	2			2 Studies [12,41]		
Hospitalization	2				1 Study [33]	2 Studies [21,33]
Outpatient care	1					1 Study [21]
Initial evaluation/treatment with medical professional	1	1 Study [52]				
Use of medication (treatment)	2	1 Study [13]		1 Study [12]		
PCR Conversions (Days)	1			1 Study [12]		
Serology (Higher IgG and IgM)	1		1 Study [24]			
Total (N)	–	**28**				

*Studies which look at both Long and Post COVID, but does not distinguish symptoms between each group

Findings across multiple studies present a range of risk factors. The most common risk factor found among studies was female gender,[21,33,35] however recent research by Kahlert et al. (2023) based on a cohort of 2912 HCW found no difference between gender and risk of a post-COVID condition.[34] Although Kahlert found no differences based on gender, over three quarters of their cohort consisted of females,[34] whereas Shukla et al. (2023) had nearly an equal proportion of males and females,[35] and Carazo (2022) had equivalent proportions of females in both case and control groups.[33] Older age was also found to be a risk factor, particularly ages greater than 40 years,[21,33,35] aligning with existing literature on post-COVID. However, contradictory evidence has emerged by recent research by Kahlert et al. (2023), where age was not found to be associated with developing post-COVID, with a cohort median age of 44.[34] Compared to Kahlert, one study which found age as a risk factor had an overall cohort mean age of 32,[35] and another with a median age of 51.[21] This conflicting evidence gives emphasis to the further need of research on the relationship between age-related factors and the susceptibility of HCW to post-COVID ill health, in addition to the role of age on other conditions which may influence the development of post-COVID.

Many studies have also found an increased risk of developing post-COVID ill health among those with pre-existing health conditions such as higher BMI, having a comorbidity, or having poor mental health prior to infection. Studies by Kahlert et al. (2023) and Peters et al. (2022) demonstrate the heightened risk of a persisting symptoms among HCW with a BMI categorized as obesity (BMI $\geq$30 kg/m2).[21,34] Conversely, Shukla et al. (2023) does not find an increased risk among those with a higher BMI but categorizes BMI into non-obese (BMI <25 kg/m2) and overweight/obese (BMI$\geq$25 kg/m2), which may be creating a lessened affect by including those overweight with those who are classified as obese.[35] This emphasizes how a uniform

categorization of HCW into non-obese versus obese categories may serve as a better predictor for determining the risk of BMI on developing a post-COVID condition. The effect of comorbidities is also a common risk factor for predicting the development of post-COVID, where presence of any comorbidity prior to infection is often associated with an increased likelihood of persisting symptoms.[21,34,35] However, the literature lacks comprehensive investigation into the role of individual pre-existing conditions, such as autoimmune disorders, respiratory diseases and conditions such as asthma, chronic obstructive pulmonary disease, or chronic lung disease, and mental health conditions such as depression and anxiety. Some research has explored certain comorbidities, such as the cross-sectional study by Shukla et al. (2023), where authors found an increased risk in those with pre-existing asthma or hypertension, but not for those with diabetes.[35] In terms of mental health, the prospective cohort study 3193 subjects from Wang et al. (2022) found that pre-infection depression, anxiety, worry about COVID-19, perceived stress, and loneliness were associated with an increased risk of post-COVID conditions and daily life impairment, with those with 2 or more types of distress at nearly 50% increased risk.[36] These results were also comparable in a sensitivity analysis run by authors, in which they excluded those with a post-COVID condition with only psychological, cognitive, or neurological symptoms.[36] This study brings to light the impact of psychological distress on participants who were infected during the pandemic, and how they view persisting symptoms to impair their daily living. A drawback to this study however is the bias in that it only includes nurses and children of nurses and is based on 3193/58612 testing positive for COVID-19 and completing a final questionnaire asking about 'long COVID.[36] Here, a response rate to the final survey may be due to nurses experiencing a more severe infection or persisting symptoms which they are more likely to report on, than those who had a mild case of COVID-19 or were asymptomatic.

The exploration of occupational factors influencing the development of post-COVID ill health was also highlighted by a few studies. The work by Kahlert et al. (2023) identified increased cumulative contact with COVID-19 patients as a significant occupational risk factor, where those with no infection or an infection later in the pandemic having a much lower duration of contact, emphasizing the heightened vulnerability of HCW working in close contact with the virus.[34] Conversely, they did not find an association with working in an ICU role setting. The differential impact of specific job roles in the healthcare sector on the risk of a post-COVID condition is also an important factor considered by many studies. The study by Shukla et al. (2023) identifies a higher risk of developing persistent symptoms among nurses when compared to physicians, and other HCW when compared to nurses and physicians, suggesting a distinct vulnerability within these subgroups.[35] These other hospital HCW included hospital staff, lab technicians, administrative staff, research staff, hospital attendants, security, and housekeeping. However, conflicting evidence from Kahlert et al. (2023) finds no such differences in the association of post-COVID between physicians, nurses, or other healthcare personnel.[34] This discrepancy in findings highlights the importance of identifying specific tasks and responsibilities, based on job roles, when examining the risk of HCW developing a post-COVID condition and how these variations in working dynamics may affect the safety and vulnerability of certain HCW groups to viruses such as SARS-CoV-2.

The literature also provides insight into infection-related factors, such as the number of acute symptoms, acute symptom severity, and subsequent hospitalization due to infection. The studies by Kahlert et al. (2023) and Peters et al. (2022) identify an increased risk in those who report a higher number of cumulative acute symptoms, suggesting that the number of symptoms may serve as an indication of infection severity.[21,34] Studies by Shukla et al. (2023) and Peters et al.

(2022) suggest a correlation between an increased severity of acute infection, and subsequently leading to a higher chance of hospitalization, as identified by Peters and in the study by Carazo.[21,33,35] However, Shukla does not find a similar association with hospitalization and developing a post-COVID condition in adjusted models, suggesting that the association of hospitalization is related to a higher prevalence of older age, severe illness, and comorbidities.[35] Other factors which may account for these discrepancies include the type and quality of treatment received by HCW with COVID-19 in each country and the available of certain medications or treatments. Other studies may also decide to exclude hospitalized cases from their sample to reduce heterogeneity.

2.3.4 Association of COVID-19 Vaccination and a Post-COVID Condition

Due to the time frame of the various studies and availability of COVID-19 vaccines becoming available, evidence for the impact of vaccination on the development of a post-COVID condition in HCW is limited. Two studies which explored the association of vaccination and development of a post-COVID condition, found a higher risk among unvaccinated HCW, and a protective effect of being vaccinated prior to infection.[33,34] However, in the Canadian study by Carazo et al. (2022), only 4% of the HCW in the study were vaccinated with at least 1 dose >14 days prior to initial infection.[33] This may be due to vaccines not being available until mid-December 2020, and many HCW being infected prior to these vaccine programs. The Switzerland study by Kahlert et al. (2023) also found a protective effect of vaccination against the number of persisting symptoms, but only for vaccination prior to a Delta SARS-CoV-2 variant. Vaccination prior to Omicron was not associated with a protective effect.[34] However, these numbers are too low to reach statistical significance in this study population, and they do not account for duration between infection date and vaccination, which may have influenced the results found.[34] In

contrast, the multicenter study from India, with 90% of the cohort having received at least 1 dose prior to infection, and 70% having 2 doses, the authors found no association with developing a post-COVID condition and vaccination status prior to infection.[35] However, this study also did not account for the duration between vaccination and infection, and a majority of HCW received the AstraZeneca vaccine. Follow up studies on these groups would be interesting to examine the impact of vaccination after infection on their post-COVID conditions. The remaining post-COVID studies did not investigate vaccination as part of their study.

2.4 Conclusion

In summary, the current literature has identified key features and risk factors among HCW for developing a post-COVID condition. However, many limitations are present among research to date. Among the published studies investigating persisting symptoms in HCW, the changing case definitions of long COVID and post-COVID throughout the pandemic have allowed for some studies to focus on persisting symptoms for a shorter duration, with a potential overestimation of clinically significant post-COVID conditions. A more stringent use of criteria, such as using the WHO post-COVID definition with a symptom duration of 3 months or more, may provide a better estimation of the prevalence among HCW. Next, most studies asked participants about persisting symptoms from a limited list of symptoms, which may result in some cases being missed, providing an underrepresented proportion of HCW with a post-COVID condition. Allowing participants to report symptoms from a wide range of options, or through an open-ended response, may be a better option to fully capture cases of a post-COVID condition. Next, it was found that there is limited research on vaccination in HCW relative to developing persisting symptoms. This may be due to studies being conducted prior to vaccine program rollouts for HCW. Alternatively, other studies which investigated the influence of vaccination either

consisted of a HCW cohort almost entirely vaccinated or having very few who had received a dose due to the timing of questionnaires. It would be beneficial to further investigate the effects of vaccination prior to infection and how it influences the risk of developing long COVID. The literature also did not provide much insight on certain pre-existing conditions, such as autoimmune diseases, respiratory conditions aside from asthma, and mental health conditions such as anxiety and depression. These are important pre-existing health conditions which may provide insight on which HCW subgroups may be at risk and need enhanced protection or interventions for mitigating long-term effects. Additionally, it was found that there is lacking information on risk of post-COVID in HCW from substance and medication use and amount, such as recreational drugs, sleeping medication, and anxiety medication. Peters et al. (2022) and Shukla et al. (2023) found smoking status to have no influence,[21,35] while Wang found a slight risk.[36] Shukla additional found alcohol use to have no association with developing a post-COVID condition[35]. It would be important to further investigate these factors to add to the existing literature. There is also a limitation on information regarding occupational factors and developing a post-COVID condition. Some studies investigate differences of job roles, with a focus on physician and nurses but lack to further explore additional roles such as healthcare aides and personal support workers. Most studies also do not further investigate workplace settings aside from the ICU. Lastly, there is very little research regarding the effects of the acute infection on work ability and developing a post-COVID condition in HCW, such as days missed from work due to COVID-19 illness.

2.5 Objective of Thesis

The specific objectives of this thesis are to:

1. Determine the prevalence of health complaints by HCW attributed to COVID-19

2. Determine the proportion of HCW with post-COVID symptoms that relate to the WHO definition of a post-COVID condition.
3. Identify pre-pandemic factors that increase or decrease post-COVID symptoms among HCW.
4. Identify factors associated with experiences during the pandemic (including vaccination) that increase or decrease risk of post-COVID symptoms among HCW.

Chapter 3: Methods

3.1 Study Design/Setting

The study is a longitudinal cohort to determine the prevalence of a post-COVID condition among a sub-cohort of HCW during the COVID-19 pandemic in four Canadian provinces. The data available for this study are from self-report questionnaire responses across four phases, from the start of the pandemic in March 2020 to September 2022.

3.2 Study Population and Recruitment

A prospective cohort of HCW was recruited at the beginning of the pandemic in March 2020 from four Canadian provinces (Alberta, British Columbia, Ontario and Quebec). HCW included medical doctors (MD) from all four provinces, registered nurses and psychiatric nurses (RN), licensed practical nurses (LPN) and health care aides (HCA) from Alberta, and personal support workers (PSW) from Ontario. Where possible, potential participants were recruited through their professional/workplace organization[58]. Alberta, BC, and Ontario MDs were contacted and invited through their college. Emails for MDs from Ontario were provided from their college for the study team to invite them directly. For Quebec MDs, a study link was provided on the Collège des Médecins du Québec website, and requests sent out to medical specialty federation presidents, inviting participation through social media posts directed at MDs. Along with physicians in general practice and family medicine, only specialists in the following areas were approached: anesthesiology, critical care, emergency medicine, geriatrics, infectious disease, internal medicine, medical microbiology, occupational medicine, preventive medicine, public health, and respiratory medicine. Community based MDs in BC and Ontario were contacted only from certain areas (BC: Abbotsford, Burnaby, Chilliwack, Coquitlam, Delta, New Westminster, Port Coquitlam, Port Moody, Surrey and White Rock; Quebec: Hamilton, Ottawa, Peel, York).

Emails for RNs who had previously given consent to be contacted about future research were provided by their college and the Association of Registered Nurses of Alberta for the team to contact them. Colleges reached out to psychiatric nurses and LPNs for recruitment. HCAs were also approached through the LPN college in Alberta. The Ontario Personal Support Workers Association contacted PSWs, along with a large organization offering home care services independent of the public system. Information provided at recruitment included purpose of the study, links to a detailed information sheet, an online consent component to provide contact details, and a phase 1 questionnaire (if consenting). Alberta participants were also asked for consent to link the Alberta health administrative database.

3.3 Data Collection

Data used in this study were collected using the Qualtrics online survey platform through self-report questionnaires, offered in both French and English. Self-report questionnaires were distributed online four times to those who consented, from the start of the pandemic to summer 2022 (Figure 1): Phase 1 in April 2020, Phase 2 in fall 2020, Phase 3 in spring 2021 and Phase 4 in summer 2022. Questionnaires are included as Appendix A. Email and telephone reminders were sent following distribution of each questionnaire, offering a telephone interview alternative. Prior to the final closing weeks of a questionnaire, a shorter questionnaire with core components was offered for those who did not complete the full version. For those initially reluctant to complete the phase 4 questionnaire, a $50 cheque (Canadian) was offered as a financial incentive.

The baseline (phase 1) questionnaire collected data on age, gender, marital status, children in the home (under 18 years old), and pre-pandemic medical history. Pre-pandemic medical history included information 12 months pre-pandemic for smoking status, treatment for anxiety or depression, use of medication for treating asthma, or history of a chronic lung disease

(emphysema, bronchitis, chronic obstructive lung disease). Ethnicity was collected at phase 2. Questionnaires at subsequent phases also collected data on substance use for alcohol, tobacco, cannabis, sleep medication, and anxiety medication (phases 2-4), COVID-19 infections, symptom severity based on 19 symptoms (community acquired pneumonia questionnaire),[59] perceived source of infection, immunological conditions (phases 3-4), work-related factors, mental health (Hospital Anxiety and Depression Scale (HADS))[60], and vaccination status. COVID-19 vaccine became available in Canada for HCW in mid-December 2020. Information on vaccinations was added to phase 2-4 questionnaires. Data included date and type of vaccine received (Pfizer, Moderna, AstraZeneca, Johnson & Johnson, other, unknown). Provincial records from public health sources regarding COVID-19 immunization type and date for Alberta, British Columbia and Quebec participants (who gave consent in the phase 4 questionnaire) were used to validate and correct self-report data. Records included COVID-19 vaccines administered between 6 December 2020 to 31 July 2022. Participants were reminded to contact the study team if they had a positive SARS-CoV-2 test or received a new vaccine dose. COVID-19 infection and vaccination status were also updated among participants who were part of a serology sub-study giving post-vaccine samples, who were asked to complete a short questionnaire at each sample.

The Phase 4 questionnaire additionally asked participants if they have had a condition they believed to be a result of, or made worse by, their COVID-19 infection (COVID-19 sequelae). If yes, participants had the option to give details in an open-ended response. Additionally, participants were asked how much this condition limits their daily life, if they have discussed it with a health professional, the type of professional, and if the professional gave a suggestion.

For each post-recruitment questionnaire, non-responders received two emails (three if no telephone) and two telephone reminders. Loss to retention included those who had moved away

from participating provinces, unwillingness to participate further, left their healthcare role (choice, retirement), or were loss due to trace.

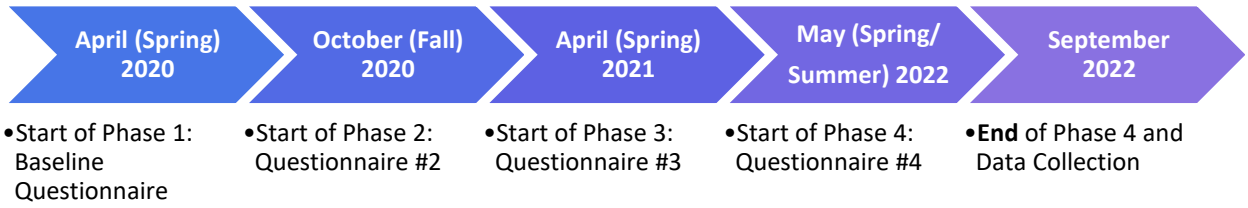


Figure 1. *Timeline of Study Phases and Questionnaire Distribution*

3.4 Sub-Cohort Selection for the study of post-covid conditions

From the full HCW cohort, we selected a sub-cohort that included all those with only one positive COVID-19 test who had completed the Phase 4 questionnaire. Positive tests for SARS-CoV-2 were detected by either home, rapid antigen, test kit or a polymerase chain reaction (PCR). Positive test information was also collected through data linkage of provincial records from public health sources regarding diagnostic SARS-CoV-2 PCR test results for Alberta, British Columbia and Quebec participants (who gave consent in either the phase 2 or 3 questionnaire). These records included test results between 6 March 2020 to 31 July 2022, and were used to supplement or correct self-report data. For Ontario participants only self-report data were available and used.

3.5 Classification of Post-COVID Symptoms and Conditions

Post-COVID symptoms and conditions were classified based on the most typical reported post-COVID symptoms in adults according to the Government of Canada, CDC, and WHO.[4,7-9] We categorized self-reported post-COVID responses into three groups: 1) classic post-COVID, 2) non-classic or "other" post-COVID, 3) non-post-COVID (Table 8). Classic post-COVID symptoms and conditions include those listed by the Government of Canada (fatigue, trouble

sleeping, shortness of breath (we also include dyspnea, difficulty breathing, asthma), general pain and discomfort, cognitive problems (memory loss, difficulty thinking/concentrating, we also include "brain fog"), mental health (depression, anxiety)). We categorized non-classic post-COVID symptoms and conditions as those who reported any of the following: blurred vision, cough, chest pain, dizziness, post-exertional malaise, fever, GI issues (diarrhea, stomach pain), hair loss, headache, hearing issues, menstrual changes, new onset allergies, pins/needles, rash, sinus issues, sore throat, tachycardia and heart palpitations, loss or altered taste and smell, weakness. We categorized non-post-COVID symptoms and conditions as those that fell outside classic and non-classic post-COVID.

Table 8. *Categorization of self-reported post-COVID symptoms and conditions attributed to COVID-19*

CLASSIC	**NON-CLASSIC "OTHER"**		**NON-POST-COVID**
Fatigue	Blurred Vision	Hearing Issues	Does not fit into classic or non-classic category
Trouble Sleeping	Cough	Menstrual Changes	
Shortness Of Breath: (Dyspnea) Trouble Breathing Asthma	Chest Pain	Weakness	
Pain (General)	Dizziness	New Onset Allergies	
Cognitive Dysfunction: Memory Loss Difficulty Thinking or Concentrating Brain Fog	Post-Exertional Malaise	Pins/Needles	
Mental Health: Anxiety Depression	Fever	Rash	
	GI Issues	Sinus Issues	
	Hair Loss	Sore Throat	
	Headache	Tachycardia and Heart Palpitations	
		Altered or Loss of Taste/Smell	

3.6 Outcome Measure

3.6.1 Report of a Post-COVID Condition

A post-COVID condition was defined as a participant having a case date at least 90 days before completion of the phase 4 questionnaire and reported at least one classic or non-classic post-COVID symptom or condition on the questionnaire when asked if they had a "condition they believe was a result of or made worse by their COVID-19 infection". Those who reported any classic post-COVID symptoms or conditions were defined as having classic post-COVID; those with only non-classic symptoms or conditions were defined as non-classic post-COVID. Participants who only reported non-post-COVID symptoms/conditions or zero limitation due to their symptoms were excluded from the final sample. Number of classic post-COVID symptoms/conditions for each participant classified as having a post-COVID condition was also calculated.

As definitions of post-covid conditions concentrate on those with a condition 3 months after infection,[8] within this sub-cohort, the proportion with a post-COVID condition was estimated for those with a case date (positive infection date) at least 90 days before completion of the phase 4 questionnaire. Those with more than one infection, a case date less than 90 days before completing the questionnaire, a report of only non-post-COVID symptoms, a report of zero limitation from their post-COVID symptoms at the time of completing the phase 4 questionnaire, or did not complete a phase 4 questionnaire, were excluded from the final sample used for analysis.

3.6.2 Post-COVID Ill-Health Variables

Among participants defined as having a post-COVID condition, additional post-COVID ill-health variables were included in the phase 4 questionnaire. The location of the questions is given in Table 9 (G6, G7, G8; Appendix A). Questions included rating daily limitation due to the post-COVID symptom/condition, from “not at all” to “very much”, on a visual analogue scale (0-100). To assess condition severity, scores were divided into either mild (1-50) or severe (51-100) post-COVID ill-health. Other variables of interest included discussion of symptoms with a health professional, including type of professional (open-ended) and what action this professional suggested (open-ended). Type of health professional and type of suggestion were categorized into the following groups: health professional (family physician; psychiatrist or psychologist; counsellor; other type of physician or specialist); Suggestion: (dietary change; exercise; long COVID program or clinic; medication; monitor symptoms and wait; rest; therapy or counselling; work modification; other type of suggestion). The variables were defined as outlined in Table 9.

Table 9. *Defining post-COVID variables*

Variable	Question	Question # (Appendix A)	Phase	Values
Post-COVID Symptom or Condition	Have a condition believed to be a result of or made worse by their COVID-19 infection	G6	Phase 4	0=No 1=Yes
Type of Post-COVID Symptoms or Conditions	Fatigue	G6 (open ended text; recoded into any of the 8 categories)	Phase 4	0= No 1= Yes
	Shortness of Breath			
	Sleep Troubles			
	Pain			
	Cognitive Dysfunction			
	Mental Health			
	Other (Non-Classic)			
	Non-post-COVID*			
Symptom Number	Number of classic post-COVID symptoms	Calculated from number of classic symptoms reported in G6	Phase 4	Range: 0 to 5
Daily limitation now**	Daily limitation due to post-COVID symptoms	G7	Phase 4	Score range: 0 to 100
Limitation Severity	Level of severity based on limitation rating	G7	Phase 4	Score Range: 0 to 100 Mild= 1-49 Severe= 50-100
Discussed with Professional	Discussed post-COVID symptom(s) with health professional	G8	Phase 4	0= No 1= Yes 9= Unknown (missing)
Type of Professional	Type of health professional	G8 (open ended; recoded)	Phase 4	1= Family GP 2= Psychiatrist or psychologist 3= counsellor 4= Other professional
Suggestion	Type of action suggested from health professional	G8 (open ended; recoded)	Phase 4	1= Dietary change 2= Exercise 3= Long COVID program or clinic 4= Medication 5= Monitor symptoms and wait 6= Rest 7= Therapy or counselling 8= Work modification 9= Other suggestion

* Reported only non-post-COVID symptoms/conditions. Excluded from final sample and not included in analysis.
** Those with limitation of zero excluded from final samples and not included in analysis

3.7 Variables for Analysis:

3.7.1 General Characteristic Variables (potential confounders)

General characteristic variables were analyzed as categorical or continuous variables. Variables included self-reported gender, age at time of infection, marital status, children <18 years old living in the household, ethnicity, body mass index (BMI), pregnant at time of infection, and HCW job role. BMI was calculated from height and weight reported in phase 2 and was considered as a stable measure and used as a proxy for pre-infection BMI. BMI was further categorized into 4 categories based on WHO classification[61]: underweight+normal weight; overweight; obese class 1; obese classes II+III. Pregnancy at time of infection was calculated using dates of infection, conception, and gestation length. The variables were defined as outlined in Table 10.

Table 10. *Defining general characteristic variables*

Variable	Question	Question # (Appendix A)	Phase	Values
Gender	Self-reported gender	A.1	Phase 1	0=Male 1=Female
Job	Job role as a HCW	N/A	Recruitment	0=MD 1=RN 2=LPN 3=HCA 4=PSW
Age	Age at time of infection	Estimated from Date of Birth, age at baseline, health records or from self-report follow up	Phase 1-4	Continuous Numeric Calculated from date of birth and infection date
Marital Status	Marital status at baseline	A.3	Phase 1	0= Married 1= Widowed/Divorced 2= Single 9= Unknown (missing)
Children <18	Children <18 living in household at baseline	A.4	Phase 1	0= No 1= Yes 9= Unknown (missing)
Race	Race/ethnicity	K_1 1.0	Phase 2	1= Indigenous 2= Asian 3= Black 4= White 5= Other 9= Unknown
Body Mass Index (BMI)	BMI (Calculated based on height and weight= kg/m^2)	K1 (height: meters) K2 (weight: kg) Calculated BMI from K1 and K2 ➢ Recoded BMI into 4 categories based on WHO classifcation[61]	Phase 3	<25= Under+Normal Weight 25-29.99= Overweight 30-34.99= Obese Class 1 ≥ 35= Obese Class II+III
Pregnant	Pregnant at time of infection	D1 to D2.1 Calculated new pregnancy variable using date of conception, gestation length and infection date	Phase 4	0= No 1= Yes 2= Not relevant (Male)

3.7.2 Potential Risk Factors

Potential risk factors were collected from phase 1-4 questionnaires. Variables of interest were analyzed as categorical or continuous variables[d]. These variables were defined as outlined in Table 11.

Potential predictive variables included:

- Pre-infection smoking: report of smoking cigarettes 12 months pre-pandemic or smoked tobacco pre-infection (phase 2-4). For those missing responses, any report of smoking less, the same, somewhat more, or much more (phases 2-4) was defined as a smoker; those who reported never smoked on any of phases 2-4 were defined as a non-smoker.
- Pre-infection substance use[a]: Using cannabis, alcohol, anxiety medication or sleep medication was defined as yes for using the same, less, somewhat more, or much more for each substance. Increased substance use was defined as yes for reporting somewhat more or more and defined as no for a response of somewhat less or the same.
- Pre-Pandemic Mental Health: Treatment 12 months pre-pandemic for conditions of anxiety or depression
- Pre-Pandemic Respiratory Conditions: Treatment 12 months pre-pandemic of asthma, report of a history of a chronic lung disease (COPD, emphysema, bronchitis)
- Pre-Pandemic Other Conditions: Other chronic conditions were categorized according to ICD-10 classification[49]. Conditions classified as “J: Diseases of the respiratory system” were considered other respiratory conditions (excluding asthma, COPD, emphysema, bronchitis), and conditions classified as “F: Mental, Behavioral, and Neurodevelopmental

disorders" were considered other mental health conditions (excluding anxiety and depression)

- Auto-immune Conditions: Report of any of the 6 following auto-immune conditions (Rheumatoid Arthritis, Ankylosing Spondylitis, Psoriasis, Psoriatic Arthritis, IBD, Lupus) in phases 3 or 4 were considered to be present pre-infection for analysis.
- Pre-Infection HADS Score[a]: Hospital Anxiety and Depression Scale (HADS) score was used as a mental health measure across each phase, by giving an indication of anxiety and depression in the previous week. It is a valid measurement tool for physicians to detect clinical depression and anxiety cases based on 14 questions scored 0-3 (7 for anxiety, 7 for depression) with a total score on each dimension ranging from 0-21. Questions were asked at each questionnaire, beginning at phase 1. Scores were taken from the questionnaire directly prior to the infection. Scores were absent for those with an infection before the first (phase 1) questionnaire. An indicator variable was used to account for missing data.
- Pre-infection COVID-19 Vaccination: Vaccination status and number of vaccine shots received prior to infection was calculated from vaccine and infection dates. The most recent type of vaccine shot received prior to infection date was identified. Duration of time since the most recent vaccine shot prior to infection was calculated in days.
- Total symptom severity[b]: Severity of infection symptoms was estimated from responses to a 19 symptom questionnaire designed to evaluate community acquired pneumonia.[59] Responses were taken from the most recent questionnaire completed following infection, which corresponded to the appropriate time window for the infection episode, where symptoms were assumed to be related to their COVID-19 infection. The questionnaire

asked whether, since the previous questionnaire, the participant had experienced an episode where they had been unwell for 2 or more consecutive days. Those with a response of yes were then prompted to rate 19 symptoms from 1 to 5 (most severe) on a visual analogue scale. Those with a response of no were given ratings of zero. An indicator variable was used to account for missing data.

- Working at start of infection: defined as yes for a response other than not working [c] . No was defined as a response of not working.
- Perceived infection source (work): response of yes or unsure. No was defined as a non-work source [c]
- Work modification due to infection: response of yes. No work modification was a response of no[c]
- Workers' Compensation Board (WCB) claim due to infection: response of yes. No WCB claim was defined as a response of no [c]
- Missed ≥31 days of work due to infection: response of 31 or more days. For a response of still off work, days were calculated using date of questionnaire – date of infection. A response of 0 to 30 days was defined as no [d]
- 1-on-1 contact with patients[b]: defined as a response of yes. Those without contact were defined as no [d]
- 1-on-1 contact with patients with COVID-19[b]: defined as a response of yes, and those without contact defined as no. Those unsure if they had contact with a patient with COVID-19 were defined as not known [d]

- Type of 1-on-1 contact with patients[b]: Contact with patients with COVID-19 were those as a response of yes (question I_1). Non-COVID-19 patients were defined as a response other than yes (question I_1) and had 1-on-1 contact with patents (H1=yes)[d]
- Type of work role setting[b]: working in a hospital role was defined as yes for working in inpatient, ambulatory, or emergency care; a community role was defined as yes for those working in/as a family MD, walk-in clinic, community health, workforce support; a residential role was defined as yes for those working in a residential institute; a homecare role was defined as yes for those working in clients' homes [d]

[a] Responses were taken from the most recent questionnaire prior to infection
[b] Responses were taken from the most recent questionnaire after infection
[c] Not working (question G2.3.3) was defined as a response of not working at start of infection.
[d] Those who have not worked as HCW since last questionnaire were defined as not working.

Table 11. *Defining potential predictive variables*

Variable	**Question**	**Question # (Appendix A)**	**Phase**	**Values** [e]
Pre-Infection Smoking*	Smoked cigarettes 12 months pre-pandemic	Non-MDs: Q13.5.2	Phase 1	1= No 2= Yes 9= Unknown (missing)
		MDs: J_5.2	Phase 2	
	or Smoked tobacco pre-infection [a] (use if missing Q13.5.2/ J_5.2)	I_2.0 l_2.0 M2.0	Phase 2 Phase 3 Phase 4	1= No 2-5= Yes 9= Unknown (missing)
Pre-Infection Substance Use [a] *	Alcohol	I_1.0 l_1.0 M1.0	Phase 2 Phase 3 Phase 4	1= No 2-5= Yes 9= Unknown (missing)
	Cannabis	I_3.0 l_3.0 M3.0	Phase 2 Phase 3 Phase 4	
	Anxiety medication	I_4.0 l_4.0 M4.0	Phase 2 Phase 3 Phase 4	
	Sleep medication	I_5.0 l_5.0 M5.0	Phase 2 Phase 3 Phase 4	
Pre-Infection Increased Substance Use [a] **	Tobacco	I_2.0 l_2.0 M2.0	Phase 2 Phase 3 Phase 4	1-3= No 4-5= Yes 9= Unknown (missing)
	Alcohol	I_1.0 l_1.0 M1.0	Phase 2 Phase 3 Phase 4	
	Cannabis	I_3.0 l_3.0 M3.0	Phase 2 Phase 3 Phase 4	
	Anxiety medication	I_4.0 l_4.0 M4.0	Phase 2 Phase 3 Phase 4	
	Sleep medication	I_5.0 l_5.0 M5.0	Phase 2 Phase 3 Phase 4	

Pre-pandemic treatment for Anxiety	Anxiety treatment 12 months pre-pandemic	Non-MDs: Q13.3.1 MDs: J_3.1	Phase 1 Phase 2	0= No 1= Yes 9= Unknown (missing)
Pre-pandemic treatment for Depression	Depression treatment 12 months pre-pandemic	Non-MDs: Q13.3.2 MDs: J_3.2	Phase 1 Phase 2	
Pre-pandemic treatment for Asthma	Asthma treatment 12 months pre-pandemic	Non-MDs: Q13.1.2 MDs: J_1.2	Phase 1 Phase 2	
Chronic Lung Disease	History of a chronic lung disease (COPD, emphysema, bronchitis)	Non-MDs: Q13.2 MDs: J_2.0	Phase 1 Phase 2	
Other Conditions	Other Mental Health (excluding anxiety, depression). Recoded	Non-MDs: Q13.4.1 MDs: J_4.0	Phase 1 Phase 2	Recoded with ICD10: A-E; G-Z= No F= Yes 9= Unknown (missing)
	Other Respiratory (excluding COPD, emphysema, bronchitis). Recoded	Non-MDs: Q13.4.1 MDs: J_4.0	Phase 1 Phase 2	Recoded with ICD10: A-I; K-Z= No J= Yes 9= Unknown (missing)
Any Mental Health Condition	Treated for anxiety or depression 12 months pre-pandemic, other MH condition	Non-MDs: Q13.3.1 MDs: J_3.1	Phase 1 Phase 2	0= No 1= Yes 9= Unknown (missing)
		Non-MDs: Q13.3.2 MDs: J_3.2	Phase 1 Phase 2	
		Non-MDs: Q13.4.1 MDs: J_4.0	Phase 1 Phase 2	Recoded with ICD10: F= Yes 9= Unknown (missing)
Any Respiratory Condition	Asthma treatment 12 months pre-pandemic	Non-MDs: Q13.1.2 MDs: J_1.2	Phase 1 Phase 2	0= No 1= Yes 9= Unknown (missing)
	chronic lung disease	Non-MDs: Q13.2 MDs: J_2.0	Phase 1 Phase 2	
	other respiratory condition	Non-MDs: Q13.4.1 MDs: J_4.0	Phase 1 Phase 2	Recoded with ICD10: F= Yes 9= Unknown (missing)
Pre-Infections HADS Answered[a]	Did they have a HADS score pre-infection	Q12.1 to Q12.14 H_2.1 to H_2.14 Mood_2.1 to Mood_2.14 L4.1.1 to L4.2.7	Phase 1 Phase 2 Phase 3 Phase 4	0 to 21=Yes 99 (Missing)= No

Pre-Infection HADS Score [a]	HADS Score for anxiety or depression	Q12.1 to Q12.14 H_2.1 to H_2.14 Mood_2.1 to Mood_2.14 L4.1.1 to L4.2.7	Phase 1 Phase 2 Phase 3 Phase 4	Score Range= 0 to 21 99= Unknown (missing)
Auto-Immune Condition	Rheumatoid Arthritis Ankylosing Spondylitis Psoriasis Psoriatic Arthritis IBD Lupus	E1 C1	Phase 3 or Phase 4	0= No 1= Yes 9= Unknown (missing)
Vaccinated	Vaccinated pre-infection	➢ Self-report (phase 2-4) ➢ Serology follow-up questionnaires ➢ Case-referent study follow-up questionnaires ➢ Self-report (phone, email, text) ➢ Provincial health data linkage (AB, BC, QC)	Phase 2-4	0= No ≥1 Dose= Yes
# of Vaccine Doses	# of vaccine doses pre-infection			Calculated from vaccine dates: Range= 0 to 4
Vaccine Type	Most recent vaccine type received pre-infection			1= Pfizer 2= Moderna 3= AstraZeneca 4= Johnson & Johnson 5= Other 9= Unknown (missing) 99= Not Vaccinated
Vaccine Date	Date each vaccine administered			Day-Month-Year (dd-mmm-yyyy)
Working at start of infection	Working at start of infection episode	G2.3.3	Phase 4	Days= Yes Still off work= Yes Not working [c] = No 9= Unknown (missing)
Believe infected at work	Believe infected at work	G2.3.1	Phase 4	0= No 1= Yes or Unsure 2= Not working [d] 9= Unknown (missing)

Missed >31 Days	Missed >31 days of work due to infection	G2.3.3 If "Still off work", days calculated with questionnaire and infection dates	Phase 4	≤ 31 Days=No >31 Days= Yes 2 = Not working Still off work= Days calculated 9= Unknown (missing)
Work Modification	Work modification due to infection	G2.3.4	Phase 4	0= No 1= Yes 2= Not Working [c] 9= Unknown (missing)
WCB Claim	Made WCB claim due to infection	G2.3.5	Phase 4	
1-on-1 patient contact [b]	1-on-1 patient contact in the most recent week	Q4.0 D_Q1.0 G1 H1	Phase 1 Phase 2 Phase 3 Phase 4	0= No 1= Yes 2= Not Working [d] 9= Unknown (missing)
1-on-1 COVID-19 patient contact [b]	1-on-1 COVID-19 patient contact (if most recent questionnaire is Phase 2 and missing E_1 response, use D_Q1.0)	Q7.0 E_1 H_1 I_1	Phase 1 Phase 2 Phase 3 Phase 4	0= No 1= Yes 2= Don't Know 3= Not Working [d] 9= Unknown (missing)
		D_Q1.0	Phase 2	0= No 9= Unknown
Type of 1-on-1 contact [b]	Type of 1-on-1 patient contact. Recoded as new variable. (Phase 1: if Q4.0=1(yes), use Q7.0; If Q7.0= 0(no) or 2(don't know), use Q4.0) (Phase 2: if D_Q1.0=1(yes), use E_1; If E_1= 0(no) or 2(don't know), use D_Q1.0) (Phase 3: if G1=1(yes), use H_1; If H_1= 0(no) or 2(don't know), use G1)	Q4.0 D_Q1.0 G1 H1	Phase 1 Phase 2 Phase 3 Phase 4	0= No 1-on-1 Contact 1= Non-COVID-19 Patient
		Q7.0 E_1 H_1 I_1	Phase 1 Phase 2 Phase 3 Phase 4	0= Non-COVID-19 Patient 1= COVID-19 Patient 2= Non-COVID-19 Patient 3= Not working [d] 9= Unknown (missing)

	(Phase 4: if H1=1(yes), use I_1; If I_1= 0(no) or 2(don't know), use H1)			
Most recent work role setting [b]	Hospital: inpatient, ambulatory, emergency	Q4.1 D_Q1.1 G1.1 H1.1	Phase 1 Phase 2 Phase 3 Phase 4	0= No 1= Yes 2= Not working [d] 9= Unknown (missing)
	Community: family MD, walk-in clinic, community health, workforce support			
	Residential: residential institute			
	Homecare: clients homes			
Unwell [b]	Unwell for 2 or more consecutive days	Q11.0 H_1 K_3 L1	Phase 1 Phase 2 Phase 3 Phase 4	0= No 1= Yes 9= Unknown (missing)
Severity [b]	Component analysis of 19 unwell symptom scores. 1st component score was taken as the severity score for an indication of infection severity. Unwell used as an indicator response variable with severity score	Q11.1 H_1.0 K_4 L1 and L2	Phase 1 Phase 2 Phase 3 Phase 4	Symptoms= 1st component score No Symptoms= 0 Missing= 0

[a] Responses were taken from the most recent questionnaire prior to infection
[b] Responses were taken from the most recent questionnaire after infection
[c] Not working (question G2.3.3) was defined as a response of not working at start of infection.
[d] Those who have not worked as HCW since last questionnaire were defined as not working.
[e] Unknown was coded when information was missing
* If missing and most recent questionnaire after infection=1, code as 1 (No). if=2-5, code as 2 (Yes)
** If missing and most recent questionnaire after infection=1 code as 1 (No).

3.7.3 Time periods

Time period (months) since start of the pandemic at the time of infection was calculated using the start date of the pandemic in Canada (defined here as March 6, 2020) and date of infection. Time period (months) since most recent vaccine was calculated using the most recent vaccine date prior to infection date.

3.8 Health Record Linkage

3.8.1 Alberta Administrative Health Database Linkage: Pre-pandemic Mental Health & Respiratory conditions

Alberta HCW who gave consent in the phase 1 baseline questionnaire were linked to Alberta's administrative health database (AHDB). AHDB records of physician visits using ICD-9 diagnostic billing codes, ambulatory care using ICD-10 billing codes, and hospital inpatient care using ICD-10 codes pre-pandemic (up to 35 months prior to March 2020) were used in a sub-analysis in Alberta participants. Data included physician diagnoses of mental health conditions (depressive disorder, anxiety disorder, acute stress reaction) and respiratory conditions (pneumonia, asthma, chronic lung disease). It does not include episodes of visits to other non-physician professionals. Physician diagnoses were identified by the first date recorded from April 1st 2017 but before the start of the pandemic (March 6th 2020). Conditions were identified as follows:

Mental Health Conditions:

- Depressive disorders: ICD-9 311; ICD-10 F32, F33
- Anxiety disorders: ICD-9 300 to 300.9; ICD-10 F40, F41, F42, F45, F48

- Acute stress reaction: ICD-9 308 to 308.9; ICD-10 F43

Respiratory Conditions:

- Pneumonia: ICD-9 480 to 486; ICD-10 J12 to J18
- Asthma: ICD-9 493, 493.0, 493.1, 493.9; ICD-10 J45
- Chronic lung disease: ICD-9 490 to 492, 496; ICD-10 J40 to J44

3.9 Statistical Methods

Descriptive statistics were presented as numbers with percentages for categorical data and medians with interquartile ranges (IQR) for continuous data. Those with and without a post-COVID condition were tabulated by each potential confounder and risk factor. Chi-square tests were used to compare proportions with post-COVID conditions and two-sided t-tests for continuous data. Descriptive statistics were also used to examine the distribution of post-COVID ill-health variables and post-COVID symptoms in those who reported a post-COVID condition. Unadjusted odds ratios (OR) for post-covid conditions and 95% confidence intervals (CI) were estimated for each confounding and risk factor of interest using bivariate logistic regression analysis. This was followed by a multivariable logistic regression that, for each factor, adjusted for three core confounders, self-reported gender, age at time of infection, and job type. To avoid problems of collinearity one variable from each prespecified group (pre-pandemic mental health, previous chronic conditions, vaccination) was selected as described below.

Independent variables from bivariate analysis with a significance of $p \leq 0.05$ was entered into a multiple logistic regression model using a stepwise procedure. Each variable was added in turn (within prespecified groups of variables, such as those associated with vaccination) to the core

model with gender, age and job. The order of adding variables at the next stage was determined by the size of the likelihood ratio test when the variable was added to the core model. After each addition of a variable, a likelihood ratio test was repeated with remaining variables individually. The variable with the lowest p value in the likelihood ratio test at this stage was then added to the overall multiple logistic regression model. Variables were dropped if they caused previous significant variables to lose significance. The significance level for the multivariable model was $p \leq 0.05$. Data management, descriptive statistical analyses, and logistic regression analyses were carried out using SPSS statistical software (v29).

3.10 Subgroup Analyses

3.10.1 Vaccination Status and Infection Period

A sub-analysis stratified by vaccination status at time of infection across infection time periods was performed to compare the relationship between vaccination and developing of a post-COVID condition over time. Data were presented using cross-tabulations and histograms of the number reports of post-COVID stratified by vaccination status and infection time period. For histograms, date of infection was categorized into 7 four-month periods 1) March-June 2020, 2) July-October 2020, 3) November 2020-February 2021, 4) March-June 2021, 5) July-October 2021, 6) November 2021-Febuary 2022, 7) March-June 2022, broadly reflecting dates of infection waves. In addition, the final multivariable logistic regression model was repeated, stratified by vaccination status with the addition of weeks since the start of the pandemic (at time of infection) to look for a change over time and developing a post-COVID condition based on vaccination. To examine whether having patient contact differed across time based on vaccination status a histogram of infection cases across the 7 time periods was shown, stratified

by vaccination. Results represent the proportion of those infected who had patient contact prior to infection.

3.10.2 Perception of Being Infected at Work

To assess changes in the perception of being infected at work over time and developing a post-COVID condition, cross-tabulations and a histogram were used. Time of infection was categorized into the same 7 periods outlined previously. Results represent the proportion of those with or without a post-COVID condition who believe they were infected at work, for each infection period.

3.10.3 Severity of Infection

A sub-analysis of infection severity was carried out using data from the most recent questionnaire following infection. Severity was derived from a component analysis of 19 symptom scores from the community-acquired pneumonia questionnaire from the phase corresponding to an infection episode. Symptom scores for those with a response of yes to the lead-in question on ill-health were selected for the component analysis. The first component extracted was taken as an indication of infection severity. An indicator variable was used to account for missing data. Severity of infection was not included in the final model as it may serve as an indicator for defining post-COVID itself. A multiple logistic regression of the final model with the addition of severity was carried out in a separate model for comparison.

To determine the additional effects of infection symptoms, each of the 19 symptoms were individually entered into a multiple logistic regression model. Each variable was added in turn to a base model with severity, an indicator variable, gender, age, and job. Next, symptoms with a significance of $p<0.05$ were entered into a base model, dropping non-significant symptoms. The

order of dropping variables at the next stage was determined by the size of the likelihood ratio test when the symptom was added to the core model. Symptoms with collinearity were omitted. After each addition of a symptom, a likelihood ratio test (LRT) was repeated with remaining symptoms individually. The symptom with the lowest LRT value in the likelihood ratio test at this stage was then removed from the overall multiple logistic regression model. This was repeated again for the next symptom with the lowest LRT. The significance level for the final symptom severity model was $P \leq 0.05$.

3.10.4 Post-COVID Severity

An analysis of the risk for development of a severe post-COVID condition was carried out. Here, a severe post-COVID condition (PCC) was defined as having any classic post-COVID symptoms/conditions and a limitation rating of ≥ 50 at the time of completing the Phase 4 questionnaire. The referent group for analysis included those with a classic PCC and a rating <50, those with non-classic PCC, and those who did not report a PCC. The analysis for any post-covid condition was repeated with this more severe outcome measure, again using bivariate regression, followed by adjustment for job, age at time of infection, with potential predictive factors (pre-pandemic conditions, pre-infection mental health, pre-infection substance use, infection time period, vaccination, work-related factors, and severity of infection) and post-COVID ill-health variables (post-COVID symptoms, number of symptoms, discussed with a health professional). Bivariate data were presented using cross-tabulations. To compare the relationship between developing severe post-COVID over time, cross-tabulations and histograms of the number reports of severe post-COVID stratified by infection time period were used. For histograms, date of infection was again categorized into four-month periods:

3.10.5 Alberta Administrative Health Database Linkage: Pre-pandemic Mental Health & Respiratory conditions Sub-Analysis

A sub-group analysis of Alberta HCW with available administrative health data was performed using bivariate logistic regression, to compare pre-pandemic mental health and respiratory conditions among those with or without a post-COVID condition. Bivariate and adjusted (job, age, gender) analysis was performed for each condition identified by a billing code (as described above in 3.8.1). Conditions include depression, anxiety, acute stress, pneumonia, asthma, and chronic lung disease. Analysis included only Alberta participants matched in the AHDB. Those who were matched but had no diagnostic billing code were coded as "No" for each condition.

3.11 Ethical Considerations

This study has received research ethics approval from the Health Research Ethics Board at the University of Alberta (Pro00099700). Unity Health Toronto Research Ethics Board also reviewed and approved the study for elements coordinated locally for Ontario participants (REB# 20-298). All participants gave online written informed consent, and all were made aware that participation was voluntary. Each questionnaire was provided with an information sheet on details regarding the study, how information would be used, stored and processed.

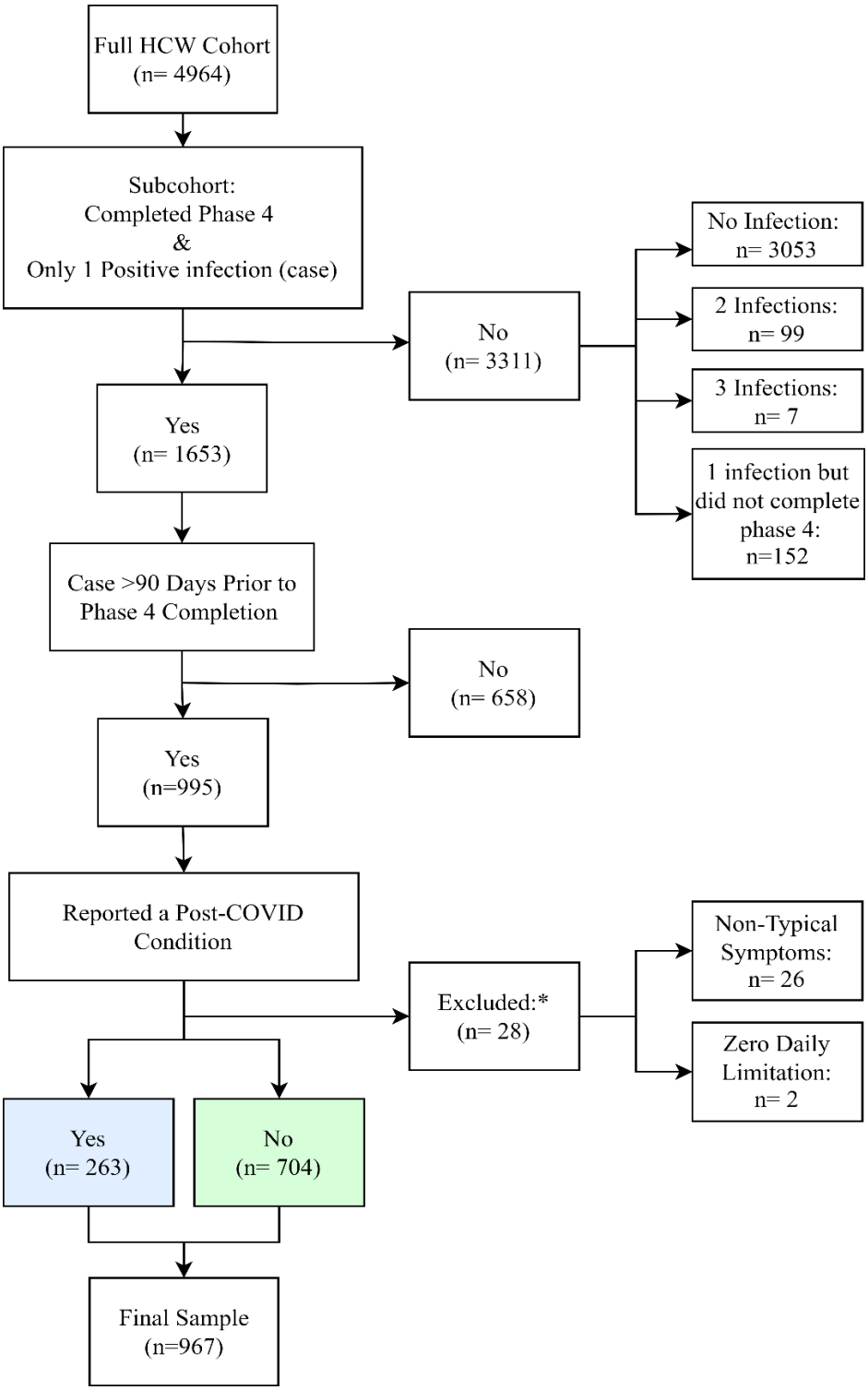
Chapter 4: Results

4.1 Characteristics of Post-COVID Ill-Health

4.1.1 Post-COVID Symptoms

Of the 4964 HCW from the prospective cohort, 1653 completed a phase 4 questionnaire and had only one positive SARS-CoV-2 infection. Among the 3311 excluded, 3053 had no infection, 106 had more than one infection, and 152 had one infection but did not complete phase 4 (Figure 2). Among this sub-cohort, 995 HCW had an infection case date greater than 90 days prior to completing their phase 4 questionnaire. From the sub-cohort, a sample of 967 participants was included in analysis, and 28 excluded. Of those excluded, 26 were due to reporting non-typical post-COVID symptoms and 2 reported typical symptoms but with zero daily limitation due to the symptoms (Figure 2). Of the 967 participants, 263 reported a post-COVID condition (PCC) (27.2%). Had the 28 omitted subjects been included in both the numerator and the denominator the prevalence would have been 291/995 (29.2%) and if just in the denominator 263/995 (26.4%).

Figure 2. Flow chart of sub-cohort and final sample selection



** Did not report classic or non-classic post-COVID symptoms; daily limitation due to reported post-COVID symptoms=0.*

Table 12 provides the characteristics of reported PCCs in HCW (n=263). The majority of HCW with a PCC reported only 1 symptom or condition (58.6%). The most commonly reported classic post-COVID symptoms were fatigue (30.8%) and shortness of breath (30.4%), followed by cognitive dysfunction (19.4%), pain (14.8%), mental health symptoms (8.0%), and sleep problems (2.7%). Common other "non-classic" post-COVID symptoms were cough (10.6%), headache (10.6%), and altered taste or smell (8.0%). The most common ICD-10 Chapters PCC were categorized into included symptoms (70.3%), the respiratory system (17.9%), nervous system (13.7%), musculoskeletal and connective tissue system (12.2%), mental health (9.1%), the circulatory system (4.9%), the genitourinary system (4.9%), and skin and subcutaneous tissue (4.9%). Table 13 shows the ratings of how much the condition currently limits daily life stratified by whether a HCW developed classic or non-classic PCC. Among the 263 participants with a PCC, 71.1% (n=187) reported at least 1 classic symptom or condition, and 29.3% (n=77) reported only symptoms or conditions considered non-classic. In conclusion, no difference was found between a classic and non-classic PCC in the degree of impact on daily living, confirmed by testing the difference between mean ratings of limitations to daily life ($t= 1.45$; $p=0.114$).

Table 12. *Characteristics of reported post-COVID conditions in HCW (N=263)*

Classic Post-Covid Symptoms Reported	**n**	**%**
Fatigue	81	30.8
Shortness of Breath	80	30.4
Cognitive Dysfunction	51	19.4
Pain	39	14.8
Mental Health	21	8.0
Sleep	7	2.7
Non-Classic Post-COVID Symptoms Reported*		
Cough	28	10.6
Headache	28	10.6
Altered Taste or Smell	21	8.0
Tachycardia, Heart palpitations, Heavy chest	16	6.1
Sinus Issues	14	5.3
Skin Issues	12	4.6
Menstrual Changes	10	3.8
GI Issues	9	3.4
Arthritis	7	2.7
Hearing Issues	6	2.3
Stamina Loss	5	1.9
Hair Loss	4	1.5
Sore Throat	4	1.5
Dizziness	4	1.5
Voice Issues	3	1.1
Pregnancy Problems	3	1.1
Number of post-COVID Symptoms Reported		
1	154	58.6
2	73	27.8
3	25	9.5
4	8	3.0
5	3	1.1
Number of participants who reported post-COVID symptoms: ICD10 Chapters*		
Symptoms (R)	185	70.3
Respiratory System (J)	47	17.9
Nervous System (G)	36	13.7
Musculoskeletal and Connective Tissues(M)	32	12.2
Mental, Behavioral and Neurodevelopmental (F)	24	9.1
Circulatory System (I)	13	4.9
Genitourinary System (N)	13	4.9
Skin and Subcutaneous Tissue (L)	13	4.9
Eye and Ear (H)	8	3.0
Digestive System (K)	8	3.0
Long COVID (U)	4	1.5
Total	**263**	**100.0**

* Symptoms <1% Not shown.

Note: since subjects can report multiple symptoms numbers do not add to 267 nor percents to 100

Table 13. *Severity (daily limitation) of reported post-COVID condition in HCW*

Currently Limits Life?				
	Classic PCC		**Non-Classic PCC**	
	n	**%**	**n**	**%**
Rating: Median (IQR)	31	15 to 52	27	10 to 51
≤25	77	41.2	36	46.8
26 to 49	52	27.8	21	27.3
50 to 75	35	18.7	14	18.2
>75	22	11.8	6	7.8
Total	187	100.0	77	100.0

4.1.2 Consultation with a Health Professional

Among HCW with a PCC, 57.4% (n=151) discussed the condition with a health professional (Table 14). The most common health professional was a family physician or general practitioner (50.3%), followed by a other specialist (16.6%). The least likely health professionals included a long COVID clinic (5.3%), a psychiatrist or psychologist (4.0%), or a counsellor (2.6%). Table 15 outlines if a suggestion was made by a health professional (n=120, 45.6%), as well as what type of suggestion. Among those who listed a suggestion, the most common reported suggestions include medication (50.8%), further diagnostic tests (25.8%), exercise (12.5%), and monitoring the condition over time (10.8%). Less frequent suggestions include rest, referral to a specialist, therapy or counselling, dietary changes, workload modifications, and a long-COVID treatment program.

Table 14. *Discussion of post-COVID condition with a health professional (N=263)*

Discussed Condition with a Health Professional		**N**	**%**
	No	112	42.6
	Yes	151	57.4
Total		263	100.0
Did they list the type of Health professional? (n=151)			
	No	48	31.8
	Yes	103	68.2
Total		151	100.0
Type of Health Professional Discussed Condition With (n=151)*			
Family Doctor/General Practitioner	No	27	17.9
	Yes	76	50.3
	Unknown	48	31.8
Other Specialist	No	78	51.7
	Yes	25	16.6
	Unknown	48	31.8
Long Covid Clinic	No	95	62.9
	Yes	8	5.3
	Unknown	48	31.8
Psychiatrist or Psychologist	No	97	64.2
	Yes	6	4.0
	Unknown	48	31.8
Counsellor	No	99	65.6
	Yes	4	2.6
	Unknown	48	31.8
Total		151	100.0

*48/151 participants who discussed their condition did not list the health professional type

Table 15. *Suggestions given by a health professional for post-COVID condition. N=263*

Did they list a suggestion from health professional?	**N**	**%**
No	143	54.4
Yes	120	45.6
Total	263	100.0
Reported Suggestions		
Medication	61	50.8
Referral to Specialist	10	8.3
Diagnostic Testing (labs, imaging, lung and cardio testing)	31	25.8
Exercise (includes physiotherapy)	15	12.5
Monitor over Time	13	10.8
Rest or Slow Down	11	9.2
Therapy or Counselling (includes mental health program)	10	8.3
Dietary Change or Supplements	9	7.5
Long-Covid Treatment Program	3	2.5
Workload modification (time off, stress/disability leave, less hours)	4	3.3
Total	120	100.0

Note: Participants may list more than 1 suggestion, therefore the total number and percentage of suggestions does not equal 120 and 100%.

4.2 Baseline Characteristics and Pre-Existing Conditions

4.2.1 Baseline Characteristics

Table 16 displays the baseline characteristics of all 967 participants, stratified by report of a post-COVID condition (PCC). The median age for individuals reporting a PCC was 44, but the bivariate OR was close to 1. In terms of self-reported gender, a higher percentage of females reported a PCC compared to males (Females: 28.5%; Males: 19.9%). An increased risk was demonstrated between female gender and the occurrence of a PCC in the bivariate analysis, but this was reduced once adjusted for age and job role. An increased risk was found in those widowed or divorced but was reduced once adjusted for confounders. No risk was found for having children under 18 in the home, being pregnant at time of infection, or ethnicity. In terms

of body mass index (BMI) based on height and weight reported in phase 3, those classified as obese were at higher risk both before and after adjusting for confounders, with risk increasing with obesity class.

4.2.2 Work Role

In regard to work role, LPNs had the highest rate of cases (50.0%) and MDs the lowest (16.8%). The odds ratios (OR) and 95% confidence intervals (CI) reflect the association between each work role and the occurrence of a post-COVID condition. In the bivariate analysis, after adjusting for gender and age, a greater risk, compared to MDs, remained for RNs, LPNs , and PSWs. HCAs also had a higher risk but given the smaller numbers, the CIs did not exclude 1.00 (Table 16).

Table 16. *Association between explanatory factors and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate			Adjusted*		
Explanatory Factors		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Job	MD	40	16.8	238	1.00	–	–	1.00	–	–
	RN	192	29.4	653	2.06	1.41 to 3.01	<0.001	2.00	1.31 to 3.03	0.001
	LPN	11	50.0	22	4.95	2.01 to 12.2	<0.001	5.00	1.99 to 12.53	<0.001
	PSW	15	39.5	38	3.23	1.55 to 6.73	0.002	3.04	1.43 to 6.48	0.004
	HCA	5	31.3	16	2.25	0.74 to 6.83	0.152	2.07	0.67 to 6.41	0.208
Gender	Male	29	19.9	146	1.00	–	–	1.00	–	–
	Female	234	28.5	821	1.61	1.04 to 2.48	0.032	1.14	0.70 to 1.86	0.597
Age[1]	Continuous (24 to 75)	44.0	10.8	967	1.01	0.99 to 1.02	0.364	1.01	1.00 to 1.02	0.200
Children <18y.o	No	122	29.3	417	1.00	–	–	1.00	–	–
	Yes	141	26.0	543	0.85	0.64 to 1.13	0.257	0.97	0.72 to 1.31	0.849
	Unknown	0	0.0	7	–	–	–	–	–	–
Marital Status	Married	196	26.2	748	1.00	–	–	1.00	–	–
	Widowed or Divorced	23	41.1	56	1.96	1.13 to 3.43	0.018	1.65	0.93 to 2.93	0.088
	Single	39	30.7	127	1.25	0.83 to 1.88	0.290	1.25	0.81 to 1.94	0.307
	Unknown	5	13.9	36	0.45	0.17 to 1.19	0.107	0.43	0.17 to 1.14	0.089
Race	First Nations	4	25.0	16	1.00	–	–	1.00	–	–
	Asian	12	17.6	68	0.64	1.18 to 2.34	0.503	0.87	0.24 to 3.21	0.833
	Black	3	23.1	13	0.90	0.16 to 5.01	0.904	0.88	0.16 to 5.00	0.885
	White	218	27.7	786	1.15	0.37 to 3.61	0.809	1.39	0.44 to 4.39	0.581
	Other	14	36.8	38	1.75	0.47 to 6.48	0.402	2.29	0.61 to 8.66	0.222
	Unknown	12	26.1	46	1.06	0.29 to 3.92	0.932	1.22	0.33 to 4.61	0.765
BMI	Under+Normal	94	23.2	405	1.00	–	–	1.00	–	–
	Overweight	64	24.7	259	1.09	0.75 to 1.56	0.658	1.02	0.70 to 1.48	0.930
	Obese Class 1	51	35.9	142	1.85	1.23 to 2.80	0.003	1.60	1.04 to 2.45	0.031
	Obese Class 2+3	34	44.2	77	2.62	1.58 to 4.34	<0.001	2.17	1.29 to 3.65	0.003
	Unknown	20	23.8	84	1.03	0.60 to 1.80	0.906	0.89	0.50 to 1.60	0.701
Pregnant[1]	No	230	28.7	801	1.00	–	–	1.00	–	–
	Yes	4	20.0	20	0.62	0.21 to 1.88	0.398	0.64	0.21 to 2.02	0.450
	Not Relevant	29	19.9	146	0.62	0.40 to 0.95	0.028	–	–	–
	Total	263	27.2	967	–	–	–	–	–	–

[1]At time of infection

*Adjusted for job, gender, and age at time of infection

4.2.3 Pre-Infection Substance Use

Table 17 outlines pre-infection substance use for smoking, alcohol, cannabis, anxiety medication, sleep medication, and whether there was an increase in substance use for each prior to infection. In bivariate analysis, increased risk of a PCC was found only among those using cannabis and sleep medication. However, risk is reduced for both after adjusting for confounders. Using anxiety medication was also found to increase risk but the CIs did not exclude 1 . In contrast, risk of a PCC is increased in those who drank more alcohol or used more sleep medication and in those with missing information for drinking amounts. Participants with missing substance use information either were infected at phase 2 or later and had not completed a previous questionnaire, or had an infection prior to phase 2, as substance use for alcohol, cannabis, anxiety medication and sleeping medication was not asked until then. In these cases, increased substance use could not be determined.

Table 17. *Association between substance use and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Infection Substance Use		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Tobacco	No	246	27.1	909	1.00	–	–	1.00	–	–
	Yes	17	30.4	56	1.18	0.65 to 2.12	0.591	0.98	0.53 to 1.80	0.938
	Unknown	0	0.0	2	–	–	–	–	–	–
Alcohol	No	55	27.6	199	1.00	–	–	1.00	–	–
	Yes	207	27.2	762	0.98	0.69 to 1.39	0.894	1.04	0.73 to 1.50	0.610
	Unknown	1	16.7	6	0.52	0.060 to 4.58	0.559	0.56	0.06 to 5.12	0.610
Cannabis	No	209	25.9	808	1.00	–	–	1.00	–	–
	Yes	53	34.6	153	1.15	1.05 to 2.20	0.026	1.37	0.93 to 2.03	0.114
	Unknown	1	16.7	6	0.57	0.07 to 4.94	0.612	0.58	0.07 to 5.18	0.625
Anxiety Medication	No	201	25.9	776	1.00	–	–	1.00	–	–
	Yes	61	33.0	185	1.41	1.00 to 1.99	0.053	1.32	0.93 to 1.88	0.125
	Unknown	1	16.7	6	0.57	0.07 to 4.93	0.611	0.58	0.07 to 5.17	0.623
Sleep Medications	No	162	24.9	650	1.00	–	–	1.00	–	–
	Yes	100	32.2	311	1.43	1.06 to 1.92	0.019	1.33	0.98 to 1.80	0.069
	Unknown	1	16.7	6	0.60	0.07 to 5.20	0.645	0.60	0.07 to 5.35	0.645
Pre-Infection Increased Substance Use										
Tobacco More	No	255	27.2	939	1.00	–	–	1.00	–	–
	Yes	6	26.1	23	0.95	0.37 to 2.43	0.909	0.78	0.30 to 2.03	0.615
	Unknown	2	40.0	5	1.79	0.30 to 10.76	0.526	1.47	0.22 to 9.58	0.690
Alcohol More	No	170	24.5	693	1.00	–	–	1.00	–	–
	Yes	75	33.0	227	1.52	1.10 to 2.10	0.012	1.49	1.06 to 2.07	0.020
	Unknown	18	38.2	47	1.91	1.03 to 3.53	0.039	1.91	1.01 to 3.61	0.048
Cannabis More	No	235	26.4	890	1.00	–	–	1.00	–	–
	Yes	25	38.5	65	1.74	1.03 to 2.93	0.037	1.56	0.91 to 2.66	0.107
	Unknown	3	25.0	12	0.93	0.25 to 3.46	0.913	0.85	0.22 to 3.29	0.812
Anxiety Medications More	No	231	26.3	877	1.00	–	–	1.00	–	–
	Yes	24	32.9	73	1.37	0.82 to 2.28	0.227	1.27	0.75 to 2.13	0.376
	Unknown	8	47.1	17	2.49	0.95 to 6.52	0.064	2.19	0.80 to 5.98	0.127
Sleep Medications More	No	205	26.0	788	1.00	–	–	1.00	–	–
	Yes	48	30.4	158	1.24	0.85 to 1.81	0.259	1.14	0.78 to 1.68	0.495
	Unknown	10	47.6	21	2.59	1.08 to 6.18	0.033	2.70	1.10 to 6.64	0.030
	Total	263	27.2	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

4.2.4 Pre-existing Mental Health

Risk for a post-COVID condition among pre-existing mental health based on self-report data are shown in Table 18. This table outlines the relation to post-covid condition of self-reported treatment for depression or anxiety, presence of other mental health conditions, or presence of any mental health condition 12 months pre-pandemic. Pre-infection scores from the Hospital Anxiety and Depression Scale, taken from the most recent questionnaire prior to infection, are also shown and range from 0-21. In the multivariable analysis, it was observed that individuals treated for anxiety, depression, or those that have other mental health disorders, were at higher risk for developing a PCC. Those who report any type of chronic mental health condition were also at higher risk. Participants with unknown information across each variable contrastingly demonstrated a reduced risk. These participants did not fully complete a phase 1 questionnaire. Both pre-infection anxiety and depression, based on HADS score, indicated a similar increased risk for a PCC. Pre-infection HADS anxiety had the lowest p-value and highest Wald test statistic after adjusting for confounders and was selected to add to a base model with job, age and gender. After adding HADS anxiety, multivariable analysis against each of the remaining mental health variables show that only other mental health disorders remain at an increased risk for developing a PCC.

Table 18. *Association between previous mental health and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate			Adjusted*						Adjusted**	
								Logistic Regression				LRT		LRT	
Pre-Pandemic Mental Health		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**	**Wald**	**Wald**	**χ^2 P value**	**Wald**	**χ^2 P value**
Self-Report Treated Depression (12m)	No	186	26.9	692	1.00	–	–	1.00	–	–	–	14.63	<0.001	15.24	<0.001[a]
	Yes	56	37.1	151	1.60	1.11 to 2.32	0.012	1.52	1.04 to 2.23	0.029	4.74				
	Unknown	21	16.9	124	0.56	0.34 to 0.91	0.020	0.49	0.30 to 0.82	0.006	7.50				
Self-Report Treated Anxiety (12m)	No	181	26.9	673	1.00	–	–	1.00	–	–	–	14.18	<0.001	14.17	<0.001[a]
	Yes	61	35.9	170	1.52	1.07 to 2.17	0.021	1.48	1.02 to 2.13	0.038	4.31				
	Unknown	21	16.9	124	0.55	0.34 to 0.91	0.020	0.49	0.30 to 0.82	0.006	7.42				
Self-Report Treated Anxiety or Depression (12m)	No	167	26.8	624	1.00	–	–	1.00	–	–	–	13.43	<0.001	13.89	<0.001[a]
	Yes	75	34.2	219	1.43	1.02 to 1.98	0.036	1.39	0.99 to 1.95	0.059	3.57				
	Unknown	21	16.9	124	0.56	0.34 to 0.92	0.023	0.49	0.30 to 0.83	0.007	7.25				
Self-Report Other MH (Chronic 12m)[1]	No	235	28.2	832	1.00	–	–	1.00	–	–	–	16.55	<0.001	17.79	<0.001
	Yes	7	63.6	11	4.45	1.29 to 15.33	0.018	5.35	1.52 to 18.86	0.009	6.82				
	Unknown	21	16.9	124	0.52	0.32 to 0.85	0.009	0.46	0.28 to 0.76	0.002	9.23				
Self-Report Any MH (12m)	No	164	26.5	620	1.00	–	–	1.00	–	–	–	14.81	<0.001	14.88	<0.001[a]
	Yes	78	35.0	223	1.50	1.08 to 2.08	0.016	1.46	1.05 to 2.05	0.027	4.92				
	Unknown	21	16.9	124	0.57	0.34 to 0.94	0.027	0.50	0.30 to 0.84	0.009	6.87				
Pre-Infection Mental Health															
HADS Ratings Available	No	9	33.3	27	1.00	–	–	1.00	–	–	–	0.73	0.402	–	–
	Yes	254	27.0	940	0.74	0.33 to 1.67	0.469	0.69	0.29 to 1.62	0.394	0.73				
Entered as Continuous Variables		Median	IQR												
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	9.0	5.5	967	1.06	1.03 to 1.09	<0.001	1.06	1.06 to 1.10	<0.001	12.52	12.52	0.001	–	–
Pre-Infection Depression (HADS)	Continuous (0 to 21)	6.0	5.0	967	1.07	1.03 to 1.11	<0.001	1.07	1.03 to 1.11	<0.001	12.26	12.26	0.002	2.49	0.115
	Total	263	27.2	967	–	–	–	–	–	–	–			–	–

[1] Excluding anxiety and depression

*Adjusted for job, gender, and age at time of infection

**Adjusted for job, gender, age at time of infection, HADS done, HADS anxiety

[a] Not statistically significant for those who answered the question (significant only for missing responses), based on logistic regression

4.2.5 Pre-existing Mental Health: Other Conditions

Table 19 shows the other mental health conditions listed by HCW (n=11). The most common condition reported was attention deficit hyperactivity disorder (ADHD) (n=4). Other conditions reported include Bipolar II, Post Traumatic Stress Disorder (PTSD), attention deficit disorder (ADD) and Post-Concussion Syndrome.

Table 19. *Self-report of other mental health conditions listed (n=11)*

	Reported a post-COVID Condition?				**Total**
	Yes		**No**		
	n	**%**	**n**	**%**	**N**
Other Mental Health Conditions*: Mental, Behavioral and Neurodevelopmental Conditions (F)	7	63.6	4	36.4	11
Conditions Reported:					
Bipolar II	0	0.0	1	100.0	1
Post Traumatic Stress Disorder	2	66.6	1	33.3	3
Attention Deficit Disorder	1	100.0	0	0.0	1
Attention Deficit Hyperactivity Disorder	2	50.0	2	50.0	4
Post-Concussion Syndrome	2	100.0	0	0.0	2
Total	7	63.6	4	36.4	11

* Excludes: Anxiety, Depression

4.2.6 Pre-existing conditions other than mental health

The occurrence of pre-pandemic (12 months prior) respiratory conditions and other chronic conditions were also examined (Table 20). In multivariable analysis, a greater risk was observed for those treated for asthma 12 months pre-pandemic, those with any respiratory condition, or those with a other chronic condition not including respiratory or mental health. Having a history of a chronic obstructive lung disease also had a higher risk (OR=4.41) but given the smaller numbers, the CIs did not exclude 1.00. Participants with unknown information, due to not fully completing a

phase 1 questionnaire, contrastingly demonstrate a reduced risk. Pre-existing other chronic conditions had the highest likelihood ratio test statistic after adjusting for confounders and was selected to add to a base model with job, age and gender. After adding other chronic condition, multivariable analysis against each of the respiratory variables show that only any report of a respiratory condition remained at an increased risk for developing a PCC.

Table 20. *Association between previous chronic conditions and developing a post-COVID condition*

		Reported a PCC		Total	Bivariate			Adjusted*					Adjusted**	
								Logistic Regression			LRT		LRT	
Pre-Pandemic Respiratory Conditions		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**	**Wald**	**χ^2 P value**	**Wald**	**χ^2 P value**
Self-Report Treated Asthma (12m)	No	194	27.2	713	1.00	–	–	1.00	–	–	15.62	<0.001	5.21	0.024
	Yes	48	36.9	130	1.57	1.06 to 2.32	0.025	1.63	1.09 to 2.44	0.016				
	Unknown	21	16.9	124	0.55	0.33 to 0.90	0.017	0.49	0.29 to 0.81	0.005				
Self-Report Have Chronic Lung Disease	No	237	28.3	836	1.00	–	–	1.00	–	–	12.74	<0.001	2.14	0.122
	Yes	5	71.4	7	6.32	1.22 to 32.79	0.028	4.41	0.83 to 23.50	0.083				
	Unknown	21	16.9	124	0.52	0.32 to 0.84	0.008	0.46	0.28 to 0.75	0.002				
Self-Report Other Respiratory (Chronic 12m)	No	241	28.9	835	1.00	–	–	1.00	–	–	10.57	0.002	1.17	0.218
	Yes	1	12.5	8	0.35	0.04 to 2.88	0.330	0.39	0.05 to 3.24	0.383				
	Unknown	21	16.9	124	0.50	0.31 to 0.82	0.006	0.45	0.27 to 0.74	0.002				
Self-Report Any Respiratory	No	192	27.2	705	1.00	–	–	1.00	–	–	14.92	<0.001	4.22	0.042
	Yes	50	36.2	138	1.52	1.03 to 2.23	0.033	1.57	1.06 to 2.32	0.024				
	Unknown	21	16.9	124	0.55	0.33 to 0.90	0.017	0.48	0.29 to 0.80	0.005				
Self-Report Other Chronic Condition (12m)	No	145	24.4	595	1.00	–	–	1.00	–	–	25.10	<0.001	–	–
	Yes	97	39.1	248	1.99	1.45 to 2.74	<0.001	1.92	1.38 to 2.68	<0.001				
	Unknown	21	16.9	124	0.63	0.38 to 1.05	0.076	0.55	0.33 to 0.92	0.023				
	Total	263	27.2	967	–	–	–	–	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

**Adjusted for job, gender, age at time of infection, other chronic condition (excluding respiratory and MH)

Table 21 gives information on the other respiratory conditions listed by HCW (n=8), with the most common being chronic sinusitis (n=4). Other conditions listed include allergies, rhinitis, and sore throat.

Table 21. *Self-report of other respiratory conditions listed (n=8)*

	Reported a post-COVID Condition?				**Total**
	Yes		**No**		
	n	**%**	**n**	**%**	**N**
Other Respiratory Conditions*: Respiratory System Conditions (J)	1	12.5	7	87.5	8
Conditions Reported:					
Chronic Allergies (airborne)	1	50.0	1	50.0	2
Chronic Rhinitis	0	0.0	2	100.0	2
Chronic Sinusitis	0	0.0	4	100.0	4
Chronic Sore Throat	0	0.0	1	100.0	1
Total	1	9.1	10	90.9	11

* Excludes: asthma, bronchitis, chronic obstructive pulmonary disease (COPD), emphysema

Note: Participants could list more than one condition, therefore total number of listed conditions do not equal n=8

Table 22 shows the different kinds of other chronic conditions listed by HCWs, classified by ICD-10 chapter. The most frequent condition listed by those who later developed a PCC was endocrine, nutritional and metabolic disorders (Chapter E; n=30) and musculoskeletal and connective tissue disorders (Chapter M; n=27).

Table 22. *Self-report of other chronic conditions (ICD-10 Chapter) and developing a post-COVID condition (PCC). (n=97)**

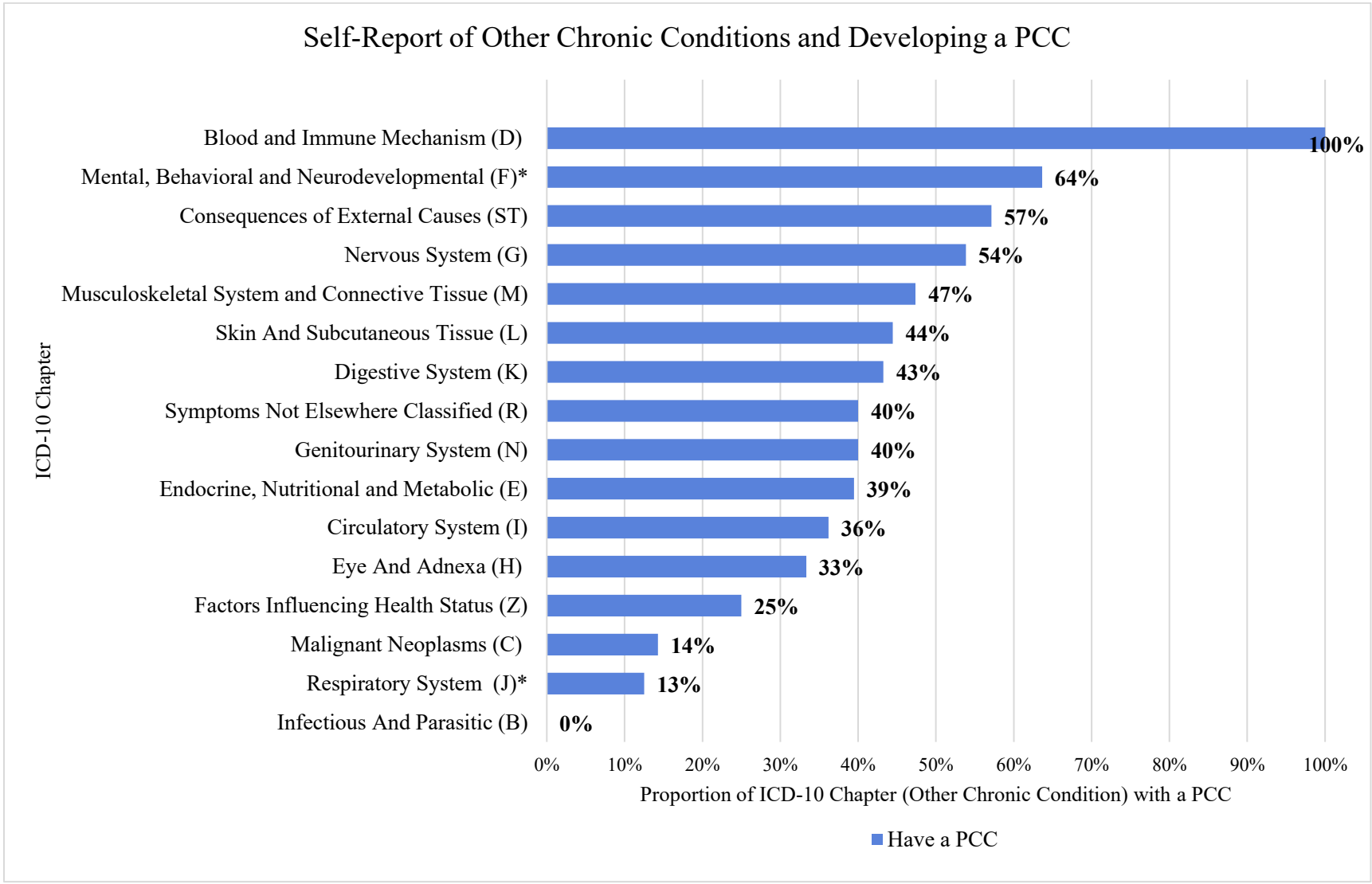
	Reported a post-COVID Condition?				**Total**
	Yes		**No**		
Other Chronic Condition*	**n**	**%**	**n**	**%**	**N**
	97	39.1	151	60.9	248
Type of Chronic Condition Reported: ICD-10 Chapter					
Infectious And Parasitic (B)	0	0.0	1	100.0	1
Malignant Neoplasms (C)	1	14.3	6	85.7	7
Diseases Of the Blood and Immune Mechanism (D)	3	100.0	0	0.0	3
Endocrine, Nutritional and Metabolic (E)	30	39.5	46	60.5	76
Nervous System (G)	21	53.8	18	46.2	39
Eye And Adnexa (H)	1	33.3	2	66.7	3
Circulatory System (I)	21	36.2	37	63.8	58
Digestive System (K)	16	43.2	21	56.8	37
Skin And Subcutaneous Tissue (L)	4	44.4	5	55.6	9
Musculoskeletal System and Connective Tissue (M)	27	47.4	30	52.6	57
Genitourinary System (N)	4	40.0	6	60.0	10
Symptoms Not Elsewhere Classified (R)	4	40.0	6	60.0	10
Injury, Poisoning, Consequences of External Causes (ST)	4	57.1	3	42.9	7
Factors Influencing Health Status and Contact with Health Services (Z)	1	25.0	3	75.0	4
Total	145	42.6	195	57.4	340

* Excludes: Mental, Behavioral and Neurodevelopmental Conditions (F), Respiratory System Conditions (J)

Note: Participants could list more than one condition, therefore total numbers and percentages do not equal 97 and 100%.

Figure 3 shows the proportion of each ICD-10 chapter that developed a PCC, with all HCW who listed a blood or immune disorder developed a PCC (n=3). Appendix B gives further details into the types of conditions listed for each ICD-10 chapter, including the total number of reports (N). Table 23 gives information on immune conditions. In multivariable analysis, an increased risk is found for those with ankylosing spondylitis and psoriatic arthritis but is based on very small numbers. In bivariate analysis, report of any immune condition was at higher risk , but was reduced once adjusted for job, age, and gender.

Figure 3. *Self-report of other chronic conditions (ICD-10 Chapter) and developing a post-COVID condition (PCC). (n=97)*



*Mental, Behavioral and Neurodevelopmental Conditions (F): excludes anxiety and depression; Respiratory System Conditions (J): excludes asthma, chronic lung disease (COPD, bronchitis, emphysema)

Table 23. *Association between previous auto-immune conditions and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Pandemic Immune Conditions		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Rheumatoid Arthritis	No	255	27.2	939	1.00	–	–	1.00	–	–
	Yes	6	46.2	13	2.30	0.77 to 6.91	0.138	1.91	0.63 to 5.84	0.254
	Unknown	2	13.3	15	0.41	0.09 to 1.84	0.246	0.46	0.10 to 2.10	0.315
Ankylosing Spondylitis	No	257	27.2	946	1.00	–	–	1.00	–	–
	Yes	4	66.7	6	5.36	0.98 to 29.45	0.053	7.01	1.19 to 41.32	0.031
	Unknown	2	13.3	15	0.41	0.09 to 1.84	0.246	0.47	0.10 to 2.15	0.330
Psoriasis	No	246	26.9	916	1.00	–	–	1.00	–	–
	Yes	15	41.7	36	1.95	0.99 to 3.83	0.055	1.87	0.94 to 3.72	0.076
	Unknown	2	13.3	15	0.42	0.09 to 1.87	0.254	0.46	0.10 to 2.13	0.324
Psoriatic Arthritis	No	258	27.2	948	1.00	–	–	1.00	–	–
	Yes	3	75.0	4	8.02	0.83 to 77.48	0.072	10.20	1.03 to 101.56	0.048
	Unknown	2	13.3	15	0.41	0.09 to 1.84	0.244	0.46	0.10 to 2.11	0.316
IBD	No	255	27.4	931	1.00	–	–	1.00	–	–
	Yes	6	28.6	21	1.06	0.41 to 2.76	0.904	1.09	0.42 to 2.88	0.855
	Unknown	2	13.3	15	0.41	0.09 to 1.82	0.240	0.45	0.10 to 2.08	0.308
Lupus	No	261	27.5	949	1.00	–	–	1.00	–	–
	Yes	0	0.0	3	0.00	–	0.999	0.00	–	0.999
	Unknown	2	13.3	15	0.41	0.09 to 1.81	0.237	0.45	0.10 to 2.07	0.305
Any of 6 Immune	No	234	26.6	880	1.00	–	–	1.00	–	–
	Yes	27	37.5	72	1.66	1.01 to 2.73	0.048	1.61	0.97 to 2.67	0.068
	Unknown	2	13.3	15	0.43	0.10 to 1.90	0.262	0.47	0.10 to 2.16	0.333
	Total	263	27.2	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

4.3 Association with Vaccination

Table 24 demonstrates the association between a PCC and vaccination prior to infection. In bivariate analysis, risk was seen for the number of months a vaccine was received prior to infection and developing a PCC but was reduced once adjusted for confounders as the CIs do not exclude 1.00 (p=0.067). The most common recent type of vaccine prior to infection in those with a PCC was Pfizer (n=165) followed by Moderna (n=36). Very few received a AstraZeneca or Johnson & Johnson vaccine prior to infection. However, both Pfizer and Moderna had the same risk of PCC. An association was found with the number of vaccines received prior to infection where those vaccinated with one, two, or three shots were less at risk for developing a PCC. This reduced risk was seen with vaccine number as a continuous variable. Overall, being vaccinated prior to infection reduced the risk for developing a PCC by over half. Among vaccine factors, the number of vaccines as a continuous variable was added to a base model with job, age and gender. After adding vaccine number, a likelihood ratio test against each of the remaining vaccine variables show that none remain a significant factor for developing a PCC.

Figure 4 demonstrates changes in developing a PCC over infection time-periods based on vaccination status. The graph shows that those infected earlier in the pandemic from March to October 2020, prior to vaccination becoming available, were more likely to develop a PCC, peaking from July to October 2020 (64%) and decreasing after. Once vaccination against COVID-19 became available in mid-December 2020 for HCWs, the proportion of those vaccinated who developed a PCC during each infection period was much lower compared to earlier in the pandemic. Among those vaccinated, developing a PCC increased slightly over time, peaking in July-October 2021 (31%) and began to reduce after October 2021.

Table 24. *Association between vaccination and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate (unadjusted)			Adjusted*					Adjusted**	
								Logistic Regression			LRT		LRT	
Vaccination		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**	**Wald**	**χ^2 P value**	**Wald**	**χ^2 P value**
Vaccinated[1]	No	54	44.3	122	1.00	–	–	1.00	–	–	16.17	<0.001	1.28	0.256
	Yes	209	24.7	845	0.41	0.28 to 0.61	<0.001	0.44	0.29 to 0.66	<0.001				
Number of vaccines[1]	0	54	44.3	122	1.00	–	–	1.00	–	–	18.04	0.001	1.97	0.560
	1	11	25.0	44	0.42	0.19 to 0.91	0.027	0.44	0.20 to 0.98	0.044				
	2	74	28.7	258	0.51	0.32 to 0.79	0.003	0.51	0.32 to 0.80	0.004				
	3	122	23.0	531	0.38	0.25 to 0.57	<0.001	0.41	0.27 to 0.63	<0.001				
	4	2	16.7	12	0.25	0.05 to 1.20	0.083	0.25	0.05 to 1.50	0.092				
Most recent type of vaccine[1, 2]	Pfizer	170	24.8	685	1.00	–	–	1.00	–	–	16.27	<0.001	1.17	0.169
	Moderna	36	24.2	149	0.97	0.64 to 1.46	0.866	0.98	0.64 to 1.48	0.912				
	AstraZeneca	0	0.0	4	–	–	–	–	–	–				
	Johnson & Johnson	1	100.0	1	–	–	–	–	–	–				
	Unknown	2	33.3	6	1.52	0.28 to 8.34	0.633	1.51	0.26 to 8.72	0.642				
Entered as Continuous Variables		**Median**	**IQR**											
Months since most recent vaccine[1,2]	Continuous (0.1 to 14.7)	3.02	4.8	845	1.06	1.01 to 1.11	0.025	1.05	1.00 to 1.10	<0.001	1.25	0.265	1.25	0.265
Number of Vaccines[1]	Continuous (0 to 4)	2.0	1.0	845	0.74	0.65 to 0.84	<0.001	0.76	0.66 to 0.87	<0.001	15.86	<0.001	–	–
	Total	263	27.2	967	–	–	–	–	–	–			–	–

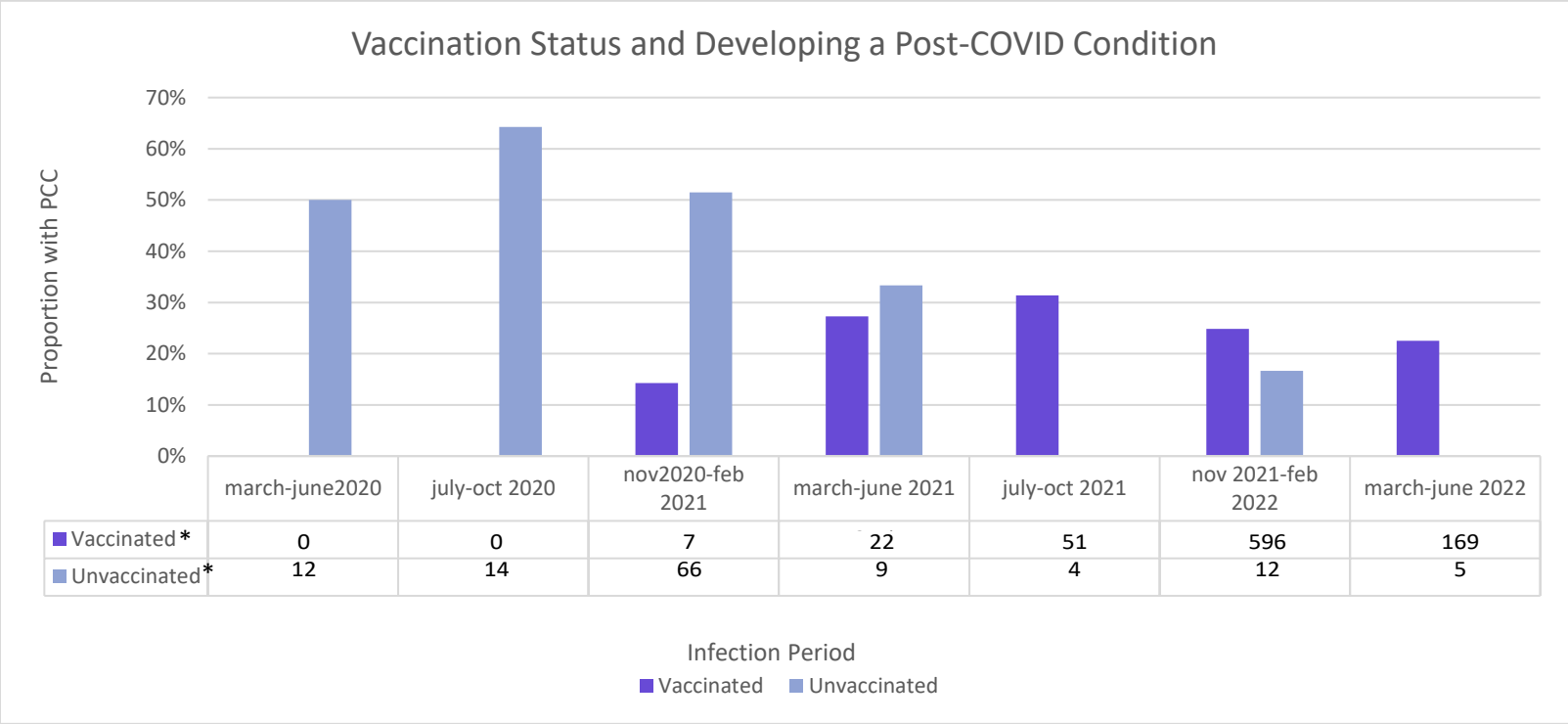
[1] At time of infection

[2] Adjusted for vaccination status

*Adjusted for job, gender, and age at time of infection

**Adjusted for job, gender, age at time of infection, Number of vaccines (continuous)

Figure 4. *Vaccination status and developing a post-COVID condition*



* Total N for vaccination status at time of infection

Time of Infection	Unvaccinated+PCC n (%)	Vaccinated+PCC n (%)	Total Unvaccinated (N)	Total Vaccinated (N)
March-June2020	6 (50)	0 (0)	12	0
July-Oct 2020	9 (64)	0 (0)	14	0
Nov2020-Feb 2021	34 (52)	1 (14)	66	7
March-June 2021	3 (33)	6 (27)	9	22
July-Oct 2021	0 (0)	16 (31)	4	51
Nov 2021-Feb 2022	2 (17)	148 (25)	12	596
March-June 2022	0 (0)	38 (22)	5	169

4.4 Association with Work Factors

4.4.1. 1-on-1 Contact with COVID-19 Patients & Role Setting

Table 25 gives the association of a PCC and working at start of the infection episode, the most recent type of 1-on-1 patient contact, and occupational role settings (hospital, community, residential, homecare) prior to infection. Working at the start of an infection episode was not found to have an association with development of a PCC. Compared to those who had no patient contact prior to infection, the risk of developing a PCC was the same whether a HCW had 1-on-1 contact with a patient with or without COVID-19. In regard to the most recent role setting prior to infection, those who worked in a hospital were at less risk of developing a PCC in bivariate analysis and in those with missing information, however this association was reduced once adjusted in the multivariable analysis. Missing information was due to these participants not fully completing a questionnaire prior to infection. No other role setting demonstrated an association with developing a PCC.

Table 25. *Association between most recent work setting and type of patient contact prior to infection and developing a post-COVID condition*

		Reported a PCC		Total	Bivariate			Adjusted*		
Occupational Variables		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Working at Start of Infection Episode	No	20	24.1	83	1.00	–	–	1.00	–	–
	Yes	231	28.0	826	1.22	0.72 to 2.07	0.453	1.24	0.72 to 2.11	0.436
	Unknown	12	20.7	58	0.82	0.37 to 1.85	0.635	0.88	0.38 to 2.01	0.755
Most recent work role: hospital	No	125	32.1	389	1.00	–	–	1.00	–	–
	Yes	131	24.6	532	0.69	0.52 to 0.92	0.012	0.77	0.56 to 1.05	0.096
	Not Working	0	0.0	1	–	–	–	–	–	–
	Unknown	7	15.6	45	0.39	0.17 to 0.90	0.026	0.44	0.19 to 1.03	0.060
Most recent work role: community	No	189	28.3	668	1.00	–	–	1.00	–	–
	Yes	67	26.5	253	0.93	0.66 to 1.27	0.669	1.12	0.79 to 1.59	0.541
	Not Working	0	0.0	1	–	–	–	–	–	–
	Unknown	7	15.6	45	0.47	0.21 to 1.06	0.072	0.53	0.23 to 1.22	0.137
Most recent work role: residential	No	219	26.8	817	1.00	–	–	1.00	–	–
	Yes	37	35.6	104	1.51	0.98 to 2.32	0.061	1.30	0.83 to 2.04	0.257
	Not Working	0	0.0	1	–	–	–	–	–	–
	Unknown	7	15.6	45	0.50	0.22 to 1.14	0.101	0.53	0.23 to 1.22	0.136
Most recent work role: homecare	No	223	27.3	816	1.00	–	–	1.00	–	–
	Yes	33	31.4	105	1.22	0.79 to 1.89	0.378	0.89	0.55 to 1.46	0.652
	Not Working	0	0.0	1	–	–	–	–	–	–
	Unknown	7	15.6	45	0.49	0.22 to 1.11	0.088	0.51	0.22 to 1.17	0.112
1on1 Patient Contact	No Contact	23	31.9	72	1.00	–	–	1.00	–	–
	Patients without COVID-19	62	29.8	208	0.91	0.51 to 1.61	0.734	0.94	0.52 to 1.69	0.839
	Patients with COVID-19	171	26.7	641	0.78	0.46 to 1.31	0.342	0.88	0.52 to 1.51	0.646
	Not Working	0	0.0	1	–	–	–	–	–	–
	Unknown	7	15.6	45	0.39	0.15 to 1.01	0.053	0.47	0.18 to 1.22	0.119
	Total	263	27.2	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

4.5 Association of Work, Time and Severity Factors with PCC

4.5.1 Work Factors Related to Infection Episode

Table 26 shows factors related to work including days off work, work modifications, making a workers' compensation board claim (WCB), and the perception of being infected at work. Among those who perceived work as the source of their infection, 35.7% developed a post-COVID condition, and were found to be at higher risk. HCW who had 31 days or more off work due to their COVID-19 episode were also at greater risk of developing a PCC (or had already done so). Those with work modifications due to their infection had a very high risk for developing (or having developed) a PCC. Making a WCB claim related to the episode was also associated with a PCC.

Figure 5 shows the proportion of HCW who reported being infected at work with a PCC, distributed by infection time periods. The data table underneath shows the distribution of infection source for each time period among HCW with a PCC. The graphs demonstrate a higher proportion of those infected earlier during the pandemic believed the source of infection was work related, peaking from November 2020 to February 2021 (69%), followed by a sharp reduction beginning in March 2021-June 2021 (22%).

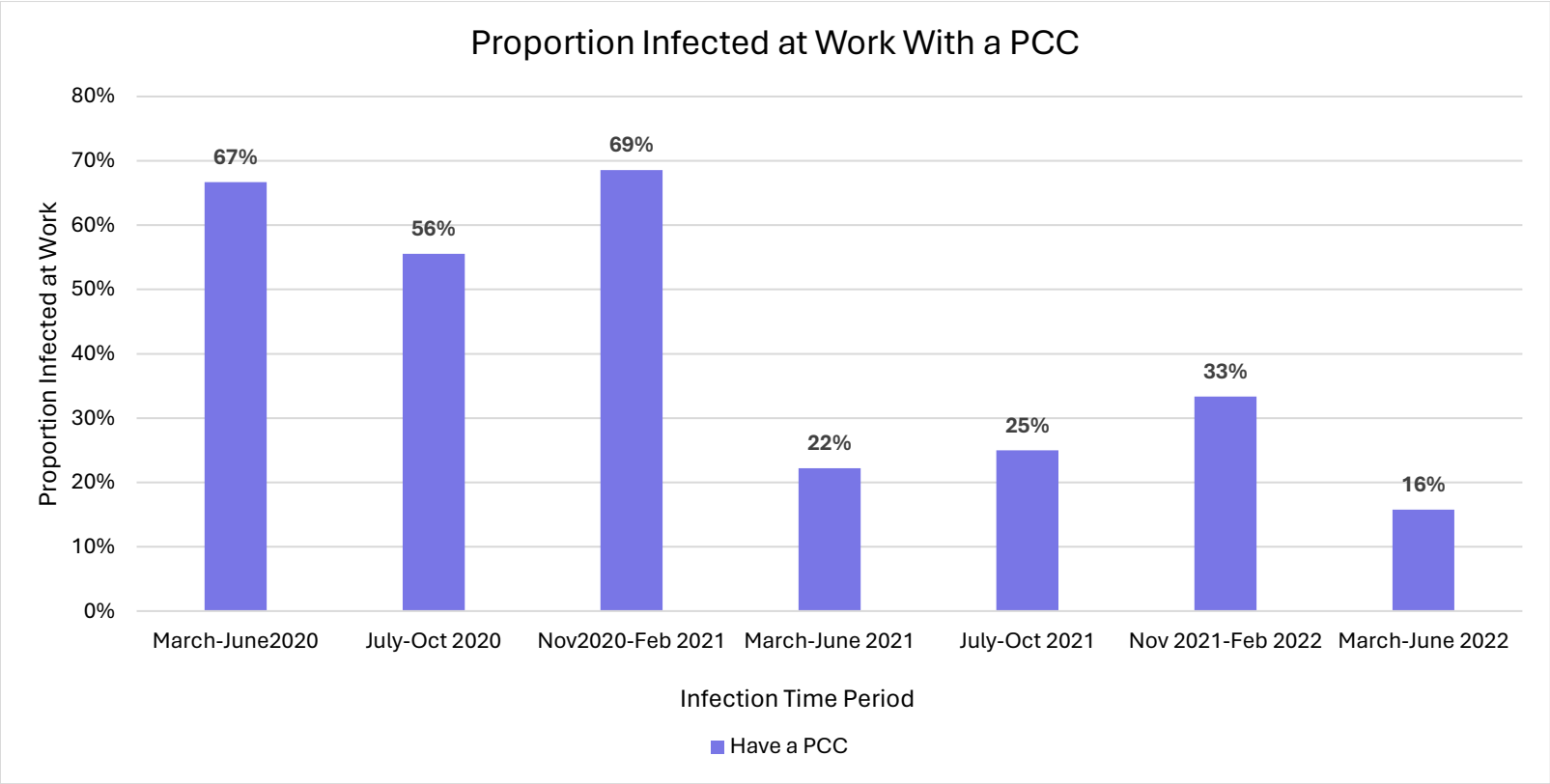
Table 26. *Association between work factors related to infection episode and developing a post-COVID condition*

		Reported a post-COVID condition		Total	Bivariate			Adjusted*		
Infection Factors		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Believe Infected at Work	No	167	24.1	693	1.00	–	–	1.00	–	–
	Yes+Unsure	95	35.7	266	1.75	1.29 to 2.38	<0.001	1.61	1.17 to 2.21	0.003
	Unknown	1	12.5	8	0.45	0.06 to 3.68	0.457	0.39	0.05 to 3.22	0.380
Missed more than 31 days of work	No	218	26.9	810	1.00	–	–	1.00	–	–
	Yes	13	81.3	16	11.77	3.32 to 41.69	<0.001	10.89	3.05 to 38.90	<0.001
	Not Working[1]	20	24.1	83	0.86	0.51 to 1.46	0.581	0.85	0.50 to 1.45	0.550
	Unknown	12	20.7	58	0.71	0.37 to 1.36	0.302	0.75	0.38 to 1.46	0.390
Work Modification due to infection	No	213	26.5	804	1.00	–	–	1.00	–	–
	Yes	18	81.8	22	12.49	4.18 to 37.31	<0.001	14.25	4.67 to 43.51	<0.001
	Not working[1]	20	24.1	83	0.88	0.52 to 1.49	0.637	0.88	0.51 to 1.50	0.634
	Unknown	12	20.7	58	0.72	0.38 to 1.39	0.333	0.77	0.39 to 1.50	0.439
WCB Claim due to infection	No	198	26.3	752	1.00	–	–	1.00	–	–
	Yes	23	44.2	52	2.22	1.25 to 3.93	0.006	1.86	1.03 to 3.34	0.038
	Not working[1]	20	24.1	83	0.89	0.52 to 1.51	0.660	0.87	0.51 to 1.48	0.596
	Unknown	22	27.5	80	1.06	0.63 to 1.78	0.822	1.05	0.62 to 1.78	0.858
	Total	263	27.2	967	–	–	–	–	–	–

[1] Not working at start of infection

*Adjusted for job, gender, and age at time of infection

Figure 5. *Changes in the perception of being infected at work with a post-COVID condition (PCC) over time.*



Time of Infection	Infected at work+PCC	PCC Total
March-June2020	4	6
July-Oct 2020	5	9
Nov 2020-Feb 2021	24	35
March-June 2021	2	9
July-Oct 2021	4	16
Nov 2021-Feb 2022	50	150
March-June 2022	6	38

4.5.2 Infection Period During the Pandemic

Table 27 demonstrates that the development of a post-COVID condition decreased as time progressed from the start of the pandemic (March 6, 2020). This reduction of risk was found as the infection date since the start of the pandemic increased (months). This demonstrates how those infected earlier in the pandemic were at higher risk for developing a PCC than those infected later. To view trends over time, infection dates were stratified into time periods grouped by months of infection. Compared to those infected at the beginning of the pandemic (March-June 2020), there was a lower risk of PCC in those infected from November 2021 to February 2022 and March to June 2022.

Table 27. Association between time of infection during the pandemic and developing a post-COVID condition

Time Since Pandemic Start at time of infection*		Reported a post-COVID condition		Total	Bivariate			Adjusted**		
		Median	IQR	N	OR	95% CI	P=	OR	95% CI	P=
Months	Continuous (0 to 26)	22.0	4.0	967	0.93	0.91 to 0.96	<0.001	0.93	0.91 to 0.96	<0.001
Time of infection*		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Infection Period	March-June 2020	6	50.0	12	1.00	–	–	1.00	–	–
	July-October 2020	9	64.3	14	1.80	0.37 to 8.68	0.464	1.34	0.27 to 6.86	0.718
	November 2020-February 2021	35	47.9	73	0.92	0.27 to 3.12	0.895	0.65	0.18 to 2.32	0.509
	March-June 2021	9	29.0	31	0.41	0.10 to 1.61	0.202	0.29	0.07 to 1.18	0.084
	July-October 2021	16	29.1	55	0.41	0.12 to 1.46	0.170	0.31	0.08 to 1.15	0.079
	Nov 2021-February 2022	150	24.7	608	0.33	0.10 to 1.03	0.056	0.25	0.07 to 0.82	0.022
	March-June 2022	38	21.8	174	0.28	0.09 to 0.92	0.035	0.22	0.06 to 0.74	0.015
	Total	263	27.2	967	–	–	–	–	–	–

* Start of pandemic: March 6, 2020

**Adjusted for job, gender, and age at time of infection

4.5.3 Severity of infection: Symptoms

Severity of symptoms pertaining to the estimated time window of HCW COVID-19 infection is outlined in Tables 28 and 29. Table 28 shows the distribution of symptom responses from HCW who felt unwell for 2 or more consecutive days. We find that a higher proportion of infected HCW were extremely bothered by fatigue, headache and coughing, and less likely to be bothered by coughing up blood, vomiting and loss of smell or taste. Table 28 also shows the weight in a 1st principal component, based on the distribution of symptom responses, using a principal components analysis. The primary component (mean of 0 and standard deviation of 1) extracted from these responses was taken as a measure of severity. This component accounted for 35.2% of the variance. Severity ratings were recorded on a 5-point scale, with responses from 705 HCW.

Table 28. *Derivation of severity score. Distribution of symptom responses (N=705)**

Symptoms	Not at all bothered — Rating — Extremely bothered										Total		Weight in 1st principal component
	1		2		3		4		5				
	N	%	N	%	N	%	N	%	N	%	N	%	
Coughing	179	25.4	99	14.0	151	21.4	168	23.8	108	15.3	705	100.0	0.497
Chest pain	474	67.2	103	14.6	52	7.4	49	7.0	27	3.8	705	100.0	0.577
Shortness of breath	408	57.9	108	15.3	65	9.2	77	10.9	47	6.7	705	100.0	0.558
Coughing up sputum	416	59.0	101	14.3	85	12.1	72	10.2	31	4.4	705	100.0	0.460
Coughing up blood	660	93.6	34	4.8	5	0.7	4	0.6	2	0.3	705	100.0	0.272
Sweating	368	52.2	103	14.6	118	16.7	82	11.6	34	4.8	705	100.0	0.657
Chills	298	42.3	106	15.0	149	21.1	114	16.2	38	5.4	705	100.0	0.632
Headache	108	15.3	95	13.5	156	22.1	200	28.4	146	20.7	705	100.0	0.637
Nausea	410	58.2	103	14.6	96	13.6	65	9.2	31	4.4	705	100.0	0.636
Vomiting	583	82.7	53	7.5	33	4.7	20	2.8	16	2.3	705	100.0	0.463
Diarrhea	457	64.8	103	14.6	64	9.1	56	7.9	25	3.5	705	100.0	0.540
Stomach pain	477	67.7	91	12.9	73	10.4	36	5.1	28	4.0	705	100.0	0.595
Muscle pain	247	35.0	98	13.9	150	21.3	122	17.3	88	12.5	705	100.0	0.693
Lack of appetite	367	52.1	118	16.7	109	15.5	67	9.5	44	6.2	705	100.0	0.643
Trouble concentrating	250	35.5	103	14.6	126	17.9	147	20.9	79	11.2	705	100.0	0.732
Trouble thinking	274	38.9	106	15.0	128	17.9	126	17.9	71	10.1	705	100.0	0.721
Trouble sleeping	229	32.5	114	16.2	142	20.1	136	19.3	84	11.9	705	100.0	0.602
Fatigue	63	8.9	97	13.8	161	22.8	201	28.5	183	26.0	705	100.0	0.724
Loss of smell or taste	530	75.2	48	6.8	48	6.8	37	5.2	42	6.0	705	100.0	0.422

** Component analysis based on responses to those who reported being unwell (n=705). Indicator variable used to account for missing responses. The 1st principal component extracted from these data (labelled severity) accounted for 35.2% of the variance.*

Tables 29 to 31 show the derivation of a final model for the association between reporting a PCC and severity of infection symptoms. In multivariable analysis, HCW with a higher total severity score had more than double the risk for developing a PCC, with a median total severity score of 0.493 (Table 29). This risk remained after adjusting for confounders. Next, Table 30 shows how we built a final model for severity of specific symptoms. In model B each symptom was added in turn to our Model B from Table 29, taking into account of confounders, responses of being unwell, and total severity score. We find a PCC was more likely to develop among those who reported higher symptom severity during their initial infection for chest pain, shortness of breath, trouble concentrating, and trouble thinking. However, these symptoms are indicative of a PCC, and may serve as a measure of a PCC itself. Alternatively, those with higher severity of gastric flu-like symptoms, including chills, nausea and vomiting were less likely to develop a PCC. We next tested each significant symptom using a likelihood ratio test in a model together (Model C). We find that chest pain, shortness of breath, and trouble thinking remain significant. To further break down these associations, we tested a new model (Model D) which excluded trouble thinking, nausea and diarrhea due to collinearity with the other significant symptoms found in Model B. We find that only chest pain and trouble thinking remain significant. In model E we decide to drop the symptom with the lowest LRT in model D (Chills). Chest pain and trouble thinking remain as important factors in the model, with the addition of shortness of breath. Based on these results we decided to test the three remaining symptoms in a final multivariable model adjusting for confounders, total severity score, and response to being unwell. We find that a higher severity of all three symptoms remain at a higher risk for developing a PCC, along with those older in age and in those working as a PSW or LPN (Table 31).

Table 29. *Association between reporting a post-COVID condition and total severity of infection symptoms (at most recent questionnaire following infection). (N=967)*

		Reported a post-COVID condition		Total	Model A			Model B		
Infection Factors		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Unwell for 2+ Days	No	39	18.7	209	1.00	–	–	1.00	–	–
	Yes	214	30.4	705	1.73	1.73 to 2.55	0.006	1.97	1.31 to 2.95	0.001
	Unknown	10	18.9	53	1.01	0.47 to 2.19	0.972	1.15	0.53 to 2.53	0.722
Severity	Range -1.57 to 3.35	Mean 0.00	SD 1.00	705	2.13	1.79 to 2.55	<0.001	2.12	1.77 to 2.55	<0.001

Model A: severity score (from 1st component) and unwell response

Model B: severity score, unwell response, job, gender, age

Table 30. *Derivation of a final model for the association between reporting a post-COVID condition and severity of infection symptoms (at most recent questionnaire following infection). (N=967)*

	Model B (Each symptom added in turn to Model B)			Model C (All significant symptoms)			Model D*			Model E			Final Model		
Symptoms	**OR**	**95% CI**	**P=**	**$\chi^2_{(LRT)}$**	**df**	**χ^2 P value**	**$\chi^2_{(LRT)}$**	**df**	**χ^2 P value**	**$\chi^2_{(LRT)}$**	**df**	**χ^2 P value**	**OR**	**95% CI**	**P=**
Coughing	0.92	0.80 to 1.07	0.277	–	–	–	–	–	–	–	–	–	–	–	–
Chest pain	1.44	1.21 to 1.71	<0.001	12.82	1	<0.001	12.25	1	<0.001	14.10	1	<0.001	1.49	1.22 to 1.81	<0.001
Shortness of breath	1.30	1.13 to 1.51	<0.001	4.56	1	0.033	3.75	1	0.053	4.18	1	0.041	1.22	1.04 to 1.44	0.017
Coughing up sputum	0.92	0.79 to 1.07	0.265	–	–	–	–	–	–	–	–	–	–	–	–
Coughing up blood	0.85	0.56 to 1.30	0.457	–	–	–	–	–	–	–	–	–	–	–	–
Sweating	0.94	0.79 to 1.11	0.444	–	–	–	–	–	–	–	–	–	–	–	–
Chills	0.77	1.01 to 1.04	0.005	0.29	1	0.594	0.68	1	0.410	–	–	–	–	–	–
Headache	0.94	0.79 to 1.12	0.512	–	–	–	–	–	–	–	–	–	–	–	–
Nausea	0.82	0.68 to 0.98	0.030	0.65	1	0.421	–	–	–	–	–	–	–	–	–
Vomiting	0.65	0.51 to 0.82	<0.001	3.44	1	0.064	3.38	1	0.066	2.92	1	0.087	–	–	–
Diarrhea	0.83	0.70 to 0.99	0.043	0.02	1	0.883	–	–	–	–	–	–	–	–	–
Stomach pain	0.88	0.73 to 1.06	0.174	–	–	–	–	–	–	–	–	–	–	–	–
Muscle pain	0.94	0.79 to 1.10	0.419	–	–	–	–	–	–	–	–	–	–	–	–
Lack of appetite	0.85	0.72 to 1.01	0.065	–	–	–	–	–	–	–	–	–	–	–	–
Trouble concentrating	1.52	1.27 to 1.82	<0.001	1.55	1	0.214	–	–	–	–	–	–	–	–	–
Trouble thinking	1.59	1.33 to 1.89	<0.001	7.31	1	0.007	24.60	1	<0.001	30.64	1	<0.001	1.75	1.45 to 2.11	<0.001
Trouble sleeping	1.04	0.90 to 1.21	0.614	–	–	–	–	–	–	–	–	–	–	–	–
Fatigue	1.17	0.94 to 1.44	0.154	–	–	–	–	–	–	–	–	–	–	–	–
Loss of smell or taste	0.89	0.76 to 1.03	0.125	–	–	–	–	–	–	–	–	–	–	–	–

Model B: severity score, unwell response, job, gender, age
Model C: severity score, unwell response, job, gender, age, chest pain, shortness of breath, chills, nausea, vomiting, diarrhea, trouble concentrating, trouble thinking
Model D: severity score, unwell response, job, gender, age, chest pain, shortness of breath, chills, vomiting, trouble thinking
* omitted due to collinearity: trouble concentrating, nausea and diarrhea
Model E: severity score, unwell response, job, gender, age, chest pain, shortness of breath, vomiting, trouble thinking
Final Model: severity score, unwell response, job, gender, age, chest pain, shortness of breath, trouble thinking

Table 31. *Final model of the association between reporting a post-COVID condition and severity of infection symptoms (at most recent questionnaire following infection). (N=967)*

		Final Model		
Factor		**OR**	**95% CI**	**P=**
Job	MD	1.00	–	–
	RN	1.46	0.91 to 2.35	0.118
	LPN	4.88	1.76 to 13.50	0.002
	PSW	3.35	1.46 to 7.67	0.004
	HCA	2.05	0.62 to 6.81	0.243
Gender	Male	1.00	–	–
	Female	1.10	0.63 to 1.92	0.728
Unwell for 2+ Days	No	1.00	–	–
	Yes	0.17	0.08 to 0.37	<0.001
	Unknown	–	–	–
Entered as continuous variables				
Age[1]	Continuous: 24 to 75	1.02	1.01 to 1.04	0.009
Severity	Range: -1.57 to 3.35	0.82	0.60 to 1.12	0.212
Chest pain	Continuous: 1 to 5	1.49	1.22 to 1.81	<0.001
Shortness of breath	Continuous: 1 to 5	1.22	1.04 to 1.44	0.017
Trouble thinking	Continuous: 1 to 5	1.75	1.45 to 2.11	<0.001

[1] Age at time of infection

4.6 Sub-Analysis using Alberta Health Records

Pre-existing conditions (up to 35 months pre-pandemic) derived from Alberta Health data linkage are shown in Table 32. This analysis includes only Albertan HCW who had given consent and had available data successfully linked (n=614). Among those with a previous diagnosis of asthma, 38.1% developed a PCC, along with 33.3% of those with a chronic lung disease, 62.5% of those with pneumonia, 32.8% of those with anxiety, 39.1% of those with depression, and 39.5% of those with acute stress. In multivariable analysis, after adjusting for job, age and gender, higher risk for developing a PCC was seen among those previously diagnosed with pneumonia, depression, and acute stress. A greater risk for a PCC was not observed for pre-existing anxiety, asthma, and chronic lung disease.

Table 32. *Association of a post-COVID condition and pre-existing conditions (billing codes) in Alberta HCW based on Alberta Health Data (35 months pre-pandemic). (n=614)*

		Reported a post-COVID Condition		Total	Bivariate			Adjusted*		
Pre-pandemic Condition		**n**	**%**	**N**	**OR**	**95% CI**	**p=**	**OR**	**95% CI**	**p=**
Pre-pandemic: Asthma	No	159	28.9	551	1.00	–	–	1.00	–	–
	Yes	24	38.1	63	1.52	0.88 to 2.61	0.131	1.34	0.80 to 2.41	0.248
Pre-pandemic: Chronic Lung Disease	No	179	29.7	602	1.00	–	–	1.00	–	–
	Yes	4	33.3	12	1.18	0.35 to 3.97	0.787	0.81	0.23 to 2.90	0.744
Pre-pandemic: Pneumonia	No	173	28.9	598	1.00	–	–	1.00	–	–
	Yes	10	62.5	16	4.09	1.47 to 11.44	0.007	3.67	1.29 to 10.43	0.015
Pre-pandemic: Anxiety	No	126	28.6	440	1.00	–	–	1.00	–	–
	Yes	57	32.8	174	1.21	0.83 to 1.77	0.315	1.14	0.77 to 1.67	0.520
Pre-Pandemic: Depression	No	133	27.4	486	1.00	–	–	1.00	–	–
	Yes	50	39.1	128	1.70	1.13 to 2.56	0.011	1.64	1.09 to 2.48	0.019
Pre-Pandemic: Acute Stress	No	149	28.2	528	1.00	–	–	1.00	–	–
	Yes	34	39.5	86	1.66	1.04 to 2.67	0.035	1.64	1.02 to 2.65	0.043
	N	183	29.8	614	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

4.7 Final Model

Derivation of a final multivariable model from factors found to be associated with a PCC is shown in Table 33. First, as shown previously, and as the selection factor for this model, each factor added to a base model containing job, gender and age at time of infection. In this model, all factors (other than availability of HADS ratings) were found to be associated with a PCC. Next, all the selected variables were included in a single multivariable model (model A). From this model, pre-infection HADS anxiety scores, other chronic mental health conditions, other chronic conditions, number of vaccines, and perception of being infected at work maintained an association with a PCC. These were used in a new multivariable model adjusted for job, age and gender (model B) and all factors remained significant. To test if any of the factors excluded from model B, which were initially associated with a PCC in bivariate analysis, affected this final model, each were tested in turn using a likelihood ratio test. We found that none of the excluded variables were associated with a PCC when added to model B and the final model was accepted. The OR and CI for the factors included in the final model are shown in Table 34.

In this final model, age at time of infection, gender, and having an available HADS rating were not associated with developing a PCC. In terms of work role, with MDs taken as the comparison group, LPNs had the highest risk followed by PSWs , and RNs. HCAs were also at increased risk, but, given the smaller numbers, the CIs did not exclude 1.00. The risk of developing a PCC was higher in those with other chronic conditions, other mental health conditions, in those believed they were infected at work, and increased with higher pre-infection HADS anxiety scores. We also found with more vaccines received prior to infection, the risk for a PCC was lowered.

Table 33. *Derivation of a multivariable model from factors found to be associated with a post-COVID condition*

	Test of each factor added to the Base Model*				Model A (all variables)				Model B (all significant variables)**				Test of each factor added to Model B			
	χ^2 (LRT)	Wald	df	χ^2 P value	χ^2 (LRT)	Wald	df	χ^2 P value	χ^2 (LRT)	Wald	df	χ^2 P value	χ^2 (LRT)	Wald	df	χ^2 P value
Job	–	–	–	–	11.04	10.64	4	0.026	14.52	13.88	4	0.006	–	–	–	–
Gender	–	–	–	–	0.17	0.17	1	0.676	0.01	0.014	1	0.906	–	–	–	–
Age	–	–	–	–	0.39	0.39	1	0.532	1.04	1.04	1	0.308	–	–	–	–
BMI	11.93	12.15	2	0.003	4.10	4.16	2	0.129	–	–	–	–	4.48	4.54	2	0.107
Drink More	8.08	8.24	2	0.018	6.50	6.58	2	0.039	–	–	–	–	5.18	5.25	2	0.075
HADS Ratings Available	0.70	0.73	1	0.402	0.15	0.66	1	0.695	1.92	1.20	1	0.166	–	–	–	–
Pre-Infection Anxiety (HADS)	13.32	12.52	2	0.001	5.49	5.50	1	0.019	10.03	9.99	1	0.002	–	–	–	–
Self-Report Other MH (Chronic 12m)	18.22	16.55	2	<0.001	4.64	4.44	1	0.031	5.82	5.56	1	0.016	–	–	–	–
Self-Report Treated Asthma (12m)	16.69	15.62	2	<0.001	2.71	2.76	1	0.100	–	–	–	–	3.00	3.06	1	0.083
Self-Report Any Respiratory	16.02	14.92	2	<0.001	0.65	0.60	1	0.421	–	–	–	–	2.04	2.07	1	0.153
Self-Report Other Chronic Condition (12m)	26.02	25.1	2	<0.001	10.86	10.98	1	<0.001	13.49	13.62	1	<0.001	–	–	–	–
Ankylosing Spondylitis	6.20	5.67	2	0.045	3.35	3.17	1	0.067	–	–	–	–	3.65	3.36	2	0.161
Psoriatic Arthritis	5.98	4.96	2	0.050	3.32	2.79	1	0.068	–	–	–	–	4.02	3.40	2	0.134
Number of Vaccines	15.57	15.86	1	<0.001	9.44	9.56	1	0.002	12.53	12.69	1	<0.001	–	–	–	–
Believe Infected at Work	9.84	9.71	2	0.007	6.90	6.82	2	0.032	7.44	7.22	2	0.024	–	–	–	–

* Base Model: Job, gender, age at time of infection

** Model B: Job, gender, age at time of infection, HADS done, HADS anxiety, other MH condition, other chronic condition (excluding MH and respiratory), vaccine number, believe infected at work

Table 34. *Final Model of associations with developing a post-COVID condition*

		Reported a post-COVID Condition		Total	Final Model		
Factor		**n**	**%**	**N**	**OR**	**95% CI**	**P=**
Job	MD	40	16.8	238	1.00	–	–
	RN	192	29.4	653	2.01	1.29 to 3.13	0.002
	LPN	11	50.0	22	4.43	1.67 to 11.74	0.003
	PSW	15	39.5	38	2.35	1.03 to 5.38	0.043
	HCA	5	31.3	16	1.56	0.46 to 5.24	0.472
Gender	Male	29	19.9	146	1.00	–	–
	Female	234	28.5	821	1.03	0.62 to 1.72	0.906
Self-Report Other Chronic Condition (12m)	No	145	24.4	595	1.00	–	–
	Yes	97	39.1	248	1.90	1.35 to 2.67	<0.001
	Unknown	21	16.9	124	–	–	–
Believe Infected at Work	No	167	24.1	693	1.00	–	–
	Yes+Unsure	95	35.7	266	1.52	1.09 to 2.12	0.014
	Unknown	1	12.5	8	0.37	0.04 to 3.13	0.362
HADS Ratings Available	No	9	33.3	27	1.00	–	–
	Yes	254	27.0	940	0.49	0.18 to 1.32	0.158
Self-Report Other MH (Chronic 12m)[1]	No	235	28.2	832	1.00	–	–
	Yes	7	63.6	11	4.55	1.29 to 16.02	0.018
	Unknown	21	16.9	124	0.51	0.30 to 0.87	0.014
Entered as continuous variables		**Median**	**IQR**				
Age[1]	Continuous (24 to 75)	44.0	10.8	967	1.01	0.99 to 1.02	0.308
Number of Vaccines[1]	Continuous (0 to 4)	2.0	1.0	967	0.77	0.66 to 0.89	<0.001
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	9.0	5.5	967	1.06	1.02 to 1.10	0.002
	Total	263	27.2	967	–	–	–

*Adjusted for job, gender, and age at time of infection

[1] At time of infection

[2] Excluding anxiety and depression

Table 35 shows the effect of the addition of time since the start of the pandemic at time of infection in months, with the start of the pandemic as March 6 2020. We see that those infected later in the pandemic were at a lower risk or developing a PCC but find that the effect of the number of vaccines received is reduced.

Table 35. *Effect of months since the start of the pandemic at time of infection on the final model*

		Final Model			Final Model with Time		
Factor		**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Job	MD	1.00	–	–	1.00	–	–
	RN	2.01	1.29 to 3.13	0.002	2.04	1.31 to 3.18	0.002
	LPN	4.43	1.67 to 11.74	0.003	4.58	1.72 to 12.21	0.002
	PSW	2.35	1.03 to 5.38	0.043	2.69	1.16 to 6.28	0.022
	HCA	1.56	0.46 to 5.24	0.472	1.61	0.47 to 5.49	0.446
Gender	Male	1.00	–	–	1.00	–	–
	Female	1.03	0.62 to 1.72	0.906	1.04	0.62 to 1.73	0.894
Self-Report Other Chronic Condition (12m)	No	1.00	–	–	1.00	–	–
	Yes	1.90	1.35 to 2.67	<0.001	1.83	1.30 to 2.58	<0.001
	Unknown	–	–	–	0.55	0.32 to 0.94	0.029
Believe Infected at Work	No	1.00	–	–	1.00	–	–
	Yes+Unsure	1.52	1.09 to 2.12	0.014	1.46	1.04 to 2.04	0.029
	Unknown	0.37	0.04 to 3.13	0.362	0.35	0.04 to 2.96	0.335
HADS Ratings Available	No	1.00	–	–	1.00	–	–
	Yes	0.49	0.18 to 1.32	0.158	0.74	0.25 to 2.20	0.583
Self-Report Other MH (Chronic 12m)[1]	No	1.00	–	–	1.00	–	–
	Yes	4.55	1.29 to 16.02	0.018	4.35	1.23 to 15.32	0.022
	Unknown	0.51	0.30 to 0.87	0.014	–	–	–
Entered as continuous variables							
Age[1]	Continuous (24 to 75)	1.01	0.99 to 1.02	0.308	1.01	0.99 to 1.02	0.301
Number of Vaccines[1]	Continuous (0 to 4)	0.77	0.66 to 0.89	<0.001	0.94	0.74 to 1.19	0.592
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	1.06	1.02 to 1.10	0.002	1.06	1.02 to 1.10	0.002
Months since pandemic start[1,2]	Continuous (0.4 to 26.8)	–	–	–	0.95	0.90 to 1.00	0.031
	Total	263	27.2	967	–	–	–

[1] At time of infection

[2] Pandemic Start Date: March 6, 2020

To investigate the difference in vaccination with the addition of time at time of infection during the pandemic, the final model was stratified into two analyses based on vaccination status. Table 36 shows the model among only unvaccinated HCW, and Table 37 among only those vaccinated. Among unvaccinated HCW (Table 36), a higher risk for developing a PCC was no longer evident based on job role, having a other chronic or mental health condition. Pre-infection anxiety and the perception of being infected at work remained at risk. A lower risk was seen for those infected later in the pandemic. Among vaccinated HCW (Table 37), a higher risk for a PCC was seen for RNs and LPNs, other chronic conditions, other mental health conditions, and pre-infection anxiety. However, no association was found based on time of infection during the pandemic, nor with the number of vaccines.

Table 36. *Final Model among unvaccinated participants only (includes months since start of pandemic at time of infection). (N=122)*

		Reported a post-COVID Condition		Total	Bivariate (Unadjusted)			Adjusted*			Final Model		
		n	%	N	OR	95% CI	P=	OR	95% CI	P=	OR	95% CI	P=
Job	MD	8	33.3	24	1.00	–	–	1.00	–	–	1.00	–	–
	RN	34	44.7	76	1.62	0.62 to 4.24	0.326	1.43	0.49 to 4.19	0.515	2.01	0.42 to 9.72	0.383
	LPN	1	25.0	4	0.67	0.06 to 7.48	0.742	0.46	0.04 to 5.58	0.539	0.33	0.02 to 5.57	0.439
	PSW	8	57.1	14	2.67	0.69 to 10.36	0.157	2.32	0.53 to 10.04	0.262	5.40	0.72 to 40.80	0.102
	HCA	3	75.0	4	6.00	0.54 to 67.28	0.146	6.17	0.50 to 76.38	0.156	24.05	0.47 to 1223.16	0.113
Gender	Male	4	28.6	14	1.00	–	–	1.00	–	–	1.00	–	–
	Female	50	46.3	108	2.16	0.64 to 7.30	0.217	1.51	0.38 to 6.01	0.560	0.99	0.19 to 5.04	0.990
Self-Report Other Chronic Condition (12m)	No	32	42.1	76	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	18	62.1	29	2.25	0.94 to 5.41	0.070	2.43	0.96 to 6.18	0.062	1.39	0.46 to 4.18	0.554
	Unknown	4	23.5	17	0.42	0.13 to 1.42	0.163	0.41	0.12 to 1.44	0.167	0.61	0.12 to 3.08	0.551
Believe Infected at Work	No	19	92.2	65	1.00	–	–	1.00	–	–	1.00	–	–
	Yes+Unsure	35	64.8	54	4.46	2.06 to 9.66	<0.001	4.76	2.09 to 10.86	<0.001	2.64	1.04 to 6.68	0.041
	Unknown	0	0.0	3	0.00	–	0.999	0.00	–	0.999	0.00	–	0.999
HADS Ratings Available	No	9	40.9	22	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	45	45.0	100	1.18	0.46 to 3.02	0.727	1.16	0.40 to 3.36	0.784	1.03	0.14 to 7.37	0.973
Self-Report Other MH (Chronic 12m)[1]	No	49	47.1	104	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	1	100.0	1	–	–	–	–	–	–	–	–	–
	Unknown	4	23.5	17	0.35	0.11 to 1.13	0.079	0.33	0.10 to 1.12	0.075	–	–	–
Entered as continuous variables		**Median**	**IQR**										
Age[2]	Continuous (24 to 70)	45.0	18.3	122	0.99	0.96 to 1.02	0.472	0.98	0.95 to 1.02	0.299	0.99	0.94 to 1.03	0.487
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	9.0	6.0	122	1.10	1.00 to 1.12	0.042	1.10	1.00 to 1.21	0.046	1.13	1.00 to 1.28	0.042
Months since pandemic start[1,2]	Continuous (0.4 to 24.8)	9.3	3.7	122	0.88	0.81 to 0.95	0.001	0.85	0.78 to 0.93	<0.001	0.84	0.74 to 0.95	0.004
	Total	54	44.3	122	–	–	–	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

[1] Pandemic Start Date: March 6, 2020

[2] At time of infection

Table 37. *Final Model among vaccinated participants only (includes months since start of pandemic at time of infection). (N=845)*

		Reported a post-COVID Condition		Total	Bivariate (Unadjusted)			Adjusted*			Final Model		
		n	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Job	MD	32	15.0	214	1.00	–	–	1.00	–	–	1.00	–	–
	RN	158	27.4	577	2.15	1.41 to 3.26	<0.001	2.15	1.36 to 3.41	0.001	2.07	1.29 to 3.35	0.003
	LPN	10	55.6	18	7.11	2.61 to 19.38	<0.001	7.39	2.66 to 20.51	<0.001	7.16	2.48 to 20.68	<0.001
	PSW	7	29.2	24	2.34	0.90 to 6.10	0.081	2.25	0.85 to 5.98	0.103	2.28	0.79 to 6.60	0.127
	HCA	2	16.7	12	1.14	0.24 to 5.44	0.872	1.09	0.22 to 5.32	0.913	0.90	0.17 to 4.65	0.900
Gender	Male	25	18.9	132	1.00	–	–	1.00	–	–	1.00	–	–
	Female	184	25.8	713	1.49	0.93 to 2.37	0.095	1.06	0.63 to 1.80	0.827	1.03	0.60 to 1.78	0.914
Self-Report Other Chronic Condition (12m)	No	113	21.8	519	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	79	36.1	219	2.03	1.44 to 2.87	<0.001	1.97	1.37 to 2.82	<0.001	1.90	1.32 to 2.74	<0.001
	Unknown	17	15.9	107	0.68	0.39 to 1.19	0.174	0.62	0.35 to 1.09	0.095	0.61	0.34 to 1.09	0.094
Believe Infected at Work	No	148	23.6	628	1.00	–	–	1.00	–	–	1.00	–	–
	Yes+Unsure	60	28.3	212	1.28	0.90 to 1.82	0.168	1.18	0.82 to 1.71	0.374	1.21	0.83 to 1.76	0.331
	Unknown	1	20.0	5	0.81	0.09 to 7.31	0.852	0.63	0.07 to 5.77	0.685	0.66	0.07 to 6.22	0.715
HADS Ratings Available	No	0	0.0	5	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	209	24.9	840	–	–	–	–	–	–	–	–	–
Self-Report Other MH (Chronic 12m)[1]	No	186	25.5	728	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	6	60.0	10	4.37	1.22 to 15.66	0.023	4.86	1.33 to 17.71	0.017	4.04	1.10 to 14.81	0.035
	Unknown	17	15.9	107	0.55	0.32 to 0.95	0.032	0.51	0.29 to 0.89	0.017	–	–	–
Entered as continuous variables		**Median**	**IQR**										
Age[2]	Continuous (24 to 75)	43.0	16.0	845	1.01	0.99 to .02	0.279	1.01	1.00 to 1.03	0.127	1.01	1.00 to 1.03	0.168
Number of Vaccines[2]	Continuous (0 to 4)	3.0	1.0	845	0.83	0.64 to 1.06	0.137	0.85	0.65 to 1.11	0.234	0.78	0.57 to 1.07	0.120
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	7.0	7.0	845	1.05	1.02 to 1.09	0.004	1.06	1.02 to 1.10	0.002	1.06	1.02 to 1.10	0.006
Months since pandemic start[1,2]	Continuous (10.5 to 26.5)	22.4	1.3	845	0.98	0.92 to 1.04	0.523	0.98	0.92 to 1.05	0.536	1.03	0.96 to 1.12	0.423
	Total	209	24.7	845	–	–	–	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

[1] Pandemic Start Date: March 6, 2020

[2] At time of infection

Table 38 shows the effect of the addition of total severity score to the final model with adjustment for whether symptoms were reported. We find that risk for a PCC based on job role remains for RNs and LPNs. The risk among those with any other mental health condition, or having pre-infection anxiety, however, is reduced, but remains high for those with a chronic condition or infected at work. Increase in age is also found to be a risk in this model with severity, and lower for those with more vaccine shots at time of infection.

Table 38. *Effect of total symptom severity on the final model*

		Final Model			Final Model with Severity		
Factor		**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Job	MD	1.00	–	–	1.00	–	–
	RN	2.01	1.29 to 3.13	0.002	1.58	1.00 to 2.50	0.050
	LPN	4.43	1.67 to 11.74	0.003	3.73	1.34 to 10.40	0.012
	PSW	2.35	1.03 to 5.38	0.043	1.81	0.75 to 4.36	0.189
	HCA	1.56	0.46 to 5.24	0.472	1.44	0.41 to 5.06	0.570
Gender	Male	1.00	–	–	1.00	–	–
	Female	1.03	0.62 to 1.72	0.906	1.00	0.59 to 1.69	0.998
Self-Report Other Chronic Condition (12m)	No	1.00	–	–	1.00	–	–
	Yes	1.90	1.35 to 2.67	<0.001	1.78	1.25 to 2.55	0.001
	Unknown	–	–	–	0.47	0.27 to 0.83	0.009
Believe Infected at Work	No	1.00	–	–	1.00	–	–
	Yes+Unsure	1.52	1.09 to 2.12	0.014	1.46	1.03 to 2.07	0.032
	Unknown	0.37	0.04 to 3.13	0.362	0.39	0.05 to 3.32	0.389
HADS Ratings Available	No	1.00	–	–	1.00	–	–
	Yes	0.49	0.18 to 1.32	0.158	0.58	0.20 to 1.65	0.304
Self-Report Other MH (Chronic 12m)[1]	No	1.00	–	–	1.00	–	–
	Yes	4.55	1.29 to 16.02	0.018	3.12	0.86 to 11.38	0.085
	Unknown	0.51	0.30 to 0.87	0.014	–	–	–
Reported Unwell Symptom Ratings	No Symptoms	–	–	–	1.00	–	–
	Had Symptoms	–	–	–	1.76	1.16 to 2.66	0.008
	Unknown	–	–	–	1.05	0.47 to 2.36	0.899
Entered as continuous variables							
Age[2]	Continuous (24 to 75)	1.01	0.99 to 1.02	0.308	1.02	1.00 to 1.03	0.034
Number of Vaccines[2]	Continuous (0 to 4)	0.77	0.66 to 0.89	<0.001	0.78	0.67 to 0.91	0.002
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	1.06	1.02 to 1.10	0.002	1.02	0.99 to 1.06	0.242
Severity of infection[1]	Continuous (-1.57 to 2.93)	–	–	–	2.04	1.68 to 2.48	<0.001
	Total	263	27.2	967	–	–	–

[1] Derived from component analysis of 19 reported unwell symptom scores; [2] At time of infection

Finally, Table 39 shows how the final model is affected when the outcome is a severe post-COVID condition (See Appendix C). Here, a severe PCC is those with classic post-COVID symptoms or conditions and rating daily limitation due to the condition 50% or more. We find that when compared to MDs, RNs and LPNs are still at higher risk, but not for increased age or gender. We no longer find an association for pre-existing chronic conditions, other mental health conditions or the perception of being infected at work but find that those with pre-infection anxiety are at higher risk. Similar to our model of developing a PCC, a higher number of vaccines still remain to lower the risk for a severe PCC.

Table 39. *Final Model investigating the risk of developing a severe PCC (classic+≥50% limitation)*

		Severe post-COVID		Total	Bivariate (Unadjusted)			Adjusted*			Final Model		
		n	%	N	OR	95% CI	P=	OR	95% CI	P=	OR	95% CI	P=
Job	MD	4	1.7	238	1.00	–	–	1.00	–	–	1.00	–	–
	RN	44	6.7	653	4.23	1.50 to 11.89	0.006	3.84	1.29 to 11.47	0.016	4.26	1.35 to 13.44	0.013
	LPN	4	18.2	22	13.00	3.00 to 56.34	<0.001	12.58	2.79 to 56.74	<0.001	12.18	2.41 to 61. 62	0.003
	PSW	4	10.5	38	6.88	1.64 to 28.81	0.008	6.04	1.38 to 26.48	0.017	3.86	0.81 to 18.44	0.091
	HCA	1	6.3	16	3.90	0.41 to 37.10	0.236	3.28	0.33 to 32.50	0.310	2.52	0.23 to 27.67	0.450
Gender	Male	4	2.7	146	1.00	–	–	1.00	–	–	1.00	–	–
	Female	53	6.5	821	2.45	0.87 to 6.88	0.089	1.39	0.46 to 4.22	0.561	1.06	0.34 to 3.34	0.922
Self-Report Other Chronic Condition (12m)	No	30	5.0	595	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	21	8.5	248	1.74	0.98 to 3.11	0.060	1.59	0.87 to 2.91	0.129	1.48	0.80 to 2.76	0.214
	Unknown	6	4.8	124	0.96	0.39 to 2.35	0.925	0.82	0.33 to 2.03	0.660	0.66	0.25 to 1.75	0.403
Believe Infected at Work	No	32	4.6	693	1.00	–	–	1.00	–	–	1.00	–	–
	Yes+Unsure	25	9.4	266	2.14	1.24 to 3.69	0.006	1.90	1.08 to 3.34	0.027	1.67	0.93 to 3.02	0.089
	Unknown	0	0.0	8	–	–	–	–	–	–	–	–	–
HADS Ratings Available	No	3	11.1	27	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	54	5.7	940	0.49	0.14 to 1.67	0.253	0.40	0.11 to 1.54	0.184	0.17	0.03 to 0.87	0.033
Self-Report Other MH (Chronic 12m)	No	49	5.9	832	1.00	–	–	1.00	–	–	1.00	–	–
	Yes	2	18.2	11	3.55	0.75 to 16.88	0.111	4.66	0.94 to 23.20	0.060	4.45	0.88 to 22.5	0.070
	Unknown	6	4.8	124	0.81	0.34 to 1.94	0.640	0.72	0.30 to 1.17	0.460	–	–	–
Entered as continuous variables		**Median**	**IQR**										
Age[1]	Continuous (24 to 75)	45	18	967	1.01	0.98 to 1.03	0.542	1.01	0.99 to 1.04	0.337	1.02	0.99 to 1.05	0.121
Number of Vaccines[1]	Continuous (0 to 4)	2.0	3.0	967	0.69	0.55 to 0.86	<0.001	0.71	0.56 to 0.90	0.004	0.74	0.58 to 0.95	0.019
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	10	6	975	1.12	1.05 to 1.19	<0.001	1.13	1.06 to 1.20	<0.001	1.13	1.06 to 1.21	<0.001
	Total	57	5.9	967	–	–	–	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

[1] At time of infection

Chapter 5: Discussion

This study aimed to address gaps in understanding the prevalence of a post-COVID condition (PCC) and the factors that increase or decrease risk of post-COVID symptoms among Canadian healthcare workers (HCW), including pre-pandemic factors and those associated with experiences during the pandemic. Our study identified a prevalence of a PCC 3 months or more following infection among HCW at 27%, surpassing that reported by the general Canadian population following infection (19%).[16] Overall, most HCW did not develop a severe PCC, with the most prevalent symptoms being fatigue, shortness of breath, and cognitive dysfunction. These findings complement many other HCW studies reporting similar results.[33,44,47,56] Furthermore, our investigation into functional limitation revealed moderate impairment, with the majority of HCW reporting only a single persisting symptom, aligning with observations from other HCW cohorts.[51]

We observed over half of those who reported a PCC discussed the condition with a health professional, the most common being a family doctor or general practitioner, following similar results from Statistics Canada on the general population.[16] The remaining individuals who did not engage with a health professional regarding their condition raise concerns, with possible explanations ranging from symptom improvement over time to the perception of mild symptoms not meriting consulting, or challenges accessing health services. Common accessibility difficulties experienced by Canadians with persisting symptoms outlined by Kuang et al. (2023) include waiting times for an appointment, appointments being delayed, cancelled or rescheduled, and experiencing obstacles in getting a referral.[16] In our study, less than half of those who spoke to a health professional listed a suggestion being made, the most common being medication, followed by diagnostic testing. It is unknown whether these suggestions reduced the functional limitation of a PCC, but it has been shown that two thirds of Canadians with persisting symptoms believe the

treatment or service they receive was not adequate.[16] These experiences may have been shared by HCW in our study but was not investigated and is an important topic for future research.

A comprehensive analysis of predisposing factors revealed several important associations with a PCC in HCW. Pre-existing conditions such as asthma, mental health conditions (anxiety, depression, other MH), other chronic conditions and obesity emerged as risk factors for developing a PCC, although not all made independent contributions in the final model. This aligns with other studies that demonstrate an increased risk among obesity,[47,54,55] asthma,[35]and depression.[23] Another HCW study has also found pre-infection distress, including anxiety and depression, to be a risk factor for developing a PCC.[36] In our study the final model however, only found pre-infection anxiety scores (HADS), other mental health conditions, and other chronic conditions remained associated with a PCC, demonstrating the multicollinearity between depression and anxiety, and between asthma and other chronic conditions. Another important finding is the heightened risk observed among certain HCW occupations (specifically RNs, LPNs, PSWs), suggesting occupation-related stressors and demands may play a role in developing a PCC. Similar findings are seen in the HCW study by Shukla et al. (2023), which also find an increased risk in non-physicians.[35]

We also found certain factors experienced during the pandemic to predispose HCW to post-COVID symptoms, including absence of vaccination. Overall, we found that being vaccinated prior to infection reduced the risk of HCW developing a PCC. In our final model, we also find that as number of vaccines increased the risk was lessened. Our study emphasizes the protective effect of vaccination, with vaccinated HCW exhibiting reduced susceptibility to a PCC, particularly when infected later in the pandemic. Overall, the effect of vaccination status found in our study aligns with the general Canadian population from the Canadian COVID-19 Antibody and Health

Survey-Cycle 2 (CCAHS-2), which found that those who received 2 or 3 doses were half as likely to report persisting symptoms compared to unvaccinated Canadians.[11] Similarly, a large Swedish population cohort study of almost 590,000 subjects found reduced risk for a PCC with any number of vaccine doses prior to infection, with a vaccine effectiveness of 58%.[62] Conversely, Shukla et al. (2023) did not find vaccination prior to infection to be associated with a PCC among HCW, however almost all participants were vaccinated at time of infection.[35]

Factors experienced during the pandemic, such as severity of initial symptoms and perceived workplace exposure, also influenced the predisposition of HCW to a PCC. We found that HCW reporting higher severity of initial symptoms were more prone to developing a PCC, and that when severity was introduced to our final model the risk of other mental health conditions or pre-infection anxiety reduced, demonstrating the multicollinearity between previous mental health conditions and ratings of symptoms during an infection episode. The association with severity of infection symptoms further adds to existing evidence from many other HCW studies.[12,21,35,54] In addition to vaccination and severity, we found that HCW who perceived being infected at work were more prone to developing a PCC. We also found timing of infection to be an important modifier, especially on the effect of vaccination, with those infected earlier to be at higher risk of a PCC. We also see this effect on the perception of being infected at work, being more strongly associated with the reporting of a PCC early in the pandemic. However, other workplace exposures, such as contact with patients with COVID-19, was not seen to be related to a PCC, similar to the HCW study based in Switzerland.[55] These findings suggest that HCW infected earlier in the pandemic may have been exposed to more virulent strains of SARS-CoV-2, highlighting vaccination as a potential protective measure against developing a PCC. HCW may have also been more concerned during the earlier months about the consequences of a COVID-19

infection, such as death. However, the effect of time period is difficult to assess due to the interplay of multiple factors, such as the emergence of new variants and waves of the pandemic, along with accessibility to vaccines when vaccine rollouts began. Overall, these findings highlight the complex relationship between susceptibility, viral strain and immunization status in shaping post-COVID ill-health outcomes among HCW.

Another finding of our study was the increased risk among HCW who missed 31 or more days of work due to infection, indicating severe limitation due to debilitating persisting symptoms. Similarly, the CCAHS found those with persisting symptoms to have missed school or work, missing on average 24 days.[16] These findings are difficult to interpret in comparison to other studies and regions due to the changing jurisdiction requirements for days off work among infected HCW over the course of the pandemic.[63] However, provisions on call-back to work may have had an impact on returning to work sooner, even among those with persisting symptoms. As Koh and Tan (2022) outline, an important rehabilitation tool to recovery from a post-COVID condition is by returning to work even with persisting symptoms, as support may be able to be provided by the workplace.[64] We also found that work modification due to infection was an increased risk for developing a PCC in HCW, however this implies that HCW were able to return to work and supports were offered by their workplace, potentially to help alleviate difficulties and limitations from persisting symptoms and may serve as a rehabilitation measure over time. However, it is unknown whether these modifications reduced the severity or functional limitation of a PCC and is a topic for future research. Compared to the average working population, a UK study found HCW to have a heightened likelihood of reporting persistent symptoms, positioning them as one of the most affected occupational groups in terms of daily functioning.[65] In addition,

existing research demonstrates the detrimental impact of persisting symptoms on the ability of individuals to return to previous levels of work.[66,67]

While our study primarily observed relatively mild cases of a PCC in HCW, future research is needed to identify specific workplace factors which predispose HCW to developing a PCC by affecting their health and how these differ between occupations, such as high workload and stress, as well as supports and treatments that aid in the recovery of persisting symptoms, especially those which impact return to work, daily functioning, and ability to perform work duties at a pre-pandemic level. Future research is also needed to help identify the gaps in why some HCW with persisting symptoms have not consulted a healthcare professional, and the effectiveness of current suggestions and treatments. Understanding characteristics of post-COVID ill-health in specific occupations such as HCW can facilitate the identification and application of appropriate and effective workplace rehabilitation measures, along with workplace supports focused on reducing the risk of developing persisting symptoms.[65,67,68]

Strengths of our study include that our questionnaires collected information prospectively, and before infection, on age, self-reported gender, height and weight (used to calculate BMI), substance use, as well as some pre-existing conditions, which allowed us to consider potential confounders and explanatory factors using data collected before the participant was infected or developed post covid conditions. Another strength is the use of validated tools to measure anxiety and depression (HADS) and severity of symptoms (community acquired pneumonia questionnaire) across multiple contacts, allowing us to investigate these factors prior to the infection time frame. Another strength is that we asked HCW about post-COVID ill-health through an open-ended response, eliminating the constraints many other studies face by using predefined response options. This allowed for a more in depth and detailed response from HCW, allowing for the

report of multiple symptoms or conditions. Further, our study included a wide range of HCW from different occupations, regions and workplace settings, which allows our results to be generalized to other HCW across Canada or in similar settings. The validation and correction of self-reported vaccination and positive test dates using Alberta, BC and Quebec provincial health data linkage also strengthens our data.

Limitations of the study include the absence of data on the duration of post-COVID symptoms and the retrospective collection of symptom data. We estimated PCC duration from the start of a positive infection date to the date of completing the final questionnaire which asks about current conditions believed to be a result of or made worse by their infection. HCW with symptoms lasting more than 3 months may have recovered completely before completing the final questionnaire and so (correctly) reporting no symptoms now. Another limitation is that we did not investigate serological biomarkers as potential predictors for a PCC. The report of a PCC was an open-ended question and the data collected was based on retrospective self-report, and thus at risk of biased recall. This may include selective recall, where a HCW selectively recalls severe symptoms that are more memorable and forget milder ones. HCW may also inaccurately interpret symptoms that occur due to other conditions, later illness or certain events as attributed to their initial COVID-19 infection. Compared to other workers, HCW may also be more likely to think of post-COVID conditions. This may lead to inaccurate reporting of symptoms experienced during the pandemic, which may affect our findings by distorting associations. In addition, self-reports on infection symptom severity may not be reflected in objective measures of functional limitation. Also, ratings of symptom severity, particularly for those recognized as classic PCC symptoms, may serve as a measure of a PCC itself and may potentially not be indicative of the initial infection. Since our study focused on Canadian HCW, findings may not be generalizable to the

general public, other countries, other occupations, or to those infected more than once by the SARS-CoV-2 virus.

Understanding potential risk factors associated with a PCC among HCW has implications for healthcare practice and policy. Our study provides insight into the importance of targeted interventions to mitigate modifiable risk factors and workplace health promotion surrounding modifiable risk factors such as obesity, vaccination, and anxiety levels. In addition, the identification of groups at risk, including those with pre-existing mental health and other chronic conditions, warrants tailored support and prevention strategies within healthcare settings, such as better workplace supports and promoting the treatment of preexisting conditions. For example, Siddiqui et al. (2023) found that HCW who perceived better workplace support over the duration of the pandemic had improved measures of anxiety, depression, and mental well-being, and a reduced risk for anxiety and depression for those who felt better supported compared to those who felt unsupported.[69] The authors also identified 5 themes as effective workplace support for the mental well-being of HCW, such as peer support and leadership.[69] Other possible supports may include focusing on the reduction of symptom severity during initial illness, such as role of antiviral treatment and symptom management, as well as the protective factor of vaccines.[70]

Monitoring and developing effective management techniques and treatments may also aid in reducing functional limitation and reduce missed days of work, such as symptom management, rehabilitation and support programs, drug treatment for certain symptoms, and cognitive pacing, helping HCW return to work sooner.[70]

In conclusion, our study contributes to understanding of post-COVID ill-health among HCW, highlighting the prevalence and risk factors associated with development of a PCC. Overall, the

majority of HCW experienced a mild PCC, with almost all HCW returning to work quickly after infection. With many HCW at risk of developing a PCC, these findings highlight the importance of identifying those who are at greater risk and developing methods to help prevent or alleviate persisting symptoms, as implications on the delivery and quality of work duties may be affected if symptoms persist in a debilitating manner. By identifying risk factors, support strategies can be created to help HCW cope with the challenges following the pandemic, while better supporting and protecting HCW and ensuring their well-being in the workforce.

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Appendices

Appendix A. *Questionnaires*

A.1 Phase 1 Questionnaire for Alberta Registered Nurses (RNs)

Covid Nurses (RNs) - April 2020

Intro **The impact of Covid-19 on the health of Alberta nurses**
Online consent and survey Thank you for considering joining this study. Before completing the questionnaire you need to read the information sheet and sign the consents. If you have any questions you can phone us on 1–866–492–6093 or contact us by email at covidRN@ualberta.ca. We will get back to you very rapidly.

It is entirely your decision whether or not you take part in the study. If you do decide to take part, please be assured we will not disclose any of your individual information to CARNA, CRPNA, or to any employer (including Alberta Health Services) unless at some later date you specifically request this in writing. Within the University, the research data may be audited by people external to the research team or by the Health Research Ethics Board, who would be bound by rules of confidentiality. Your results will remain confidential to the University team and your individual details will not appear in any report or publication.

If you would like to participate please read the information sheet then click Next, read and complete the consent form and if you are willing, move on to fill out the questionnaire.

Please note: If you are using a public computer, please aim to complete the survey in one sitting

C1title **Consent Form**

C1header
The impact of Covid-19 on the health of Alberta nurses
Principal Investigator: Dr. Nicola Cherry
Contact details: Toll free phone: 1-866-492-6093
Email: covidRN@ualberta.ca

CONSENT TO PARTICPATE IN THE STUDY

C1p1 C1.1. Do you understand that you have been asked to be in a research study?

- ○ Yes (1)
- ○ No (2)

C1p2 C1.2. Have you read a copy of the information sheet?

- ○ Yes (1)
- ○ No (2)

C1p3
C1.3. Do you understand the benefits and risks involved in taking part in this research study?
Note: There is a section on benefits and risks in the information sheet

- ○ Yes (1)
- ○ No (2)

C1p4
C1.4. Do you understand that you can phone 1–866–492–6093 or contact us at covidRN@ualberta.ca to ask questions or discuss the study?

- ○ Yes (1)
- ○ No (2)

C1p5
C1.5. Do you understand that you are free to withdraw from the study at any time, without having to give a reason and without affecting your employment or medical care?

- ○ Yes (1)
- ○ No (2)

C1p6
C1.6. Has the issue of confidentiality been explained to you?
Note: there is a paragraph on confidentiality in the information sheet*.*

- ○ Yes (1)
- ○ No (2)

C1p7
C1.7. Do you understand who will have access to your records?
Note: again, see the paragraph on confidentiality in the information sheet*.*

- ○ Yes (1)
- ○ No (2)

C1p8 C1.8. **If you agree** to take part in this research study, please type your name below and confirm today's date.

C1p8_name
Name

_____

C1p8_date Date (day/month/year)

_____

C2title **Consent to Linkage with health data in the Alberta administrative health database**

By signing this consent you are agreeing to the study team collecting and using your personal health information from the Alberta administrative health database and allowing its inspection as described in the information sheet.

PLEASE NOTE: If you do not consent to this data linkage you are still most welcome to join the cohort and to complete the questionnaire today.

C2p1

C2.1 I agree to Alberta Health linking my Alberta Health number to administrative health records and passing information to the investigators at the University of Alberta.

- ○ Yes (1)
- ○ No (2)

C2p2
C2.2 Please type your name below and put today's date

C2p3name
Name

_____

C2p3date
Date (day/month/year)

_____

C2p4

I know my Alberta Health Number

- ○ Yes (1)
- ○ No (2)

C2p4number
My Alberta Health number is:

_____

C2p4dateofbirth
My date of birth is (day/month/year):

_____

C2p5

I agree to Alberta Health using my name, address and date of birth to find my Alberta Health Number.

- ○ Yes (1)
- ○ No (2)

C2p6
If you agree, please fill in the details below

- ○ First name (1) _____
- ○ Middle name (if no middle name please type 'none') (2) _____
- ○ Last name (3) _____

C2p7

If you are not usually known by your first name, what is your preferred name?

_____

C2p8

What is your date of birth (day/month/year)?

_____

C3title
We plan to contact you again after the peak of the epidemic has passed.
At that time we will ask for further consent, but if you are willing for us to contact you again please, type your name below and confirm today's date.

C3agree I agree to be contacted again.

- ○ Yes (23)
- ○ No (24)

C3name Name

_____

C3date Date (day/month/year)

_____

C3subtitle Please give your email and phone number below, so that we can contact you again.

C3email Email

_____

C3phone Phone number

_____

Thank you for agreeing to fill in the questionnaire. It should not take too long.

May we first collect a few demographic details

A) Demographics

A.1 Which gender do you identify with?

- ○ Male (11)
- ○ Female (12)
- ○ Other (13)

A.2 What is your age in years (today)?

_____

A.3 Are you now

- ○ Married, or living as married? (1)
- ○ Widowed, divorced? (2)
- ○ Single? (3)

A.4 Do you have any children <18 years living in your household?

- ○ Yes (1)
- ○ No (2)

A.5 What year did you get your initial nursing qualification?

_____

A.6 Are you a

- ☐ Registered nurse? (1)
- ☐ Licensed practical nurse (4)
- ☐ Registered psychiatric nurse (5)
- ☐ Nurse practitioner (6)
- ☐ Other (2) _____

Introduction **The rest of this questionnaire is about the period since March 6th – the day the first Covid-19 case was diagnosed in Alberta.**

When we ask about your work in a nursing role we mean work for which, in Alberta, you needed to be registered with CARNA, CRPNA, or CLPNA.

Q101 **B) Employment since March 6th**

Q1.0 Since March 6th 2020, have you been carrying out ***any*** role as a nurse in Alberta?

- ○ Yes (23)
- ○ No (24)

Q1.1 Why not?

- ○ Retired (1)
- ○ Sickness/disability with onset before 6th March (2)
- ○ Maternity leave (3)
- ○ Family responsibilities (4)
- ○ Other, namely (5) _____

Q2.0 Since 6th March 2020 have you had any period when you have been self-isolating (including quarantine) at home and unable to attend work ***because of you were at high risk to spread the Covid-19 virus?***

- ○ Yes (23)
- ○ No (24)

Q2.1 Why was this?

- [ ] You had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (1)
- [ ] A family member had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (2)
- [ ] You had (inadequately protected) contact with a patient or colleague with known, presumed or suspected Covid-19 (3)
- [ ] You had returned from international travel (4)
- [ ] Other, namely (5) _____

Q2.2 What was the date of the first day of this self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

Q2.3 What was (or will be) the date of the last day of this self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

Q3.0 Since 6th March 2020 have you had any period when you have been self-isolating at home but **NOT** because you were at high risk to spread COVID-19?

- ○ Yes (23)
- ○ No (24)

Q3.1 What was the date of the first day of this self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

Q3.2 What was (or will be) the date of the last day of this self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

End of Block: Block 3

Start of Block: Block 4

Q4.0 In the most recent week you have worked since March 6th, has your role as a nurse in Alberta involved **contact with patients?**

- ○ Yes (23)
- ○ No (24)

Q4.1 What role have you held while in contact with patients? (check all that apply)

- ☐ Hospital nurse working in an inpatient setting. (1)
- ☐ Nurse in ambulatory or outpatient settings in a hospital (2)
- ☐ Nurse in an emergency room (3)
- ☐ Nurse in a community health setting (4)
- ☐ Nurse providing clinical support to a residential institution or contained community (such as care home, prison, first nations), please specify (5) _____
- ☐ Nurse providing clinical support to a workforce, please specify (6) _____
- ☐ Other nursing role, please specify (7) _____

Q4.1.1.1 In the last week you have worked since 6th March were you working in (Check all that apply)

- [ ] Critical care (1)
- [ ] ICU (2)
- [ ] Wards designated for the care of infectious patients (3)
- [ ] General (adult) medical wards (4)
- [ ] Wards for the care of geriatric patients (5)
- [ ] Wards for the care of psychiatric patients (6)
- [ ] Wards for the care of pediatric patients (7)
- [ ] Wards for the care of obstetrical patients (8)
- [ ] Operating room (9)
- [ ] Providing services such as diagnostic imaging, namely (10) _____
- [ ] Clinical manager or clinical nurse educator (11)
- [ ] Other, namely (8) _____

Q4.2 In the most recent week you have worked since March 6th 2020, was your role as a nurse primarily without contact with patients because you were working in

- ☐ Public health? (1)
- ☐ Administration? (2)
- ☐ Teaching or research? (3)
- ☐ Other, namely (4) _____

Q5.0 What was the age range of your patients in your most recent week at work since March 6th? Please check one or more below to reflect the great majority of your patients

- ☐ All ages including children (1)
- ☐ All ages 18 years and older (2)
- ☐ (3)
- ☐ 5 (4)
- ☐ 18 (5)
- ☐ 55 (6)
- ☐ >=70 years? (7)
- ☐ Other, namely (8) _____

Q6.0 ***In your most recent week at work since March 6th,*** how many days did you work in a nursing role in Alberta?

_____

Q6title ***In your most recent week at work since March 6th,***

Q6.1 What was the **total number of hours in that week** you worked and had **in person** contact with patients? (best estimate)

_____

Q6.1.1 **How many patients did you see in person** in your most recent week at work since March 6th? (best estimate)

_____

Q6.1.2 What proportion of the patients you saw **in person** in that week were screened (for symptoms or fever) before you were in contact with them?

if no patients seen in person please check 100%

- ○ 100% (1)
- ○ >90% but not 100% (2)
- ○ 50-90% (3)
- ○ some, but (4)
- ○ none (5)

Q6.2 What was the total number of hours in that week you worked with patients by **phone, email or videoconferencing**? (best estimate)

_____

Q6.3 What was the total number of hours in that week you worked as a nurse, without patient contact? (best estimate)

_____

Q7.0 Since March 6th has your work involved contact with known, presumed or suspected Covid-19 patients?

- ○ Yes (25)
- ○ No (26)
- ○ Don't know (29)

Q7.1
Since March 6th on how many days have you had one-on-one contact with known, presumed or suspected COVID-19 patients?

_____

Q7.2 Since March 6th, have you taken part in (or been within 2 m of) aerosol generating medical procedures (see below)?

- ○ Yes (23)
- ○ No (24)

Q7.2.a If yes, what procedures? (check all that apply)

- [ ] Intubation and related procedures (manual ventilation, open endotracheal suctioning, extubation) (1)
- [ ] Cardiopulmonary resuscitation (2)
- [ ] Bi-level Positive Airway Pressure (BiPAP, CPAP) (3)
- [ ] Humidified high flow oxygen systems (ARVO, Optiflow) (4)
- [ ] Tracheostomy care (5)
- [ ] Bronchoscopy (6)
- [ ] Sputum induction (7)
- [ ] Nebulized/aerosolized medication administration (8)
- [ ] Open respiratory/airway suctioning (9)
- [ ] High frequency oscillatory ventilation (10)
- [ ] Other, namely (11) _____

Q7.3 Please estimate on how many days since 6th March you have been involved in aerosol generating medical procedures

_____

Q7.4 Were any of these on patients with known, presumed or suspected Covid-19?

- ○ Yes (25)
- ○ No (26)
- ○ Don't know (27)

Q7.5 Have there been any times when you have had contact with known, presumed or suspected COVID-19 patients when you, personally, did NOT HAVE ACCESS to all the approved Personal Protective Equipment (PPE)?

- ○ Yes (23)
- ○ No (24)

Q7.5.1 Which types of (clean) PPE were not available?

- ☐ N 95 respirator (4)
- ☐ Procedure mask (7)
- ☐ Eye protection (8)
- ☐ Face shield (9)
- ☐ Gown (10)
- ☐ Gloves (11)
- ☐ Other, namely (12) _____

Q7.6 Have there been any times when you have had contact with known, presumed or suspected COVID-19 patients where appropriate PPE was available but you did not use it effectively?

- ○ Yes (23)
- ○ No (24)

Q7.6.1 Please describe the incident where PPE was not used effectively.

_____

_____

_____

_____

_____

Qc **C) Your perceptions and concerns**

Q8.1 Please mark on the line below **how true** the following statements are about your work, during your most recent week at work since March 6th, compared with working before March 6th.

	Completely disagree **Completely agree**
My hours of work are about the same (1)	
My work tasks are about the same (4)	
The patient make-up is about the same (5)	
My patients are no more stressed (6)	
My co-workers are no more stressed (7)	
I am no more stressed (8)	

JS

Q8.2 Please mark on the line below **how confident** you feel about working with patients with known, presumed or suspected COVID-19.

	Not at all confident **Very confident**
I have the clinical knowledge I need (1)	
I know how to use the required PPE (9)	
I know how and when to refer for testing (10)	
I know how and when to refer for treatment (14)	
I have the support I need from co-workers (15)	
I have access to all the required PPE (16)	
There are sufficient staff to do the job safely (17)	

JS

Q8.3 Please mark on the line below to **show your worries** about the COVID-19 epidemic.

	Not at all worried **Very worried**
That I shall be infected (1)	
That I shall infect my family (21)	
That I shall infect my patients (22)	
That I shall infect my co-workers/colleagues (23)	
That I shall not be able to cope with the work (24)	
That I shall have to let people die (25)	
That my experience is inadequate (26)	
That I shall fail myself and my family (27)	

Q8.4 Please mark on the line below to show where you will **find support** during this time.

	No support at all **Very strong support**
My immediate family (1)	
My colleagues or co-workers (19)	
A senior colleague or mentor (20)	
My immediate organization (21)	
Alberta Health Services (23)	
Alberta's Chief Medical Officer of Health (24)	
The United Nurses of Alberta or Alberta Union of Provincial Employees (27)	
My religious community (28)	

Q8.4.5

	No support at all **Very strong support**
Others (including CARNA or CRPNA), namely (1)	

Q9title Considering events affecting your work as a nurse during the COVID-19 epidemic (since 6th March),

Q9.1 What has been the most difficult or stressful event you have had to deal with?
(If you prefer not to answer, please put "N/A" and go to the next question)

_____

_____

_____

_____

_____

Q9.2 What has been the event that has most reinforced your pride in your professional behaviour?
(If you prefer not to answer, please put "N/A" and go to the next question)

_____

_____

_____

_____

_____

Q10.0 Do you have reason to believe that you may have been infected with the COVID-19 virus?

- ○ Yes (23)
- ○ No (24)

Q10.1 Have you been tested for COVID-19?

- ○ Yes (23)
- ○ No (24)

Q10.2 What date were you tested?

- ○ Day (1) _____
- ○ Month (2) _____
- ○ Year (3) _____

Q10.3 Have you had the result?

- ○ Yes (23)
- ○ No (24)

Q10.4 What was the result?

- ○ Positive (4)
- ○ Negative (5)

Q11title

Your Health

Next, we would ask you to complete two short questionnaires, one on symptoms you may have experienced for at least TWO CONSECUTIVE DAYS since March 6th. and then a short mood scale to tell us how you have been coping in the last week.

Q11.0 Since March 6th, have you had an episode when you have been unwell for two or more consecutive days (whether or not you reported for duty)?

- ○ Yes (23)
- ○ No (24)

Q11.1 Please mark below **how much you have been bothered** FOR TWO OR MORE CONSECUTIVE DAYS since March 6th for each symptom/problem listed below. If more than one incident, record the symptoms/problems from the one that bothered you most.

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Coughing (1)					
Chest pains (4)					
Coughing up sputum (5)					
Coughing up blood (6)					
Sweating (7)					
Chills (8)					
Headache (9)					

Nausea (10)	
Vomiting (11)	
Diarrhea (12)	
Stomach pain (13)	
Muscle pain (14)	
Lack of appetite (15)	
Trouble concentrating (16)	
Trouble thinking (17)	
Trouble sleeping (18)	
Fatigue (19)	

Q11.17

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Other, namely (1)					

Q12title
In the mood questionnaire below, please check the box alongside the reply that is closest to how you have been feeling IN THE PAST WEEK. **Don't take too long over your replies; your immediate answer is best.**

Q12.1
In the past week I feel tense or 'wound up':

- ○ Most of the time (1)
- ○ A lot of the time (2)
- ○ From time to time, occasionally (3)
- ○ Not at all (4)

Q12.2 *In the past week*
I still enjoy the things I used to enjoy:

- ○ Definitely as much (1)
- ○ Not quite so much (2)
- ○ Only a little (3)
- ○ Hardly at all (4)

Q12.3 *In the past week*
I get a sort of frightened feeling as if something awful is about to happen:

- ○ Very definitely and quite badly (1)
- ○ Yes, but not too badly (2)
- ○ A little but it doesn't worry me (3)
- ○ Not at all (4)

Q12.4 *In the past week*
I can laugh and see the funny side of things:

- ○ As much as I always could (1)
- ○ Not quite so much now (2)
- ○ Definitely not so much now (3)
- ○ Not at all (4)

Q12.5 *In the past week*
Worrying thoughts go through my mind:

- ○ A great deal of the time (1)
- ○ A lot of the time (2)
- ○ Not too often (3)
- ○ Very little (4)

Q12.6 *In the past week*
I feel cheerful:

- ○ Never (1)
- ○ Not often (2)
- ○ Sometimes (3)
- ○ Most of the time (4)

Q12.7 *In the past week*
I can sit at ease and feel relaxed:

- ○ Definitely (1)
- ○ Usually (2)
- ○ Not Often (3)
- ○ Not at all (4)

Q12.8 *In the past week*
I feel as if I am slowed down:

- ○ Nearly all the time (1)
- ○ Very often (2)
- ○ Sometimes (3)
- ○ Not at all (4)

Q12.9 *In the past week*
I get a sort of frightened feeling like ‘butterflies’ in the stomach:

- ○ Not at all (1)
- ○ Occasionally (2)
- ○ Quite often (3)
- ○ Very often (4)

Q12.10 *In the past week*
I have lost interest in my appearance:

- ○ Definitely (1)
- ○ I don't take as much care as I should (2)
- ○ I may not take quite as much care (3)
- ○ I take just as much care as ever (4)

Q12.11 *In the past week*
I feel restless as if I have to be on the move:

- ○ Very much indeed (1)
- ○ Quite a lot (2)
- ○ Not very much (3)
- ○ Not at all (4)

Q12.12 *In the past week*
I look forward with enjoyment to things:

- ○ As much as I ever did (1)
- ○ Rather less than I used to (2)
- ○ Definitely less than I used to (3)
- ○ Hardly at all (4)

Q12.13 *In the past week*
I get sudden feelings of panic:

- ○ Very often indeed (1)
- ○ Quite often (2)
- ○ Not very often (3)
- ○ Not at all (4)

Q12.14 *In the past week*
I can enjoy a good book or radio or television program:

- ○ Often (1)
- ○ Sometimes (2)
- ○ Not often (3)
- ○ Very seldom (4)

Q13.1 **Has a physician ever told you that you had asthma?**

- ○ Yes (1)
- ○ No (2)

Q13.1.1 In the 12 months up to March 6th did you have any asthma symptoms or asthma attacks?

- ○ Yes (1)
- ○ No (2)

Q13.1.2 In the 12 months up to March 6th, have you taken any medicine for asthma such as inhalers (pumps), nebulizers, pills, liquids or injections?

- ○ Yes (1)
- ○ No (2)

Q13.2 **Do you have chronic bronchitis, emphysema or chronic obstructive pulmonary disease or COPD?**

- ○ Yes (1)
- ○ No (2)

Q13.3 **Have you ever been treated for anxiety or depression?** In 'treatment' we include both medication and psychological interventions.

- ○ Yes (1)
- ○ No (2)

Q13.3.1 In the 12 months up to March 6th, did you receive any treatment for anxiety?

- ○ Yes (1)
- ○ No (2)

Q13.3.2 In the 12 months up to March 6th, did you receive any treatment for depression?

- ○ Yes (1)
- ○ No (2)

Q13.4 In the 12 months up to March 6th, did you have any other chronic condition?

- ○ Yes (1)
- ○ No (2)

Q13.4.1 If yes, please specify

_____

Q13.5 Have you ever smoked at least one cigarette a day for as long as a year?

- ○ Yes (1)
- ○ No (2)

Q13.5.1 If yes, at what age did you start?

_____

Q13.5.2 Did you smoke cigarettes in the 12 months leading up to March 6th?

- ○ Yes (4)
- ○ No (5)

Q13.5.3 If no, what age did you stop?

_____

Q13.5.4 How many cigarettes a day do you/did you smoke?

_____

Q14 The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, please indicate your response by marking on the line below HOW OFTEN you felt or thought a certain way.

	Never	Almost Never	Sometimes	Fairly Often	Very Often
In the last month, how often have you felt that you were unable to control the important things in your life? (1)					
In the last month, how often have you felt confident about your ability to handle your personal problems? (20)					
In the last month, how often have you felt that things were going your way? (21)					
In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? (22)					

Q15 For each item, please mark below the place that best indicates how much you agree with the following statements as they apply to you over the last month. If a particular situation has not occurred recently, answer according to how you think you would have felt.

	Not true at all	Rarely true	Sometimes true	Usually true	True nearly all of the time
I am able to adapt to change (1)					
I tend to bounce back after hardship or illness (23)					

A.2 Phase 2 Questionnaire for Alberta Healthcare Aides (HCAs)

Covid Alberta Health Care Aides Phase 2 - Fall 2020

Intro **The impact of Covid-19 on the health of Alberta Health Care Aides Phase II**

Dear ${e://Field/RecipientFirstName}

On ${e://Field/EmbeddedDataA} you completed an on-line questionnaire about your experiences of working through the COVID-19 pandemic. We are now asking if you would complete a second questionnaire to update your record of working during the continuing outbreaks across Canada. We plan to contact you once more after the winter to complete a third questionnaire (in May, if the epidemic is quieter by then).

If you should have a positive test for the virus between now and May, we want to know this, so that we can carry out a brief focused investigation. We need to do this in real time so that, if you are infected, you can recall events around the time this happened - but we can only do this rapidly if you tell us as soon as you get the result. We plan to remind you by email every month or so to tell us as soon as practicable if you have a positive result, regardless of why you had the test or if you had symptoms. Once you tell us, we will ask you, and four others matched to you from the cohort, to complete a brief questionnaire, on-line or by phone to help identify events at work that may have helped transmit infection.

The questionnaire today is very similar to the one you completed before and again should take only about 20 minutes. Please read the information sheet then complete the consent section below before moving on to complete the questionnaire.

Since you completed the first questionnaire, we have been funded by the Canadian Immunology Task Force to assess antibodies to the Covid-19 in the serum of health care workers in this study. To do this we need a blood sample and we ask below for your consent to arrange this, and for the sample to be tested for COVID-19 antibodies at your provincial laboratory. We aim to send you your antibody results very soon after you give your sample. We would like to store any left-over serum for up to two years, in case other tests come along that can give further information about immunity, and we ask your consent to that also.

Finally, we are asking for your consent to access, through the provincial labs, all results, positive or negative, of ANY tests you have had (or will have) for the virus or antibodies since the start of the epidemic in early March.

C1title **Consent Form**

C1header **The impact of Covid-19 on the health of Alberta Health Care Aides**
Principal Investigator: Dr. Nicola Cherry Contact details: Toll free phone: 1-866-492-6093
Email: covidHCW@ualberta.ca

Consent to complete the second questionnaire

C1p1 C1.1. Do you understand that you have been asked to be in a research study?

- Yes (1)
- No (2)

C1p2 C1.2. Have you read a copy of the information sheet?

- Yes (1)
- No (2)

C1p3
C1.3. Do you understand the benefits and risks involved in taking part in this research study?
Note: There is a section on benefits and risks in the information sheet

- Yes (1)
- No (2)

C1p4
C1.4. Do you understand that you can phone 1–866–492–6093 or contact us at covidHCW@ualberta.ca to ask questions or discuss the study?

- ○ Yes (1)
- ○ No (2)

C1p5
C1.5. Do you understand that you are free to withdraw from the study at any time, without having to give a reason and without affecting your employment or medical care?

- ○ Yes (1)
- ○ No (2)

C1p6
C1.6. Has the issue of confidentiality been explained to you?
Note: there is a paragraph on confidentiality in the information sheet.

- ○ Yes (1)
- ○ No (2)

C1p7
C1.7. Do you understand who will have access to your records?
Note: again, see the paragraph on confidentiality in the information sheet.

- ○ Yes (1)
- ○ No (2)

C2_1 C1.8. **If you consent** to complete the second questionnaire, please type your name here

C1p8_name
Name

_____

C1p8_date Date (day/month/year)

_____

C2_test A central aim of the study is to assess antibodies in the blood of health care workers. If you agree, 5 ml of blood will be taken with a needle from a vein in your arm. The serum from this sample will be analyzed for Covid-19 antibodies by the provincial laboratory of the province in which you are working. The results will be confidential and not shown on any electronic medical record. There will be no cost to you. No testing other than serology for Covid-19 antibodies will be carried out on this sample. If you agree to giving a blood sample and for the laboratory to carry out the testing for antibodies, please put your name below. We will then contact you to make arrangements for this at a facility convenient for you.

If you have already had the covid vaccine it is too early for antibody testing so please check the 'vaccine' box below

Do you consent to such a blood test?

- ○ Yes (1)
- ○ No (2)
- ○ Not eligible because already received covid vaccine (3)

C2_test_N Name

_____

C2_test_D Date (day/month/year)

_____

C2_test_city Please write below the town or city that would be most convenient for this blood sample

_____

C2_test_st During the next few months, further tests for antibodies may be developed that will indicate the type of antibody response that is most protective. If you agree, we will store serum left over from the initial testing for up to two years at the Canadian BioSample repository (website: Canadian Biosample Repository) so that we can carry out such further analyses, if these are indicated. Again, no testing other than serology for Covid-19 antibodies will be carried out on this stored sample, and only the research team will have access to it. Your sample will be identified by your name and a unique study identification number while it is stored. If we do further tests, we will send you the results of those also.

Do you consent to the storage of left-over serum for such possible future analysis?

- ○ Yes (1)
- ○ No (2)

C2_test_st_N Name

_____

C2_test_st_D Date (day/month/year)

_____

C2q2_ins
In the first questionnaire we asked the name and date of any tests you had had for the Covid virus. We ask again in today's questionnaire. We want to have a full record of the dates and outcomes of everyone in the cohort.

C2p4res Do you consent to the provincial laboratory of the province in which you were tested giving us the date and result of any test for the virus or antibodies to the virus during the period of this study (that is, from 1st March 2020 to June 30th 2021)?

- ○ Yes (3)
- ○ No (4)

C2p4resName Name

_____

C2p4resDate
Date (day/month/year)

_____

C2p4resBDate To help identify your tests please give us your date of birth below (dd/mm/yyyy)

_____

Thank you for agreeing to fill in the second questionnaire for the Health Care Aides and COVID-19 study. We start with some questions that relate to the whole period since the start of the pandemic.

A.1 1. Since the start of the spread of Covid-19 in Alberta in early March, in which health zones have you been **working** (tick all that apply).

- ☐ South (1)
- ☐ Calgary (2)
- ☐ Central (3)
- ☐ Edmonton (4)
- ☐ North (5)
- ☐ Outside province, namely (6) _____

A.1.1 1.1 In which zone have you spent **most time working**?

- ○ South (1)
- ○ Calgary (2)
- ○ Central (3)
- ○ Edmonton (4)
- ○ North (5)
- ○ Outside province, namely (6) _____

A.2 2. Since the start of the spread of Covid-19 in early March, in which health zones have you been **living** (tick all that apply)

- [ ] South (1)
- [ ] Calgary (2)
- [ ] Central (3)
- [ ] Edmonton (4)
- [ ] North (5)
- [ ] Outside province, namely (6) _____

A.2.1 2.1 In which have zone you **lived most of the time**?

- ○ South (1)
- ○ Calgary (2)
- ○ Central (3)
- ○ Edmonton (4)
- ○ North (5)
- ○ Outside province, namely (6) _____

B **B) Employment since ${e://Field/EmbeddedDataA}**

Recall: When we ask about your work in a HCA role we mean work for which, in Alberta, you needed to be on the HCA register.

B_Q1.0 Since ${e://Field/EmbeddedDataA}, have you been carrying out any role as a HCA in Alberta?

- ○ Yes (1)
- ○ No (2)

B_Q1.1 Why not?

- ○ Retired (1)
- ○ Sickness/disability with onset before ${e://Field/EmbeddedDataA} (2)
- ○ Maternity leave (3)
- ○ Family responsibilities (4)
- ○ Other, namely (5) _____

C **C) Periods of self-isolation**

C_Q1.0 Since ${e://Field/EmbeddedDataA} how many times have you had any period when you have been self-isolating (including quarantine) at home and unable to attend work ***because you were at high risk to spread the Covid-19 virus?***

- ○ One or more (1)
- ○ None (2)

C_Q1.1 How many times?

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 or more (3)

C_Q1.2 Please tell us about the most recent time you have been self-isolating at home and unable to attend work since ${e://Field/EmbeddedDataA}

Why was this (check all that apply)?

- [ ] You had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (1)
- [ ] A family member had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (2)
- [ ] You had (inadequately protected) contact with a patient or colleague with known, presumed or suspected Covid-19 (3)
- [ ] You had returned from international travel (4)
- [ ] Other, namely (5) _____

C_Q1.3 What was the **date of the first day** of this (most recent) self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

C_Q1.4 What was (or will be) the **date of the last day** of this self-isolation?

- ○ Day (8) _____
- ○ Month (9) _____
- ○ Year (10) _____

C_Q2.0 Since ${e://Field/EmbeddedDataA} how many times have you had any period when you have been self-isolating at home but **NOT** because you were at high risk to spread COVID-19?

- One or more (1)
- None (2)

C_Q2.1 How many times?

- 1 (1)
- 2 (2)
- 3 or more (3)

C_Q2.1_inst If more than one, please tell us about the most recent period since ${e://Field/EmbeddedDataA} when you have been self-isolating at home but NOT because you were at high risk to spread COVID-19

C_Q2.2 What was the date of the first day of this (most recent) self-isolation?

- Day (8) _____
- Month (9) _____
- Year (10) _____

C_Q2.3 What was (or will be) the date of the last day of this self-isolation?

- Day (8) _____
- Month (9) _____
- Year (10) _____

C_Q2.4 Why were you self-isolating?

_____

_____

_____

_____

_____

D D) Employment in your most recent week at work since ${e://Field/EmbeddedDataA}

D_Q1.0 In the most recent week you have worked since ${e://Field/EmbeddedDataA}, has your role as a HCA in Alberta involved **one-on-one contact with patients** (in person or remotely)?

- ○ Yes (1)
- ○ No (2)

D_Q1.1 What role have you held while in contact with patients? (check all that apply)

- ☐ HCA working in an inpatient setting in a hospital (1)
- ☐ HCA in ambulatory or outpatient settings in a hospital (2)
- ☐ HCA in an emergency room (3)
- ☐ HCA in a community health setting (4)
- ☐ HCA providing clinical support to a residential institution or contained community (such as care home, prison, first nations), please specify (5)

_____

- ☐ HCA providing clinical support to a workforce, please specify (6)

_____

- ☐ Other HCA role, please specify (7)

_____

D_Q1.1.1.1 In the last week you have worked since ${e://Field/EmbeddedDataA} were you working in (Check all that apply)

- ☐ Critical care? (1)
- ☐ ICU? (2)
- ☐ Wards designated for the care of infectious patients? (3)
- ☐ General (adult) medical wards? (4)
- ☐ Wards for the care of geriatric patients? (5)
- ☐ Wards for the care of psychiatric patients? (6)
- ☐ Wards for the care of pediatric patients? (7)
- ☐ Wards for the care of obstetrical patients (8)
- ☐ Other, namely (9) _____

D_Q1.1.1.2 What institutional requirements/arrangements are now in place for PPE?

	Yes (1)	**No** (2)
Continuous masking? (1)	○	○
Restricted access to some types of PPE? (4)	○	○
Wards designated for the care of infectious patients? (5)	○	○
Fit-testing for each new type/model of mask (6)	○	○
Decontamination and re-use of N95 masks? (7)	○	○
Provision of a buddy for donning/doffing PPE? (8)	○	○

D_Q1.2 In the most recent week you have worked since ${e://Field/EmbeddedDataA}, was your role as a HCA primarily without one-on-one contact with patients because you were working in

- [ ] Public health? (1)
- [ ] Administration? (2)
- [ ] Teaching or research? (3)
- [ ] Other, namely (4) _____

D_2 What was the age range of your patients in your most recent week at work since ${e://Field/EmbeddedDataA}? **Please check one or more below to reflect the great majority of your patients**

- [ ] All ages including children (1)
- [ ] All ages 18 years and older (2)
- [ ] (3)
- [ ] 5 (4)
- [ ] 18 (5)
- [ ] 55 (6)
- [ ] >=70 years? (7)
- [ ] Other, namely (8) _____

D_3title *In your **most recent week** at work since ${e://Field/EmbeddedDataA},*

D_3.0 How many days did you work in a HCA role in Alberta?

_____

D_3.1 What was the **total number of hours in that week** you worked with one-on-one **in person** contact with patients? (best estimate)

_____

D_3.1.1 **How many patients** did you see one-on-one **in person** in your most recent week at work since ${e://Field/EmbeddedDataA}? (best estimate)

_____

D_3.1.2 What proportion of these patients you saw **in person** in that week were screened (for symptoms or fever) before you were in one-on-one contact with them?

if no patients seen in person please check 100%

- ○ 100% (1)
- ○ >90% but not 100% (2)
- ○ 50-90% (3)
- ○ some, but (4)
- ○ none (5)

D_3.2 What was the total number of hours in that week you worked one-on-one with patients by **phone, email or videoconferencing**? (best estimate)

_____

D_3.3 What was the total number of hours in that week you worked as a HCA, without one-to-one patient contact? (best estimate)

_____

E **E) Work with patients since ${e://Field/EmbeddedDataA}**

E_1 Since ${e://Field/EmbeddedDataA}, has your work as a HCA involved one-on-one in person contact with known, presumed or suspected Covid-19 patients?

- Yes (1)
- No (2)
- Don't know (9)

E_1.1 Since ${e://Field/EmbeddedDataA} on how many days have you had one-on-one contact with at least one known, presumed or suspected COVID-19 patient (best estimate)

_____

E_1.2 Since ${e://Field/EmbeddedDataA}, have you taken part in (or been within 2 meters of) aerosol generating medical procedures on any patients (suspected of COVID-19 or not)?

- Yes (1)
- No (2)

E_1.2_ If yes, what procedures? (check all that apply)

- [ ] Intubation and related procedures (manual ventilation, open endotracheal suctioning, extubation) (1)
- [ ] Cardiopulmonary resuscitation (2)
- [ ] Bi-level Positive Airway Pressure (BiPAP, CPAP) (3)
- [ ] Humidified high flow oxygen systems (ARVO, Optiflow) (4)
- [ ] Tracheostomy care (5)
- [ ] Bronchoscopy/laryngoscopy (6)
- [ ] Sputum induction (7)
- [ ] Nebulized/aerosolized medication administration (8)
- [ ] Open respiratory/airway suctioning (9)
- [ ] High frequency oscillatory ventilation (10)
- [ ] Other, namely (11) _____

E_1.3 Please estimate on how many days since ${e://Field/EmbeddedDataA} have you taken part in (or been within 2 meters of) aerosol generating medical procedures

_____

E_1.3.1 Were any of these procedures on patients with known, presumed or suspected Covid-19?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

E_2.0 Since ${e://Field/EmbeddedDataA}, have there been any times when you have had contact with patients (suspected of COVID-19 or not) when you, personally, did NOT HAVE ACCESS to all the appropriate/approved Personal Protective Equipment (PPE).

- ○ Yes (1)
- ○ No (2)

E_2.1 Which types of (clean) PPE were **not available**? Please check all that apply

- ☐ N 95 respirator (1)
- ☐ Procedure mask (2)
- ☐ Eye protection (3)
- ☐ Face shield (4)
- ☐ Gown (5)
- ☐ Gloves (6)
- ☐ Other, namely (7) _____

E_2.2 Was this PPE ever not available when you were working with a known, presumed or suspected covid-19 patient?

- ○ Yes (1)
- ○ No (2)

E_3.0 Since ${e://Field/EmbeddedDataA} have you experienced any malfunction of PPE, like slipping of a mask or tear in a glove?

- ○ Yes, please describe: (1) _____
- ○ No (2)

E_3.1 Was this malfunction while you were working with a known, presumed or suspected COVID-19 patient?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

E_4 Have there been any times when you have had contact with patients where appropriate PPE was available but you did not use it effectively?

- ○ Yes (1)
- ○ No (2)

E_4.1 Please describe the incident where PPE was not used effectively.

_____

_____

_____

_____

_____

E_4.2 Did this involve a known, presumed or suspected covid-19 patient?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

E_5 Since ${e://Field/EmbeddedDataA} have you experienced any type of discomfort or adverse effect (such as sweating or skin rash) that lasted more than a day, due to wearing PPE?

- ○ Yes (1)
- ○ No (2)

E_5.1 Which type of PPE caused discomfort or adverse effects? Please check all that apply

- ☐ N 95 respirator (1)
- ☐ Procedure mask (2)
- ☐ Eye protection (3)
- ☐ Face shield (4)
- ☐ Gown (5)
- ☐ Gloves (6)
- ☐ Other, namely (7) _____

E_5.2 What type of discomfort/adverse effect(s)

_____

E_5.3 Did this this make it less likely that you would use effective PPE?

- ○ Yes, please give details (1)

_____

- ○ No (2)

E_6.0 Since ${e://Field/EmbeddedDataA}, apart from direct patient care, have you been working with objects (such as bed linen. medical equipment, bathrooms, food trays) that have been used with known, presumed or suspected COVID-19 patients?

- ○ Yes (1)
- ○ No (2)

E_6.0.1 Please describe objects:

_____

_____

_____

_____

_____

E_6.1 On how many days since ${e://Field/EmbeddedDataA} have you been working with such objects? (best estimate)

_____

E_7 Do you ***now*** have any difficulties getting access to PPE that you believe to be necessary to do your job?

- ○ Yes (1)
- ○ No (2)

E_7.0 What types of PPE are difficult to access? Please check all that apply

- ☐ N 95 respirator (1)
- ☐ Procedure mask (2)
- ☐ Eye protection (3)
- ☐ Face shield (4)
- ☐ Gown (5)
- ☐ Gloves (6)
- ☐ Other namely (7) _____

E_7.1 Why is access difficult?

	Yes (1)	**No** (2)
Not available at all (1)	○	○
Available but only for certain procedures (10)	○	○
Available, but only for certain staff (11)	○	○
Available, but need to jump through hoops to get them (12)	○	○
Other namely (9)	○	○

Qc **F) Your perceptions and concerns**

F_1 Please mark on the line below **how** true the following statements are about your work, during your most recent week at work since [PDK], compared with working before the spread of COVID-19 in early March

	Completely disagree **Completely agree**
My hours of work are longer (1)	
My work tasks are about the same (4)	
The patient make-up is about the same (5)	
My patients are no more stressed (6)	
My co-workers are no more stressed (7)	
I am no more stressed (8)	
I sleep just as well as I did before the epidemic (9)	

F_1.2 Please mark on the line below **how confident** you feel about working with patients with known, presumed or suspected COVID-19.

	Not at all confident **Very confident**
I have the clinical knowledge I need (1)	
I know how to use the required PPE (9)	
I know how and when to refer for testing (10)	
I know how and when to refer for treatment (14)	
I have the support I need from co-workers (15)	
I have access to all the required PPE (16)	
There are sufficient staff to do the job safely (17)	

F_1.3 Please mark on the line below to **show your worries** about the COVID-19 epidemic.

	Not at all worried **Very worried**
That I shall be infected (1)	
That I shall infect my family (21)	
That I shall infect my patients (22)	
That I shall infect my co-workers/colleagues (23)	
That I shall not be able to cope with the work (24)	
That I shall have to let people die (25)	
That my experience is inadequate (26)	
That I shall fail myself and my family (27)	

F_1.4 Please mark on the line below to show where you will **find support** during this time.

	No support at all **Very strong support**
My immediate family (1)	
My colleagues or co-workers (19)	
A senior colleague or mentor (20)	
My immediate organization (21)	
Alberta Health Services (23)	
Alberta's Chief Medical Officer of Health (24)	
The managers of the HCA registry (27)	
My religious community (28)	

F_1.4_others

	No support at all **Very strong support**
Others, namely (1)	

F_2_inst Since **the start of the epidemic** has your employer, professional organization, union or other group **offered support** to help you cope with the mental health challenges of the pandemic? Please check all that apply below.

F_2.1 One-on-one support (on-line or in person) from a specialist counsellor, psychologist or similar?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

F_2.1.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.2 One-on-one support from a colleague or peer nominated to do this?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

F_2.2.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.3 An on-line support group where you could discuss and ask questions?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

F_2.3.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.4 An on-line self-learning tool with advice about how to manage stress?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

F_2.4.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.5 A helpline with a number you could call if you were distressed?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (3)

F_2.5.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.6 An Employee Assistance Program (EAP)?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

F_2.6.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.7 Was any other mental health support available to you through your work or work contacts?

- ○ Yes, please describe (1) _____
- ○ No (2)
- ○ Don't know (9)

F_2.7.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

F_2.8 Are there other mental health supports you would have valued during this time?

- ○ Yes, please describe (1) _____
- ○ No (2)

F_2.10 Since **the start of the epidemic** have you discussed any mental health issues with a health professional (such as your family doctor) you accessed through channels **outside work**?

- ○ Yes, what type of health professional was this? (1) _____
- ○ No (2)

F_3.0 Since **the start of the epidemic** in early March, has your income from your work as a HCA changed importantly?

- ○ My income has increased (1)
- ○ My income has decreased (2)
- ○ My income is about the same as before the start of the epidemic (3)

F_3.1.1 Please (roughly) estimate the increase as a percentage (%):

_____

F_3.2.1 Please (roughly) estimate the decrease as a percentage (%):

_____

G G. Infection with COVID-19

G_1.0 Since ${e://Field/EmbeddedDataA} do you have reason to believe that you may have been infected with the COVID-19 virus?

- Yes (1)
- No (2)

G_2.0 Since ${e://Field/EmbeddedDataA} have you been tested for the COVID-19 virus?

- Yes (1)
- No (2)

G_2.1 How many times have you been tested?

_____

G_2.2 Were the results of any of these positive for the COVID-19 virus?

- Yes (1)
- No (2)
- Still waiting for results (3)

G_2.2.1 What was the date of the (first) test you know to have been positive?

- Day (1) _____
- Month (2) _____
- Year (3) _____

G_2.2.2 Do you think you were infected at work?

- ○ Yes (1)
- ○ No (2)
- ○ Unsure (3)

G_2.2.2.1 What/where was the most likely source of infection?

_____

G_2.3 What was the most recent date you were tested?

- ○ Day (1) _____
- ○ Month (2) _____
- ○ Year (3) _____

G_3.0 Apart from swab tests for the virus itself, have you had the blood test for **antibodies** to the virus?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

G_3.1 Was the result positive for antibodies to the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)
- ○ Still waiting for results (3)

G_3.2 What was the date of the (first) test you know to have been positive?

- ○ Day (1) _____
- ○ Month (2) _____
- ○ Year (3) _____

G_3.3 What was the date of the most recent test?

- ○ Day (1) _____
- ○ Month (2) _____
- ○ Year (3) _____

V1 Have you been vaccinated against COVID-19? *Answer 'Yes' if you have received at least one dose of the COVID-19 vaccine.*

- ○ Yes (1)
- ○ No (2)

V2 How many doses of the COVID-19 vaccine have you received so far?

- ○ One dose (1)
- ○ Two doses (2)
- ○ More than two doses (3)

V3a When did you receive your **first** dose of the COVID-19 vaccine?

	Day	Month	Year
Date **first** dose (1)	▼ 1 (1 ... 31 (31)	▼ 1 (1 ... 12 (12)	▼ 2020 (1 ... 2021 (2)

V3b1 Do you have a date scheduled for your second dose?

- ○ Yes (1)
- ○ No (2)

V3b2 When did you receive (or will you receive) your **second** dose of the COVID-19 vaccine?

	Day	Month	Year
Date **second** dose (1)	▼ 1 (1 ... 31 (31)	▼ 1 (1 ... 12 (12)	▼ 2020 (1 ... 2021 (2)

V4 Which vaccine did you receive?
Was it:

- ○ Pfizer and BioNTech mRNA vaccine (1)
- ○ Moderna mRNA vaccine (2)
- ○ AstraZeneca Oxford vaccine (3)
- ○ Other, please specify (4) _____
- ○ Don't know (5)

G_4.0 **Since the spread of the virus in early March** has anyone you know personally (other than a colleague or patient), been infected with the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)

H_title

H) Your Health

Finally, we would ask you to complete two short questionnaires, one on symptoms you may have experienced for at least TWO CONSECUTIVE DAYS since ${e://Field/EmbeddedDataA}. and then a short mood scale to tell us how you have been coping in the last week.

H_1 Since ${e://Field/EmbeddedDataA}, have you had an episode when you have been unwell for two or more consecutive days (whether or not you reported for duty)?

- ○ Yes (1)
- ○ No (2)

H_1.0 Please mark below **how much you have been bothered** FOR TWO OR MORE CONSECUTIVE DAYS since ${e://Field/EmbeddedDataA} for each symptom/problem listed below. If more than one incident, record the symptoms/problems from the one that bothered you most.

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Coughing (1)					
Chest pains (4)					
Coughing up sputum (5)					
Coughing up blood (6)					
Sweating (7)					
Chills (8)					
Headache (9)					

Nausea (10)	
Vomiting (11)	
Diarrhea (12)	
Stomach pain (13)	
Muscle pain (14)	
Lack of appetite (15)	
Trouble concentrating (16)	
Trouble thinking (17)	
Trouble sleeping (18)	
Fatigue (19)	

H_1.17

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Other, including shortness of breath and anosmia (loss of sense of smell), namely (1)					

H_2title In the mood questionnaire below, please check the box alongside the reply that is closest to how you have been feeling IN THE PAST WEEK.
Don't take too long over your replies; your immediate answer is best.

H_2.1
In the past week I feel tense or 'wound up':

- ○ Most of the time (1)
- ○ A lot of the time (2)
- ○ From time to time, occasionally (3)
- ○ Not at all (4)

H_2.2 *In the past week*
I still enjoy the things I used to enjoy:

- ○ Definitely as much (1)
- ○ Not quite so much (2)
- ○ Only a little (3)
- ○ Hardly at all (4)

H_2.3 *In the past week*
I get a sort of frightened feeling as if something awful is about to happen:

- ○ Very definitely and quite badly (1)
- ○ Yes, but not too badly (2)
- ○ A little but it doesn't worry me (3)
- ○ Not at all (4)

H_2.4 *In the past week*
I can laugh and see the funny side of things:

- ○ As much as I always could (1)
- ○ Not quite so much now (2)
- ○ Definitely not so much now (3)
- ○ Not at all (4)

H_2.5 *In the past week*
Worrying thoughts go through my mind:

- ○ A great deal of the time (1)
- ○ A lot of the time (2)
- ○ Not too often (3)
- ○ Very little (4)

H_2.6 *In the past week*
I feel cheerful:

- ○ Never (1)
- ○ Not often (2)
- ○ Sometimes (3)
- ○ Most of the time (4)

H_2.7 *In the past week*
I can sit at ease and feel relaxed:

- ○ Definitely (1)
- ○ Usually (2)
- ○ Not Often (3)
- ○ Not at all (4)

H_2.8 *In the past week*
I feel as if I am slowed down:

- ○ Nearly all the time (1)
- ○ Very often (2)
- ○ Sometimes (3)
- ○ Not at all (4)

H_2.9 *In the past week*
I get a sort of frightened feeling like ‘butterflies’ in the stomach:

- ○ Not at all (1)
- ○ Occasionally (2)
- ○ Quite often (3)
- ○ Very often (4)

H_2.10 *In the past week*
I have lost interest in my appearance:

- ○ Definitely (1)
- ○ I don't take as much care as I should (2)
- ○ I may not take quite as much care (3)
- ○ I take just as much care as ever (4)

H_2.11 *In the past week*
I feel restless as if I have to be on the move:

- ○ Very much indeed (1)
- ○ Quite a lot (2)
- ○ Not very much (3)
- ○ Not at all (4)

H_2.12 *In the past week*
I look forward with enjoyment to things:

- ○ As much as I ever did (1)
- ○ Rather less than I used to (2)
- ○ Definitely less than I used to (3)
- ○ Hardly at all (4)

H_2.13 *In the past week*
I get sudden feelings of panic:

- ○ Very often indeed (1)
- ○ Quite often (2)
- ○ Not very often (3)
- ○ Not at all (4)

H_2.14 *In the past week*
I can enjoy a good book or radio or television program:

- ○ Often (1)
- ○ Sometimes (2)
- ○ Not often (3)
- ○ Very seldom (4)

I I) Substance use

I_1.0 Are you now drinking **more** alcohol than before the epidemic?

- ○ Did not drink alcohol before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_1.1 How many alcoholic drinks a WEEK do you usually drink now?
(One drink is a small beer, one glass of wine, or a single measure of spirits)

_____

I_2.0 Are you now smoking more tobacco than before the epidemic?

- ○ Did not smoke tobacco before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_2.1 How many cigarettes a DAY do you usually smoke now?

_____

I_3.0 Are you now using more cannabis than before the epidemic?

- ○ Did not use cannabis before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_3.1 How many times a WEEK do you usually use cannabis now?

_____

I_4.0 Are you now using more medication for anxiety than before the epidemic?

- ○ Did not use anxiety medications before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_4.1 How many times **per week** do you usually use medication for anxiety now?

_____

I_5.0 Are you now using more medication to help you sleep than before the epidemic?

- ○ Did not use sleep medications before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_5.1 How many times **per week** do you usually use sleep medication now?

_____

K J) Ethnicity and status in Canada

K_1 1.0 How do you describe yourself? Would you say that you are:

- ○ First Nations (North American Indian) Métis or Inuk (Inuit), please specify: (1) _____
- ○ Asian (including Filipino), please specify: (2) _____
- ○ Black (3)
- ○ White (4)
- ○ Other, please specify: (5) _____

K2_title K) Status in Canada

K_1 What is your status in Canada? Are you a

- ○ Temporary resident (1)
- ○ Permanent resident (2)
- ○ Canadian citizen (3)
- ○ Other, namely (4) _____

Finally, to fully understand the impact of the epidemic on those working through it, we would find it helpful to know of any events or incidents at work since ${e://Field/EmbeddedDataA} that you have found particularly difficult or stressful. If you feel able to tell us about such an event or incident, please do so here.
Please enter NONE, if you do not have an event or incident to describe.

_____

_____

_____

_____

A.3 Phase 3 Questionnaire for Ontario Personal Support Workers (PSWs)

Covid Ontario PSW Phase 3 - Spring 2021

Intro Dear ${e://Field/RecipientFirstName} ${e://Field/RecipientLastName}, On ${e://Field/EmbeddedDataA} you completed a questionnaire about your experiences of working through the COVID-19 pandemic. We are now asking if you would complete a further questionnaire to update your record of working during the latest outbreaks. We plan to contact you with one more short 'recovery' questionnaire early in 2022.

The questionnaire today is very similar to the ones you completed before and again should take only about 20 minutes. Please read the information sheet HERE then complete the consent section below before moving on to complete the questionnaire.

Those of you who have received one or more shots of vaccine have been – or will be – invited to consider joining a sub-study to look at the longevity of antibodies to the virus. That has a separate consent process that we are not addressing here. If you have NOT had the vaccine we ask for your consent to an additional blood sample to be tested for COVID-19 antibodies

We are asking for your consent to access, though the provincial labs, all results, positive or negative, of any tests you have had (or will have) for the virus or antibodies since the start of the epidemic to March 31st, 2022.

Finally, we are asking you to consider giving your consent to the research team sharing your anonymized data with the Canadian Immunology Task Force. Knowledge of your identity would be retained only by the research team here, and no data that would allow someone to identify you would be included in the anonymized data set.

C1title **Consent Form**

C1header The impact of Covid-19 on the health of Ontario PSW
Principal Investigator: Dr. Nicola Cherry Contact details: Toll free phone: 1-866-492-6093
Email: covidHCW@ualberta.ca

Consent to complete the third questionnaire

C1p1 C1.1. Do you understand that you have been asked to be in a research study?

- ○ Yes (1)
- ○ No (2)

C1p2 C1.2. Have you read a copy of the information sheet?

- ○ Yes (1)
- ○ No (2)

C1p3
C1.3. Do you understand the benefits and risks involved in taking part in this research study?
Note: There is a section on benefits and risks in the information sheet

- ○ Yes (1)
- ○ No (2)

C1p4
C1.4. Do you understand that you can phone 1–866–492–6093 or contact us at covidHCW@ualberta.ca to ask questions or discuss the study?

- ○ Yes (1)
- ○ No (2)

C1p5
C1.5. Do you understand that you are free to withdraw from the study at any time, without having to give a reason and without affecting your employment or medical care?

- ○ Yes (1)
- ○ No (2)

C1p6
C1.6. Has the issue of confidentiality been explained to you?
Note: there is a paragraph on confidentiality in the information sheet.

- ○ Yes (1)
- ○ No (2)

C1p7
C1.7. Do you understand who will have access to your records?
Note: again, see the paragraph on confidentiality in the information sheet.

- ○ Yes (1)
- ○ No (2)

C2_1 C1.8. **If you consent** to complete the third questionnaire, please type your name here

C1p8_name
Name

_____

C1p8_date Date (day/month/year)

_____

C2_1 Have you had one or more shots of the vaccine.

- ○ Yes (1)
- ○ No (2)

C2_test
We are asking your consent to give a blood sample to further assess the presence of any antibodies to the covid virus. If you agree, 2x5 ml of blood will be taken with a needle from a vein in your arm. The serum from this sample will be analyzed for Covid-19 antibodies by the Alberta or BC provincial laboratory or, in Ontario and Quebec, by Dynacare Laboratories. The results will be confidential. There will be no cost to you. No testing other than for Covid-19 antibodies will be carried out on this sample. If you agree to giving a blood sample and for the laboratory to carry out the testing for antibodies, please put your name below. We will then contact you to make arrangements for this at a facility convenient for you.

Do you consent to such a blood test?

- ○ Yes (1)
- ○ No (2)

C2_test_name Name

_____

C2_test_date Date (day/month/year)

_____

C2_test_st
If you agree, we will store serum left over from the initial testing for up to two years at the Canadian BioSample repository (website: Canadian Biosample Repository) so that we can carry out further antibody testing, if indicated. Again, no testing other than for Covid-19 antibodies will be carried out on this stored sample, and only the research team or their designates will have access to it. Your sample will be identified by your name and a unique study identification number while it is stored. If we do further tests, we will send you the results of those also.

Do you consent to the storage of left-over serum for such possible future analysis?

- ○ Yes (1)
- ○ No (2)

C2_test_st_N Name

_____

C2_test_st_D Date (day/month/year)

_____

C2p4res Do you consent to us asking the provincial laboratory of the province(s) in which you were tested for the date and results of any test for the virus or antibodies during the period of this study (that is from 1st March 2020 to 31st March 2022)?

- ○ Yes (1)
- ○ No (2)

C2p4resName Name

_____

C2p4resDate
Date (day/month/year)

_____

C2CITF Do you agree to elements of your anonymized dataset being shared with the Canadian Immunology Task Force (CITF)? No identifying data would be shared nor would any data which we could foresee allowing anyone to infer your identify

- ○ Yes (1)
- ○ No (2)

C2CITF_name Name

_____

C2CITF_date
Date (day/month/year)

_____

Thank you for agreeing to fill in the third questionnaire for the HCW and COVID-19 study. It seeks to update your experiences since you completed your previous questionnaire on ${e://Field/EmbeddedDataA}

A. Employment since ${e://Field/EmbeddedDataA}
Recall: When we ask about your work in a PSW role we mean work for which, in Ontario, you needed to have a PSW Certificate.

A1 Since ${e://Field/EmbeddedDataA}, have you been carrying out any role as a PSW in Ontario?

- ○ Yes (1)
- ○ No (2)

A1.1 Why not? Check all that apply

- ☐ Retired (1)
- ☐ Sickness/disability with onset before ${e://Field/EmbeddedDataA} (2)
- ☐ Parental leave (3)
- ☐ Family responsibilities (4)
- ☐ Other, namely (5) _____

A2 1. Since ${e://Field/EmbeddedDataA}, in which health zones have you been working in (tick all that apply).

- [ ] North: North West and North East (1)
- [ ] West: Erie St. Clair, South West, Waterloo Wellington, Hamilton Niagara Haldimand Brant (2)
- [ ] Central: Central West, Central, Mississauga Halton, North Simcoe Muskoka (3)
- [ ] East: Central East, South East and Champlain (4)
- [ ] Toronto: Toronto Central (5)
- [ ] Outside province, namely (6) _____

A2.1 1.1 In which zone have you spent **most time working**?

- ○ North: North West and North East (1)
- ○ West: Erie St. Clair, South West, Waterloo Wellington, Hamilton Niagara Haldimand Brant (2)
- ○ Central: Central West, Central, Mississauga Halton, North Simcoe Muskoka (3)
- ○ East: Central East, South East and Champlain (4)
- ○ Toronto: Toronto Central (5)
- ○ Outside province, namely (6) _____

B1 We have a record that you have received a first shot of vaccine on ${e://Field/Vaccine1}. Is that correct?

- ○ Yes (1)
- ○ No (2)
- ○ I have not yet had any vaccine (3)

B1.1 What was the date of your first shot?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

Q312 What was the date of your first shot?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

B2 We have a record that your first shot was **${e://Field/Vaccine_type}** (If we have written 'of unknown type', please select no)

Is that correct?

- ○ Yes (1)
- ○ No (2)

B2.1 What type of vaccine was your first shot?

- ○ Pfizer (1)
- ○ Moderna (2)
- ○ AstraZeneca (3)
- ○ Other, namely (4) _____
- ○ Don't know (9)

B3 Please mark on the line below **how** much were you bothered by side effects to the vaccine AFTER YOUR FIRST SHOT?

	Not at all bothered	Very bothered
Fatigue (1)		
Myalgia (muscle pain) (21)		
Arthralgia (joint pain) (22)		
Headache (23)		
Malaise (24)		
Feeling feverish (25)		
Chills (26)		
Diarrhea/ loose stools (27)		

Nausea/vomiting (28)	
Skin reaction/rash (29)	
Swollen glands (30)	
Pain at injection site (31)	
Redness at injection site (32)	

B3.1

	Not at all bothered	Very bothered
Other, namely (33)		

B4 Where you pregnant at the time of receiving this first shot?

- ○ Yes (1)
- ○ No (2)
- ○ Not applicable (3)

B4.1 How many weeks along were you (what was your estimated gestation)?

_____

B4_2v Have you had your second shot?

- ○ Yes (1)
- ○ No (2)

B4.1_2v What was the date of your second shot?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

B4.2_2v Was this the same type as your first shot?

- ○ Yes (1)
- ○ No, please give details (2) _____

B4.3_2v Please mark on the line below **how** much were you bothered by side effects to the vaccine AFTER YOUR 2nd SHOT?

	Not at all bothered	Very bothered
Fatigue (1)		
Myalgia (muscle pain) (21)		
Arthralgia (joint pain) (22)		
Headache (23)		

Malaise (24)	
Feeling feverish (25)	
Chills (26)	
Diarrhea/ loose stools (27)	
Nausea/vomiting (28)	
Skin reaction/rash (29)	
Swollen glands (30)	
Pain at injection site (31)	
Redness at injection site (32)	

B4.3_others_2v

	Not at all bothered	Very bothered
Other, namely (19)		

C1 Have you been offered a vaccine against Covid-19?

- ○ Yes (1)
- ○ No (2)

C1.1 Did you agree to having this vaccine?

- ○ Yes (1)
- ○ No (2)

C1.2 Have you had a first shot?

- ○ Yes (1)
- ○ No (2)

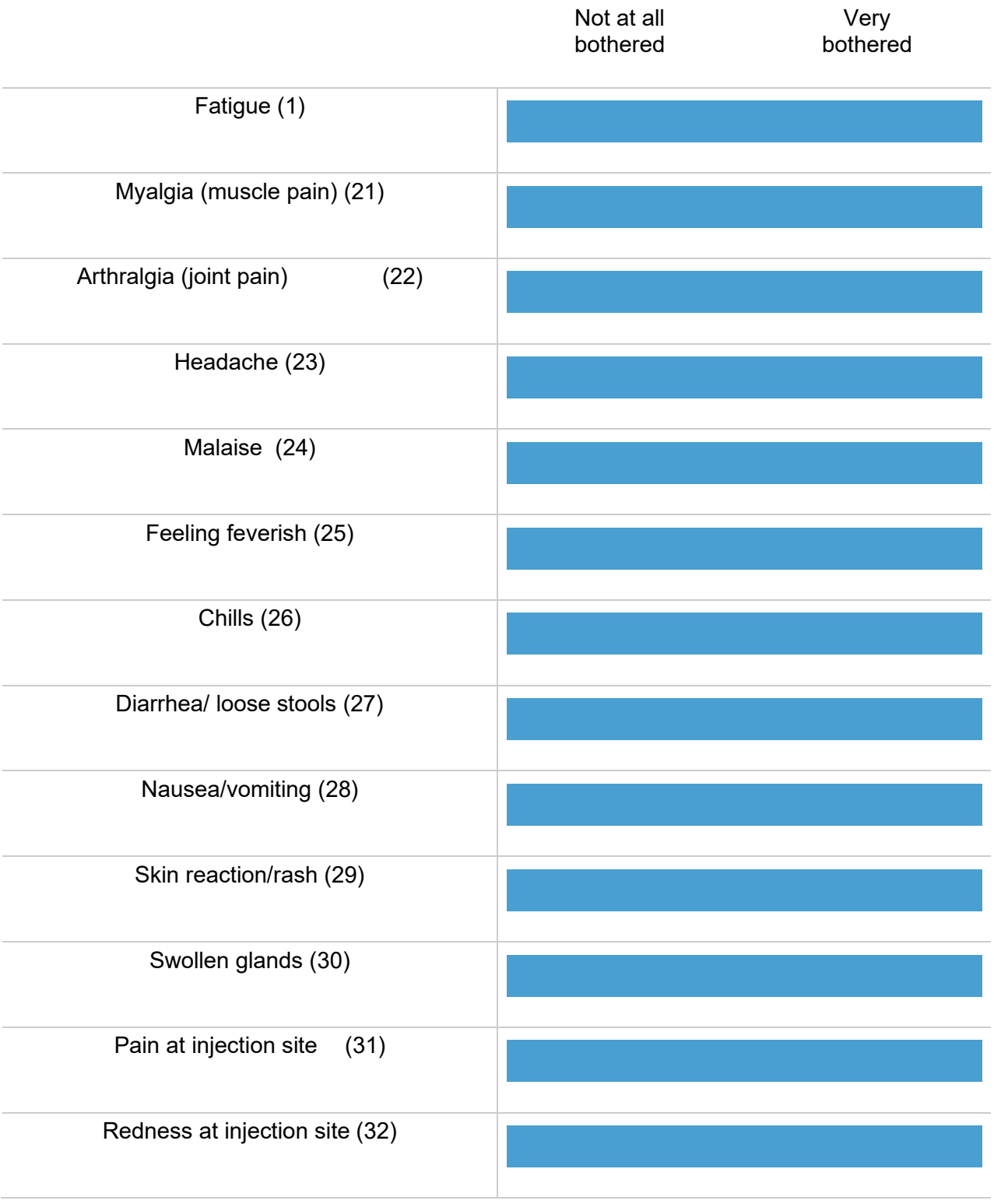
C1.2.1 What was the date of your first shot?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

C1.2.2 What type of vaccine was your first shot?

- ○ Pfizer (1)
- ○ Moderna (2)
- ○ AstraZeneca (3)
- ○ Other, namely (4) _____
- ○ Don’t know (9)

C2 How much were you bothered by side effects to the vaccine AFTER YOUR FIRST SHOT?



C2_other

	Not at all bothered	Very bothered
Other, namely (19)		

C2_1 Why did you not agree to have the vaccine? (please check all that apply)

- ☐ I am pregnant or breastfeeding (please specify) (1) _____
- ☐ I have a condition that counter-indicates having the vaccine (please specify) (2) _____
- ☐ I am allergic to one of the ingredients (please specify which) (3) _____
- ☐ I am worried by the reports of rare but serious side effects (4)
- ☐ I want to wait to see if there are any long-term effects (5)
- ☐ I am concerned about Covid-19 vaccines because trials were too rushed (6)
- ☐ I am concerned about mRNA vaccines because they are new and untried (7)
- ☐ The new variants may escape any current vaccine (8)
- ☐ I mistrust all vaccines (9)
- ☐ Other, namely (10) _____

C2.1.1

	Very unlikely	Very likely indeed
How likely is it that you will accept a covid-19 vaccine in the next 12 months? (1)		

C3 Have you had your second shot?

- ○ Yes (1)
- ○ No (2)

C3.1 What was the date of your second shot?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

C3.2 Was this the same type as your first shot?

- ○ Yes (1)
- ○ No, please give details (2) _____

C3.3 Please mark on the line below **how** much were you bothered by side effects to the vaccine AFTER YOUR 2nd SHOT?

	Not at all bothered — Very bothered
Fatigue (1)	
Myalgia (muscle pain) (21)	
Arthralgia (joint pain) (22)	
Headache (23)	
Malaise (24)	
Feeling feverish (25)	
Chills (26)	
Diarrhea/ loose stools (27)	
Nausea/vomiting (28)	
Skin reaction/rash (29)	
Swollen glands (30)	
Pain at injection site (31)	
Redness at injection site (32)	

C3.4

	Not at all bothered	Very bothered
Other, namely (19)		

D1 Did you have the influenza vaccine in the fall of 2019?

- Yes (1)
- No (2)
- Can't remember (3)

D1a Did you have the influenza vaccine in the fall of 2020 or more recently?

- Yes (1)
- No (2)
- Can't remember (3)

D1.1 Please give the month (best estimate) and year you had the 2020 influenza vaccine.

	Month	Year
Date (1)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

D1.2 Why did you not have the 2020 flu vaccine?

_____

_____

_____

_____

_____

E1 Do you have any following medical condition? Please check all that apply to you

- ☐ Rheumatoid arthritis (1)
- ☐ Ankylosing spondylitis (2)
- ☐ Psoriatic arthritis (3)
- ☐ Psoriasis (4)
- ☐ Inflammatory bowel disease (ulcerative colitis, Crohn's disease) (5)
- ☐ Lupus (6)
- ☐ Other chronic autoimmune inflammatory disease, namely (7) _____
- ☐ Other medical condition (including post-transplantation, chemotherapy or other cancer treatments) that might affect an antibody response to vaccination Please specify (8) _____
- ☐ None of those listed (9)

E2 Are you taking any medication that might affect your response to a vaccination? If taking medication and not sure if it might affect a response, please check not sure and give details

- ○ Yes (1)
- ○ No (2)
- ○ Not sure (3)

E2.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
			(1)	(1)	(1)
1. (1)	▼ January (1 ... December (12)	▼ 2021 (1 ... 1932 (1932)			

E2_2 Do you want to enter another medication?

- ○ Yes (1)
- ○ No (2)

E2_2.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
			(1)	(1)	(1)
2. (1)	▼ January (1 ... December (12)	▼ 2021 (1 ... 1932 (1932)			

E2_1.3 Do you want to enter another medication?

- ○ Yes (1)
- ○ No (2)

E2_1.3.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
			(1)	(1)	(1)

3. (1)	▼ January (1 ... December (12)	▼ 2021 (1 ... 1932 (1932)			

E2_1.4 Do you want to enter another medication?

- ○ Yes (1)
- ○ No (2)

E2_1.4.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
			(1)	(1)	(1)
4. (1)	▼ January (1 ... December (12)	▼ 2021 (1 ... 1932 (1932)			

E2_1.5 Do you want to enter another medication?

- ○ Yes (1)
- ○ No (2)

E2_1.5.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
			(1)	(1)	(1)
5. (1)	▼ January (1 ... December (12)	▼ 2021 (1 ... 1932 (1932)			

F **F) Periods of self-isolation**

F1 Since ${e://Field/EmbeddedDataA}, how many times have you had a period when you have been self-isolating (including quarantine) at home and unable to attend work

- ○ One or more (1)
- ○ None (2)

F1.1 How many times?

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 or more (3)

F1.2 Please tell us about the most recent time you have been self-isolating at home and unable to attend work since ${e://Field/EmbeddedDataA}

Why was this (check all that apply)?

- ☐ You had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (1)
- ☐ A family member had an infection or symptoms known, presumed or suspected to be caused by Covid-19 (2)
- ☐ You had (inadequately protected) contact with a patient, client or colleague with known, presumed or suspected Covid-19 (3)
- ☐ You had returned from international travel (4)
- ☐ Other, namely (5) _____

F1.3 What was the **date of the first day** of this (most recent) self-isolation?

	Day	Month	Year
Date (8)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

F1.4 What was (or will be) the **date of the last day** of this self-isolation?

	Day	Month	Year
Date (8)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

D **G) Employment in your most recent week at work since ${e://Field/EmbeddedDataA}**

G1 In the most recent week you have worked since ${e://Field/EmbeddedDataA}, has your role as a PSW in Ontario involved **one-on-one contact with patients or clients** (in person or remotely)?

- ○ Yes (1)
- ○ No (2)

G1.1 What role have you held while in contact with patients or clients? (check all that apply)

- ☐ A PSW working in an inpatient setting in a hospital (1)
- ☐ A PSW in ambulatory or outpatient settings in a hospital (2)
- ☐ A PSW in an emergency room (3)
- ☐ A PSW working in clients' homes (4)
- ☐ A PSW providing clinical support to a residential institution or contained community (such as care home, prison, first nations), please specify (5) _____
- ☐ A PSW providing clinical support to a workforce, please specify (6) _____
- ☐ Other clinical role, please specify (7) _____

G1.1.1.1 In the most recent week you have worked since ${e://Field/EmbeddedDataA} were you working in (Check all that apply)

- [ ] Critical care? (1)
- [ ] ICU? (2)
- [ ] Wards designated for the care of infectious patients or clients? (3)
- [ ] General (adult) medical wards? (4)
- [ ] Wards for the care of geriatric patients or clients? (5)
- [ ] Wards for the care of psychiatric patients or clients? (6)
- [ ] Wards for the care of pediatric patients or clients? (7)
- [ ] Wards for the care of obstetrical patients or clients (8)

_____

- [ ] Other, namely (9) _____

G1.1.1.2 What institutional requirements/arrangements are now in place for PPE?

	Yes (1)	**No** (2)
Continuous masking? (D_Q1.1.1.2_1)	○	○
Face shield or goggles for all physical exams (D_Q1.1.1.2_2)	○	○
Restricted access to some types of PPE? (D_Q1.1.1.2_3)	○	○
Fit-testing for each new type/model of mask (D_Q1.1.1.2_4)	○	○
Decontamination and re-use of N95 masks? (D_Q1.1.1.2_5)	○	○
Provision of a buddy for donning/doffing PPE? (D_Q1.1.1.2_6)	○	○

G1.2 In the most recent week you have worked since ${e://Field/EmbeddedDataA}, was your role as a PSW primarily without one-on-one contact with patients or clients because you were working in

- ☐ Public health? (1)
- ☐ Administration? (2)
- ☐ Teaching or research? (3)
- ☐ Other, namely (4) _____

G_2 What was the age range of your patients or clients in your most recent week at work since ${e://Field/EmbeddedDataA}?

Please check one or more below to reflect the great majority of your patients or clients

- ☐ All ages including children (1)
- ☐ All ages 18 years and older (2)
- ☐ (3)
- ☐ <18 years (4)
- ☐ 18 (5)
- ☐ 55 (6)
- ☐ >=70 years? (7)
- ☐ Other, namely (8) _____

G **In your most recent week at work since ${e://Field/EmbeddedDataA}**

G3 How many days did you work in a PSW role in Ontario?

▼ 1 day (1) ... 7 days (7)

G3.1 What was the **total number of hours in that week** you worked with **one-on-one in person** contact with patients or clients? (best estimate)

▼ 0 hours (0) ... 168 hours (168)

G3.1.1
How many patients or clients did you see **one-on-one in person** in your most recent week at work since ${e://Field/EmbeddedDataA} (best estimate)
If greater than 500, please choose 500.

▼ 0 (0) ... 500 (500)

G3.1.2 What proportion of these patients or clients that you saw **one-on-one in person** in that week were screened **for symptoms or fever** before you were in one-on-one contact with them?
If you did not see patients or clients one-on-one in person please check 100%

- ○ 100% (1)
- ○ > 90% but not 100% (2)
- ○ 50 - 90% (3)
- ○ some but < 50% (4)
- ○ none (5)

G3.1.2.1 What proportion of these patients or clients that you saw **one-on-one in person** in that week were screened **by a test for the virus** before you were in one-on-one contact with them?
If you did not see patients or clients one-on-one in person please check 100%

- ○ 100% (1)
- ○ > 90% but not 100% (2)
- ○ 50 - 90% (3)
- ○ some but < 50% (4)
- ○ none (5)

G3.2 What was the total number of hours in that week you worked **one-on-one with patients or clients by phone, email or videoconferencing**? (best estimate)

▼ 0 hours (0) ... 167 hours (167)

G3.3 What was the total number of hours in that week you worked as a PSW, **without one-to-one** patient or client contact? (best estimate)

▼ 0 hours (0) ... 167 hours (167)

H **H) Work with patients or clients since ${e://Field/EmbeddedDataA}**

H_1 Since ${e://Field/EmbeddedDataA}, has your work as a PSW involved **one-on-one in person** contact with known, presumed or suspected Covid-19 patients or clients?

- Yes (1)
- No (2)
- Don't know (9)

H1.0.1 Were any of these patients or clients infected with one of the variant strains identified as being of concern?

- Yes (1)
- No (2)
- Don’t know (9)

H_1.1 Since ${e://Field/EmbeddedDataA} on how many days have you had **one-on-one contact** with at least one known, presumed or suspected COVID-19 patient or client (best estimate)

_____

H_1.2 Since ${e://Field/EmbeddedDataA}, have you taken part in (or been within 2 meters of) aerosol generating medical procedures on any patients or clients (suspected of COVID-19 or not)?

- Yes (1)
- No (2)

H_1.2_ What procedures? (check all that apply)

- ☐ Intubation and related procedures (manual ventilation, open endotracheal suctioning, extubation) (1)
- ☐ Cardiopulmonary resuscitation (2)
- ☐ Bi-level Positive Airway Pressure (BiPAP, CPAP) (3)
- ☐ Humidified high flow oxygen systems (ARVO, Optiflow) (4)
- ☐ Tracheostomy care (5)
- ☐ Bronchoscopy/laryngoscopy (6)
- ☐ Sputum induction (7)
- ☐ Nebulized/aerosolized medication administration (8)
- ☐ Open respiratory/airway suctioning (9)
- ☐ High frequency oscillatory ventilation (10)
- ☐ Other, namely (11) _____

H_1.3 Please estimate on how many days since ${e://Field/EmbeddedDataA} you have been involved in aerosol generating medical procedures

_____

H_1.3.1 Were any of these procedures on patients or clients with known, presumed or suspected Covid-19?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

H_2.0 Since ${e://Field/EmbeddedDataA}, have there been any times when you have had contact with patients or clients, (suspected of COVID-19 or not) when you, personally, did **NOT HAVE ACCESS** to all the appropriate/approved Personal Protective Equipment (PPE).

- ○ Yes (1)
- ○ No (2)

H_2.1 Which types of (clean) PPE were **NOT** available? Please check all that apply

- ☐ N 95 respirator (1)
- ☐ Procedure mask (2)
- ☐ Eye protection (3)
- ☐ Face shield (4)
- ☐ Gown (5)
- ☐ Gloves (6)
- ☐ Other, namely (7) _____

H_2.2 Was this PPE ever not available when you were working with a known, presumed or suspected covid-19 patient or client?

- ○ Yes (1)
- ○ No (2)

H_3.0 Since ${e://Field/EmbeddedDataA} have you experienced any malfunction of PPE, like slipping of a mask or tear in a glove?

- ○ Yes, please describe: (1) _____
- ○ No (2)

H_3.1 Was this malfunction while you were working with a known, presumed or suspected COVID-19 patient or client?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

H_4 Have there been any times when you have had contact with patients or clients where appropriate PPE was available but you did not use it effectively?

- ○ Yes (1)
- ○ No (2)

H_4.1 Please describe the incident where PPE was not used effectively.

_____

_____

_____

_____

_____

H_4.2 Did this involve a known, presumed or suspected covid-19 patient or client?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

H_5 Since ${e://Field/EmbeddedDataA} have you experienced any type of discomfort or adverse effect (such as sweating or skin rash) that lasted more than a day, due to wearing PPE?

- ○ Yes (1)
- ○ No (2)

H_5.1 Which type of PPE caused discomfort or adverse effects? Please check all that apply

- ☐ N 95 respirator (1)
- ☐ Procedure mask (2)
- ☐ Eye protection (3)
- ☐ Face shield (4)
- ☐ Gown (5)
- ☐ Gloves (6)
- ☐ Other, namely (7) _____

H_5.2 What type of discomfort/adverse effect(s)

_____

H_5.3 Did this this make it less likely that you would use effective PPE?

- ○ Yes, please give details (1)

_____

- ○ No (2)

H_6.0 Since ${e://Field/EmbeddedDataA}, apart from direct patient or client care, have you been working with objects (such as bed linen, medical equipment, bathrooms, food trays) that have been used with known, presumed or suspected COVID-19 patients?

- ○ Yes (1)
- ○ No (2)

H_6.1 Please describe objects:

_____

_____

_____

_____

_____

H_6.2 On how many days since ${e://Field/EmbeddedDataA} have you been working with such objects? (best estimate)

_____

H_7 Do you ***now*** have any difficulties getting access to PPE that you believe to be necessary to do your job?

- ○ Yes (1)
- ○ No (2)

H_7.0 What types of PPE are difficult to access? Please check all that apply

- [ ] N 95 respirator (1)
- [ ] Procedure mask (2)
- [ ] Eye protection (3)
- [ ] Face shield (4)
- [ ] Gown (5)
- [ ] Gloves (6)
- [ ] Other namely (7) _____

H_7.1 Why is access difficult?

	Yes (1)	**No** (2)
Not available at all (1)	○	○
Available but only for certain procedures (10)	○	○
Available, but only for certain staff (11)	○	○
Available, but need to jump through hoops to get them (12)	○	○

H_7.1_other **Other namely**

_____

I **I) Your perceptions and concerns**

I_1 Please mark on the line below **how true** the following statements are about your work, during your most recent week at work since ${e://Field/EmbeddedDataA}, compared with working before the spread of COVID-19 in early March 2020

	Completely disagree **Completely agree**
My hours of work are longer (1)	
My work tasks are about the same (4)	
The patient or client make-up is about the same (5)	
My patients or clients are no more stressed (6)	
My co-workers are no more stressed (7)	
I am no more stressed (8)	
I sleep just as well as I did before the epidemic (9)	

I_1.2 Please mark on the line below **how confident** you feel about working with patients or clients with known, presumed or suspected COVID-19.

	Not at all confident **Very confident**
I have the clinical knowledge I need (1)	
I know how to use the required PPE (9)	
I know how and when to refer for testing (10)	
I know how and when to refer for treatment (14)	
I have the support I need from co-workers (15)	
I have access to all the required PPE (16)	
I shall have access to all the PPE I need, going forward (18)	
The PPE recommended will prevent transmission (19)	
There are sufficient staff to do the job safely (20)	
The new variants of the virus will be sufficiently controlled (17)	

I_1.3 Please mark on the line below to **show your worries** now about the COVID-19 pandemic.

	Not at all worried **Very worried**
That I shall be infected (1)	
That I shall infect my family (21)	
That I shall infect my patients or clients (22)	
That I shall infect my co-workers/colleagues (23)	
That I shall not be able to cope with the work (24)	
That I shall have to let people die (25)	
That my experience is inadequate (26)	
That I shall fail myself and my family (27)	

I_1.4 Please mark on the line below to show where you will **find support** during this time.

	No support at all — **Very strong support**
My immediate family (1)	
My colleagues or co-workers (19)	
A senior colleague or mentor (20)	
My immediate organization (21)	
Ontario Health Services (23)	
Ontario's Chief Medical Officer of Health (24)	
The managers of the OPSWA (27)	
My religious community (28)	

I_1.4_others

	No support at all — **Very strong support**
Others, namely (1)	

I_2_inst **Since the start of the epidemic** has your employer, professional organization, union or other group **offered support** to help you cope with the mental health challenges of the pandemic? Please check all that apply below.

I_2.1 One-on-one support (on-line or in person) from a specialist counsellor, psychologist or similar?

- Yes (1)
- No (2)
- Don't know (9)

I_2.1.1 Did you take advantage of this?

- Yes (1)
- No (2)

I_2.2 One-on-one support from a colleague or peer nominated to do this?

- Yes (1)
- No (2)
- Don't know (9)

I_2.2.1 Did you take advantage of this?

- Yes (1)
- No (2)

I_2.3 An on-line support group where you could discuss and ask questions?

- Yes (1)
- No (2)
- Don't know (9)

I_2.3.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

I_2.4 An on-line self-learning tool with advice about how to manage stress?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

I_2.4.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

I_2.5 A helpline with a number you could call if you were distressed?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

I_2.5.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

I_2.6 An Employee Assistance Program (EAP)?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

I_2.6.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

I_2.7 Was any other mental health support available to you through your work or work contacts?

- ○ Yes, please describe (1) _____
- ○ No (2)
- ○ Don't know (9)

I_2.7.1 Did you take advantage of this?

- ○ Yes (1)
- ○ No (2)

I_2.10 Are there other mental health supports you would have valued during this time?

- ○ Yes, please describe (1) _____
- ○ No (2)

I_2.10.1 **Since the start of the epidemic** have you discussed any mental health issues with a health professional (such as your family doctor) you accessed through channels **outside work**?

- ○ Yes, what type of health professional was this? (1) _____
- ○ No (2)

J **J. Infection with COVID-19**

J_1.0 Since ${e://Field/EmbeddedDataA} do you have reason to believe that you may have been infected with the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)

J_2.0 Since ${e://Field/EmbeddedDataA} have you been tested for the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)

J_2.1 How many times have you been tested?

_____

J_2.2 Were the results of any of these positive for the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)
- ○ Still waiting for results (3)

J_2.2.1 What was the date of the (first) test you know to have been positive?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

J_2.2.2 Do you think you were infected at work?

- ○ Yes (1)
- ○ No (2)
- ○ Unsure (3)

J_2.2.2.1 What/where was the most likely source of infection?

_____

J_2.3 What was the most recent date were you tested?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

J_3.0 Apart from swab tests for the virus itself, have you had the blood test for **antibodies** to the virus?

- ○ Yes (1)
- ○ No (2)
- ○ Don't know (9)

J_3.1 Was the result positive for antibodies to the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)
- ○ Still waiting for results (3)

J_3.2.1 What was the most recent date you were tested for antibodies?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

J_3.3 What was the date of the (first) test you know to have been positive for antibodies?

	Day	Month	Year
Date (1)	▼ 1 (1 ... 31 (31)	▼ January (1 ... December (12)	▼ 2020 (1 ... 2022 (2022)

J_4.0 Since the spread of the virus in March 2020 has anyone you know personally (other than a colleague, patient or client), been infected with the COVID-19 virus?

- ○ Yes (1)
- ○ No (2)

K **K) Your health**

K1 How tall are you without shoes?

	ft	inches
Your height (1)	▼ 4 (1 ... 7 (7)	▼ 0 (1 ... 11 (11)

K2 How much do you weigh?

	lbs
Your weigh (1)	▼ 80 (1 ... 579 (579)

K_3 Since ${e://Field/EmbeddedDataA}, have you had an episode when you have been unwell for two or more consecutive days (whether or not you reported for duty)?

- ○ Yes (1)
- ○ No (2)

K_4 Please mark below **how much you have been bothered** FOR TWO OR MORE CONSECUTIVE DAYS since ${e://Field/EmbeddedDataA} for each symptom/problem listed below. If more than one incident, record the symptoms/problems from the one that bothered you most.

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Coughing (1)					
Chest pains (4)					
Shortness of breath (21)					
Coughing up sputum (5)					
Coughing up blood (6)					
Sweating (7)					
Chills (8)					
Headache (9)					
Nausea (10)					
Vomiting (11)					

Diarrhea (12)	
Stomach pain (13)	
Muscle pain (14)	
Lack of appetite (15)	
Trouble concentrating (16)	
Trouble thinking (17)	
Trouble sleeping (18)	
Fatigue (19)	

K_4.1

	Not at all bothered	A little	Moderately	Quite a bit	Extremely bothered
Other, incl. loss of sense of taste, Namely (1)					

Mood_2title In the mood questionnaire below, please check the box alongside the reply that is closest to how you have been feeling **IN THE PAST WEEK**.
Don't take too long over your replies; your immediate answer is best.

Mood_2.1 *In the past week*
I feel tense or 'wound up':

- ○ Most of the time (1)
- ○ A lot of the time (2)
- ○ From time to time, occasionally (3)
- ○ Not at all (4)

Mood_2.2 *In the past week*
I still enjoy the things I used to enjoy:

- ○ Definitely as much (1)
- ○ Not quite so much (2)
- ○ Only a little (3)
- ○ Hardly at all (4)

Mood_2.3 *In the past week*
I get a sort of frightened feeling as if something awful is about to happen:

- ○ Very definitely and quite badly (1)
- ○ Yes, but not too badly (2)
- ○ A little but it doesn't worry me (3)
- ○ Not at all (4)

Mood_2.4 *In the past week*
I can laugh and see the funny side of things:

- ○ As much as I always could (1)
- ○ Not quite so much now (2)
- ○ Definitely not so much now (3)
- ○ Not at all (4)

Mood_2.5 *In the past week*
Worrying thoughts go through my mind:

- ○ A great deal of the time (1)
- ○ A lot of the time (2)
- ○ Not too often (3)
- ○ Very little (4)

Mood_2.6 *In the past week*
I feel cheerful:

- ○ Never (1)
- ○ Not often (2)
- ○ Sometimes (3)
- ○ Most of the time (4)

Mood_2.7 *In the past week*
I can sit at ease and feel relaxed:

- ○ Definitely (1)
- ○ Usually (2)
- ○ Not Often (3)
- ○ Not at all (4)

Mood_2.8 *In the past week*
I feel as if I am slowed down:

- ○ Nearly all the time (1)
- ○ Very often (2)
- ○ Sometimes (3)
- ○ Not at all (4)

Mood_2.9 *In the past week*
I get a sort of frightened feeling like ‘butterflies’ in the stomach:

- ○ Not at all (1)
- ○ Occasionally (2)
- ○ Quite often (3)
- ○ Very often (4)

Mood_2.10 *In the past week*
I have lost interest in my appearance:

- ○ Definitely (1)
- ○ I don't take as much care as I should (2)
- ○ I may not take quite as much care (3)
- ○ I take just as much care as ever (4)

Mood_2.11 *In the past week*
I feel restless as if I have to be on the move:

- ○ Very much indeed (1)
- ○ Quite a lot (2)
- ○ Not very much (3)
- ○ Not at all (4)

Mood_2.12 *In the past week*
I look forward with enjoyment to things:

- ○ As much as I ever did (1)
- ○ Rather less than I used to (2)
- ○ Definitely less than I used to (3)
- ○ Hardly at all (4)

Mood_2.13 *In the past week*
I get sudden feelings of panic:

- ○ Very often indeed (1)
- ○ Quite often (2)
- ○ Not very often (3)
- ○ Not at all (4)

Mood_2.14 *In the past week*
I can enjoy a good book or radio or television program:

- ○ Often (1)
- ○ Sometimes (2)
- ○ Not often (3)
- ○ Very seldom (4)

I **L) Substance use**

L_1.0 Are you now drinking more alcohol than before the epidemic?

- ○ Did not drink alcohol before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_1.1 How many alcoholic drinks a WEEK do you usually drink now?
(One drink is a small beer, one glass of wine, or a single measure of spirits)

_____

I_2.0 Are you now smoking more tobacco than before the epidemic?

- Did not smoke tobacco before the epidemic or now (1)
- Less (2)
- About the same (3)
- Somewhat more (4)
- Much more (5)

I_2.1 How many cigarettes a DAY do you usually smoke now?

_____

I_3.0 Are you now using more cannabis than before the epidemic?

- Did not use cannabis before the epidemic or now (1)
- Less (2)
- About the same (3)
- Somewhat more (4)
- Much more (5)

I_3.1 How many times a WEEK do you usually use cannabis now?

_____

I_4.0 Are you now using more medication for anxiety than before the epidemic?

- ○ Did not use anxiety medications before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_4.1 How many times **per week** do you usually use medication for anxiety now?

_____

I_5.0 Are you now using more medication to help you sleep than before the epidemic?

- ○ Did not use sleep medications before the epidemic or now (1)
- ○ Less (2)
- ○ About the same (3)
- ○ Somewhat more (4)
- ○ Much more (5)

I_5.1 How many times **per week** do you usually use sleep medication now?

_____

End

Finally, to fully understand the impact of the epidemic on those working through it, we would find it helpful to know of any events or incidents at work since ${e://Field/EmbeddedDataA} that you have found particularly difficult or stressful. If you feel able to tell us about such an event or incident, please do so here.

Please enter NONE, if you do not have an event or incident to describe.

_____

_____

_____

A.4 Phase 4 Questionnaire for Alberta Physicians (MDs)

Covid Alberta Physicians Phase 4 - Spring/Summer 2022

Intro Dear ${e://Field/RecipientFirstName} ${e://Field/RecipientLastName}, On ${e://Field/PKD} you completed your most recent questionnaire about your experiences of working through COVID-19. We have now reached the final questionnaire, in which we aim to complete the record of your exposures and health during the pandemic and to see how you are getting on now. This final questionnaire is similar to those you have already completed and should only take about 20 minutes. Please read the information sheet then complete the consent section below, before moving on to complete the questionnaire. You will see that we are asking your consent to receive information on vaccine shots (if you have had any) from your provincial health authority to be sure we have a complete record. Almost all of you agreed last time that we could share de-identified data with the Canadian Immunology Task Force, that has been funding the later phases of the study. They have now asked us to come back to you with a further request – that they can share the de-identified data with a wider group and make it, together with data from other studies funded by government, available to all interested parties. We have put a paragraph about this in the information sheet and the explicit request for consent will appear below, for those of you who have given a serology sample. Please note that whatever decision you make about this is entirely up to you. If you decide not to give this extra consent, that decision will be known only to the study team, and we will not share your data with the CITF. Your completion of this final questionnaire is quite independent of your decision about data-sharing. Whether or not you agree to that, we hope very much that you will complete this final questionnaire.

C1title **Consent Form**

C1header The impact of Covid-19 on the health of Alberta physicians
Principal Investigator: Dr. Nicola Cherry Contact details: Toll free phone: 1-866-492-6093
Email: covidHCW@ualberta.ca

Consent to complete the final questionnaire

C1p1 C1.1. Do you understand that you have been asked to be in a research study?

- ○ Yes
- ○ No

C1p2 C1.2. Have you read a copy of the information sheet?

- ○ Yes
- ○ No

C1p3
C1.3. Do you understand the benefits and risks involved in taking part in this research study?
Note: There is a section on benefits and risks in the information sheet

- ○ Yes
- ○ No

C1p4
C1.4. Do you understand that you can phone 1–866–492–6093 or contact us at covidHCW@ualberta.ca to ask questions or discuss the study?

- ○ Yes
- ○ No

C1p5
C1.5. Do you understand that you are free to withdraw from the study at any time, without having to give a reason and without affecting your employment or medical care?

- ○ Yes
- ○ No

C1p6
C1.6. Has the issue of confidentiality been explained to you?
Note: there is a paragraph on confidentiality in the information sheet.

- ○ Yes
- ○ No

C1p7
C1.7. Do you understand who will have access to your records?
Note: again, see the paragraph on confidentiality in the information sheet.

- ○ Yes
- ○ No

C2_1 C1.8. **If you consent** to complete this final questionnaire, please type your name here

C1p8_name
Name

_____

C1p8_date Date (day/month/year)

_____

C1p9 Do you consent to us asking your provincial health authority to provide us with information on the date and type of any vaccine shot for COVID-19 you received between December 2020 and June 30th, 2022?

- ○ Yes
- ○ No
- ○ No vaccine

C1p9_name
Name

_____

C1p9_date Date (day/month/year)

_____

C_CITF Do you agree that the CITF may share your coded data and serology results with researchers in Canada and internationally? Your coded data will be shared with researchers performing for-profit research and non-profit research. These data may be shared via the cloud. The data will be used to perform research concerning COVID-19 and related health outcomes. Data that you agree to share will be stored indefinitely under the custodianship of McGill University. No identifying data would be shared nor would any data which we could foresee allowing anyone to infer your identity.

- ○ Yes
- ○ No

C_CTIF_1
Name

_____

C_CTIF_2 Date (day/month/year)

_____

Thank you for agreeing to fill in the final questionnaire for the HCW and COVID-19 study. It seeks to update your experiences since you completed your previous questionnaire on ${e://Field/PKD}

A. Employment since ${e://Field/PKD}

Recall: When we ask about your work in a physician role we mean work for which, in Alberta, you needed to be registered with the CPSA.

A1 Since ${e://Field/PKD}, have you carried out any role as a physician in Alberta?

- ○ Yes
- ○ No

A1.1 Why not? Check all that apply

- ☐ Retired
- ☐ Sickness/disability with onset before ${e://Field/PKD}
- ☐ Parental leave
- ☐ Family responsibilities
- ☐ Other, namely _____

A2 1. Since ${e://Field/PKD}, in which health zones have you been working in (tick all that apply).

- [ ] South
- [ ] Calgary
- [ ] Central
- [ ] Edmonton
- [ ] North
- [ ] Outside province, namely _____

A2.1 1.1 In which zone have you spent **most time working**?

- ○ South
- ○ Calgary
- ○ Central
- ○ Edmonton
- ○ North
- ○ Outside province, namely _____

B1.1
You have told us you have had vaccine shots against COVID-19 with the most recent shot on ${e://Field/recentvacdate}

Have you had any further shots since ${e://Field/recentvacdate}?

- ○ Yes
- ○ No

B1.2 We do not have a record that you have had any vaccine shots against COVID-19. **Have you had any**?

- ○ Yes
- ○ No

B2.1 What was the **date of the most recent** shot?

	Day	Month	Year
Date	▼ 1 ... 31	▼ January ... December	▼ 2020 ... 2022

B2.2 What type of vaccine was the most recent shot?

- ○ Pfizer
- ○ Moderna
- ○ Astra-Zeneca
- ○ Other, namely _____
- ○ Don't know

B2.3 **How many shots** have you had in total?

- ○ 1 shot
- ○ 2 shots
- ○ 3 shots
- ○ More than 3 shots

B3 Did you have the influenza vaccine in the fall of 2021 or more recently?

- ○ Yes
- ○ No
- ○ Can't remember

B3.1 Please give the **month** (best estimate) and year you had this recent influenza vaccine.

	Month	Year
Date	▼ January ... December	▼ 2020 ... 2022

C1 Do you have any of the following medical conditions? Please check all that apply to you

- ☐ Rheumatoid arthritis
- ☐ Ankylosing spondylitis
- ☐ Psoriatic arthritis
- ☐ Psoriasis
- ☐ Inflammatory bowel disease (ulcerative colitis, Crohn's disease)
- ☐ Lupus
- ☐ Other chronic autoimmune inflammatory disease? Please specify

_____

- ☐ Other medical condition or treatment (except chemotherapy or organ transplant) that might affect an antibody response to vaccination? Please specify

_____

- ☐ None of those listed

C2 In the last 3 years, have you undergone chemotherapy?

- ○ Yes
- ○ No

C2.1 What period did this span?

	Month	Year
Start	▼ January ... December	▼ 2018 ... 2022
End (note: if ongoing , please put today's date)	▼ January ... December	▼ 2018 ... 2022

C3 In the last 3 years have you had an organ transplant requiring anti-rejection medication?

- ○ Yes
- ○ No

C3.1 What period did this medication span?

	Month	Year
Start	▼ January ... December	▼ 2018 ... 2022
End (note: if ongoing , please put today's date)	▼ January ... December	▼ 2018 ... 2022

C4 Since the start of pandemic, have you taken any medication that might **affect your response to a vaccination?** If taking medication and not sure if it might affect a response, please check not sure and give details in the grid below.

- ○ Yes
- ○ No
- ○ Not sure

C4.1 Please give the details in the grid below

	When did you first start taking this Medication **MONTH**	When did you first start taking this Medication **YEAR**	For what conditions or symptoms are you taking this medication?	What tablets or other medications have you used?	How often do you take/use it?
1.	▼ January ... December	▼ 2022 ... 1932			
2	▼ January ... December	▼ 2022 ... 1932			
3	▼ January ... December	▼ 2022 ... 1932			
4	▼ January ... December	▼ 2022 ... 1932			

D1 Have you been pregnant (with a positive pregnancy test) since the start of the pandemic?

- ○ Yes (note: please include any pregnancy electively terminated on medical or social grounds)
- ○ No
- ○ Not applicable

D1.1 How many times?

- ○ One
- ○ Two
- ○ Three or more

D2 What was the estimated **date of conception** of the **first** pregnancy during the pandemic?

	Month	Year
Date of conception	▼ January ... December	▼ 2022 ... 2019

D2.1 What was the gestation at the end of the pregnancy? Note: if still pregnant now chose 88 as gestation length.

	Weeks
⊗ Gestation	▼ 1 ... 88

D2.2 How did this terminate?

- ○ Spontaneous abortion (miscarriage)
- ○ Induced abortion (on social or medical grounds, including ectopic pregnancy)

D2.3 Did you/your employer make any changes to your work/tasks to reduce the risk of COVID-19 infection because of this pregnancy?

- ○ No
- ○ Yes please specify changes _____

D3 What was the estimated **date of conception** of the **second** pregnancy during the pandemic?

	Month	Year
Date of conception	▼ January ... December	▼ 2022 ... 2019

D3.1 What was the gestation at the end of the pregnancy? Note: if still pregnant now chose 88 as gestation length.

	Weeks
Gestation	▼ 1 ... 88

D3.2 How did this terminate?

- ○ Spontaneous abortion (miscarriage)
- ○ Induced abortion (on social or medical grounds, including ectopic pregnancy)

D3.3 Did you/your employer make any changes to your work/tasks to reduce the risk of COVID-19 infection because of this pregnancy?

- ○ No
- ○ Yes please specify changes _____

D4 What was the estimated **date of conception** of the **third** pregnancy during the pandemic?

	Month	Year
Date of conception	▼ January ... December	▼ 2022 ... 2019

D4.1 What was the gestation at the end of the pregnancy? Note: if still pregnant now chose 88 as gestation length.

	Weeks
Gestation	▼ 1 ... 88

D4.2 How did this terminate?

- ○ Spontaneous abortion (miscarriage)
- ○ Induced abortion (on social or medical grounds, including ectopic pregnancy)

D4.3 Did you/your employer make any changes to your work/tasks to reduce the risk of COVID-19 infection because of this pregnancy?

- ○ No
- ○ Yes please specify changes _____

E1 Since the beginning of the pandemic (March 2020) have you had any period of more than 4 weeks when you have not been working as a physician? Do not include periods when you have been self-isolating because of the virus.

- ○ Yes
- ○ No

E1.1 How many periods were there of >4 weeks when you were not working as a physician since March 1st 2020?

- ○ One
- ○ Two
- ○ Three
- ○ Four or more

E2 When did the **first** period start?

	Month	Year
Start date	▼ January ... December	▼ 2020 ... 2022

E2.1 When did the **first** period end? (Note: If continuing please put today's date)

	Month	Year
End date	▼ January ... December	▼ 2020 ... 2022

E2.2 Why were you not working as a physician during this time? Please check all that apply

- ☐ Ill-heath/disability
- ☐ Parental leave
- ☐ Family responsibilities
- ☐ Travel outside Canada
- ☐ In paid employment not as a physician
- ☐ Unemployed and looking for work
- ☐ Other, please specify _____

E3 When did the **second** period start?

	Month	Year
Start date	▼ January ... December	▼ 2020 ... 2022

E3.1 When did the **second** period end? (Note: If continuing please put today's date)

	Month	Year
End date	▼ January ... December	▼ 2020 ... 2022

E3.2 Why were you not working as a physician during this time? Please check all that apply

- ☐ Ill-heath/disability
- ☐ Parental leave
- ☐ Family responsibilities
- ☐ Travel outside Canada
- ☐ In paid employment not as a physician
- ☐ Unemployed and looking for work
- ☐ Other, please specify _____

E4 When did the **third (or most recent)** period start?

	Month	Year
Start date	▼ January ... December	▼ 2020 ... 2022

E4.1 When did this **third (or most recent)** period end? (Note: If continuing please put today's date)

	Month	Year
End date	▼ January ... December	▼ 2020 ... 2022

E4.2 Why were you not working as a physician during this time? Please check all that apply

- ☐ Ill-heath/disability
- ☐ Parental leave
- ☐ Family responsibilities
- ☐ Travel outside Canada
- ☐ In paid employment not as a physician
- ☐ Unemployed and looking for work
- ☐ Other, please specify _____

F1 Since ${e://Field/PKD}, how many times have you had a period when you have been self-isolating (including quarantine) at home and unable to attend work

- ○ One or more
- ○ None

F1.1 How many times?

- ○ 1
- ○ 2
- ○ 3 or more

F1.2 Please tell us about the **most recent time** you have been self-isolating at home and unable to attend work since ${e://Field/PKD}

Why was this (check all that apply)?

- ☐ You had an infection or symptoms known, presumed or suspected to be caused by COVID-19
- ☐ A family member had an infection or symptoms known, presumed or suspected to be caused by COVID-19
- ☐ You had (inadequately protected) contact with a patient or colleague with known, presumed or suspected COVID-19
- ☐ You had returned from international travel
- ☐ Other, namely _____

F1.3 What was the **date of the first day** of this (most recent) self-isolation?

	Day	Month	Year
Date	▼ 1 ... 31	▼ January ... December	▼ 2020 ... 2022

F1.4 What was (or will be) the **date of the last day** of this self-isolation?

	Day	Month	Year
Date	▼ 1 ... 31	▼ January ... December	▼ 2020 ... 2022

G May we please now ask about all episodes when you had, or thought you had COVID-19? We appreciate that you may well have told us about this previously

G1 Have you ever had a **positive test** for the SARS-COV-2 (COVID-19) virus since the start of the pandemic?

- ○ Yes
- ○ No

G1.1 **How many episodes** have you had when you tested positive? (Note: if several tests for the same episode, treat that as one episode).

- ○ One
- ○ Two
- ○ Three
- ○ More than 3, please specify the number _____

G2 When was the **first episode** where you had a positive test?

	Month	Year
First episode	▼ January ... December	▼ 2020 ... 2022

G2.1 What sort of test(s) did you have that were positive for that first episode? Please check all that apply

- ☐ Home kit
- ☐ Rapid test administered by a health professional
- ☐ PCR test

G2.2 Were you admitted to hospital for this first episode?

- ○ Yes
- ○ No

G2.2.1 Were you admitted to an ICU?

- ○ Yes
- ○ No

G2.2.2 Were you intubated?

- ○ Yes
- ○ No

G2.2.3 How many days in total were you a hospital inpatient?

	Days
Hospitalization Length	▼ 1 ... 90

G2.3.1 Do you think you were infected at work?

- ○ Yes
- ○ No
- ○ Unsure

G2.3.2 What/where was the most likely source of infection?

_____

G2.3.3 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G2.3.4 When you returned to work, was there any modification to your role or tasks to help you recover?

- ○ Yes
- ○ No

G2.3.4.1 Please describe

_____

G2.3.5 Did you/your employer make a WCB claim related to this episode?

- ○ Yes
- ○ No
- ○ Don't know

G3 When was the **second episode** where you had a positive test?

	Month	Year
Second episode	▼ January ... December	▼ 2020 ... 2022

G3.1 What sort of test(s) did you have that were positive for that second episode? Please check all that apply

- [ ] Home kit
- [ ] Rapid test administered by a health professional
- [ ] PCR test

G3.2 Were you admitted to hospital for this second episode?

- ○ Yes
- ○ No

G3.2.1 Were you admitted to an ICU?

- ○ Yes
- ○ No

G3.2.2 Were you intubated?

- ○ Yes
- ○ No

G3.2.3 How many days in total were you a hospital inpatient?

	Days
Hospitalization Length	▼ 1 ... 90

G3.3.1 Do you think you were infected at work?

- ○ Yes
- ○ No
- ○ Unsure

G3.3.2 What/where was the most likely source of infection?

_____

G3.3.3 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G3.3.4 When you returned to work, was there any modification to your role or tasks to help you recover?

- ○ Yes
- ○ No

G3.3.4.1 Please describe

_____

G3.3.5 Did you/your employer make a WCB claim related to this episode?

- ○ Yes
- ○ No
- ○ Don't know

G4 When was the **third or most recent** where you had a positive test?

	Month	Year
Third or most recent episode	▼ January ... December	▼ 2020 ... 2022

G4.1 What sort of test(s) did you have that were positive for this third or most recent episode? Please check all that apply

- ☐ Home kit
- ☐ Rapid test administered by a health professional
- ☐ PCR test

G4.2 Were you admitted to hospital for this third or most recent episode?

- ○ Yes
- ○ No

G4.2.1 Were you admitted to an ICU?

- ○ Yes
- ○ No

G4.2.2 Were you intubated?

- ○ Yes
- ○ No

G4.2.3 How many days in total were you a hospital inpatient?

	Days
Hospitalization Length	▼ 1 ... 90

G4.3.1 Do you think you were infected at work?

- ○ Yes
- ○ No
- ○ Unsure

G4.3.2 What/where was the most likely source of infection?

_____

G4.3.3 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G4.3.4 When you returned to work, was there any modification to your role or tasks to help you recover?

- ○ Yes
- ○ No

G4.3.4.1 Please describe

_____

G4.3.5 Did you/your employer make a WCB claim related to this episode?

- ○ Yes
- ○ No
- ○ Don't know

G5.1 Have you had any episodes when you believed you had COVID but tests were negative (or you were not tested)?

- ○ Yes
- ○ No
- ○ Uncertain

G5.2 How many episodes have you had where you believe you had COVID-19 but without a positive test?

- ○ One
- ○ Two
- ○ Three
- ○ More than 3, please specify the number _____

G5.3 When was the first time you had an episode of ill-health that you believe to have been COVID-19 but without a positive test?

	Month	Year
Date	▼ January ... December	▼ 2020 ... 2022

G5.4 Did you have any (negative) tests at that time?

- ○ Yes
- ○ No

G5.4.1 What sort of test (please check all that apply)?

- ☐ Home kit
- ☐ Rapid test administered by a health professional
- ☐ PCR test

G5.4.2 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G5.5 When was the **second episode** you believe was COVID-19 but without a positive test?

	Month	Year
Date	▼ January ... December	▼ 2020 ... 2022

G5.5.1 Did you have any (negative) tests at that time?

- ○ Yes
- ○ No

G5.5.1.1 What sort of test (please check all that apply)?

- ☐ Home kit
- ☐ Rapid test administered by a health professional
- ☐ PCR test

G5.5.2 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G5.6 When was the **third or most recent** time you believe was COVID-19 but without a positive test?

	Month	Year
Date	▼ January ... December	▼ 2020 ... 2022

G5.6.1 Did you have any (negative) tests at that time?

- ○ Yes
- ○ No

G5.6.1.1 What sort of test (please check all that apply)?

- ☐ Home kit
- ☐ Rapid test administered by a health professional
- ☐ PCR test

G5.6.2 How many days in total were you away from work because of this episode?

- ○ Days _____
- ○ Not working at the start of the episode
- ○ Still off work

G6 Since you had COVID-19 (whether or not confirmed by a test), have you had any condition that you believe was a result of, or made worse by, your COVID-19 infection? If yes, please use the space below to tell us about this condition.

- ○ Yes _____
- ○ No

G7 Currently, how much does this condition limit your everyday life?

	Not at all	**Very Much**
${G6/ChoiceTextEntryValue/1}		

G8 Have you discussed this with a health professional? If yes, please tell us what type of health care professional, and what they suggested.

- ○ Yes _____
- ○ No

H **H) Employment in your most recent week at work since ${e://Field/PKD}**

H1 In the most recent week you have worked since ${e://Field/PKD}, has your role as a physician in Alberta involved **one-on-one contact with patients** (in person or remotely)?

- ○ Yes
- ○ No

H1.1 What role have you held while in contact with patients? (check all that apply)

- ☐ Hospital physician providing one-on-one inpatient care
- ☐ Hospital physician providing one-on-one ambulatory care
- ☐ Emergency room physician
- ☐ Family physician
- ☐ Physician providing sessions at walk-in clinics or similar
- ☐ Physician providing one-on-one clinical support to a residential institution or contained care community (such as care home, prison, First Nations Community) please specify _____
- ☐ Physician providing clinical support to a workforce, please specify _____
- ☐ Other clinical role, please specify _____

H1.1.2 In the most recent week you have worked since ${e://Field/PKD} were you working in (Check all that apply)

- [ ] Critical care?
- [ ] ICU?
- [ ] Wards designated for the care of infectious patients?
- [ ] General (adult) medical wards?
- [ ] Wards for the care of geriatric patients?
- [ ] Wards for the care of psychiatric patients?
- [ ] Wards for the care of pediatric patients?
- [ ] Providing services such as diagnostic imaging, namely _____
- [ ] Other, namely _____

H1.2 In the most recent week you have worked since ${e://Field/PKD}, was your role as a physician primarily without one-on-one contact with patients because you were working in

- [ ] Public health?
- [ ] Administration?
- [ ] Teaching or research?
- [ ] Other, namely _____

H1.2.1 What was the age range of your patients in your most recent week at work since ${e://Field/PKD}?

Please check one or more below to reflect the great majority of your patients

- ☐ All ages including children
- ☐ All ages 18 years and older
- ☐
- ☐ <18 years
- ☐ 18
- ☐ 55
- ☐ >=70 years?
- ☐ Other, namely _____

H1.2.1.1 What institutional requirements/arrangements are now in place for PPE?

	Yes	No
Continuous masking?	○	○
Face shield or goggles for all physical exams	○	○
Restricted access to some types of PPE?	○	○
Fit-testing for each new type/model of mask	○	○
Decontamination and re-use of N95 masks?	○	○
Provision of a buddy for donning/doffing PPE?	○	○

H **In your most recent week at work since ${e://Field/PKD}**

H3 How many days did you work in a physician role in Alberta?

▼ 1 day ... 7 days

H3.1 What was the **total number of hours in that week** you worked with **one-on-one in person** contact with patients? (best estimate)

▼ 0 hours ... 168 hours

H3.1.1
How many patients did you see **one-on-one in person** in your most recent week at work since ${e://Field/PKD} (best estimate)
If greater than 500, please choose 500.

▼ 0 ... 500

H3.1.2 What proportion of these patients that you saw **one-on-one in person** in that week were screened **for symptoms or fever** before you were in one-on-one contact with them?
If you did not see patients one-on-one in person please check 100%

- ○ 100%
- ○ > 90% but not 100%
- ○ 50 - 90%
- ○ some but < 50%
- ○ none

H3.1.2.1 What proportion of these patients that you saw **one-on-one in person** in that week were screened **by a test for the virus** before you were in one-on-one contact with them?
If you did not see patients one-on-one in person please check 100%

- ○ 100%
- ○ > 90% but not 100%
- ○ 50 - 90%
- ○ some but < 50%
- ○ none

H3.2 What was the total number of hours in that week you worked **one-on-one with patients by phone, email or videoconferencing**? (best estimate)

▼ 0 hours ... 167 hours

H3.3 What was the total number of hours in that week you worked as a physician, **without one-to-one** patient contact? (best estimate)

▼ 0 hours ... 167 hours

I **I) Work with patients since ${e://Field/PKD}**

I_1 Since ${e://Field/PKD}, has your work as a physician involved **one-on-one in person** contact with known, presumed or suspected Covid-19 patients?

- ○ Yes
- ○ No
- ○ Don't know

I_1.1 Since ${e://Field/PKD} on how many days have you had **one-on-one contact** with at least one known, presumed or suspected COVID-19 patient (best estimate)

_____

I_1.2 Since ${e://Field/PKD}, have you taken part in (or been within 2 meters of) aerosol generating medical procedures on any patients (suspected of COVID-19 or not)?

- ○ Yes
- ○ No

I_1.2_ What procedures? (check all that apply)

- ☐ Intubation and related procedures (manual ventilation, open endotracheal suctioning, extubation)
- ☐ Cardiopulmonary resuscitation
- ☐ Bi-level Positive Airway Pressure (BiPAP, CPAP)
- ☐ Humidified high flow oxygen systems (ARVO, Optiflow)
- ☐ Tracheostomy care
- ☐ Bronchoscopy/laryngoscopy
- ☐ Sputum induction
- ☐ Nebulized/aerosolized medication administration
- ☐ Open respiratory/airway suctioning
- ☐ High frequency oscillatory ventilation
- ☐ Other, namely _____

I_1.3 Please estimate on how many days since ${e://Field/PKD} you have been involved in aerosol generating medical procedures

_____

I_1.3.1 Were any of these procedures on patients with known, presumed or suspected COVID-19?

- ○ Yes
- ○ No
- ○ Don't know

I_2.0 Since ${e://Field/PKD}, have there been any times when you have had contact with patients, (suspected of COVID-19 or not) when you, personally, did **NOT HAVE ACCESS** to all the appropriate/approved Personal Protective Equipment (PPE).

- ○ Yes
- ○ No

I_2.1 Which types of (clean) PPE were **NOT** available? Please check all that apply

- ☐ N 95 respirator
- ☐ Procedure mask
- ☐ Eye protection
- ☐ Face shield
- ☐ Gown
- ☐ Gloves
- ☐ Other, namely _____

I_2.2 Was this PPE ever not available when you were working with a known, presumed or suspected COVID-19 patient?

- ○ Yes
- ○ No

I4 Do you ***now*** have any difficulties getting access to PPE that you believe to be necessary to do your job?

- ○ Yes
- ○ No

I4.1 What types of PPE are difficult to access? Please check all that apply

- ☐ N 95 respirator
- ☐ Procedure mask
- ☐ Eye protection
- ☐ Face shield
- ☐ Gown
- ☐ Gloves
- ☐ Other namely _____

I4.2 Why is access difficult?

	Yes	No
Not available at all	○	○
Available but only for certain procedures	○	○
Available, but only for certain staff	○	○
Available, but need to jump through hoops to get them	○	○

I3 Since ${e://Field/PKD}, apart from direct patient care, have you been working with objects (such as bed linen, medical equipment, bathrooms, food trays) that have been used with known, presumed or suspected COVID-19 patients?

- ○ Yes
- ○ No

I3.1 On how many days since ${e://Field/PKD} have you been working with such objects? (best estimate)

_____

J **J) Your perceptions and concerns**

J1 Please mark on the line below **how true** the following statements are about your work, during your most recent week at work since ${e://Field/PKD}, compared with working before the spread of COVID-19 in early March 2020

	Completely disagree **Completely agree**
My hours of work are longer	
My work tasks are about the same	
The patient make-up is about the same	
My patients are no more stressed	
My co-workers are no more stressed	
I am no more stressed	
I sleep just as well as I did before the pandemic	
I now feel more pride as a physician than before the pandemic	

J2 Please mark on the line below **how confident** you feel **NOW** about working with patients with known, presumed or suspected COVID-19.

	Not at all confident **Very confident**
I have the clinical knowledge I need	
I know how to use the required PPE	
I know how and when to refer for testing	
I know how and when to refer for treatment	
I have the support I need from co-workers	
I have access to all the required PPE	
I shall have access to all the PPE I need, going forward	
The PPE recommended will prevent transmission	
There are sufficient staff to do the job safely	
New variants of the virus will be sufficiently controlled	

J3 Please mark on the line below to **show your worries NOW** about the COVID-19 pandemic.

	Not at all worried **Very worried**
That I shall be infected	
That I shall infect my family	
That I shall infect my patients	
That I shall infect my co-workers/colleagues	
That I shall not be able to cope with the work	
That I shall have to let people die	
That my experience is inadequate	
That I shall fail myself and my family	
That the care I give will be substandard	

J4 Please mark on the line below to show where you are **NOW finding support** during this time.

	No support at all — **Very strong support**
My immediate family	
My colleagues or co-workers	
A senior colleague or mentor	
My immediate organization	
Alberta Health Services	
Alberta's Chief Medical Officer of Health	
The Alberta Medical Association	
My religious community	

J4.2 Is there anywhere else that you find support that was not listed (such as the College of Family Physicians)?

- ○ Yes, please specify _____
- ○ No

J4.21 Please mark on the line below to show how much you are NOW finding support from this other source

	No support at all — **Very strong support**
${J4.2/ChoiceTextEntryValue/1}	

K1 **Since the start of the pandemic** has your employer, professional organization, union or other group **offered support** to help you cope with the mental health challenges of the pandemic? Please check all that apply below.

K1.1 One-on-one support (on-line or in person) from a specialist counsellor, psychologist or similar?

- ○ Yes
- ○ No
- ○ Don't know

K1.1.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.1.2 Please mark on the line how helpful you found this one-on-one support:

	Very helpful **Not at all helpful**
	

K1.2 One-on-one support from a colleague or peer nominated to do this?

- ○ Yes
- ○ No
- ○ Don't know

K1.2.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.2.2 Please mark on the line how helpful you found this peer support:

	Very helpful **Not at all helpful**
	

K1.3 An on-line support group where you could discuss and ask questions?

- ○ Yes
- ○ No
- ○ Don't know

K1.3.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.3.2 Please mark on the line how helpful you found this on-line support group:

	Very helpful **Not at all helpful**
	

K1.4 An on-line self-learning tool with advice about how to manage stress?

- ○ Yes
- ○ No
- ○ Don't know

K1.4.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.4.2 Please mark on the line how helpful you found this on-line self-learning tool

	Very helpful **Not at all helpful**
	

K1.5 A helpline with a number you could call if you were distressed?

- ○ Yes
- ○ No
- ○ Don't know

K1.5.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.5.2 Please mark on the line how helpful you found this helpline:

	Very helpful **Not at all helpful**
	

K1.6 An Employee Assistance Program (EAP)?

- ○ Yes
- ○ No
- ○ Don't know

K1.6.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.6.2 Please mark on the line how helpful you found the EAP:

	Very helpful **Not at all helpful**
	

K1.7 Was any other mental health support available to you through your work or work contacts?

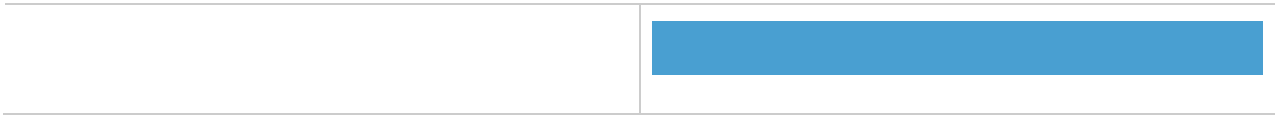
- ○ Yes, please describe _____
- ○ No
- ○ Don't know

K1.7.1 Did you take advantage of this?

- ○ Yes
- ○ No

K1.7.2 Please mark on the line how helpful you found this other mental health support:

Very helpful **Not at all helpful**



K1.8 Are there other mental health supports you would have valued during this time?

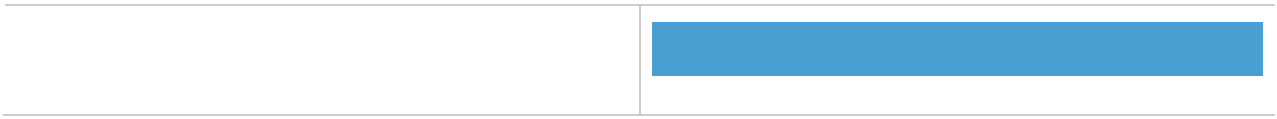
- ○ Yes, please describe _____
- ○ No

K1.9 **Since the start of the pandemic** have you discussed any mental health issues with a health professional (such as your family doctor) you accessed through channels **outside work**?

- ○ Yes, what type of health professional was this?
  _____
- ○ No

K1.9.1 Please mark on the line how helpful you found this discussion with a health professional:

Very helpful **Not at all helpful**



L **L) Your health**

L1 Since ${e://Field/PKD}, have you had an episode when you have been unwell for **two or more consecutive days** (whether or not you reported for duty)?

- ○ Yes
- ○ No

L2 Please mark below **how much you have been bothered** FOR TWO OR MORE CONSECUTIVE DAYS since ${e://Field/PKD} for each symptom/problem listed below. If more than one incident, record the symptoms/problems from the one that bothered you most.

	Not at all bothered **Extremely bothered**
Coughing	
Chest pains	
Shortness of breath	
Coughing up sputum	
Coughing up blood	
Sweating	
Chills	
Headache	
Nausea	

Vomiting	
Diarrhea	
Stomach pain	
Muscle pain	
Lack of appetite	
Trouble concentrating	
Trouble thinking	
Trouble sleeping	
Fatigue	
Loss of smell or taste	

L2.1 Did you experience any other symptoms/problems? If yes, please specify.

- ○ Yes _____
- ○ No

L2.2 Please mark below **how much you have been bothered** by these **other symptoms** FOR TWO OR MORE CONSECUTIVE DAYS since ${e://Field/PKD}.

	Not at all bothered **Extremely bothered**
	

L4.0 In the mood questionnaire below, please check the box alongside the reply that is closest to how you have been feeling **IN THE PAST WEEK**.
Don't take too long over your replies; your immediate answer is best.

L4.1.1 *In the past week*
I feel tense or 'wound up':

- ○ Most of the time
- ○ A lot of the time
- ○ From time to time, occasionally
- ○ Not at all

L4.1.2 *In the past week*
I still enjoy the things I used to enjoy:

- ○ Definitely as much
- ○ Not quite so much
- ○ Only a little
- ○ Hardly at all

L4.1.3 *In the past week*
I get a sort of frightened feeling as if something awful is about to happen:

- ○ Very definitely and quite badly
- ○ Yes, but not too badly
- ○ A little but it doesn't worry me
- ○ Not at all

L4.1.4 *In the past week*
I can laugh and see the funny side of things:

- ○ As much as I always could
- ○ Not quite so much now
- ○ Definitely not so much now
- ○ Not at all

L4.1.5 *In the past week*
Worrying thoughts go through my mind:

- ○ A great deal of the time
- ○ A lot of the time
- ○ Not too often
- ○ Very little

L4.1.6 *In the past week*
I feel cheerful:

- ○ Never
- ○ Not often
- ○ Sometimes
- ○ Most of the time

L4.1.7 *In the past week*
I can sit at ease and feel relaxed:

- ○ Definitely
- ○ Usually
- ○ Not Often
- ○ Not at all

L4.2.1 *In the past week*
I feel as if I am slowed down:

- ○ Nearly all the time
- ○ Very often
- ○ Sometimes
- ○ Not at all

L4.2.2 *In the past week*
I get a sort of frightened feeling like ‘butterflies’ in the stomach:

- ○ Not at all
- ○ Occasionally
- ○ Quite often
- ○ Very often

L4.2.3 *In the past week*
I have lost interest in my appearance:

- ○ Definitely
- ○ I don't take as much care as I should
- ○ I may not take quite as much care
- ○ I take just as much care as ever

L4.2.4 *In the past week*
I feel restless as if I have to be on the move:

- ○ Very much indeed
- ○ Quite a lot
- ○ Not very much
- ○ Not at all

L4.2.5 *In the past week*
I look forward with enjoyment to things:

- ○ As much as I ever did
- ○ Rather less than I used to
- ○ Definitely less than I used to
- ○ Hardly at all

L4.2.6 *In the past week*
I get sudden feelings of panic:

- ○ Very often indeed
- ○ Quite often
- ○ Not very often
- ○ Not at all

L4.2.7 *In the past week*
I can enjoy a good book or radio or television program:

- ○ Often
- ○ Sometimes
- ○ Not often
- ○ Very seldom

M **M) Substance use**

M1.0 Are you now drinking more alcohol than before the pandemic?

- ○ Did not drink alcohol before the pandemic or now
- ○ Less
- ○ About the same
- ○ Somewhat more
- ○ Much more

M1.1 How many alcoholic drinks a WEEK do you usually drink now?
(One drink is a small beer, one glass of wine, or a single measure of spirits)

_____

M2.0 Are you now smoking more tobacco than before the pandemic?

- ○ Did not smoke tobacco before the pandemic or now
- ○ Less
- ○ About the same
- ○ Somewhat more
- ○ Much more

M2.1 How many cigarettes a DAY do you usually smoke now?

_____

M3.0 Are you now using more cannabis than before the pandemic?

- ○ Did not use cannabis before the pandemic or now
- ○ Less
- ○ About the same
- ○ Somewhat more
- ○ Much more

M3.1 How many times a WEEK do you usually use cannabis now?

_____

M4.0 Are you now using more medication for anxiety than before the pandemic?

- ○ Did not use anxiety medications before the pandemic or now
- ○ Less
- ○ About the same
- ○ Somewhat more
- ○ Much more

M4.1 How many times **per week** do you usually use medication for anxiety now?

_____

M5.0 Are you now using more medication to help you sleep than before the pandemic?

- ○ Did not use sleep medications before the pandemic or now
- ○ Less
- ○ About the same
- ○ Somewhat more
- ○ Much more

M5.1 How many times **per week** do you usually use sleep medication now?

_____

N N) In the last week...

N1 Compared to how you were before the start of the pandemic, how pronounced have the following symptoms been in **the past week**?

	Very Pronounced **Not at all pronounced**
Fatigue or easy fatiguability	
Poor concentration or memory	
Breathing problems (shortness of breath)	
Headache	
Myalgia (muscle pain)	

N1.1 Did you experience other symptoms in the past week? If yes, please specify.

- ○ Yes _____
- ○ No

N1.1.2 Compared to how you were before the start of the pandemic, how pronounced have **these other** symptoms been in **the past week**?

	Very Pronounced **Not at all pronounced**
${N1.1/ChoiceTextEntryValue/1}	

N1.0

Finally, to fully understand the impact of the pandemic on those working through it, we would find it helpful to know of any events or incidents at work since ${e://Field/PKD} that you have found particularly difficult or stressful. If you feel able to tell us about such an event or incident, please do so here.

Please enter NONE, if you do not have an event or incident to describe.

_____

_____

_____

_____

_____

Appendix B. *Details of other chronic conditions listed by participants by ICD-10 Chapter*

Type of Chronic Condition Reported: ICD-10 Chapter	Reported a PCC n	Total N	Self-Reported Chronic Condition
Infectious And Parasitic (B)	0	1	• H. Pylori Infection
Malignant Neoplasms (C)	1	7	• Breast Cancer • Thyroid Cancer • Cancer, Unspecified
Diseases Of The Blood And Immune Mechanism (D)	3	3	• Autoimmune, Unspecified • Anemia • Blood Disorder, Unspecified
Endocrine, Nutritional And Metabolic (E)	30	76	• Alpha 1 Antitrypsin Deficiency • Dyslipidemia • Graves Disease • Hashimoto Disease • High Cholesterol • Hypothyroidism • Obesity • Polycystic Ovarian Syndrome • Type 1 Or 2 Diabetes
Mental, Behavioral And Neurodevelopmental (F)	7	11	• Attention Deficit Disorder • Attention Deficit Hyperactivity Disorder • Bipolar II • Post Traumatic Stress Disorder • Post-Concussion Syndrome
Nervous System (G)	21	39	• Central Spinal Stenosis • Epilepsy • Essential Tremor • Headaches Or Migraines • Inflammation • Insomnia • Multiple Sclerosis • Sleep Apnea
Eye And Adnexa (H)	1	3	• Glaucoma • Meniere's Disease • Presbyopia
Circulatory System (I)	21	58	• Angina • Atrial Fibrillation • Cardiomyopathy • High Blood Pressure • Hypertension • Premature Ventricular Contraction • Raynaud Syndrome • Supraventricular Tachycardia
Respiratory System (J)	1	8	• Chronic Allergies (Airborne) • Chronic Rhinitis • Chronic Sinusitis • Chronic Sore Throat

Digestive System (K)	16	37	• Celiac • Crohn's Disease • Diverticulosis/Diverticulitis • Gastroesophageal Reflux Disease • Iritable Bowel Syndrome • Primary Sclerosing Cholangitis • Ulcerative Colitis
Skin And Subcutaneous Tissue (L)	4	9	• Acne • Contact Dermatitis • Eczema • Granuloma Annulare • Hidradenitis Suppurativa • Psoriasis
Musculoskeletal System And Connective Tissue (M)	27	57	• Ankle Or Foot Or Knee Pain • Ankylosing Spondylitis • Arthritis: Psoriatic, Rheumatoid, Osteo-, Seronegative Inflammatory • Central Spinal Stenosis • Chronic Neck Or Back Pain • Degenerative Disc Disorder • Fibromyalgia • Foraminal Stenosis • Gout • Low Bone Density • Lupus • Myofascial Pain Syndrome • Nerve Pain • Rheumatism • Tendonitis
Genitourinary System (N)	4	10	• Bladder Issues • Endometriosis • Menopause • Ovarian Cysts • Perimenopause
Symptoms Not Elsewhere Classified (R)	4	10	• Cervical Cell Changes • Chronic Cough • Chronic Fatigue • Dyspnea • Loss Of Voice • Low Testosterone • Neurological Symptoms, Unspecified • Tachycardia, Unspecified
Injury, Poisoning, Consequences Of External Causes (S, T)	4	7	• Allergies, Unspecified • Finger Amputation
Factors Influencing Health Status And Contact With Health Services (Z)	1	4	• Pregnancy

***Appendix C**. Sub-Analysis: Factors Associated With Developing a Severe post-COVID Condition*

Factors associated with developing a severe PCC are given in Appendix D. Post-COVID ill-health factors among HCW who developed a severe post-COVID condition are shown in Table C1. Here, a severe post-COVID condition is characterized as reporting any classic post-COVID symptom or condition and having ≥50% daily limitation due to the condition. Those with a mild post-COVID condition either reported any classic condition and a limitation <50% or having non-classic post-COVID. We find that those who were at higher risk for a severe PCC reported fatigue, shortness of breath, or a mental health condition. The risk of severe PCC also increased with the more classic post-COVID symptoms reported, where 35.6% of those with two symptoms, 36% of those with three symptoms, and 62.5% of those with four symptoms developed a severe PCC. In bivariate analysis, those who discussed their condition with a health professional were at increased risk of severe PCC but is reduced once adjusted for confounders.

Unlike developing any PCC, a severe PCC was not associated with pre-existing respiratory conditions or other chronic conditions (Table C2). Interestingly Table C3 shows that those with rheumatoid arthritis, psoriasis or any immune condition, were at higher risk of developing a severe PCC. In multivariable analysis (Table C4), no association was found with pre-pandemic mental health, but was for pre-infection depression and anxiety. As shown in Table C5, those with a severe PCC were more likely to use anxiety medication and sleep medication. Those with a missing response for smoked more were at increased risk, as well those who drank more or used more sleep medication pre-infection were at higher risk for severe PCC. Time of infection since the beginning of the pandemic (Table C6) also showed an association with a severe PCC, with a reduced risk in those infected later on in the pandemic, particularly from November 2021 to February 2022 and March 2020 to June 2022. Figure C1 shows the proportion of HCW who

developed a severe PCC over time, categorized by infection period. We find that those infected earlier in the pandemic more likely to develop a severe PCC, peaking from July to October 2020 where 6 of the 14 infections during that period (43%) developed a severe PCC, and 17.2% of those infected prior to March 2021 developed a severe PCC. Following March 2021, only 4.6% (40/868) developed a severe PCC. In terms of vaccination (Table C7), those vaccinated at time of infection were much less likely to develop a severe PCC, along with the higher number of vaccines received prior to infection. Figure C2 shows us that a higher proportion with a severe PCC was seen in those who were unvaccinated and infected earlier in the pandemic, with 18.5% (17/92) of unvaccinated HCW infected before March 2021 developing a severe PCC and only 4.8% (40/838) of vaccinated after March 2021 developing a condition. Table C8 shows the association between work factors relating to the infection episode and developing a severe PCC. Similar to developing any PCC, a severe PCC was more likely among those who believed being infected at work, missed 31 or more days of work, had to receive work medication and made a WCB claim due to the infection episode. Figure C3 shows the proportion of HCW infected at work with a PCC who missed 31 or more days over time. We see that only those infected earlier in the pandemic prior to March 2021 and missed 31 or more days of work developed a PCC or a severe PCC. Following March 2021, no HCW who developed a PCC and believe they were infected at work missed 31 or more days of work. Figure C4 shows the proportion of HCW with a PCC or severe PCC who believe they were infected at work and whether they made a WCB claim. We see that a higher proportion those infected at work earlier in the pandemic who develop a PCC make a WCB claim, with most severe PCC WCB claims occurring from July to October 2020 (80%).

Table C1. *Association between symptoms and severity of post-COVID condition (PCC)*. N=263*

	Severe PCC	Total	Bivariate		Adjusted**	
Factor	n (%)	N	OR (95% CI)	P value	OR (95% CI)	P value
Reported post-COVID symptom						
Fatigue	29 (35.8)	81	3.07 (1.67 to 5.63)	<0.001	3.40 (1.81 to 6.42)	<0.001
Sleep	1 (14.3)	7	0.60 (0.07 to 5.05)	0.634	0.52 (0.06 to 4.47)	0.551
Shortness of Breath	24 (30.0)	80	1.95 (1.06 to 3.58)	0.032	1.97 (1.05 to 3.70)	0.035
Pain	12 (30.8)	39	1.77 (0.83 to 3.76)	0.139	1.68 (0.78 to 3.62)	0.187
Cognitive Dysfunction	14 (27.5)	51	1.49 (0.74 to 3.00)	0.267	1.62 (0.79 to 3.32)	0.193
Mental Health	12 (57.1)	21	5.84 (2.32 to 14.69)	<0.001	6.20 (2.39 to 16.07)	<0.001
Other Non-Classic	24 (16.4)	146	0.50 (0.28 to 0.91)	0.023	0.48 (0.26 to 0.88)	0.017
Number of Symptoms						
1	17 (11.0)	154	1.00 (–)	–	1.00 (–)	–
2	26 (35.6)	73	4.46 (2.22 to 8.94)	<0.001	5.35 (2.58 to 11.08)	<0.001
3	9 (36.0)	25	4.53 (1.74 to 11.84)	0.002	4.38 (1.63 to 11.75)	0.003
4	5 (62.5)	8	13.43 (2.95 to 61.26)	<0.001	14.44 (3.06 to 68.21)	<0.001
5	0 (0.0)	3	–	–	–	–
Discussed with health professional						
No	28 (17.5)	160	1.00 (–)	–	1.00 (–)	–
Yes	29 (28.2)	103	1.85 (1.02 to 3.34)	0.042	1.78 (0.98 to 3.25)	0.060
Total	57 (21.7)	263	–	–	–	–

*Non-Severe PCC: non-classic PCC, classic PCC with <50% limitation; Severe PCC: classic PCC with ≥50% limitation.

**Adjusted for job, gender, and age at time of infection

Table C2. *Association between developing a severe post-COVID condition and previous conditions*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Pandemic Respiratory Conditions		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Self-Report Treated Asthma (12m)	No	43	6.0	713	1.00	–	–	1.00	–	–
	Yes	8	6.2	130	1.02	0.47 to 2.28	0.957	1.05	0.48 to 2.32	0.897
	Unknown	6	4.8	124	0.79	0.33 to 1.90	0.603	0.70	0.29 to 1.71	0.435
Self-Report Have Chronic Lung Disease	No	49	5.9	836	1.00	–	–	1.00	–	–
	Yes	2	28.6	7	6.42	1.22 to 33.96	0.029	3.71	0.65 to 21.35	0.142
	Unknown	6	4.8	124	0.82	0.34 to 1.95	0.648	0.71	0.30 to 1.72	0.453
Self-Report Other Respiratory (Chronic 12m)	No	51	6.1	835	1.00	–	–	1.00	–	–
	Yes	0	0.0	8	–	–	–	–	–	–
	Unknown	6	4.8	124	0.78	0.33 to 1.86	0.578	0.69	0.29 to 1.67	0.410
Self-Report Any Respiratory	No	42	6.0	705	1.00	–	–	1.00	–	–
	Yes	9	6.5	138	1.10	0.52 to 2.32	0.799	1.12	0.53 to 2.37	0.777
	Unknown	6	4.8	124	0.62	0.33 to 1.93	0.623	0.71	0.29 to 1.73	0.448
Self-Report Other Chronic Condition (12m)	No	30	5.0	595	1.00	–	–	1.00	–	–
	Yes	21	8.5	248	1.74	0.98 to 3.11	0.060	1.59	0.87 to 2.91	0.129
	Unknown	6	4.8	124	0.96	0.39 to 2.35	0.925	0.82	0.33 to 2.03	0.660
	Total	57	5.9	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

Table C3. *Association between developing a severe post-COVID condition and previous auto-immune conditions*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Pandemic Immune Conditions		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Rheumatoid Arthritis	No	53	5.6	939	1.00	–	–	1.00	–	–
	Yes	4	30.8	13	7.43	2.22 to 24.92	0.001	6.08	1.76 to 21.06	0.004
	Unknown	0	0.0	15	–	–	–	–	–	–
Ankylosing Spondylitis	No	56	5.9	946	1.00	–	–	1.00	–	–
	Yes	1	16.7	6	3.18	0.37 to 27.67		4.49	0.44 to 45.83	0.205
	Unknown	0	0.0	15	–	–	–	–	–	–
Psoriasis	No	51	5.6	916	1.00	–	–	1.00	–	–
	Yes	6	16,7	36	3.39	1.35 to 8.52	0.009	3.20	1.25 to 8.20	0.015
	Unknown	0	0.0	15	–	–	–	–	–	–
Psoriatic Arthritis	No	57	6.0	948	1.00	–	–	1.00	–	–
	Yes	0	0.0	4	–	–	–	–	–	–
	Unknown	0	0.0	15	–	–	–	–	–	–
IBD	No	55	5.9	931	1.00	–	–	1.00	–	–
	Yes	2	9.5	21	1.68	0.38 to 7.38	0.494	1.79	0.40 to 8.02	0.448
	Unknown	0	0.0	15	–	–	–	–	–	–
Lupus	No	57	6.0	949	1.00	–	–	1.00	–	–
	Yes	0	0.0	3	–	–	–	–	–	–
	Unknown	0	0.0	15	–	–	–	–	–	–
Any of 6 Immune	No	48	5.5	880	1.00	–	–	1.00	–	–
	Yes	9	12.5	72	2.48	1.16 to 5.28	0.019	2.38	1.10 to 5.13	0.028
	Unknown	0	0.0	15	–	–	–	–	–	–
	Total	57	5.9	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

Table C4. *Association between developing a severe post-COVID condition and previous mental health conditions*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Pandemic Mental Health		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Self-Report Treated Depression (12m)	No	36	5.2	692	1.00	–	–	1.00	–	–
	Yes	15	9.9	151	2.01	1.07 to 3.77	0.030	1.89	0.99 to 3.60	0.054
	Unknown	6	4.8	124	0.93	0.38 to 2.25	0.866	0.82	0.33 to 2.02	0.663
Self-Report Treated Anxiety (12m)	No	36	5.3	673	1.00	–	–	1.00	–	–
	Yes	15	8.8	170	1.71	0.91 to 3.21	0.093	1.66	0.87 to 3.16	0.127
	Unknown	6	4.8	124	0.90	0.37 to 2.18	0.815	0.80	0.32 to 1.96	0.620
Self-Report Treated Anxiety or Depression (12m)	No	33	5.3	624	1.00	–	–	1.00	–	–
	Yes	18	8.2	219	1.60	0.88 to 2.91	0.120	1.56	0.85 to 2.87	0.156
	Unknown	6	4.8	124	0.91	0.37 to 2.22	0.837	0.81	0.33 to 2.00	0.639
Self-Report Other MH (Chronic 12m)[1]	No	49	5.9	832	1.00	–	–	1.00	–	–
	Yes	2	18.2	11	3.55	0.75 to 16.88	0.111	4.66	0.94 to 23.20	0.060
	Unknown	6	4.8	124	0.81	0.34 to 1.94	0.640	0.72	0.30 to 1.73	0.460
Self-Report Any MH (12m)	No	32	5.2	620	1.00	–	–	1.00	–	–
	Yes	19	8.5	223	1.71	0.95 to 3.09	0.074	1.67	0.91 to 3.06	0.095
	Unknown	6	4.8	124	0.93	0.38 to 2.28	0.882	0.83	0.33 to 2.06	0.686
Pre-Infection Mental Health										
HADS Ratings Available	No	3	11.1	27	1.00	–	–	1.00	–	–
	Yes	54	5.7	940	0.49	0.14 to 1.67	0.253	0.40	0.11 to 1.54	0.184
Entered as continuous variables		**Median**	**IQR**							
Pre-Infection Anxiety (HADS)	Continuous (0 to 21)	10	5.25	975	1.12	1.05 to 1.19	<0.001	1.13	1.06 to 1.20	<0.001
Pre-Infection Depression (HADS)	Continuous (0 to 21)	7	6	975	1.12	1.05 to 1.20	<0.001	1.12	1.05 to 1.20	<0.001
	Total	57	5.9	967	–	–	–	–	–	–

[1] Excluding anxiety and depression

*Adjusted for job, gender, and age at time of infection

Table C5. *Association between developing a severe post-COVID condition and previous substance use*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Pre-Infection Substance Use		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Tobacco	No	54	5.9	909	1.00	–	–	1.00	–	–
	Yes	3	5.4	56	0.90	0.27 to 2.96	0.857	0.70	0.21 to 2.39	0.568
	Unknown	0	0.0	2	–	–	–	–	–	–
Alcohol	No	12	6.0	199	1.00	–	–	1.00	–	–
	Yes	45	5.9	762	0.98	0.51 to 1.89	0.947	1.06	0.54 to 2.10	0.862
	Unknown	0	0.0	6	–	–	–	–	–	–
Cannabis	No	45	5.6	808	1.00	–	–	1.00	–	–
	Yes	12	7.8	153	1.44	0.75 to 2.80	0.277	1.20	0.60 to 2.43	0.605
	Unknown	0	0.0	6	–	–	–	–	–	–
Anxiety Medication	No	37	4.8	776	1.00	–	–	1.00	–	–
	Yes	20	10.8	185	2.42	1.37 to 4.28	0.002	2.27	1.26 to 4.07	0.006
	Unknown	0	0.0	6	–	–	–	–	–	–
Sleep Medications	No	29	4.5	650	1.00	–	–	1.00	–	–
	Yes	28	9.0	311	2.12	1.24 to 3.63	0.006	1.89	1.09 to 3.27	0.023
	Unknown	0	0.0	6	–	–	–	–	–	–
Pre-Infection Increased Substance Use										
Tobacco More	No	55	5.9	939	1.00	–	–	1.00	–	–
	Yes	0	0.0	23	–	–	–	–	–	–
	Unknown	2	40.0	5	10.72	1.75 to 65.46	0.010	11.41	1.50 to 86.71	0.019
Alcohol More	No	31	4.5	693	1.00	–	–	1.00	–	–
	Yes	21	9.3	227	2.18	1.22 to 3.87	0.008	2.12	1.18 to 3.83	0.012
	Unknown	5	10.6	47	2.54	0.94 to 6.87	0.066	2.48	0.87 to 7.04	0.090
Cannabis More	No	51	5.7	890	1.00	–	–	1.00	–	–
	Yes	5	7.7	65	1.37	0.53 to 3.56	0.517	1.14	0.43 to 3.05	0.791
	Unknown	1	8.3	12	1.50	0.19 to 11.81	0.703	1.30	0.15 to 10.98	0.811
Anxiety Medications More	No	45	5.1	877	1.00	–	–	1.00	–	–
	Yes	7	9.6	73	1.96	0.85 t 4.52	0.114	1.73	0.74 to 4.06	0.209
	Unknown	5	29.4	71	7.70	2.60 to 22.81	<0.001	1.52	0.78 to 2.96	0.214
Sleep Medications More	No	39	4.9	788	1.00	–	–	1.00	–	–
	Yes	13	8.2	158	1.72	0.90 to 3.31	0.103	1.48	1.02 to 2.13	0.038
	Unknown	5	23.8	21	6.00	2.09 to 17.23	<0.001	0.49	0.30 to 082	0.006
	Total	57	5.9	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

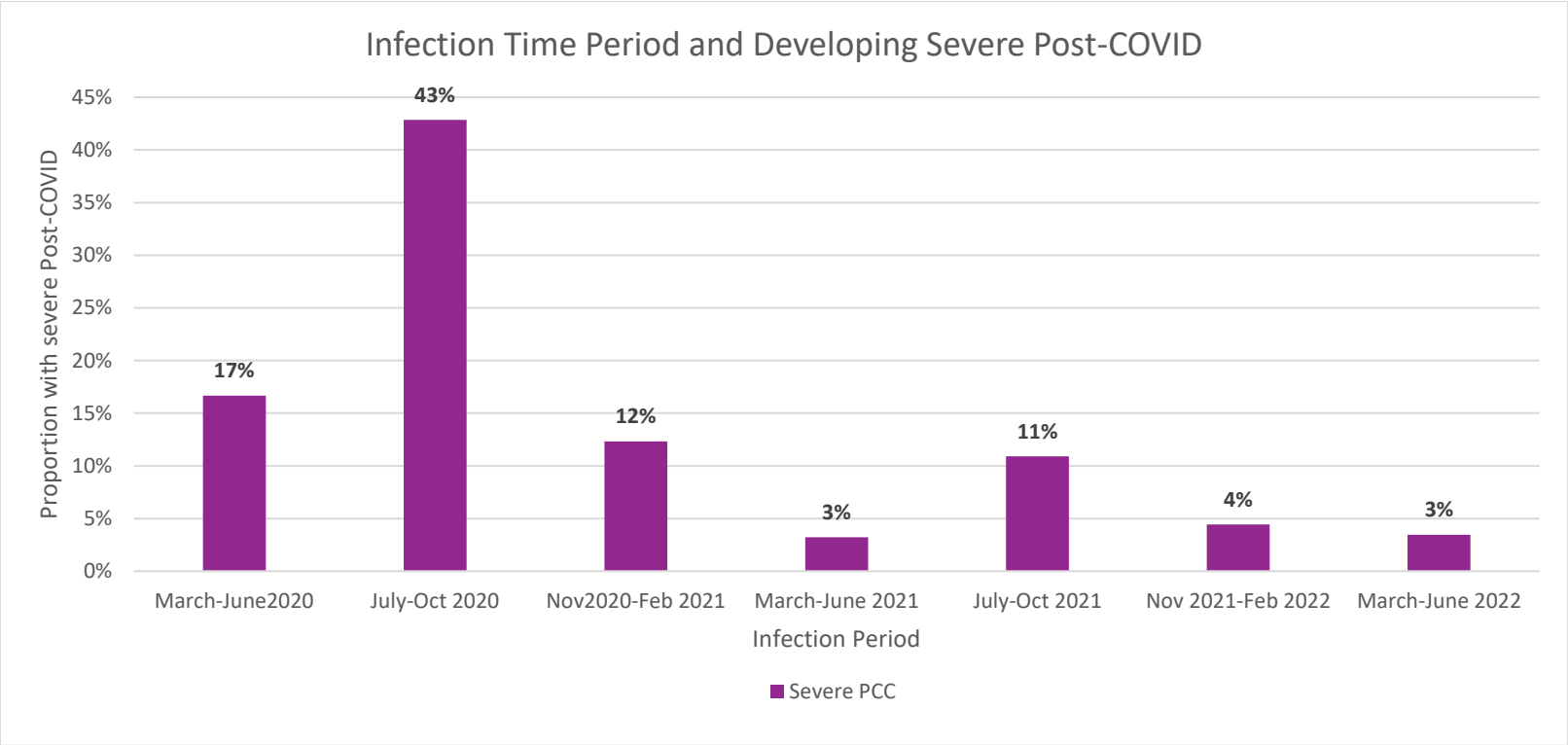
Table C6. *Association between developing a severe post-COVID condition and time of infection*

Time Since Pandemic Start at time of infection**		Severe post-COVID condition		Total	Bivariate			Adjusted*		
		n	%	N	OR	95% CI	P=	OR	95% CI	P=
Infection Period	March-June 2020	2	16.7	12	1.00	–	–	1.00	–	–
	July-Oct 2020	6	42.9	14	3.75	0.59 to 23.87	0.162	2.41	0.32 to 18.46	0.396
	Nov 2020-Feb 2021	9	12.3	73	0.70	0.132 to 3.74	0.679	0.39	0.06 to 2.38	0.306
	March-June 2021	1	3.2	31	0.17	0.01 to 2.04	0.161	0.09	0.01 to 1.23	0.071
	July-Oct 2021	6	10.9	55	0.61	0.11 to 3.48	0.580	0.39	0.06 to 2.62	0.331
	Nov 2021-Feb 2022	27	4.4	608	0.23	0.05 to 1.11	0.068	0.15	0.03 to 0.83	0.030
	March-June 2022	6	3.4	174	0.18	0.03 to 1.00	0.050	0.12	0.02 to 0.75	0.024
Entered as continuous variable		**Median**	**IQR**							
Weeks	Continuous	95.0	56.5	967	0.98	0.97 to 0.99	<0.001	0.98	0.97 to 0.99	<0.001
	Total	57	5.9	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

** Start of pandemic: March 6, 2020

Figure C1. *Development of a severe post-COVID condition by infection period*



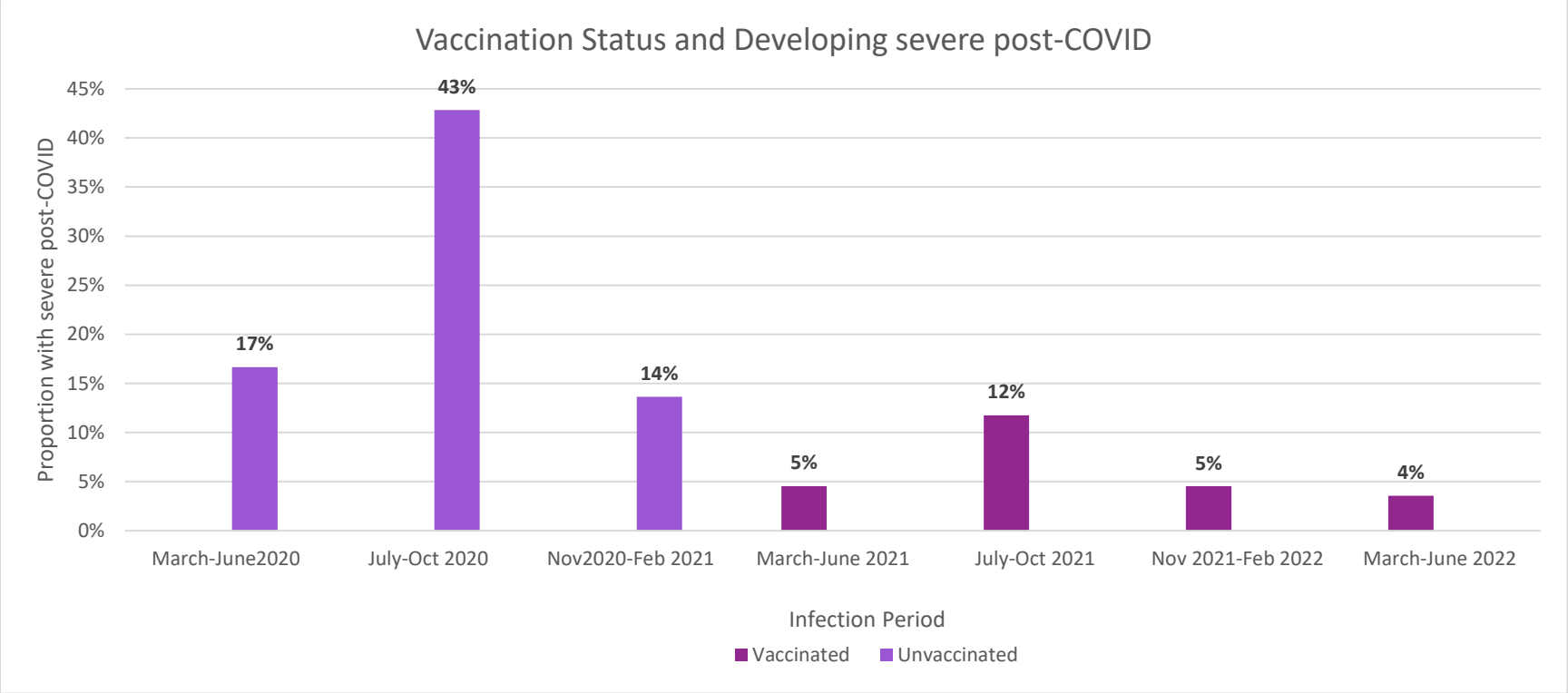
Time of Infection	**severe PCC**	non-PCC	non-severe PCC	Non-Severe	**Total infections**	% of total with severe PCC
March-June2020	**2**	6	4	10	**12**	17%
July-Oct 2020	**6**	5	3	8	**14**	43%
Nov2020-Feb 2021	**9**	38	26	64	**73**	12%
March-June 2021	**1**	22	8	30	**31**	3%
July-Oct 2021	**6**	39	10	49	**55**	11%
Nov 2021-Feb 2022	**27**	458	123	581	**608**	4%
March-June 2022	**6**	136	32	168	**174**	3%
Total	**57**	704	206	910	**967**	5.9%

Table C7. *Association between developing a severe post-COVID condition and vaccination at time of infection*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Vaccination		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Vaccinated[1]	No	17	13.9	122	1.00	–	–	1.00	–	–
	Yes	40	4.7	845	0.31	0.17 to 0.56	<0.001	0.33	0.18 to 0.62	<0.001
Entered as continuous variables		**Median**	**IQR**							
Weeks since most recent vaccine[1,2]	Continuous	11.0	20.1	967	1.02	0.99 to 1.04	0.176	1.01	0.99 to 1.03	0.289
Number of Vaccines[1,2]	Continuous (0 to 4)	2.0	3.0	967	0.69	0.55 to 0.86	<0.001	0.71	0.56 to 0.90	0.004
	Total	57	5.9	967	–	–	–	–	–	–

*Adjusted for job, gender, and age at time of infection

Figure C2. *Development of a severe post-COVID condition by infection period and vaccination status*



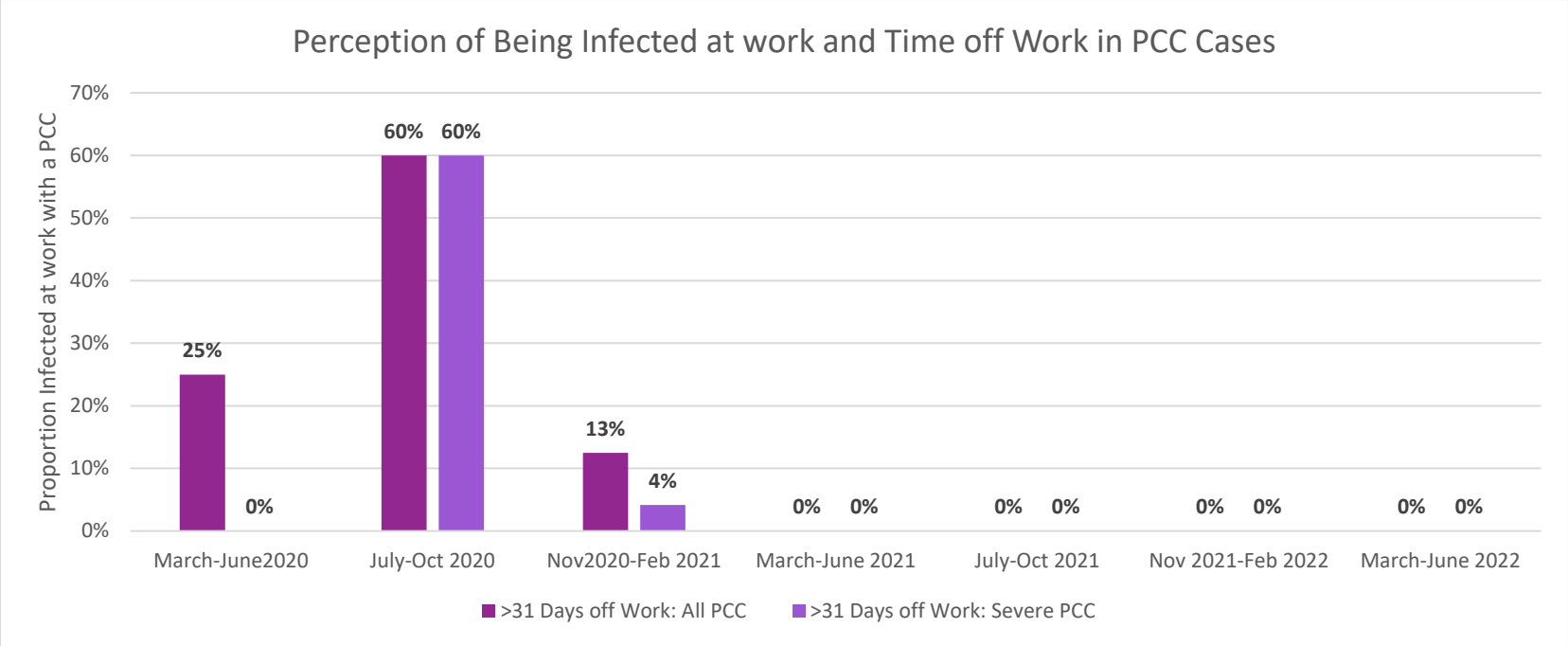
Time of Infection	Total infections	**Vaccinated severe**	**Unvaccinated severe**	**Vaccinated Total**	**Unvaccinated Total**	% total vaccinated severe	% total unvaccinated severe
March-June2020	12	**0**	**2**	0	12	-	17%
July-Oct 2020	14	**0**	**6**	0	14	-	43%
Nov2020-Feb 2021	73	**0**	**9**	7	66	0%	14%
March-June 2021	31	**1**	**0**	22	9	5%	0%
July-Oct 2021	55	**6**	**0**	51	4	12%	0%
Nov 2021-Feb 2022	608	**27**	**0**	596	12	5%	0%
March-June 2022	174	**6**	**0**	169	5	4%	0%
Total	967	**40**	**17**	845	122	4.7%	13.9%

Table C8. *Association between developing a severe post-COVID condition and work factors relating to infection episode*

		Severe post-COVID condition		Total	Bivariate			Adjusted*		
Infection Factors		**n**	**%**	**N**	**OR**	**95% CI**	**P=**	**OR**	**95% CI**	**P=**
Working at start of infection	No	5	6.0	83	1.00	–	–	1.00	–	–
	Yes	50	6.1	826	1.01	0.39 to 2.60	0.992	1.02	0.39 to 2.66	0.974
	Unknown	2	3.4	58	0.56	0.10 to 2.98	0.494	0.63	0.11 to 3.44	0.590
Believe Infected at Work	No	32	4.6	693	1.00	–	–	1.00	–	–
	Yes+Unsure	25	9.4	266	2.14	1.24 to 3.69	0.006	1.90	1.08 to 3.34	0.027
	Unknown	0	0.0	8	–	–	–	–	–	–
Missed more than 31 days of work	No	44	5.4	810	1.00	–	–	1.00	–	–
	Yes	6	37.5	16	10.45	3.63 to 30.05	<0.001	9.36	3.19 to 27.45	<0.001
	Not Working[1]	5	6.0	83	1.12	0.43 to 2.90	0.822	1.10	0.42 to 2.89	0.855
	Unknown	2	3.4	58	0.62	0.15 to 2.63	0.519	0.70	0.16 to 3.01	0.630
Work Modification due to infection	No	45	5.6	84	1.00	–	–	1.00	–	–
	Yes	5	22.7	22	4.96	1.75 to 14.06	0.003	5.69	1.91 to 16.98	0.002
	Not working[1]	5	6.0	83	1.08	0.42 to 2.81	0.872	1.08	0.41 to 2.83	0.884
	Unknown	2	3.4	58	0.60	0.14 to 2.55	0.491	0.68	0.16 to 2.93	0.604
WCB Claim due to infection	No	39	5.2	752	1.00	–	–	1.00	–	–
	Yes	9	17.3	52	3.83	1.74 to 8.41	<0.001	3.10	1.37 to 7.02	0.007
	Not working[1]	5	6.0	83	1.17	0.45 to 3.06	0.746	1.14	0.443 to 3.02	0.788
	Unknown	4	5.0	80	0.96	0.34 to 2.77	0.943	0.97	0.331 to 2.83	0.952
Unwell for 2+ Days	No	8	3.8	209	1.00	–	–	1.00	–	–
	Yes	47	6.7	705	1.80	0.93 to 3.86	0.135	1.96	0.89 to 4.32	0.093
	Unknown	2	3.8	53	0.99	0.20 to 5.78	0.985	1.23	0.25 to 6.12	0.798
Entered as continuous variable		**Median**	**IQR**							
Severity of Infection[1]	Continuous (-1.08 to 2.93)	1.08	1.45		1.73	1.17 to 2.55	0.006	2.65	1.94 to 3.62	<0.001
	Total	57	5.9	967	–	–	–	–	–	–

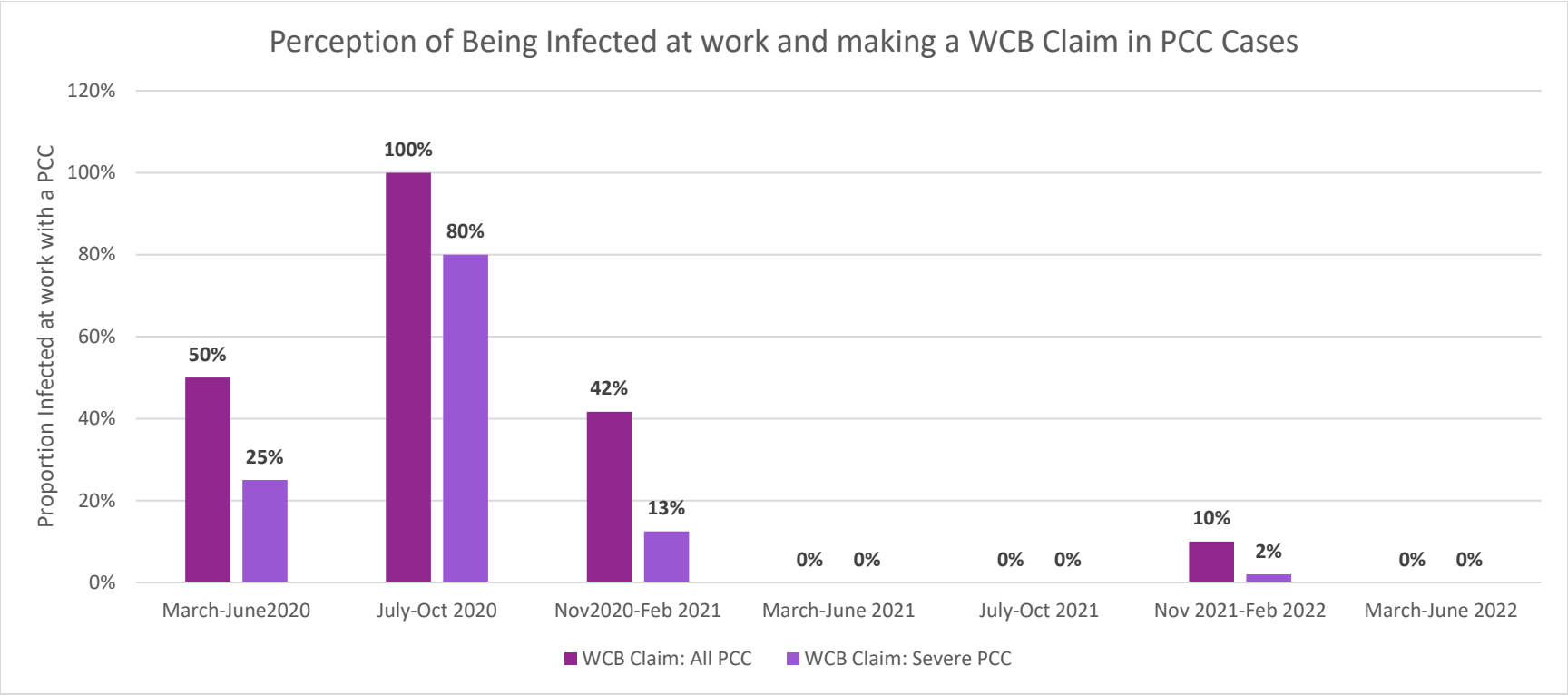
*Adjusted for job, gender, and age at time of infection

Figure C3. *Missed days of work based on the perception of being infected at work over time and developing a post-COVID condition (PCC)*



Time of Infection	≥31 Days off Work: Infected at Work+Severe PCC	≥31 Days off Work: Infected at Work+All PCC	Infected at Work+PCC
March-June2020	0	1	4
July-Oct 2020	3	3	5
Nov2020-Feb 2021	1	3	24
March-June 2021	0	0	2
July-Oct 2021	0	0	4
Nov 2021-Feb 2022	0	0	50
March-June 2022	0	0	6

Figure C4. *WCB Claim based on the perception of being infected at work over time and developing a post-COVID condition (PCC)*



Time of Infection	WCB Claim: Infected at Work+Severe PCC	WCB Claim: Infected at Work+PCC	Infected at work+PCC
March-June2020	1	2	4
July-Oct 2020	4	5	5
Nov 2020-Feb 2021	3	10	24
March-June 2021	0	0	2
July-Oct 2021	0	0	4
Nov 2021-Feb 2022	1	5	50
March-June 2022	0	0	6