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REPORT

Medical Treatments and Costs of COVID-19 Claims and "Long COVID" in the California Workers' Compensation System – 2023 Update

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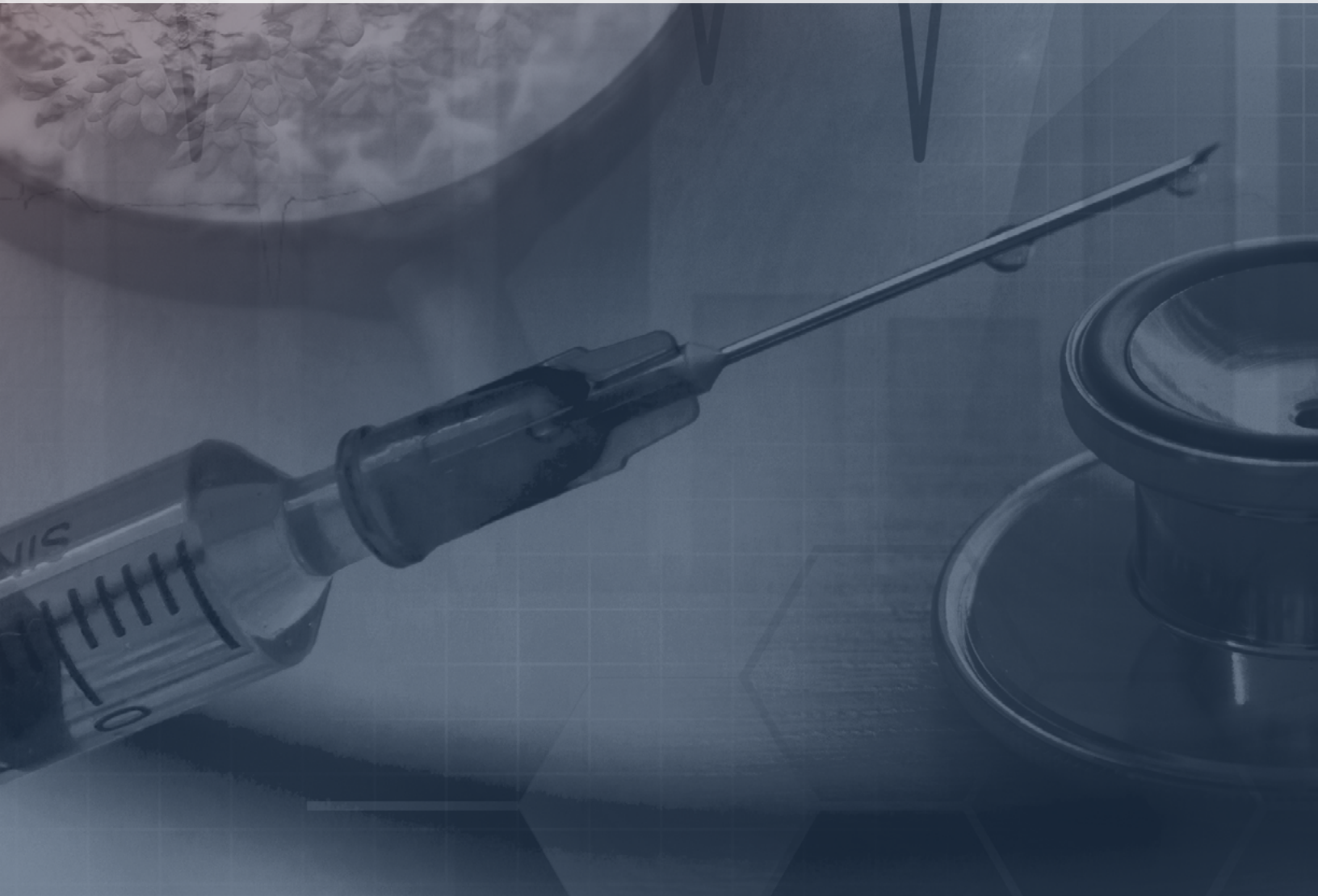

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Acknowledgements

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Executive Summary

Since March 2020, over 300,000 COVID-19 workers' compensation claims have been filed in California.[1] The number and average cost of COVID-19 claims declined in 2021 and 2022 compared to the early months of the pandemic, partly due to higher population immunity driven by vaccinations and prior infections. Still, many claims continued to be filed, particularly from healthcare workers on the frontline of COVID-19 patient care and others who had to work outside the home and face higher exposure to COVID-19 infection. In March 2022, the WCIRB published a study on the patterns of medical treatment and costs of COVID-19 claims based on claim experience mostly during the pre-vaccine period. The study showed that COVID-19 claims that involved medical treatments, particularly hospitalizations, incurred significant medical costs.[2] The study also provided an early assessment of the prevalence of "long COVID" (post-acute sequelae of SARS-CoV-2 infection, PASC), a constellation of persistent symptoms that can emerge or linger in various body systems long after the initial infection, in the workers' compensation system. The study estimated that approximately 11% of COVID-19 claims with an initial mild infection received medical treatment for long COVID symptoms over a 4-month post-acute care period. The rate of long COVID spiked to about 40% for those hospitalized for the initial infection.

Since then, additional experience of COVID-19 claims has become available, providing additional insights into the impacts of long COVID on permanent disability. The WCIRB has updated the analysis of medical treatments and costs of COVID-19 claims in the California workers' compensation system based on almost 10,000 insured COVID-19 claims with medical payments and a reported accident date between April 2020 and December 2021. This study update focuses on a comparison of claims filed in 2020 to those filed in 2021 when vaccines became more widely available to California workers. The 2023 update analyzes the prevalence of long COVID over a 12-month post-acute care period and the characteristics of workers experiencing long COVID. The update also estimates the long COVID prevalence of workers being treated in the California group health insurance system to validate the estimates in the workers' compensation system and includes an additional analysis of how comorbidities affect long COVID among patients with group health insurance.

The key findings of the study include:

- **Medical Characteristics of COVID-19 Claims:**
  - Overall, COVID-19 claims for the two accident years share a similar mix of clinical severity of acute COVID-19. Specifically, the vast majority (91%) of claims for both accident years (AYs) involved a mild initial infection that did not require hospitalization, while about 7% required hospitalization and 2% are death claims. However, among hospital claims, those filed in 2021 have a higher share of severe cases (defined as those requiring hospitalization but not ICU care) and a lower share of critical cases (defined as those that required ICU care) (**Table 1**).
  - Compared to non-COVID workers' compensation claims for both AYs, COVID-19 claims continued to be more likely to involve hospitalization (5 times more) and fatality (20 times more).
  - At 6 months from initial treatment, the average medical payments per mild COVID-19 claim are comparable between the two accident years. However, for severe claims, the average payments were significantly lower in 2021, while for critical claims, the average payments were higher in 2021 than in 2020 (**Figure 3**). The cost differential for hospital claims is mostly driven by inpatient costs (**Figure 4**), which are driven by the length of hospital stays and the use of ventilators (**Figure 5** and **Figure 6**).
  - Treatment patterns during the first 30 days for COVID-19 claims with a mild initial infection are relatively similar between the two accident years, although with fewer COVID-19 laboratory tests and more diagnostic radiology services per claim in 2021 (**Figure 7** and **Figure 8**).
- **Estimated Prevalence of Long COVID in the Workers' Compensation System:**
  - Cumulatively over a 12-month post-acute care period, approximately 13% of COVID-19 claims with medical payments received treatments for long COVID symptoms in the workers' compensation system. The share of claims involving long COVID differed by clinical severity of acute COVID-19 (12% for mild, 38% for severe and 41% for critical claims) (**Figure 9**).
  - The treatments for long COVID symptoms were found to persist over the 12-month post-acute care period, particularly for workers who were initially hospitalized (**Figure 10**).
    - Of workers initially hospitalized, about 20% continued to receive care for long COVID symptoms after 6 months following acute care, and 12% still needed treatments after 11 months.
    - Of workers with a mild initial infection, about 5% continued with treatments for long COVID symptoms after 6 months following acute care and 2% after 11 months.

1 The total COVID-19 claims include denied claims and claims arising from both self-insured and insured employers as of March 20, 2023. Workers' Compensation Information System (WCIS) of the Division of Workers' Compensation, California Department of Industrial Relations: https://www.cwci.org/CV19claims.html

2 Zhang J, Chen L and Yu Y (2022). Medical Treatments and Costs of COVID-19 Claims and an Early Look at "Long COVID" in the California Workers' Compensation System. WCIRB.

- Respiratory issues, such as shortness of breath, cough and chest pain, are the leading types of long COVID symptoms and were treated in more than one-half of long COVID workers' compensation claims over the 12-month post-acute care period, regardless of the clinical severity of acute COVID-19. In addition, fatigue, musculoskeletal and neurological conditions were among the leading types of long COVID symptoms treated in both mild and hospital claims (**Figure 12**).

- **Characteristics of Workers Treated for Long COVID Symptoms:**
  - The risks of long COVID increase with age and are higher among female workers (**Figure 13** and **Figure 14**). Workers aged over 40 had a higher-than-average risk of developing long COVID.
  - The healthcare industry accounts for over half of all long COVID claims identified in the workers' compensation system. Within the healthcare industry, approximately 17% of COVID-19 claims involved treatment for long COVID symptoms during the 12-month post-acute care period, followed by the manufacturing (13%) and retail trade (11%) industries (**Figure 15**).
  - The risks of long COVID appear to be influenced by vaccination status, with healthcare workers who were more likely to be vaccinated in early 2021 having a 14% lower risk of developing long COVID than healthcare workers who had a COVID-19 infection in 2020. However, workers in other industries who were less likely to be vaccinated in the early months of 2021 had a 27% higher risk of long COVID compared to 2020 (**Figure 16**).

- **Impacts of Long COVID on Permanent Disability:**
  - Based on available unit statistical report data, claims involving treatments for long COVID symptoms are four times as likely to receive permanent disability (PD) benefits as compared to other COVID-19 claims without treatment for long COVID symptoms (**Figure 17**). For hospital claims involving PD benefits, the average estimated permanent disability rating for claims involving long COVID is 36% compared to 24% for other COVID-19 claims (**Figure 18**).
  - The average incurred medical costs for long COVID claims involving PD benefits are almost three times as high as other COVID-19 claims involving PD benefits (**Figure 19**).

- **Comparison of the Long COVID Prevalence Estimates between the Workers' Compensation System and Group Health Insurance System in California:**
  - The estimated prevalence of long COVID among those with an infection in 2020 in the workers' compensation system is reasonably consistent with the estimates from the group health insurance data consisting of a sample of more than 19,000 California workers treated for COVID-19 in the group health insurance system in 2020 (**Figure 21**).
  - The overall prevalence of long COVID was similar between the group health insurance system and workers' compensation system. However, the estimated prevalence among COVID-19 patients who were initially hospitalized in the group health insurance system is lower than that in the workers' compensation system, potentially driven by different insurance coverage and declines in group health insurance enrollment due to the volatile labor market during the pandemic.

- **Comorbidities and Long COVID:**
  - Based on comorbidities identified in two years of pre-pandemic medical transaction data in the group health insurance system, comorbidities were found to be associated with a higher risk of long COVID. The risk of long COVID was almost twice as likely for patients who were treated for any comorbidities over the two years preceding the pandemic (**Figure 23**).

Limitations of this study are addressed throughout this report, summarized in the **Conditions and Limitations** section and must be considered when interpreting the findings.

Background

It has been over three years since the onset of the COVID-19 pandemic, bringing dramatic and far-reaching impacts worldwide. In 2020, the health and well-being of many thousands of Californians were severely affected, as many sectors of the economy largely shut down and the healthcare system in California was overwhelmed with almost 2 million infected individuals. However, the rapid development and rollout of COVID-19 vaccines, starting around January 2021, as well as the introduction of boosters in 2022 and improved prevention and treatment protocols have significantly reduced the severity of COVID-19 infections. Despite the continuing emergence of variants that have caused several surges, California's businesses and workforce have adapted to a more open economy operating within the framework of public health guidelines. Since March 2020, more than 300,000 COVID-19 claims have been filed in the California workers' compensation system. While the number and average cost of COVID-19 workers' compensation claims reported declined in 2021 and 2022, partly due to higher population immunity driven by vaccinations and prior infections, many claims continued to arise from healthcare workers on the frontline of COVID-19 patient care and others who had to work outside the home and face higher exposure to COVID-19 infection.

In March 2022, the WCIRB published a study examining the patterns of medical treatment and costs of COVID-19 claims. The study found that COVID-19 claims with medical payments were more likely to involve hospitalization and fatality than non-COVID-19 claims, with hospital and death COVID-19 claims incurring significant medical costs.[3] Additionally, the study provided initial estimates of the prevalence of "long COVID" (also called "post-acute sequelae of SARS-CoV-2 infection," PASC), a constellation of persistent symptoms that can emerge or linger in various body systems long after the initial infection. The initial estimates suggested that approximately 11% of COVID-19 claims that had a mild initial infection received treatments for long COVID symptoms over a 4-month post-acute care period. The rate of long COVID spiked to about 40% for those hospitalized for the initial infection. However, it is important to note that the 2022 study reflected data mostly in the pre-vaccine period and was limited to evaluating long COVID patterns only through four months after the acute care period.

Since the publication of the 2022 study, additional COVID-19 claim experience has become available, providing further insights into the impacts of long COVID on permanent disability. Although limited research has been published on long COVID among workers, one study based on the Current Population Survey data estimated that approximately half a million workers in the U.S. labor force were unable to work through June 2022 partly due to long COVID.[4] Other studies reviewed also indicated that approximately 20 percent of their respective survey respondents were not working due to health issues related to COVID-19.[5] According to the ongoing household pulse survey on long COVID between June 2022 and March 2023 by the National Center for Health Statistics and Census Bureau, approximately 30% of adults in California who ever had COVID-19 experienced long COVID symptoms that lasted for three months or longer, and about a quarter of those currently experiencing long COVID have significant limitations in daily activities as a result of long COVID.[6]

Given the potentially significant health and financial impacts of long COVID on workers and the workers' compensation system, the WCIRB reviewed available claim experience and medical transaction data of 2020 and 2021 COVID-19 insured claims to provide an update to the 2022 WCIRB study, including:

- An analysis of medical treatments and costs of COVID-19 claims focusing on a comparison of claims filed in 2020 and those filed in 2021 when vaccines became available
- Estimates of long COVID prevalence over a 12-month post-acute care period
- Characteristics of workers experiencing long COVID
- Impacts of long COVID on permanent disability

Similar to the 2022 WCIRB study, this 2023 update also estimates the prevalence of long COVID among workers treated in the group health insurance system based on a sample of California workers with group health insurance,[7] with additional analysis of the relationship between comorbidities and long COVID prevalence. The purpose of the long COVID analysis in the group health data is to validate the reasonableness of the estimated long COVID prevalence in the workers' compensation system.

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3 Zhang J, Chen L and Yu Y (2022). Medical Treatments and Costs of COVID-19 Claims and an Early Look at "Long COVID" in the California Workers' Compensation System. WCIRB.

4 Goda GS and Soltas E (2022). The Impacts of COVID-19 Illnesses on Workers. NBER Working Paper No. w30435, Available at SSRN: https://ssrn.com/abstract=4216221

5 Evans RA, McAuley H, Harrison EM, et al. Physical, cognitive, and mental health impacts of COVID-19 after hospitalisation (PHOSP-COVID): a UK multicentre, prospective cohort study [published correction appears in Lancet Respir Med. 2022 Jan;10(1):e9]. Lancet Respir Med. 2021;9(11):1275-1287; Ziauddeen N, Gurdasani D, O'Hara ME, et al. Characteristics and impact of Long Covid: Findings from an online survey. PLoS One. 2022;17(3):e0264331. Published 2022 Mar 8.

6 National Center for Health Statistics, CDC: Household Pulse Survey on Long COVID as of March 13, 2023. https://www.cdc.gov/nchs/covid19/pulse/long-covid.htm The household survey is a 20-minute online survey designed to complement the ability of the federal statistical system to rapidly respond and provide relevant information about the impact of the COVID-19 pandemic in the U.S. The data is collected using a two-weeks on, two-weeks off approach. The questions on long COVID symptoms that lasted for three months or longer were added on June 1, 2022. The survey results are based on a sample of California adults who responded to the online survey.

7 This study analyzed de-identified COVID-19 patient data in the Merative™ MarketScan® Research Databases, including the Commercial Claims and Encounters Database and the Medicare Supplemental and Coordination of Benefits Database (collectively referred to as "group health data" in this report). The group health data has medical claims and medical service billing information of a large sample of patients with group health insurance in California between 2018 and 2020 and the medical service information of patients in the 2020 cohort through August 2022. The group health data does not include Medi-Cal data but does include medical data on a sample of Medicare-eligible California workers receiving both Medicare benefits and employer-sponsored health insurance coverage. MarketScan is a registered trademark of Merative Corporation in the United States, other countries, or both.

Research Questions

The key research questions of the study include:

1 **How do the medical treatments and costs of COVID-19 claims in 2020 compare to those of COVID-19 claims in 2021?**

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2 **What is the estimated prevalence of long COVID over a 12-month post-acute care period in the California workers' compensation system?**

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3 **What are the characteristics of workers experiencing long COVID? Are they more likely to have permanent disabilities?**

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4 **How does long COVID prevalence in the California workers' compensation system compare to long COVID prevalence in the California group health insurance system?**

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5 **How do comorbidities affect the prevalence of long COVID?**

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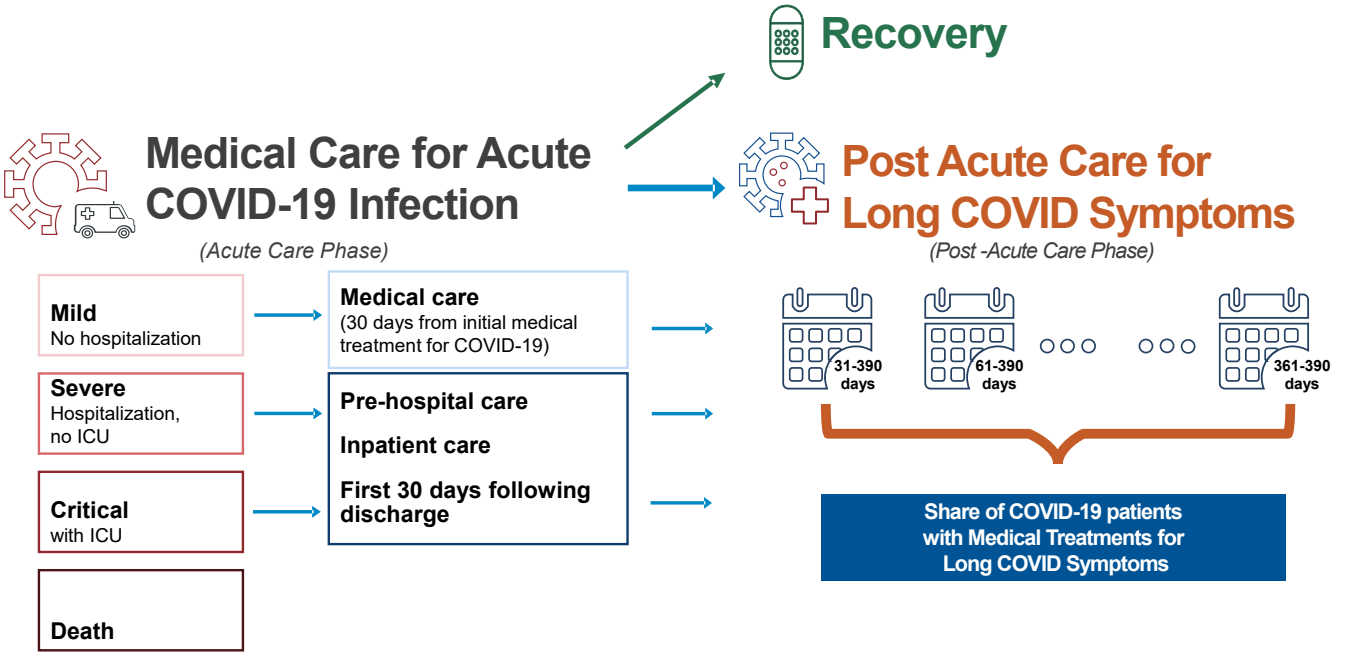
Research Methods

Research Framework and Key Definitions

The current study utilized a research framework similar to the 2022 WCIRB study to examine the patterns of medical treatment for individuals who had a COVID-19 infection. This includes both medical care for acute COVID-19 infection and post-acute care for long COVID symptoms, based on information published by the U.S. Centers for Disease Control and Prevention (CDC) and other research available at the time of the study. The key definitions used in the analysis are shown in **Figure 1,** specifically:

- **COVID-19 claims are categorized by clinical severity of acute COVID-19 based on the level of medical care provided:**
  - Mild claims did not require hospitalization
  - Severe claims required hospitalization but not intensive care unit (ICU) care
  - Critical claims required ICU care
  - Death claims involved fatality and may have required hospitalization
- **Timeframe for acute care for a COVID-19 infection**
  - For mild claims, acute care is provided during the first 30 days following the first medical visit, at which an initial diagnosis of COVID-19 is typically confirmed
  - For severe and critical claims, acute care includes pre-hospital care, inpatient care and post-hospital care through the first 30 days following hospital discharge
- **Timeframe for post-acute care for claims with long COVID symptoms**
  - For mild claims, post-acute care starts after the first 30 days following the first medical visit and lasts from day 31 through day 390
  - For severe and critical claims, post-acute care starts after 30 days from hospital discharge[8] and lasts from day 31 through day 390

Figure 1. Framework for Analyzing Medical Care for Acute COVID-19 Infections and Long COVID Symptoms



8 A small share (10%) of hospital claims involved multiple hospital admissions, and the median time between the first and last hospital admission available in the data is 33 days. Therefore, it is reasonable to consider multiple hospital episodes all part of the acute care. For the purpose of our study, for these hospital claims, post-acute care starts after 30 days following the last hospital discharge.

Data Sources

This study analyzed COVID-19 workers' compensation insured claims that had an accident date between April 2020 and December 2021 with paid transactions in the WCIRB's medical transaction database and with medical payments in either the Unit Statistical Report (USR) or indemnity transaction database as of February 7, 2023. COVID-19 claims in the workers' compensation system were defined for the purpose of this study as those reported with a Cause of Injury or Nature of Injury Code 83 in the WCIRB indemnity transaction data or the WCIRB USR data, or those reported with a Catastrophe Number 12 in the WCIRB USR data. For comparison purposes, we also analyzed reported non-COVID-19 claims in the WCIRB USR, indemnity transaction and medical transaction databases with an accident date during the same period. We analyzed paid medical services provided between April 2020 and January 2023 for both COVID-19 and non-COVID-19 claims as of February 7, 2023. Denied claims were excluded from the analysis.

Similar to the 2022 WCIRB study, we analyzed de-identified COVID-19 patient data in the Merative™ MarketScan® Research Databases, including the Commercial Claims and Encounters Database and the Medicare Supplemental and Coordination of Benefits Database (collectively referred to as "group health data" in this report). Our objective is to compare the long COVID prevalence among California workers who were treated in the group health insurance system to those who were treated in the workers' compensation system and validate the reasonableness of the estimates from the workers' compensation system. The group health data includes medical claims and medical service billing information on a large sample of patients with group health insurance plans in California between 2018 and 2022, reported as of October 2022. The group health data was reported by health insurers and self-insured employers and includes individuals employed by mostly large employers that provide health insurance or whose plans are administered by a large group health insurance plan. The group health data does not include Medi-Cal data but does include medical data on a sample of Medicare-eligible California workers receiving both Medicare supplemental benefits and employer-sponsored health insurance coverage.

In the group health data, COVID-19 patients were defined as those with at least one paid medical service with an International Classification of Diseases (ICD) code for COVID-19 (U07.1) between April 2020 and December 2020. We excluded patients with only COVID-19 test or vaccine transactions reported in the dataset. We further defined patients who were hospitalized for COVID-19 as those with an ICD code for COVID-19 (U07.1) at hospital admission and with inpatient diagnostic-related group (DRG) code for respiratory or viral infections (**Table A1** in the Appendix). This approach enabled us to focus our analysis on patients admitted for COVID-19 as the primary diagnosis. We limited the study population in the group health data to workers aged 16 and above who were actively employed in 2020 to align with the COVID-19 workers' compensation claim sample.

To facilitate a comparison between COVID-19 patients in the two datasets, we adopted a similar method of categorizing claims as mild, severe, critical and death by clinical severity of acute COVID-19 based on the primary medical procedure code information. However, due to different data reporting requirements, we used slightly different methods to identify COVID-19 deaths in the two datasets. In the workers' compensation data, we relied on the death information reported in the WCIRB USR and indemnity transaction data, while in the group health data, COVID-19 deaths were identified using discharge status information reported on the health insurance claim form (UB-04 form[9]). We excluded COVID-19 death claims from the long COVID analysis of both datasets.

Methods of Analyzing Long COVID

Similar to the 2022 WCIRB study, this study adopted the definition of long COVID, also known as post-acute sequelae of SARS-CoV-2 infection (PASC), developed by the U.S. National Institute of Health (NIH). According to the NIH, long COVID encompasses two types of symptoms: 1) symptoms that persist for weeks or even months after the acute phase of illness has passed and 2) new symptoms and findings that have emerged after the acute infection. While there is still limited consensus on the timeframe for post-COVID-19 symptoms that qualify as long COVID, the U.S. Department of Health and Human Services and other health organizations, including the CDC and World Health Organization, generally agree that symptoms persisting beyond 30 to 90 days after the initial diagnosis are considered long COVID.[10] As such, this study continued to use the same timeframe as the 2022 WCIRB study for the post-acute care period, which begins on day 31 following the acute care period, to identify medically-treated long COVID symptoms (**Figure 1**).

This study continued to rely on ICD information reported in the medical transaction data of either the workers' compensation system or the group health insurance system to identify long COVID claims. The mapping between ICD codes and long

9 The UB-04 form, also known as the Form CMS-1450, is the uniform institutional provider claim form suitable for hospitals to use in billing payers.

10 U.S. Department of Health and Human Services: https://www.covid.gov/longcovid/definitions; World Health Organization: Post COVID-19 Conditions (Long COVID). https://www.who.int/europe/news-room/fact-sheets/item/post-covid-19-condition and U.S. Centers for Disease Control and Prevention: Long COVID or Post-COVID Conditions. https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html

COVID symptoms was updated based on the latest published information from the CDC and other medical research available at the time of this study (**Table A2** in the Appendix).[11]

Estimating the Prevalence of Long COVID in the Workers' Compensation System

In this study, long COVID claims in the workers' compensation system were defined as COVID-19 claims with any medical treatment that had at least one ICD code for a long COVID symptom during the post-acute care period. The prevalence of long COVID was estimated as the share of long COVID claims relative to all non-death COVID-19 claims. Also, we created categories for long COVID symptoms primarily based on the body systems impacted by long COVID that are consistent with published research. The categories of long COVID symptoms, therefore, provide only an approximation of different long-term health complications of COVID-19 and do not represent a precise counting of different ICD codes reported for the treatment of a long COVID patient.

Estimating the Prevalence of Long COVID in the Group Health Insurance System

There are several notable differences between the group health data and the workers' compensation data that required additional adjustments to estimate the long COVID prevalence in the group health data more accurately.

First, the group health data includes pre-pandemic longitudinal medical transaction data of COVID-19 patients; therefore, we were able to identify claims with long COVID symptoms that had not been treated during the two years preceding the pandemic (January 2018 through February 2020) as well as prior to the COVID-19 infection in 2020. This is an important adjustment because some long COVID symptoms (e.g., chronic fatigue, anxiety disorders, and muscle pain) are non-specific and can be a result of many medical conditions other than COVID-19. As a result, long COVID claims in the group health data are those that received treatment for new long COVID symptoms after the initial infection.

Second, group health insurance coverage differs from workers' compensation coverage. Workers' compensation insurance covers medical treatments exclusively related to work-related injuries and diseases that are compensable in the workers' compensation system. With respect to workers' compensation claims for COVID-19, only medical treatments for a work-related COVID-19 illness and its sequalae are covered and encompassed in the workers' compensation claim. As a result, we can reasonably infer that all paid medical treatments, including those for long COVID symptoms, on COVID-19 claims in the workers' compensation system are part of COVID-19 care. However, group health insurance is much more comprehensive than workers' compensation insurance, covering medical treatments for various medical conditions regardless of whether they are work-related. Therefore, for COVID-19 patients treated in the group health insurance system, potentially only a subset of the new long COVID symptoms treated (after removing symptoms treated before the COVID-19 infection) is attributed to COVID-19. The remaining new symptoms most likely represent the background rates of new symptoms treated in the group health system, which would have been expected in the absence of a COVID-19 pandemic. Consequently, without removing these background rates of new symptoms, the estimated number of COVID-19 patients with any new long COVID symptom treated in group health would be inflated. Adjusting for the background rates of long COVID symptoms has been a typical challenge in studies that use electronic health records or health insurance claims data, requiring the creation of an appropriate control patient group to address potential overestimation.

We addressed the potential overestimation by employing a matched case-control study design and analyzing the excess prevalence of long COVID between the case and control patient groups (**Figure 2**). The case patient group consisted of all workers with COVID-19 treatment identified in the group health data, as described in the Data Sources section. The non-COVID-19 patients in the control group were California workers who were aged 16 and above, had active employment in 2020 and had at least one medical visit for non-COVID-19 medical conditions in 2020 (no ICD code U07.1 reported on any medical transaction in the group health data).[12] The non-COVID-19 patients in the control group were categorized in the mild (no hospital care), severe (required hospital care without ICU care) and critical (required ICU care) groups, using the same methodology as the COVID-19 patients in the case group. The control patient group was then matched to the case patient group separately for mild, severe and critical groups based on age, gender and the time (service month) of initial care, using propensity score matching.[13] We combined the groups of severe and critical patients into the hospitalized patient group in the long COVID analysis.

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11 We also included in the mapping the new ICD code for long COVID (U09.9, effective October 2021) and ICD code for sequelae of other specified infectious and parasitic diseases (B94.8), which was typically used before U09.9 was created for a diagnosis of long COVID.

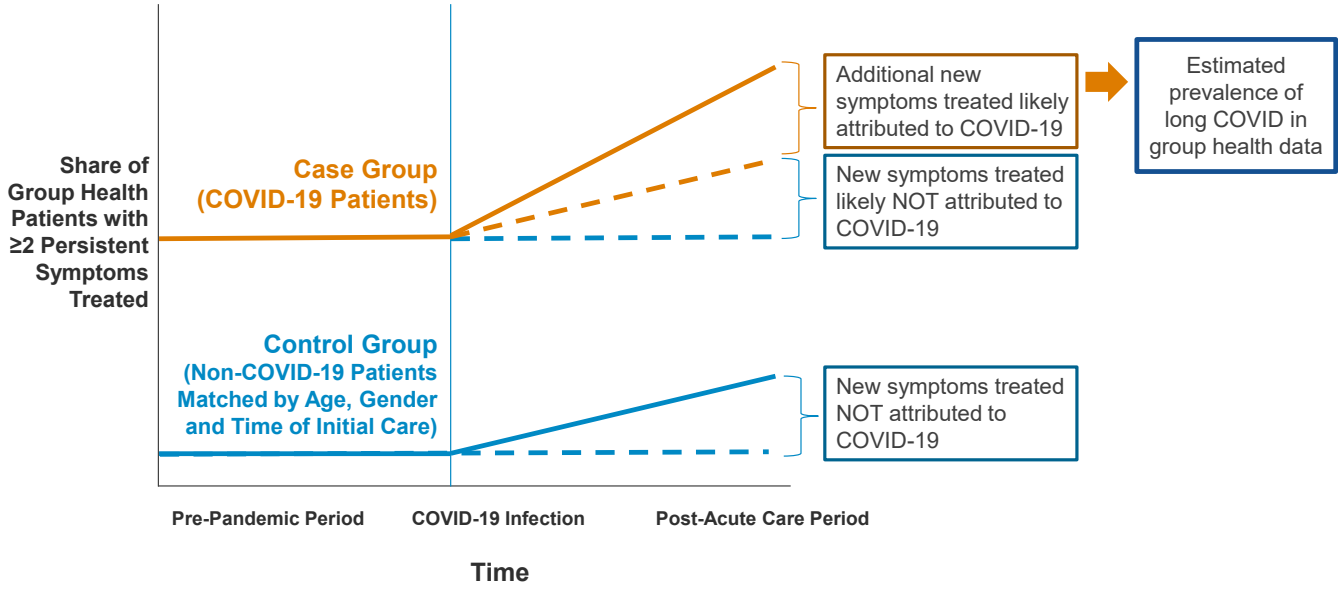
12 Non-COVID-19 patients in the control group had a wide range of medical conditions, such as musculoskeletal, circulatory, cardiac, mental/psychiatric, digestive and respiratory conditions. Some of these patients may have had mild cases of COVID-19 that were not treated in the group health insurance system. For this study, patients in both the workers' compensation system and the group health insurance system were considered COVID-19 patients only if they had medical treatments during the acute phase of the infection.

13 The matching method was nearest neighbor. The matching ratio was 1:2 between COVID-19 patients and non-COVID-19 patients for mild, severe and critical groups.

As shown in **Figure 2**, the expected prevalence of long COVID in the group health insurance system in the absence of the pandemic would be the share of non-COVID-19 patients with new persistent symptoms treated. In contrast, the prevalence of long COVID in the case patient group would be a combination of the expected prevalence as described above and the true prevalence of long COVID. Therefore, the excess prevalence of long COVID in the case patient group compared to the control group would be a more accurate estimate of long COVID prevalence in the group health data, as it adjusted for the expected prevalence of new symptoms in the absence of the pandemic.

Third, to enhance the identification of long COVID claims in the group health data, we employed a definition that required treatment for a minimum of two long COVID symptoms (represented by two distinct ICD codes) in the 12-month post-acute care period. This adjustment is necessary for improving the accuracy of identifying long COVID claims in the group health data as, compared to the case patient group, a higher share of non-COVID-19 patients in the control group had only one persistent symptom treated. The difference can be attributed to the coverage provided by group health insurance, which is more likely to capture a broad range of medical conditions beyond those specific to COVID-19.

Figure 2. Case and Control Groups in the Group Health Data



Lastly, we used the case and control groups to analyze the relationship between comorbidity and the risks of long COVID. We identified the COVID-19 patients and non-COVID-19 patients in the group health data who had any pre-existing comorbidities associated with a higher risk of severe COVID-19 between January 2018 and February 2020 based on the medical service information. The list of comorbidities was updated based on the published information from the CDC at the time of the study (**Figure A1** in the Appendix). We compared the excess long COVID prevalence in the case patient group between those with at least one comorbidity that was treated and those without any treated comorbidities.

It is important to note that for the purpose of our analysis using either workers' compensation data or group health data, long COVID claims are those that received medical treatment for long COVID symptoms during the post-acute care period. Our definition does not capture workers who did not seek care for long COVID symptoms or those who received medical care outside the workers' compensation system or the group health insurance system. It is important to note that our estimates of long COVID prevalence rely on the ICD information reported in the medical transaction data of either the workers' compensation system or the group health insurance system, are subject to the availability of ICD information and may change as more data becomes available.

Research Findings

Research question 1: *How do the medical treatments and costs of COVID-19 claims in 2020 compare to those of COVID-19 claims in 2021?*

Research Questions

In total, excluding denied claims, almost 10,000 COVID-19 workers' compensation claims with an accident date between April 2020 and December 2021 were reported with paid transactions in the WCIRB's medical transaction database and with medical payments in either the USR or indemnity transaction database. Over 70% of these COVID-19 claims were for Accident Year (AY) 2020 before COVID-19 vaccines became available. This study sample of COVID-19 claims does not include indemnity-only COVID-19 claims, which accounted for 41% of all insured COVID-19 claims reported in California workers' compensation system in 2020 and a higher share (45%) in 2021.[14] **Table 1** compares the distribution of initial clinical severity of COVID-19 claims in 2020 to that of COVID-19 claims in 2021. For both accident years, 91% of COVID-19 claims involved a mild initial infection that did not require hospitalization during the acute care period, and about 2% resulted in fatality.

Table 1. Distribution of COVID-19 Claims and Non-COVID-19 Claims for Accident Years 2020 and 2021 included in the Study by Clinical Severity

Clinical Severity of Acute COVID-19 by Levels of Medical Care Needed	Share of COVID-19 Claims with Medical Payments (N = 9,430)		Share of Non-COVID-19 Claims with Medical Payments (N = 434,773)
	AY2020	AY2021	AY2020-2021
Mild (no hospital care)	91.2%	91.0%	98.8%
Severe (no ICU, excl. deaths)	3.3%	4.3%	0.9%
Critical (w/ ICU, excl. deaths)	3.3%	2.7%	0.3%
Death	2.2%	2.1%	0.1%
Total	**100%**	**100%**	**100%**

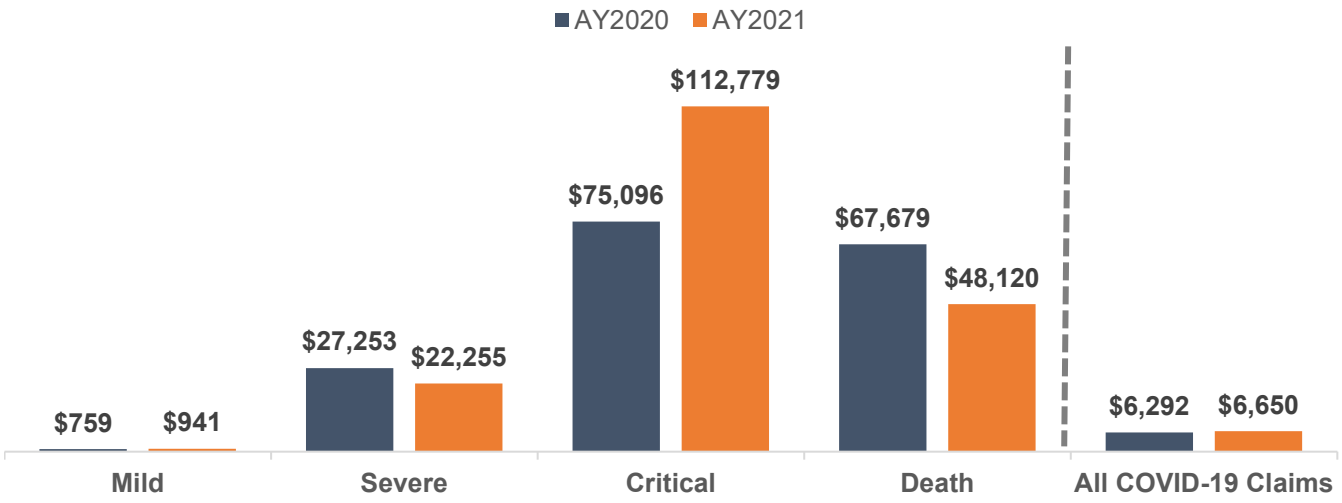
However, when compared to hospital claims for AY2020, hospital claims for AY2021 showed a slightly higher share of severe claims that required hospitalization but not intensive care, and a lower share of critical claims that required intensive care. This pattern suggests some shift in the distribution of severe and critical hospital claims in 2021, potentially driven by increased availability of hospital resources, vaccines and improved treatment protocols. Specifically, medical professionals became more effective in triaging and treating COVID-19 patients who required hospital care during the second year of the pandemic, potentially resulting in more efficient allocation of hospital resources. As a result, some hospitalized COVID-19 patients who would have required ICU care in 2020 did not need it in 2021. Consequently, patients who received ICU care in 2021 may have had more critical conditions than critical patients in 2020. In addition, there was higher population immunity in California in 2021 due to vaccinations and prior infections, which lowered the risk of critical illness from a COVID-19 infection.

As expected, the distribution of disease severity and levels of medical care needed on non-COVID-19 claims in 2021 remained almost identical to that in 2020. Compared to non-COVID-19 workers' compensation claims, COVID-19 claims continued to be more likely to involve hospitalization (5 times more) and fatality (20 times more). Based on the available USR data, these COVID-19 hospital and death claims bear the majority (68%) of total medical costs, including both paid and estimated future costs, on COVID-19 claims. In contrast, non-COVID-19 hospital and death claims contribute to about a quarter of overall medical costs on non-COVID-19 claims.

During the first six months of medical treatment, the overall average medical payments on COVID-19 claims are comparable between 2020 and 2021, but the pattern differs across initial clinical severity categories (**Figure 3**). Notably, the cost differential is more pronounced for hospital and death claims. For hospital claims, the average payments for severe claims in 2021 were 18% lower than those in 2020, while average payments for critical claims in 2021 were about 50% higher than those in 2020. The difference in medical costs for COVID-19 hospital claims between the two accident years reflects the likely shift in patient mix as previously discussed (**Table 1**): the overall clinical severity for severe claims in 2021 declined due to improved treatment protocols and a more efficient allocation of hospital resources to COVID-19 patients, while critical claims in 2021 likely have a higher share of claims requiring more intensive care.

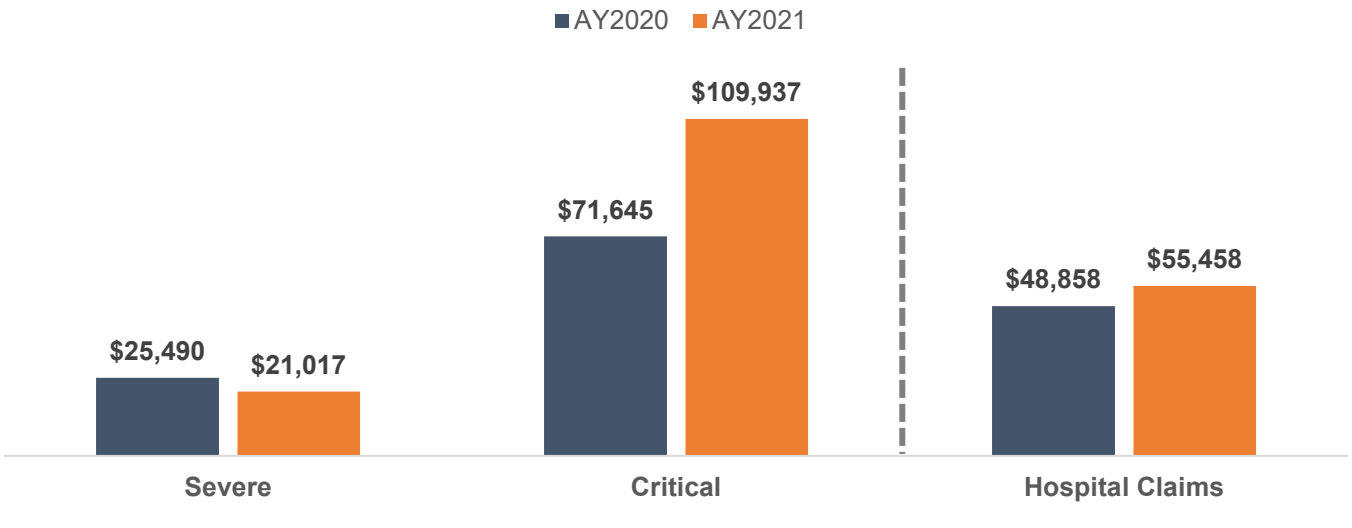
14 WCIRB. COVID-19 in California Workers' Compensation – 2022 Update. September, 2022.

Figure 3. Average Medical Payments for COVID-19 Claims during the First Six Months[15]



To further analyze the average medical payments for hospital claims, we examined the inpatient costs and found that for both accident years the cost of inpatient care accounted for more than 94% of the total payments during the first six months of treatment (**Figure 4**). The higher payment share for inpatient care can be attributed to the unique prognosis of COVID-19 and level of intensive medical care needed. The average inpatient costs for hospital claims (including both severe and critical claims) in 2021 were about 14% higher than in 2020. The higher costs in 2021 were driven by some very costly critical claims.

Figure 4. Average Payments for COVID-19 Inpatient Care[16]

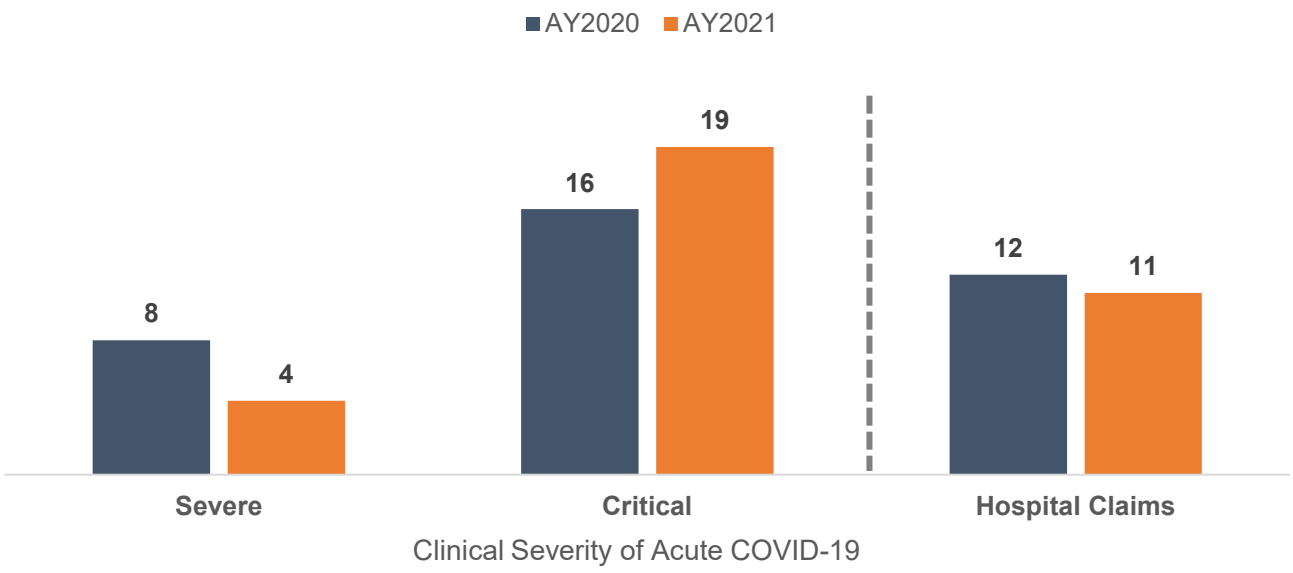


A key driver of inpatient cost is the length of hospital stay. Overall, the average duration of hospital stays was shorter for COVID-19 claims in 2021 compared to 2020, which partly reflects the impact of vaccines, improved treatment protocols and changes in the allocation of hospital resources (**Figure 5**). Specifically, severe claims in 2021 required about four days of hospital care, which is half of the duration of hospital stays for severe claims in 2020. However, the pattern differed for critical claims, which on average required a longer hospital stay in 2021.

15 To account for the payment lag in the WCIRB medical transaction data when comparing claims of different accident years, we calculated the six-month medical payments for COVID-19 claims as the payments for the medical services provided within six months from the initial medical treatment and paid by February 7, 2022 for AY2020 claims and paid by February 7, 2023 for AY2021 claims. Costs do not include medical settlement payments.

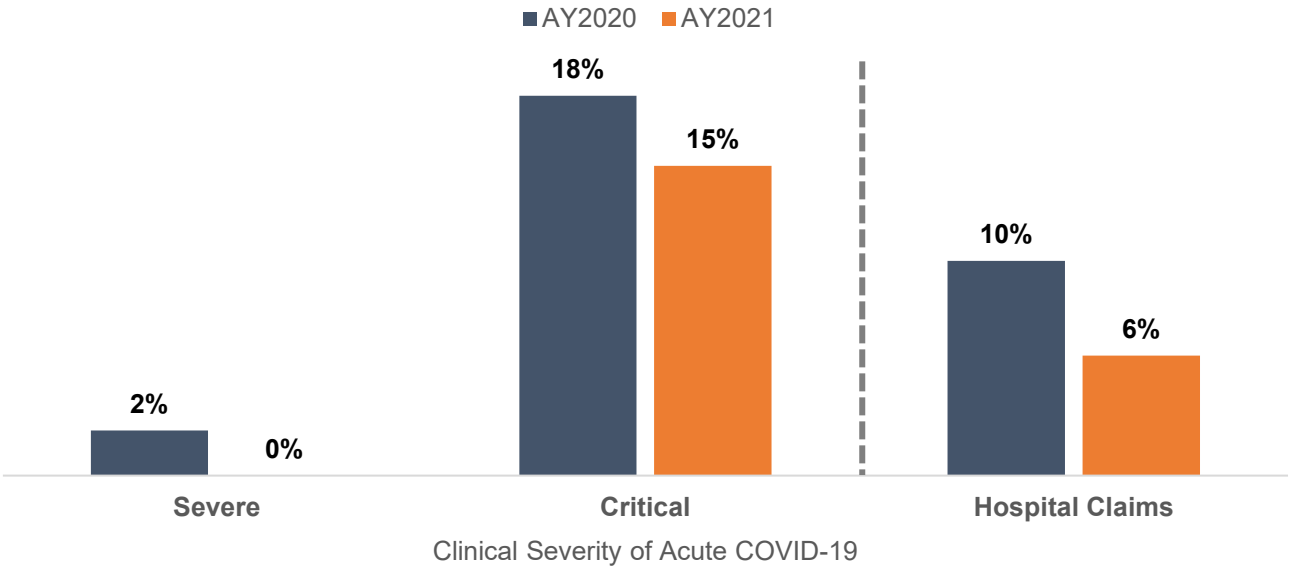
16 Payments for inpatient care include the medical payments for diagnostic-related procedures (DRGs), inpatient room and board charges or inpatient physician services. Inpatient payments for AY2020 hospital claims were as of February 7, 2022 and those for AY2021 hospital claims were as of February 7, 2023 to account for the payment lag in the WCIRB medical transaction data.

Figure 5. Average Length (Days) of Hospital Stay for COVID-19 Hospital Claims



Ventilator use is another key driver of inpatient costs for COVID-19 claims, as it is more commonly required for critically ill COVID-19 patients in need of ICU care. We identified ventilator use during inpatient care using inpatient diagnostic-related group (DRG) procedures, which relate the severity of a patient's illness and complexity of treatments to the costs incurred by the hospital.[17] As shown in **Figure 6,** there was a substantial decrease (44%) in the share of COVID-19 hospital claims that involved ventilators in 2021 for both severe and critical claims. The pattern is consistent with the impact of vaccinations and the improved effectiveness of medical professionals in treating more severe COVID-19 infections over time.

Figure 6. Use of Ventilators on COVID-19 Hospital Claims



For mild COVID-19 claims, the leading types of medical services during the acute care period (i.e., first 30 days following the initial medical treatment) are similar between the two accident years. Physician services, outpatient and medical equipment and supplies accounted for about 80% of medical payments during the acute care phase, while pharmaceuticals accounted for a very small share (2%) (**Figure 7**). Non-medical care services, including medical-legal, medical liens and others (such as copy services), accounted for about 15% of the payments.

17 The leading DRG procedures on COVID-19 hospital claims by claim share and payment share are included in **Figure A2** in the Appendix.

However, we observed a few slight differences between the two accident years. Specifically, mild claims in 2021 had a slightly higher share of payments for physician services than in 2020 (64% vs. 62%), which was partly driven by higher average payments for office visits, the leading type of physician services. The cost of office visits in 2021 was higher as a result of the 2021 update to the Medicare-based fee schedule in the workers' compensation system that increased the reimbursement allowance for office visits.[18] The number of office visits per 100 mild claims during the first 30 days, however, remained similar between the two accident years (**Figure 8**). Additionally, there were more diagnostic radiology services for chest images and CT scans per claim in the first 30 days for AY2021 claims than for AY2020 claims. In addition, AY2021 claims had a lower share of payments for medical equipment and supplies (4% vs. 9%), mostly because fewer laboratory-based COVID-19 tests per mild claim were conducted in the workers' compensation system as free rapid at-home tests became more widely available in 2021 (**Figure 7** and **Figure 8**).

Figure 7. Leading Types of Medical Services Provided in the First 30 Days for Mild COVID-19 Claims[19]

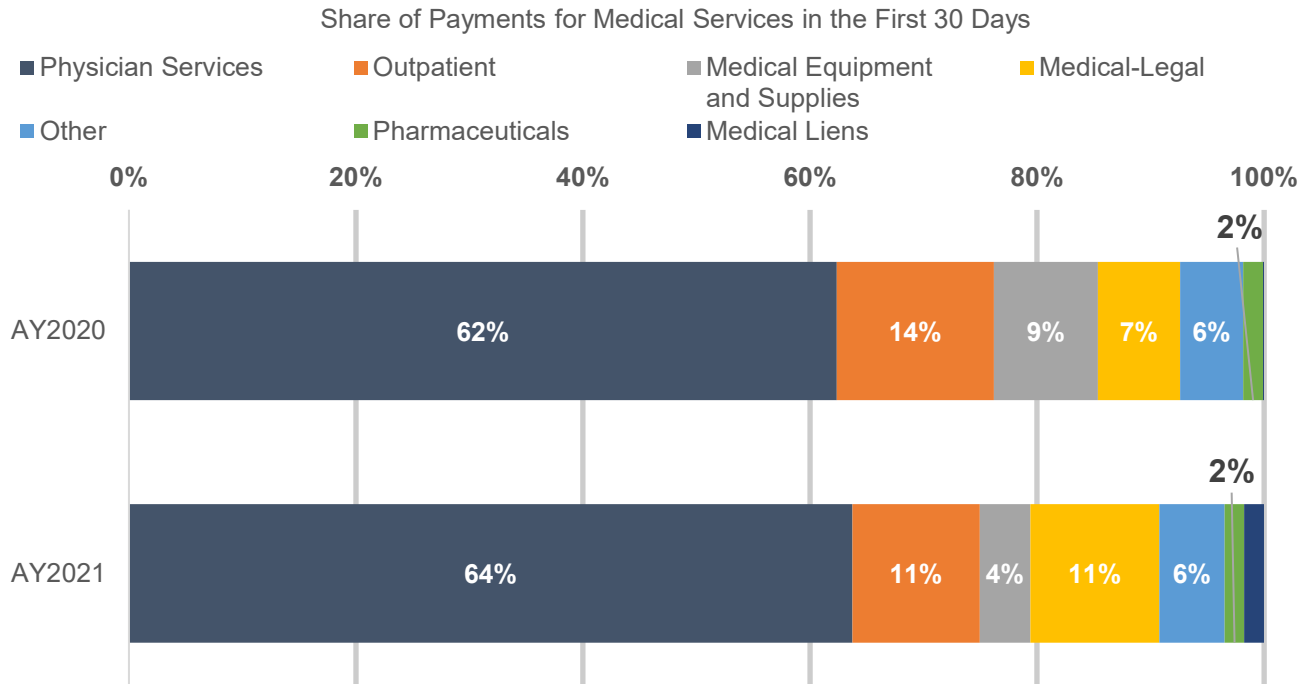
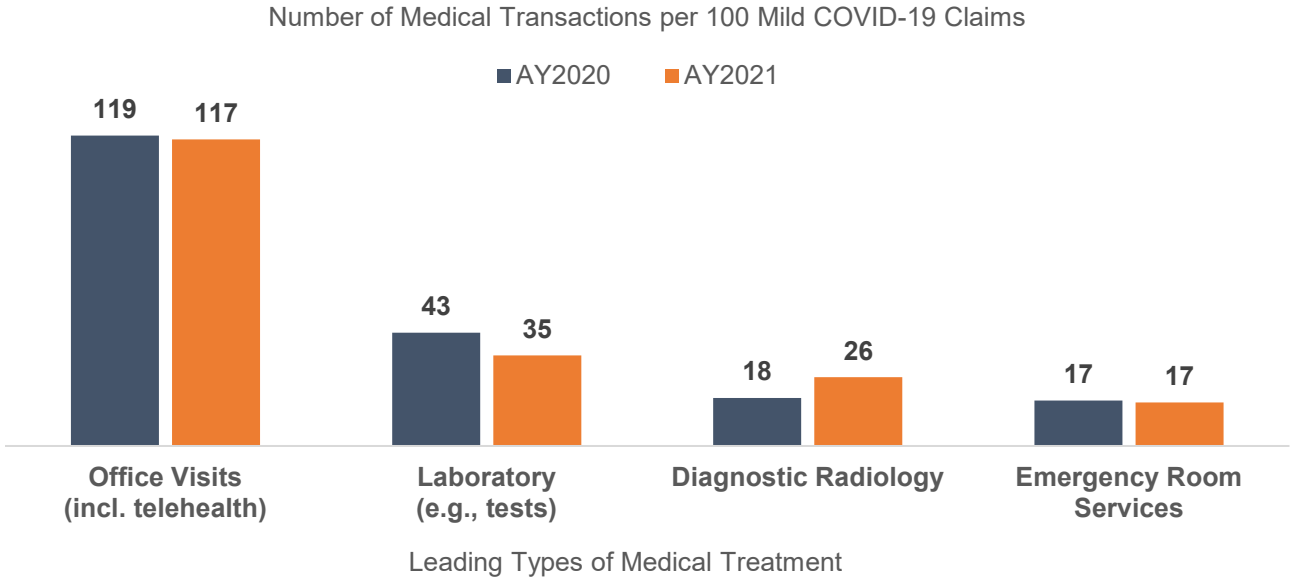


Figure 8. Service Utilization during the First 30 Days after Initial Medical Treatment for Mild COVID-19 Claims[20]



18 California Department of Industrial Relations, Division of Workers' Compensation. https://www.dir.ca.gov/DIRNews/2021/2021-16.html

19 Other services include copy services, dental services and other unclassifiable services.

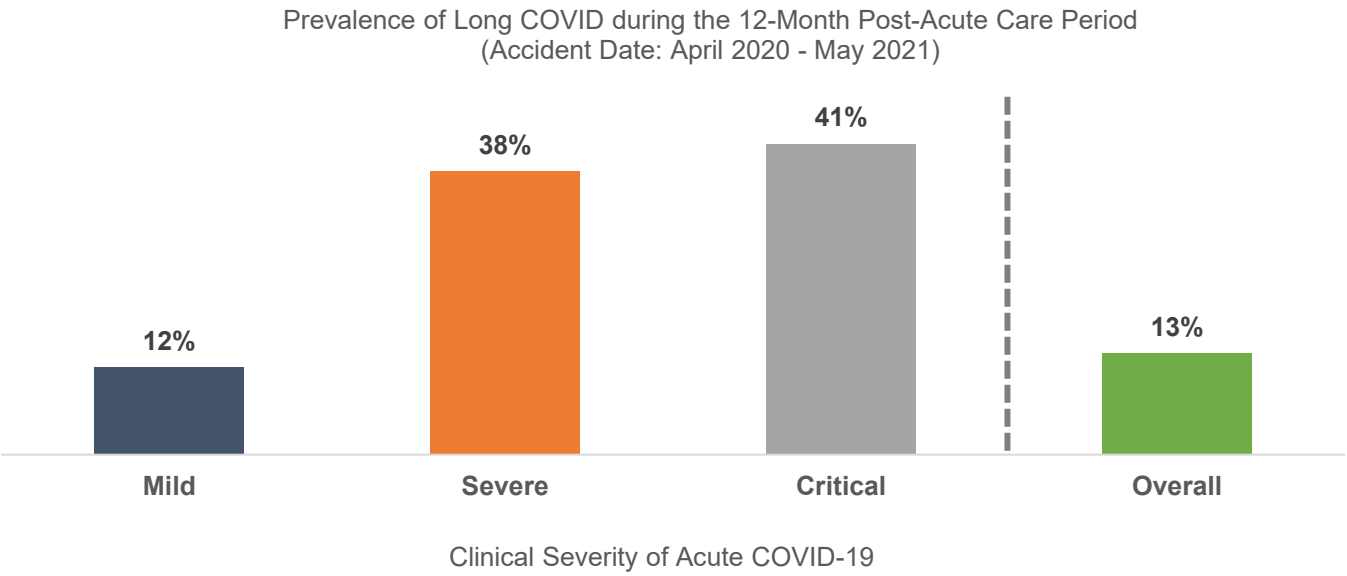
20 Figure 8 focuses on the leading types of medical treatments, which include those in the physician services, outpatient and medical equipment and supplies categories of Figure 7.

Research question 2: *What is the estimated prevalence of long COVID over a 12-month post-acute care period in the California workers' compensation system?*

Research Questions

Overall, approximately one out of eight (13%) COVID-19 workers' compensation claims with medical payments continued to involve medical treatment for long COVID symptoms during the 12-month post-acute care period (**Figure 9**). The estimated prevalence of long COVID among workers' compensation claims with medical payments is similar to that reported in other jurisdictions.[21] Also, as published research suggested,[22] long COVID is more prevalent among COVID-19 workers' compensation claims that involved hospitalization for the acute infection than mild claims that did not require hospitalization. **Figure 9** shows that approximately 12% of COVID-19 claims with mild infections involved long COVID over one year following acute care, while the estimated share of severe and critical COVID-19 claims that involved long COVID over one year was 38% and 41%, respectively. These long COVID claims were those that required continued post-acute care for COVID-19 or any COVID-19 sequelae impacting different body systems, such as respiratory, musculoskeletal and neurological systems.[23] It is common for COVID-19 patients to seek care several months after acute care as persistent symptoms may worsen over time, requiring medical attention. Long COVID patients may also seek care at intermittent times for long COVID symptoms as symptoms of different body systems may emerge, relapse and recover in different cycles.[24]

Figure 9. Estimated Prevalence of Long COVID in the California Workers' Compensation System Varies by Category of Initial Clinical Severity



One of the key questions about long COVID is how long the symptoms persist. To address this, we examined the prevalence of long COVID symptoms by intervals of 30 days over the 12-month period following acute care. As shown in **Figure 10,** the share of mild COVID-19 claims that received medical treatment for long COVID symptoms decreased from 12% in the first month to 2% by the end of the year. However, long COVID symptoms were more persistent for COVID-19 claims that involved hospitalization during the acute COVID-19 phase. For these claims, about 20% continued to receive care for long COVID symptoms after 6 months following acute care (211-390 days), and about one in eight claims still received medical treatment for long COVID symptoms in the 12th month (361-390 days).

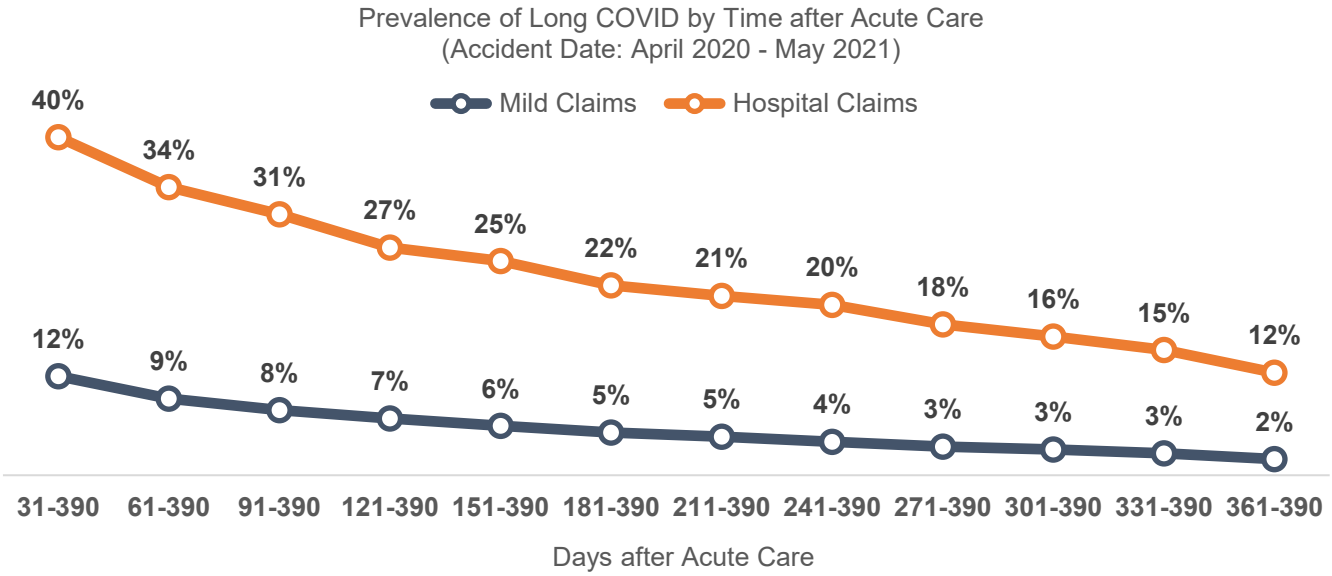
21 Savych B (2022). Long COVID in the Workers' Compensation System Early in the Pandemic. WCRI. The study estimated that, among workers with any medical care (a third of the sample of workers with COVID-19), about 20 percent received treatment for long COVID conditions in the post-acute period, based on workers' compensation data across 31 U.S. states.

22 Savych B (2022). Long COVID in the Workers' Compensation System Early in the Pandemic. WCRI; Choo M, Moss RJ and Arnautović N (2022). Long COVID in Workers' Compensation: A First Look. NCCI.

23 These COVID-19 claims had at least one medical treatment transaction with an ICD code of COVID-19 (U07.1), long COVID (U09.9 effective 10/01/2021 or B94.8 before 10/1/2021) or any long COVID symptom of various body systems. The full list of long COVID symptom ICD codes is included in **Table A2** in the Appendix.

24 Davis HE, McCorkell L, Vogel JM et al. Long COVID: Major findings, mechanisms and recommendations. Nat Rev Microbiol. 2022;21:133–146.

Figure 10. Persistence of Long COVID in the California Workers' Compensation System over the 12-Month Post-Acute Care Period



Our analysis also looked at the number of long COVID symptoms treated in the workers' compensation system. Overall, we found that over 60% of long COVID claims involved treatment for multiple long COVID symptoms (**Figure 11**). In addition, workers who were hospitalized for the acute infection are more likely to develop multiple long COVID symptoms. As shown in **Figure 11**, about 60% of mild long COVID claims involved multiple long COVID symptoms compared to almost 80% for long COVID claims that involved hospital care for the acute infection.

Figure 11. Distribution of Long COVID Workers' Compensation Claims by Number of Long COVID Symptoms[25]

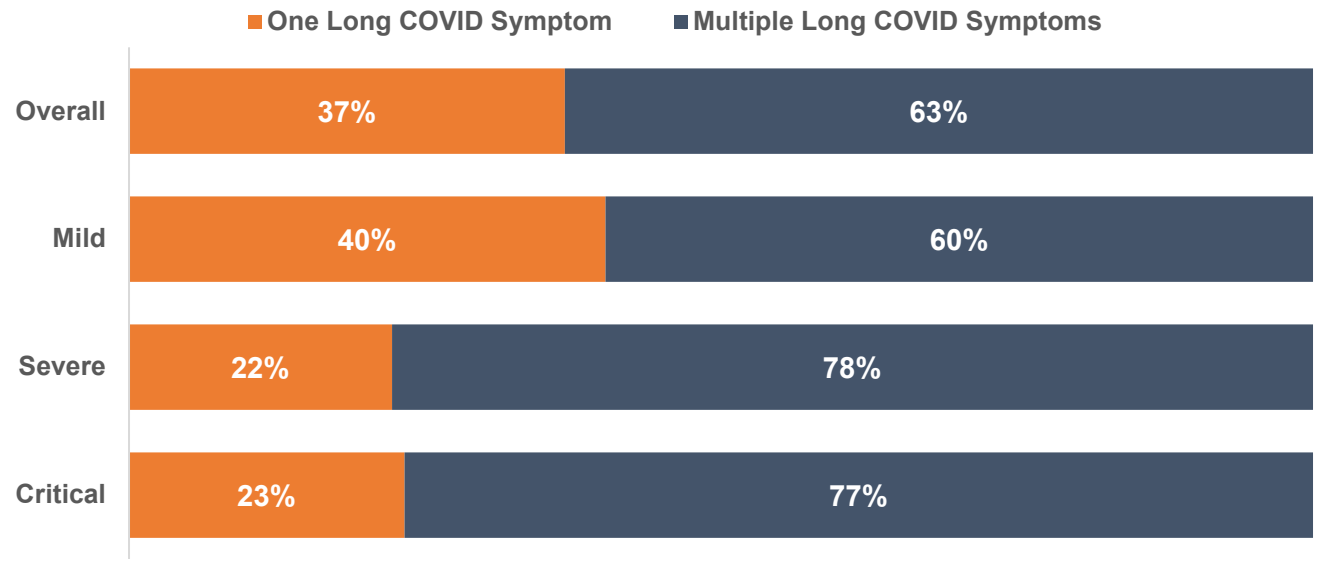


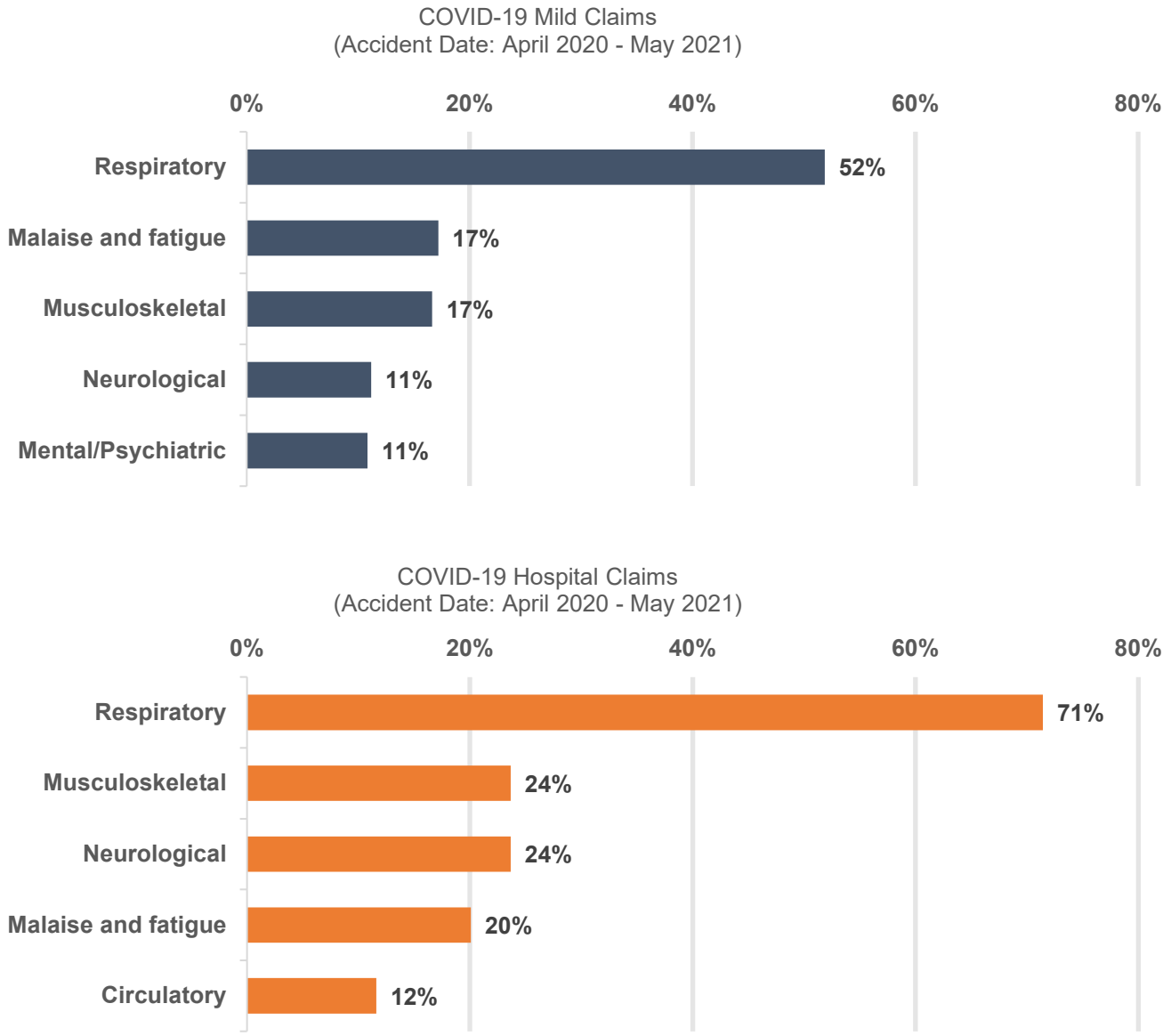
Figure 12 shows the leading categories of long COVID symptoms that were treated in the workers' compensation system. Respiratory-related issues, such as shortness of breath, cough and chest pain, were treated in over one-half of mild claims and over 70% of hospital claims. Also, approximately one in five of both mild and hospital claims received medical treatment for malaise and fatigue. Notably, COVID-19 patients who were initially hospitalized for the acute infection were more likely to receive care for more severe long COVID symptoms. For example, approximately one in four COVID-19 patients continued with treatment for musculoskeletal and neurological conditions, such as post-viral and related fatigue syndromes. Additionally,

25 Long COVID claims involving one long COVID symptom were those that involved treatment with the reporting of one long COVID ICD code. Those with multiple long COVID symptoms were claims that involved treatment with the reporting of multiple distinct long COVID ICD codes.

about one in eight received medical care for circulatory issues (e.g., heart palpitations). Meanwhile, mental/psychiatric conditions, which mainly include anxiety and sleep disorders, were treated in more than one in ten mild claims. These wide-ranging long COVID symptoms, when prolonged, can heavily affect a worker's productivity and daily life.

In addition, about one in five long COVID claims continued with COVID-19 care[26] in the post-acute care period without the reporting of any specific symptoms through ICD codes. These claims primarily involved office visits and diagnostic tests to evaluate heart and lung functions.

Figure 12. Leading Categories of Long COVID Symptoms Treated in the California Workers' Compensation System



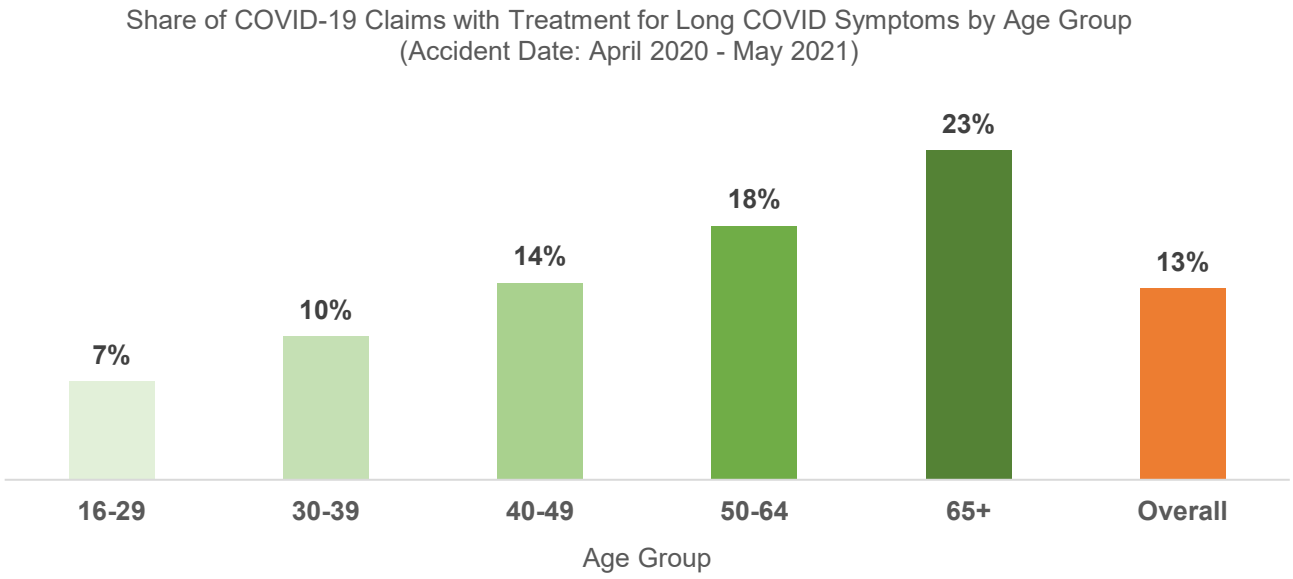
26 Approximately 19% of long COVID patients who had a mild initial infection and 15% of those who were hospitalized for the acute infection continued to have paid medical services with an ICD code for COVID-19 (U07.1) or long COVID (U09.9 or B94.8) following acute care in the workers' compensation system. For the purpose of this study, these claims were counted as those with long COVID.

Research question 3: *What are the characteristics of workers experiencing long COVID? Are they more likely to have permanent disabilities?*

Research Questions

The risk of developing long COVID increases with age. As shown in **Figure 13**, over the 12-month post-acute care period, approximately one in ten workers between ages 30 and 39, who previously were treated for COVID-19, received treatment for long COVID symptoms. Workers aged 40 and above had a higher-than-average risk of developing long COVID. In particular, almost one in five of those aged 50 and 64 and almost a quarter of those aged 65 and above received treatment for long COVID symptoms. This pattern is consistent with published research,[27] and is most likely related to older workers being more likely to have pre-existing comorbidities and thus more severe COVID-19. In our sample of COVID-19 claims, workers between the ages of 50 and 64 account for about one-half of those involving hospitalization for acute infections. While vaccines became available in early 2021, the majority (85%) of long COVID claims in our analysis sample had the initial infection during the pre-vaccine period. Therefore, due to the timing of the initial infections in our study sample, the risk differential of long COVID across age groups may not reflect the full effects of vaccines.

Figure 13. Estimated Prevalence of Long COVID by Age Group

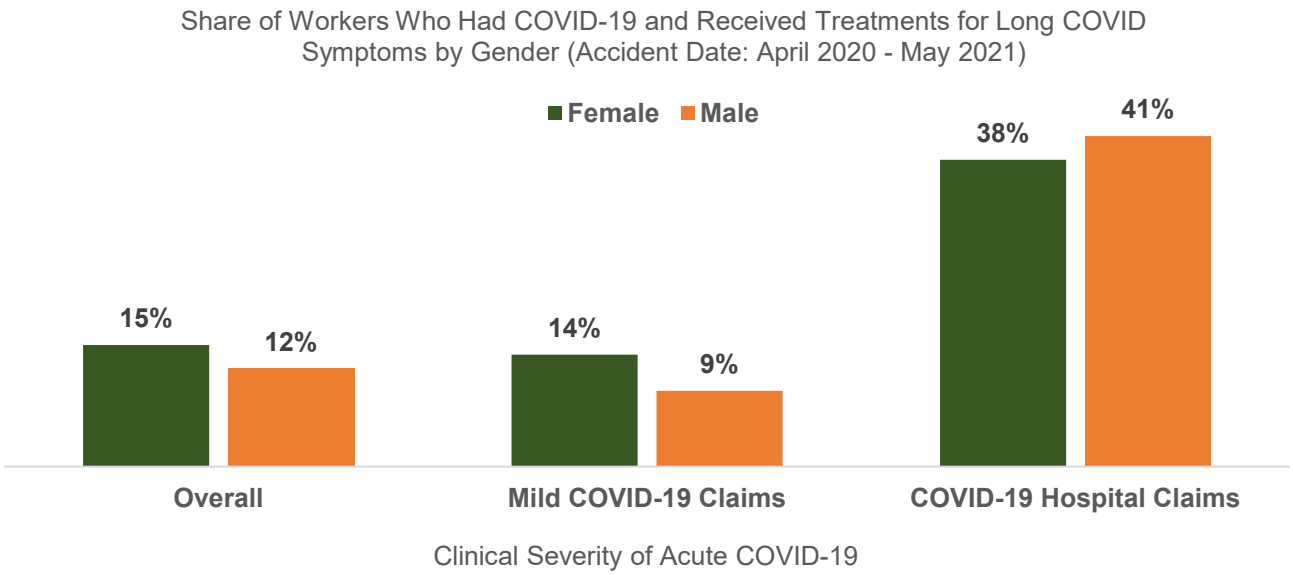


We also examined whether the risk of long COVID varies by gender. Overall, as shown in **Figure 14**, female workers were more likely to receive medical treatment for long COVID symptoms during the 12-month post-acute care period. This finding is consistent with published research reviewed in both the workers' compensation and general healthcare systems.[28] The pattern in our sample is mostly driven by a significantly higher prevalence of long COVID among female workers who had a mild initial infection than male workers. This may be related to the prevalence of COVID-19 claims filed by healthcare workers and the high share of female workers in this industry.

27 Savych B (2022). Long COVID in the Workers' Compensation System Early in the Pandemic. WCRI; Choo M, Moss RJ and Arnautović N (2022). Long COVID in Workers' Compensation: A First Look. NCCI.; Mizrahi B, Sudry T, Flaks-Manov N, et al. Long covid outcomes at one year after mild SARS-CoV-2 infection: nationwide cohort study. *BMJ*. 2023;380:e072529. Published 2023 Jan 11.

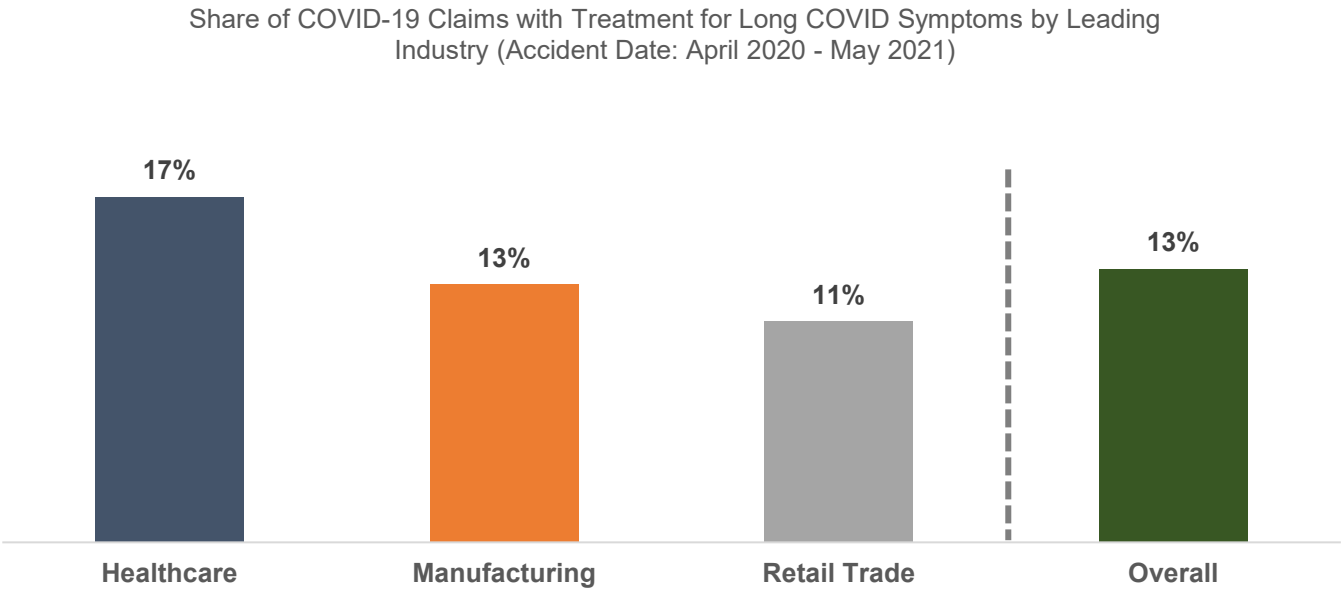
28 Choo M, Moss RJ and Arnautović N (2022). Long COVID in Workers' Compensation: A First Look. NCCI; New York State Insurance Fund (2023). Shining a light on long COVID: an analysis of workers' compensation data; Su Y, Yuan D, Chen DG, et al. Multiple Early Factors Anticipate Post-Acute COVID-19 Sequelae. Cell. 2022;185(5):881-895.e20.

Figure 14. Estimated Prevalence of Long COVID by Gender



When reviewing the risk of long COVID by industry sectors, we found that the healthcare industry accounts for over half (54%) of all long COVID claims identified in the workers' compensation system. Within the healthcare industry, approximately 17% of COVID-19 claims had treatment for long COVID symptoms, followed by the manufacturing (13%) and retail trade (11%) industries (**Figure 15**). The pattern is not surprising as healthcare workers have been at the front line of COVID-19 patient care and have had more exposure to the virus, which increases the risk of long COVID. Workers in the manufacturing and retail industries may have had limited opportunities to work from home throughout the pandemic and therefore may have also been more exposed to COVID-19 infection and risks of long COVID. Manufacturing and retail industries were also found to be among the industries with the highest share of long COVID claims besides the healthcare industry in other published studies using workers' compensation data.[29]

Figure 15. Estimated Prevalence of Long COVID by Leading Industry Sectors[30]

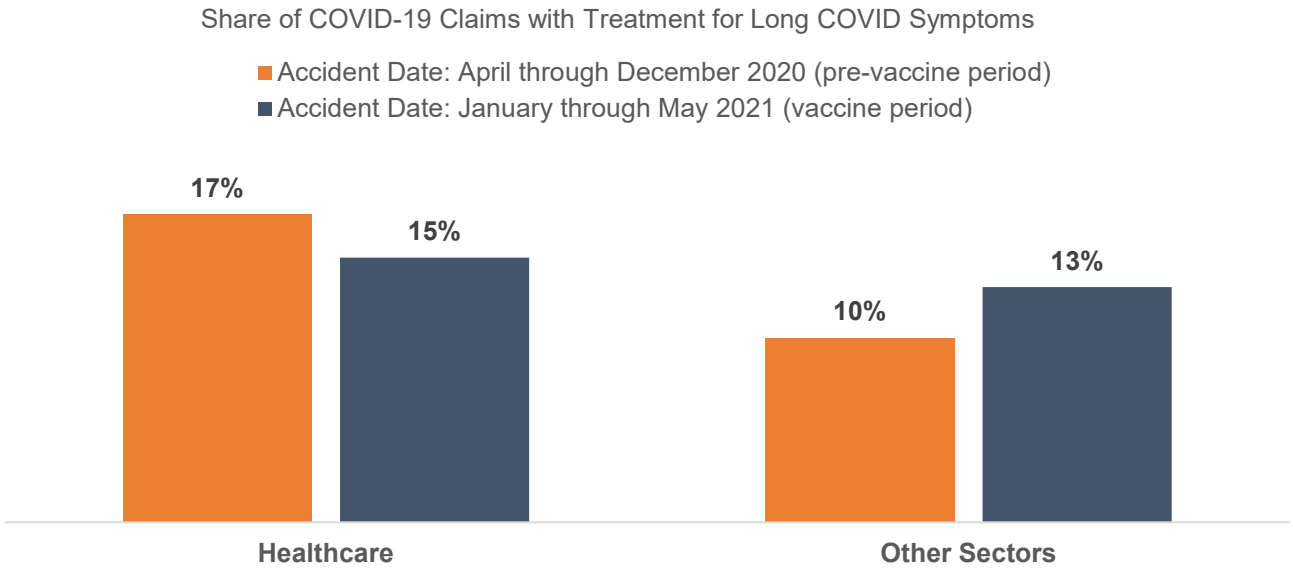


29 Savych B (2022). Long COVID in the Workers' Compensation System Early in the Pandemic. WCRI.

30 Industry sectors are based on the North American Industry Classification System (NAICS) sectors. The NAICS sector assigned to each claim is derived from a crosswalk between the NAICS sector codes and the reported classification codes from the WCIRB unit statistical data and WCIRB indemnity transaction data. The estimated prevalence of long COVID by leading industry sector was calculated as the total number of long COVID claims in each industry sector relative to all COVID-19 claims in the same industry sector.

We also delved into the healthcare industry and conducted an initial review of the potential impacts of vaccines on the risk of long COVID based on a comparison of available claim experience during the pre-vaccine and vaccine periods. Vaccinations were first available in California in December 2020, with healthcare workers among the first to be vaccinated in early 2021. In August 2021, the California Department of Public Health issued the first order in the nation requiring COVID-19 vaccinations for healthcare workers, allowing limited exceptions for qualifying medical and religious reasons.[31] While vaccination status for individual workers is not available in the workers' compensation data, it is reasonable to assume COVID-19 claims in the healthcare industry with a reported accident date between January and May 2021 were significantly more likely to involve vaccinated workers than COVID-19 claims in other industries. Based on available claim experience during the vaccine period, we found that healthcare workers who had a COVID-19 infection in early 2021 had a 14% lower risk of long COVID during the 12-month post-care acute period than in 2020. On the other hand, workers in other industries, who were less likely to be vaccinated in the early months of 2021, had a 27% higher risk of long COVID (**Figure 16**). The different trajectories of long COVID prevalence among healthcare workers compared to workers in other industries over the two accident years suggests a potential protective effect of vaccines against long COVID. This preliminary finding aligns with published research that demonstrates some evidence for a decrease in the risk of long COVID among vaccinated populations.[32]

Figure 16. Estimated Prevalence of Long COVID among Healthcare Workers by Vaccine Period



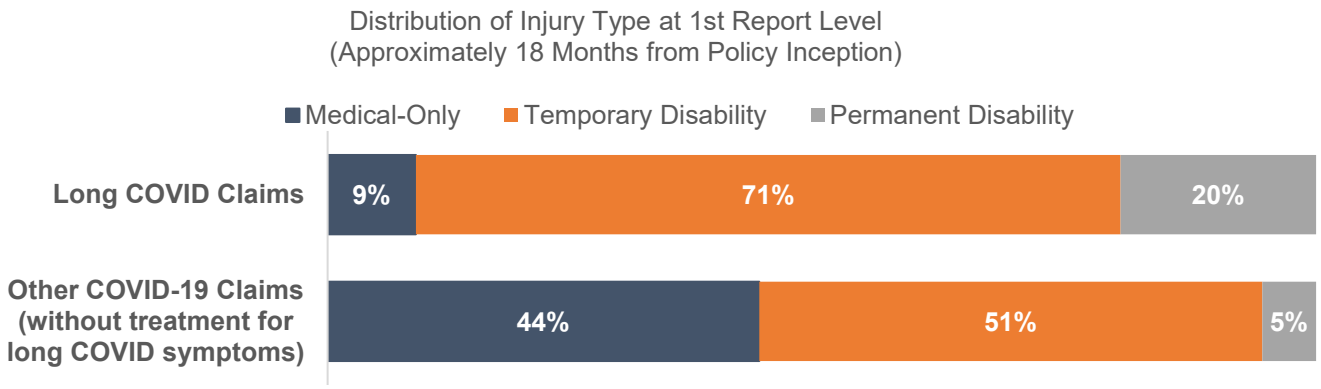
Workers experiencing long COVID may require additional medical care, as well as time away from work to recover. For some, long COVID symptoms may result in a disability that may impair a worker's ability to perform their job or perform it at the level they did prior to infection.[33] We examined the indemnity benefits (i.e., wage replacement) on long COVID claims valued as of approximately 18 months from the policy inception based on WCIRB USR data. As shown in **Figure 17**, a much smaller share of long COVID claims had only medical benefits than other COVID-19 claims that did not involve treatment for long COVID symptoms, while 91% of long COVID claims incurred either temporary disability (TD) or permanent disability (PD) benefits, which is significantly higher than other COVID-19 claims (56%). In particular, the share of long COVID claims involving PD benefits is four times as high among long COVID claims as among other COVID-19 claims (20% vs 5%).

31 California Department of Public Health Order on August 5, 2021.https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/Order-of-the-State-Public-Health-Officer-Health-Care-Worker-Vaccine-Requirement.aspx

32 Davis HE, McCorkell L, Vogel JM *et al.* Long COVID: Major findings, mechanisms and recommendations. *Nat Rev Microbiol.* 2022;21:133–146; Mizrahi B, Sudry T, Flaks-Manov N, et al. Long covid outcomes at one year after mild SARS-CoV-2 infection: nationwide cohort study. *BMJ.* 2023;380:e072529. Published 2023 Jan 11.

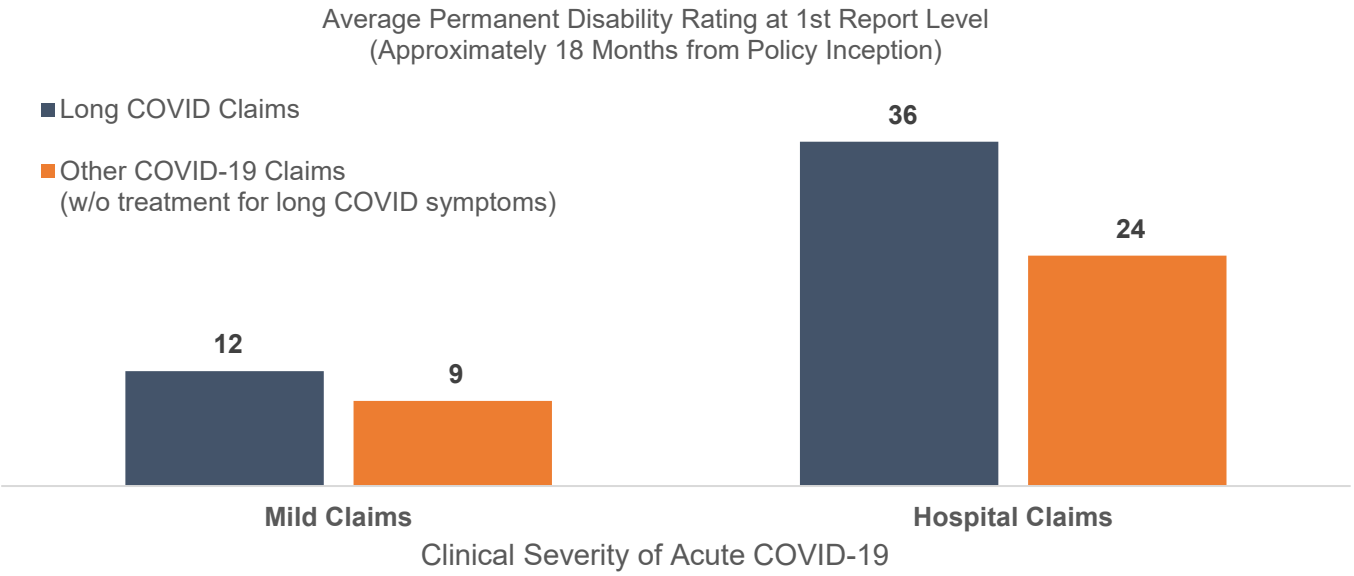
33 Preliminary findings from the state of Washington using the workers' compensation data showed that after returning to work, 17% of workers with long COVID required reduced hours, while 12% required modified jobs. Long COVID presentation at the 2023 WCRI Annual Conference; Ham (2022). Long-Haulers and Labor Market Outcomes. Institute working paper (Federal Reserve Bank of Minneapolis. Opportunity and Inclusive Growth Institute).

Figure 17. Temporary and Permanent Disability for Long COVID Claims



In California, the PD rating is based on the extent of permanent disability and determines the amount of PD benefits the injured worker receives. Among COVID-19 claims involving PD benefits, long COVID claims have a much higher average estimated PD rating than other COVID claims (**Figure 18**). For hospital claims with PD benefits, the average estimated PD rating for long COVID claims is 36% compared to 24% on COVID-19 claims without treatment for long COVID symptoms.

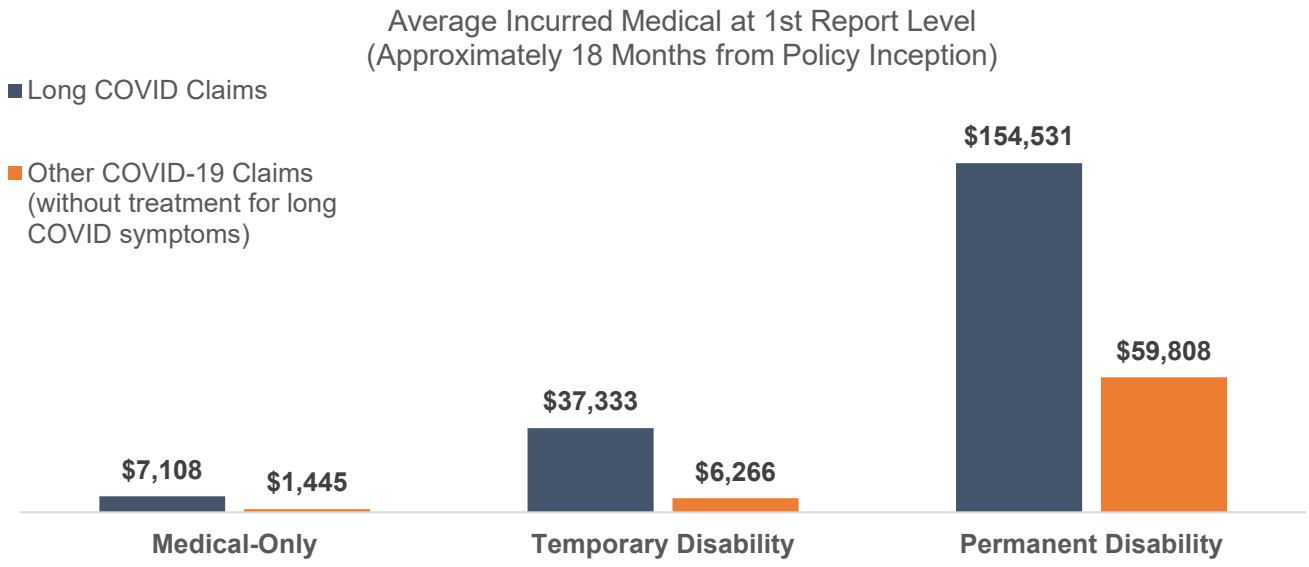
Figure 18. Permanent Disability Rating[34] for Long COVID Claims



34 Figure 18 includes COVID-19 claims in the WCIRB USR data as of approximately 18 months from policy inception. The majority (73%) of these claims remained open as of approximately 18 months from policy inception, therefore the average PD ratings in the analysis represent estimated ratings and not final ratings.

As expected, the average incurred medical payments valued at approximately 18 months from policy inception for long COVID claims with disability benefits are significantly higher than other COVID-19 claims, six times as high on TD claims and almost three times as high on PD claims (**Figure 19**). Our analysis further identified that home health services (including nursing care and rehabilitation services), ambulance services, as well as portable oxygen systems, are key drivers of medical costs on long COVID claims. These services are often needed to manage more severe symptoms of long COVID and help patients recover.

Figure 19. Average Incurred Medical for Long COVID Claims with Temporary or Permanent Disability



Research question 4: *How does long COVID prevalence in the California workers' compensation system compare to long COVID prevalence in the California group health insurance system?*

Research Questions

The comparison of estimates of long COVID prevalence in workers treated in the group health system with those treated in the workers' compensation system is limited to COVID-19 patients with an infection in 2020, as the sample of COVID-19 patients in the group health data were those that had the initial infection in that year. As shown in **Table 2**, COVID-19 patients in the group health data share a somewhat similar distribution of clinical severity of acute COVID-19 as those in the workers' compensation system, with the vast majority having a mild infection. The group health data shows a higher share of mild COVID-19 patients, possibly due to the emergency nature of the pandemic that may have led workers to seek care under group health insurance, particularly in the first few months of the pandemic.

Table 2. Clinical Severity Distribution of COVID-19 Patients: Group Health System versus Workers' Compensation System (Accident Year 2020)

Clinical Severity of Acute COVID-19	Share of COVID-19 Patients in the Workers' Compensation Data (N = 7,226)	Share of COVID-19 Patients in the California Group Health Data (N = 19,572)
Mild (no hospital care)	93.2%	95.3%
Severe (no ICU, excl. deaths)	3.3%	2.2%
Critical (w/ ICU, excl. deaths)	3.4%	2.5%
Total	**100%**	**100%**

As detailed in the Research Methods section, some new symptoms treated for COVID-19 patients during the post-acute care period may not be directly related to COVID-19, as group health insurance covers medical treatments for a wide range of medical conditions regardless of whether they are work-related and linked to the original COVID-19 illness. In order to estimate the background rates of symptoms that are not attributable to COVID-19, we created a control group of approximately 39,000 non-COVID-19 patients who were similar in age, gender and the time of initial care (see **Table A3** in the Appendix for more information on the control group). In addition, in order to more accurately identify long COVID claims in the group health data, we adjusted the definition of long COVID claims in the group health insurance system to COVID-19 claims that involved treatment for at least two long COVID symptoms during the post-acute care period.

As shown in **Figure 20**, for patients with a mild illness in the acute phase, 25% of COVID-19 patients and 13% of non-COVID-19 patients received medical treatments for persistent symptoms during the 12-month post-acute care period. This implies an excess risk of long COVID of 12 percentage points between the case and control patient groups, which translates to about one in eight workers who survived COVID-19 experiencing long COVID during the 12-month post-acute care period. For patients who required hospital care in the acute phase, the excess risk of long COVID is much higher, about 20 percentage points. This translates to about one in five workers who were initially hospitalized for COVID-19 at risk of developing long COVID. Overall, the excess risk of long COVID among COVID-19 survivors in the group health insurance system is estimated to be 13%, or about one in eight. This estimate reasonably validates the estimates in the workers' compensation system, albeit with a lower prevalence estimate for patients who were hospitalized for the initial infection (**Figure 21**).

Figure 20. Estimated Prevalence of Long COVID in the Group Health Insurance System[35] (Accident Year 2020)

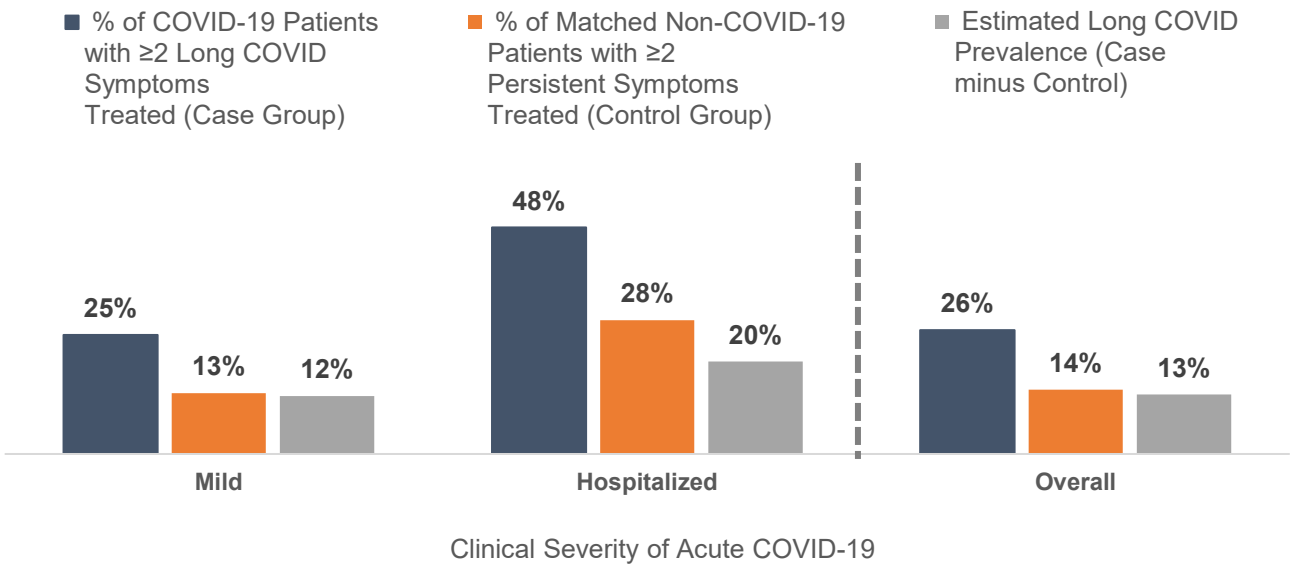
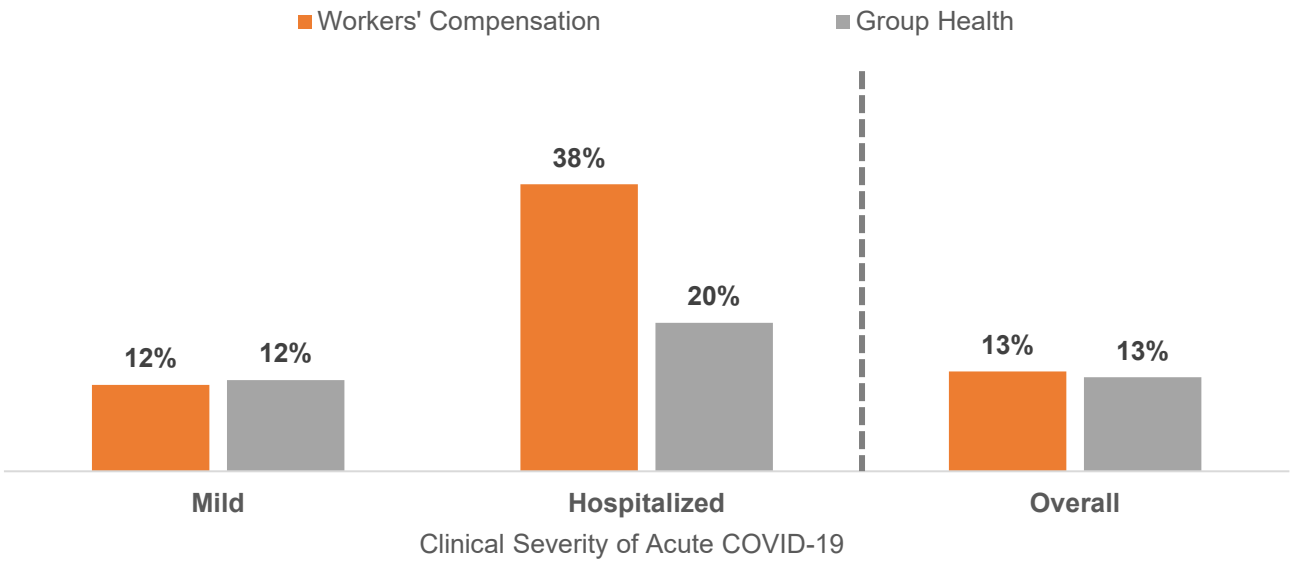


Figure 21. Estimated Prevalence of Long COVID during the 12-Month Post-Acute Care Period in the Group Health Insurance System and Workers' Compensation System in California[36] (Accident Year 2020)



The lower estimated prevalence of long COVID in the group health insurance system among workers who were hospitalized for the initial infection may be attributed to several factors. First, during the early stages of the pandemic, many private insurers voluntarily opted to temporarily waive copayments or deductibles related to COVID-19 treatments. However, by late 2021, most insurers reintroduced the out-of-pocket payments for such treatments, leading to increased cost sharing in group health plans.[37] This change in private health coverage may have influenced the decisions of workers covered by group health insurance when considering whether to seek care, particularly among those who were initially hospitalized and may have needed additional treatments for long COVID symptoms compared to those with a mild initial infection. According to a recent U.S. health insurance survey of over 6,000 respondents under age 65 by the Commonwealth Fund, approximately one in five

35 The non-COVID-19 patients who were hospitalized in 2020 were more likely to have cardiovascular or chronic kidney diseases and experience subsequent cardiac or renal symptoms during the post-acute care period, compared to COVID-19 patients who were hospitalized for COVID-19 in the same year. The cardiac and renal symptoms were rare among the long COVID symptoms treated in the COVID-19 patient case group. Therefore, in order to more accurately estimate long COVID prevalence in the group health data, we excluded cardiac and renal symptoms from the set of long COVID symptoms for both case and control patient groups.

36 To enable a valid comparison of long COVID prevalence between group health and workers' compensation datasets, we limited the workers' compensation COVID-19 claims to those with an initial infection in 2020 and excluded cardiac and renal symptoms that were treated during the post-acute care period. Our study identified only 3 (0.3%) long COVID claims for AY2020 in the workers' compensation system to have cardiac or renal symptoms as the only type of long COVID symptoms.

37 Kates J, Cox C and Cubanski J et al. (2023). Commercialization of COVID-19 Vaccines, Treatments, and Tests: Implications for Access and Coverage. Kaiser Family Foundation.

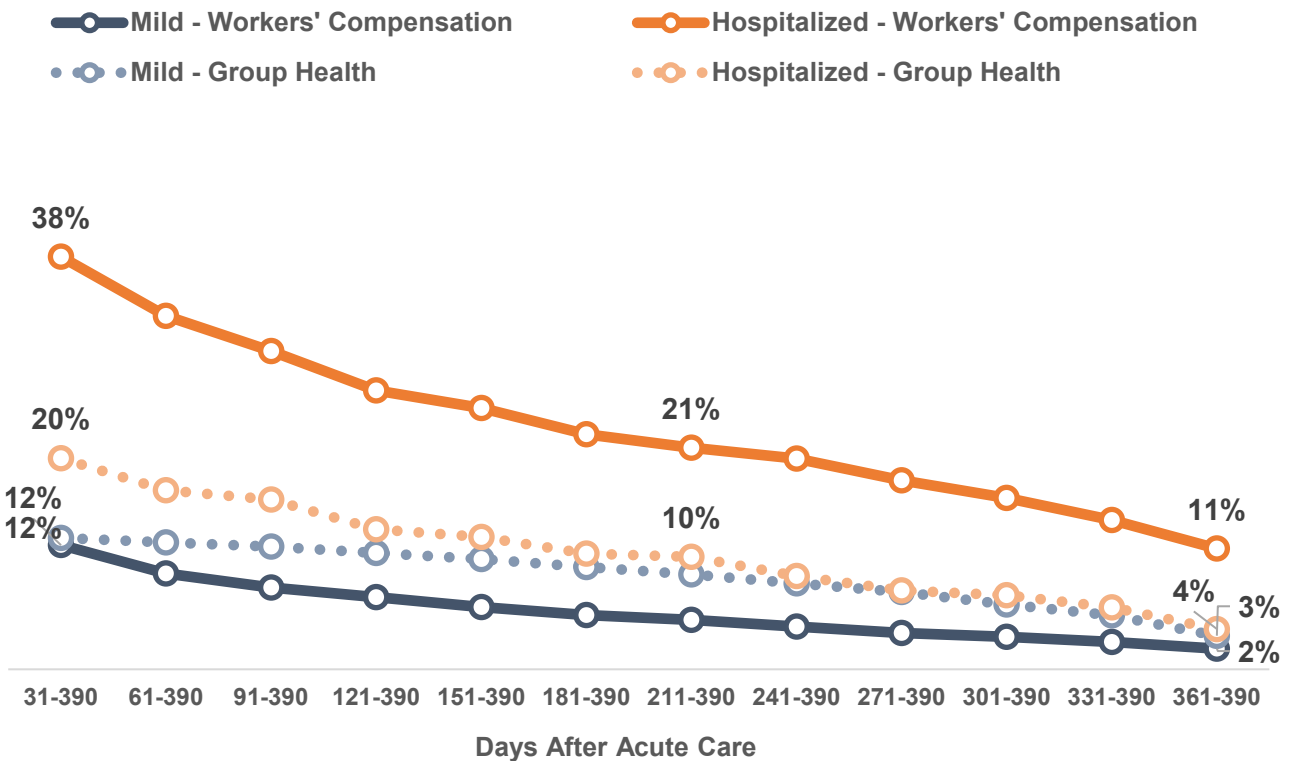
working-age adults fully insured under either group health or individual insurance reported skipping or delaying care in 2022 due to the high cost sharing associated with their insurance plans.[38]

Second, the share of working-age adults with group health insurance declined during the pandemic, as indicated by a 2021 report by the U.S. Census Bureau.[39] The report showed that the decline in coverage was mostly driven by the volatile labor market during the pandemic that caused many people to lose their jobs. At the same time, the Census Bureau report indicated an increase in the share of working-age adults covered by public insurance programs such as Medicaid. It is possible that COVID-19 patients who were hospitalized during acute care were more likely to lose their group health coverage and transition to a public insurance program. Consequently, the group health data may not accurately capture the treatments received by those who lost group health coverage, particularly for long COVID symptoms. In contrast, workers with COVID-19 workers' compensation claims, especially those involving hospitalization, do not lose coverage during treatment and recovery. As a result, the workers' compensation data may capture long COVID treatments for hospital claims more accurately than the group health data.

Third, it is important to consider that non-COVID-19 patients in the control group who were hospitalized in 2020 may have more serious underlying medical conditions that necessitated inpatient care at a time when non-urgent hospital procedures and treatments were often limited to mitigate the spread of COVID-19. Consequently, these patients may be more susceptible to experiencing persistent symptoms in the long term. When comparing the excess risk of long COVID between the case group of COVID-19 hospitalized patients and this control group, it is possible that the true prevalence of long COVID among those who were previously hospitalized for COVID-19 is underestimated.

Long COVID symptoms persisted over time similarly for patients treated in both insurance systems (**Figure 22**). In the group health insurance system, among those who were hospitalized for the acute infection, approximately 10% (half of the share (20%) in the first month) continued to receive treatments for long COVID symptoms after 6 months following acute care (211-390 days), and 4% (about a fifth of the share in the first month) still required treatments for long COVID symptoms in the 12th month (361-390 days). For mild cases, long COVID symptoms appear to be slightly more persistent in the group health system over time, but the trends converged in the 12th month.

Figure 22. Persistence of Long COVID over the 12-Month Post-Acute Care Period in the Group Health Insurance System and Workers' Compensation System in California (Accident Year 2020)



38 The Commonwealth Fund (2022). The State of U.S. Health Insurance in 2022. https://www.commonwealthfund.org/publications/issue-briefs/2022/sep/state-us-health-insurance-2022-biennial-survey

39 Keisler-Starkey K and Mykyta L (2022). Employment-Based Health Insurance Declines for Working-Age Adults During Pandemic. U.S. Census Bureau. https://www.census.gov/library/stories/2021/09/private-health-coverage-of-working-age-adults-drops-from-early-2019-to-early-2021.html

Research question 5: *How do comorbidities affect the prevalence of long COVID?*

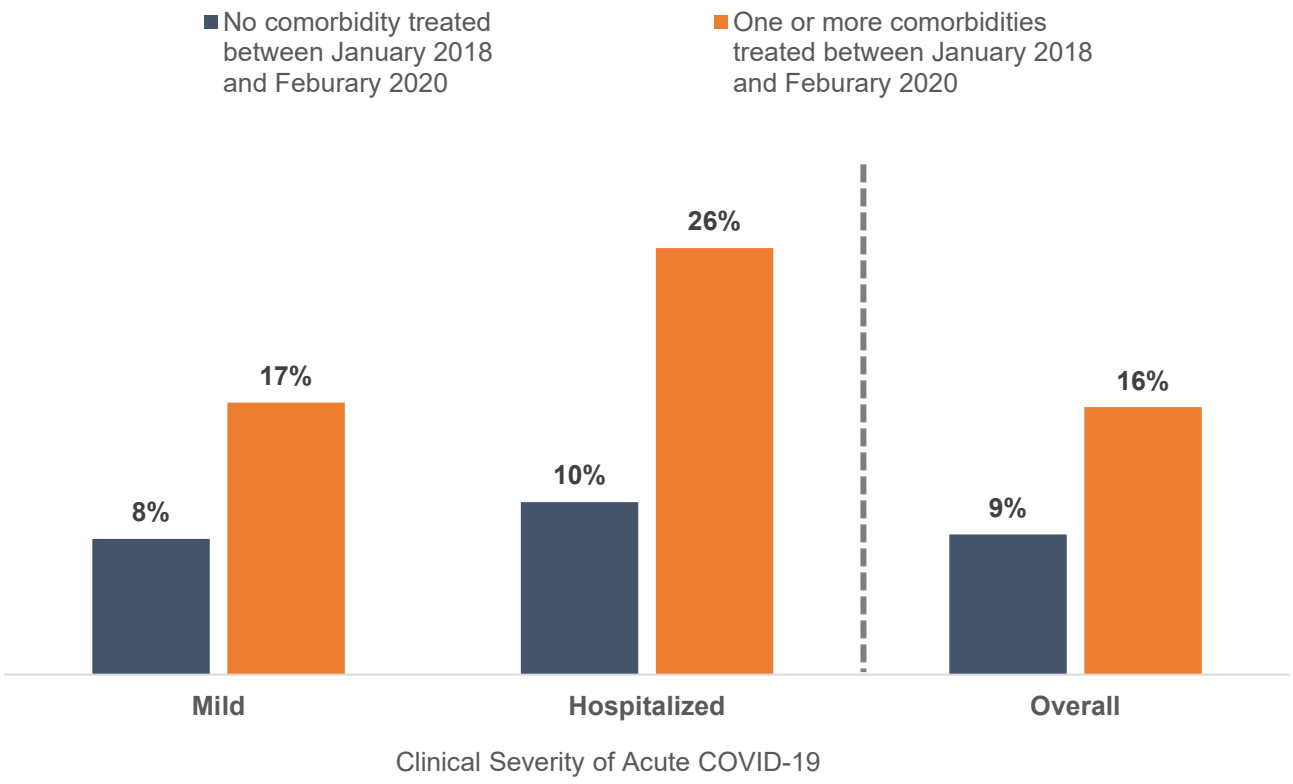
Research Questions

Published research has shown that patients with certain pre-existing comorbidities, such as hypertension, obesity and diabetes, are at a higher risk of experiencing severe illness from COVID-19.[40] Additionally, those who had any comorbidity before contracting COVID-19 are less likely to return to their pre-infection physical function. Research on the impact of comorbidities on long COVID has been emerging, and one study in the U.K. suggested that people with comorbidities are more likely to develop long COVID symptoms.[41]

While we do not have reliable information on pre-injury health status for workers filing COVID-19 claims in the workers' compensation system, we were able to gain a better understanding of the potential impact of pre-infection comorbidities on the prevalence of long COVID by analyzing the comorbidity information of workers in the group health data. Similar to how we estimated long COVID prevalence, we assessed the excess risk of long COVID for those with and those without a comorbidity between the case and control patient groups. It is important to note that the comorbidity status of each patient was based on whether the patient received care for any comorbidity during the two years preceding the pandemic, and therefore may not capture comorbidities that were not treated during the two-year period.

Based on the sample of California workers in the group health data, the presence of comorbidities is associated with a higher risk of developing long COVID (**Figure 23**). The risk differential is fairly consistent across patients with different clinical severity of acute COVID-19: those with any pre-existing comorbidity would be approximately twice as likely to develop long COVID than those without any treated comorbidity. Our analysis also identified hypertension, cancer and use of corticosteroids (immunosuppressants) as the leading risk factors for long COVID among patients with a mild initial infection, while diabetes or obesity increases risks for developing long COVID among patients who were hospitalized for the acute infection.

Figure 23. Estimated Prevalence of Long COVID in the California Group Health Insurance System by Comorbidity Status[42]



40 CDC. Underlying Medical Conditions Associated with Higher Risk for Severe COVID-19: Information for Healthcare Professionals. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html

41 Evans RA, McAuley H, Harrison EM, et al. Physical, cognitive, and mental health impacts of COVID-19 after hospitalisation (PHOSP-COVID): a UK multicentre, prospective cohort study [published correction appears in Lancet Respir Med. 2022 Jan;10(1):e9]. *Lancet Respir Med.* 2021;9(11):1275-1287

42 See **Table A4** in the Appendix for more information on the case and control groups by comorbidity status.

Conclusions

Our study analyzed approximately 10,000 COVID-19 claims with medical payments filed in the California workers' compensation system with an accident date between April 2020 and December 2021, revealing key differences in the patterns of medical treatment and costs between COVID-19 claims in 2020 and those in 2021. These differences may reflect increased availability of hospital resources, the impacts of vaccines and improved treatment protocols, as well as higher population immunity during the second year of the pandemic. Specifically, while the vast majority of COVID-19 claims involved mild initial infections in both years, there are notable shifts in the distribution of hospital claims in 2021. We observed a slightly higher share of severe claims that required hospitalization but not intensive care and a lower share of critical claims that required intensive care. Hospital claims in 2021 also had a shorter average hospital stay and a lower share of claims requiring ventilator support. Despite these changes, COVID-19 claims in both years remained significantly more likely to involve hospitalization and fatality than non-COVID-19 claims. These hospital and death claims, particularly those involving ICU care, remained the key medical cost drivers of COVID-19 claims.

Our updated estimates of the prevalence of long COVID showed that about one in eight workers who previously had medical treatments for a COVID-19 infection received medical treatments for long COVID symptoms during a 12-month period following acute care. Similar to what we found previously, the risk of developing long COVID is significantly higher (more than 3 times) for those who were hospitalized for the acute infection than those who had a mild initial infection. Furthermore, we found long COVID symptoms persisted over time, with about one in eight of those who were initially hospitalized still requiring medical care for long COVID symptoms in the 12th month after acute care. Our estimates of long COVID and its persistence in the workers' compensation system are reasonably validated by our estimates of a large sample of more than 19,000 California workers who received COVID-19 care in the group health insurance system.

Our findings on the characteristics of workers who experienced long COVID were also consistent with published research. Workers who are older, female, employed in the healthcare industry, and have pre-existing comorbidities are more likely to experience long COVID. Healthcare workers, who were more likely to be vaccinated than workers in other industries in early 2021, appeared to have a lower risk of developing long COVID when initially infected in early 2021 compared to other workers.

Based on preliminary data on COVID-19 claims involving disability benefits, we found that workers who developed long COVID were significantly more likely to receive permanent disability benefits than workers who had COVID-19 but did not require treatment for long COVID symptoms. The average incurred medical cost for long COVID claims involving permanent disability benefits was also substantially higher than other COVID-19 claims with permanent disability benefits.

As the scientific understanding and published information on long COVID evolves and more post-acute infection data becomes available, the WCIRB plans to update the long COVID analysis. In this future study, the WCIRB intends to explore medical costs and treatment patterns for long COVID claims and the potential reopening of claims to treat long COVID symptoms, as well as continue to examine the impacts of long COVID on permanent disability.

Conditions and Limitations

- The analysis of the California workers' compensation claims is based solely on the experience of insured employers and does not reflect self-insured employer experience. The analysis of COVID-19 patients who utilized group health insurance for COVID-19 care is based on a sample of workers of both insured and self-insured employers in California and does not reflect the entire group healthcare system.

- The COVID-19 workers' compensation claims included in the analysis are COVID-19 claims with paid transactions in the WCIRB's medical transaction database and with medical payments in either the USR or indemnity transaction database as of February 7, 2023. We conducted reasonableness checks on these claims, such as age and industry mix, and believe this group of claims is a good representation of COVID-19 claims in the workers' compensation system.

- The estimated prevalence of long COVID using medical transaction data in both the workers' compensation system and group health insurance system represents medically treated long COVID symptoms among workers in either system, which may be those with more serious health complications of COVID-19 that warranted medical attention. However, it is important to note that our estimates do not capture workers who received care for long COVID symptoms outside either system or chose to not seek care for their symptoms. Furthermore, the clinical guidelines for diagnosing and treating long COVID are still evolving, and the biological mechanisms and full range of long COVID symptoms are not yet fully understood. Therefore, our long COVID analysis, which relied on the ICD information reported on the medical service records in the two datasets, was based on published scientific information available at the time of the analysis. The WCIRB will continue to incorporate updates in the medical literature in the follow-up analysis of long COVID.

- The workers' compensation data in this study reflects information on claims submitted by insurers to the WCIRB through submissions of USR data, indemnity transaction data and medical transaction data. While the individual insurer data submissions are regularly checked for consistency and comparability with other data submitted by the insurer, as well as with data submitted by other insurers, the source information underlying each insurer's data submission is not audited by the WCIRB.

Appendix

Table A1. List of Diagnostic-Related Group (DRG) Codes Used to Identify Group Health Patients Hospitalized for Acute COVID-19 Infection

DRG Code	DRG Description
003	ECMO or Tracheostomy with Mechanical Ventilation >96 Hours or Principal Diagnosis Except Face, Mouth and Neck with Major O.R. Procedures
004	Tracheostomy with Mechanical Ventilation >96 Hours or Principal Diagnosis Except Face, Mouth and Neck without Major O.R. Procedures
166	Other Respiratory System O.R. Procedures with MCC
167	Other Respiratory System O.R. Procedures with CC
168	Other Respiratory System O.R. Procedures without CC/MCC
177	Respiratory Infections and Inflammations with MCC
178	Respiratory Infections and Inflammations with CC
179	Respiratory Infections and Inflammations without CC/MCC
189	Pulmonary Edema and Respiratory Failure
193	Simple Pneumonia and Pleurisy with MCC
194	Simple Pneumonia and Pleurisy with CC
195	Simple Pneumonia and Pleurisy without CC/MCC
199	Pneumothorax with MCC
200	Pneumothorax with CC
201	Pneumothorax without CC/MCC
204	Respiratory Signs and Symptoms
205	Other Respiratory System Diagnoses with MCC
206	Other Respiratory System Diagnoses without MCC
207	Respiratory System Diagnosis with Ventilator Support >96 Hours
208	Respiratory System Diagnosis with Ventilator Support < = 96 Hours
865	Viral Illness with MCC
866	Viral Illness without MCC
870	Septicemia or Severe Sepsis with Mechanical Ventilation >96 Hours
871	Septicemia or Severe Sepsis without Mechanical Ventilation >96 Hours with MCC
872	Septicemia or Severe Sepsis without Mechanical Ventilation >96 Hours without MCC

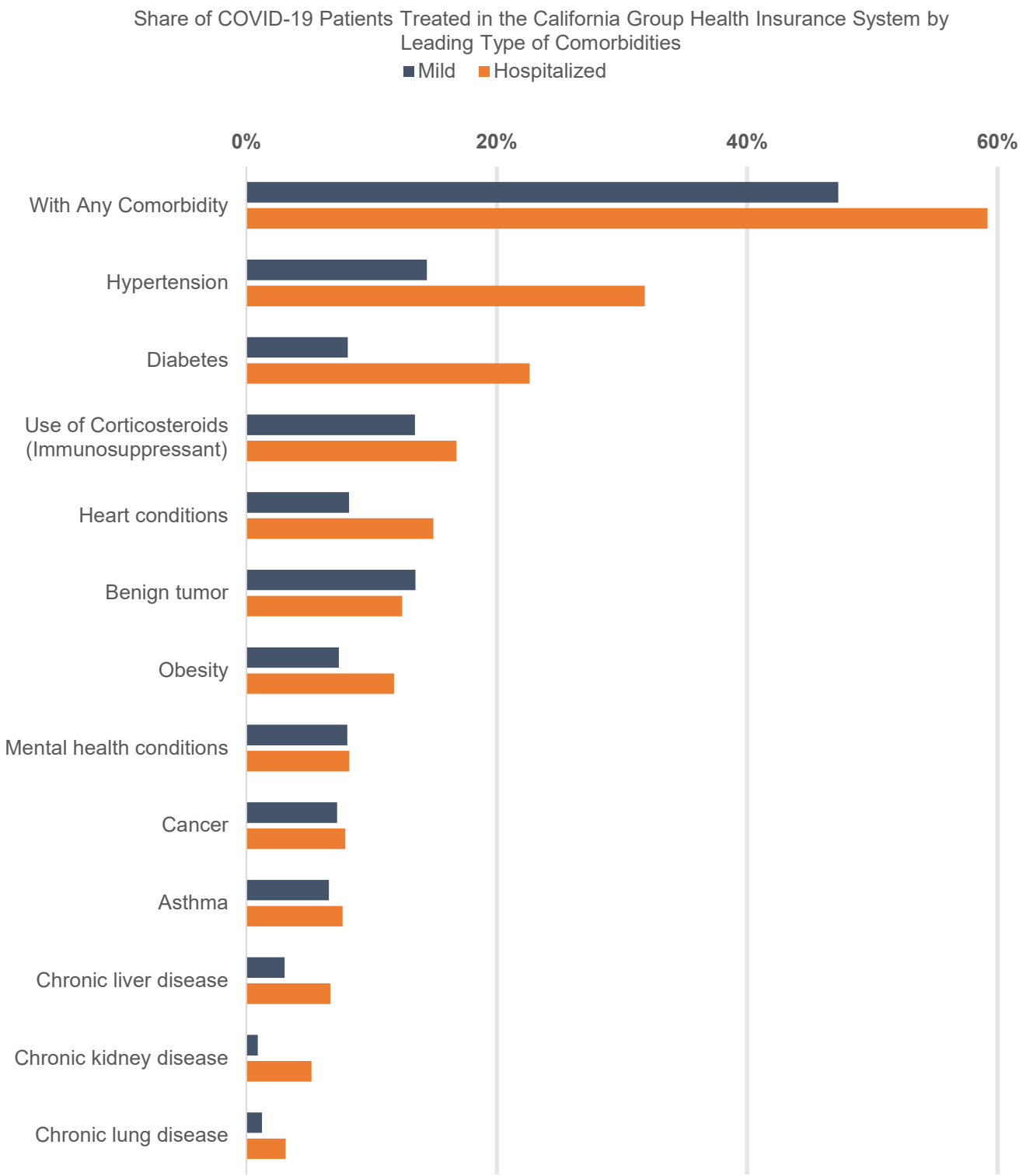
Table A2. The International Classification of Diseases (ICD) Information Used to Identify Long COVID Symptoms[43]

Long COVID Symptom Category	ICD code
Cardiac	B332, I05-I09, I20-I25, I40-I43, I47-I49, I514, J108, J118, O903, Z986
Circulatory	D473, D65, D68-D69, D758, G46, I67-I68, I82, M362, R00-R01, R030
Diabetes	E102
General Symptoms	Malaise and Fatigue (R531, R538), Fever (R50), Headache (R51), Unspecified pain (R52), Digestive symptoms (R19)
Mental / Psychiatric	F063-F064, F325, F334, F348-F349, F39, F40-F41, G47, R063, R45-R46
Musculoskeletal	M255-M256, M546-M549, M62-M63, M791, M796
Neurological	A85-A86, F01-F03, F05, G04-G05, G26, G31, G50-G59, G61-G65, G933, R26-R29, R400, R41, R438, R439, R44
Renal	N17-N19
Respiratory	I26, J06, J09, J12, J22, J80-J84, J90-J99, R05-R09, R91
Continued Care for Post-COVID-19 Conditions[44]	B948, U071, U099

43 Bull-Otterson L, Baca S, Saydah S, et al. Post–COVID Conditions Among Adult COVID-19 Survivors Aged 18–64 and ≥65 Years — United States, March 2020–November 2021. MMWR Morb Mortal Wkly Rep 2022;71:713–717. http://dx.doi.org/10.15585/mmwr.mm7121e1; CDC: Long COVID or Post-COVID Conditions. https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html

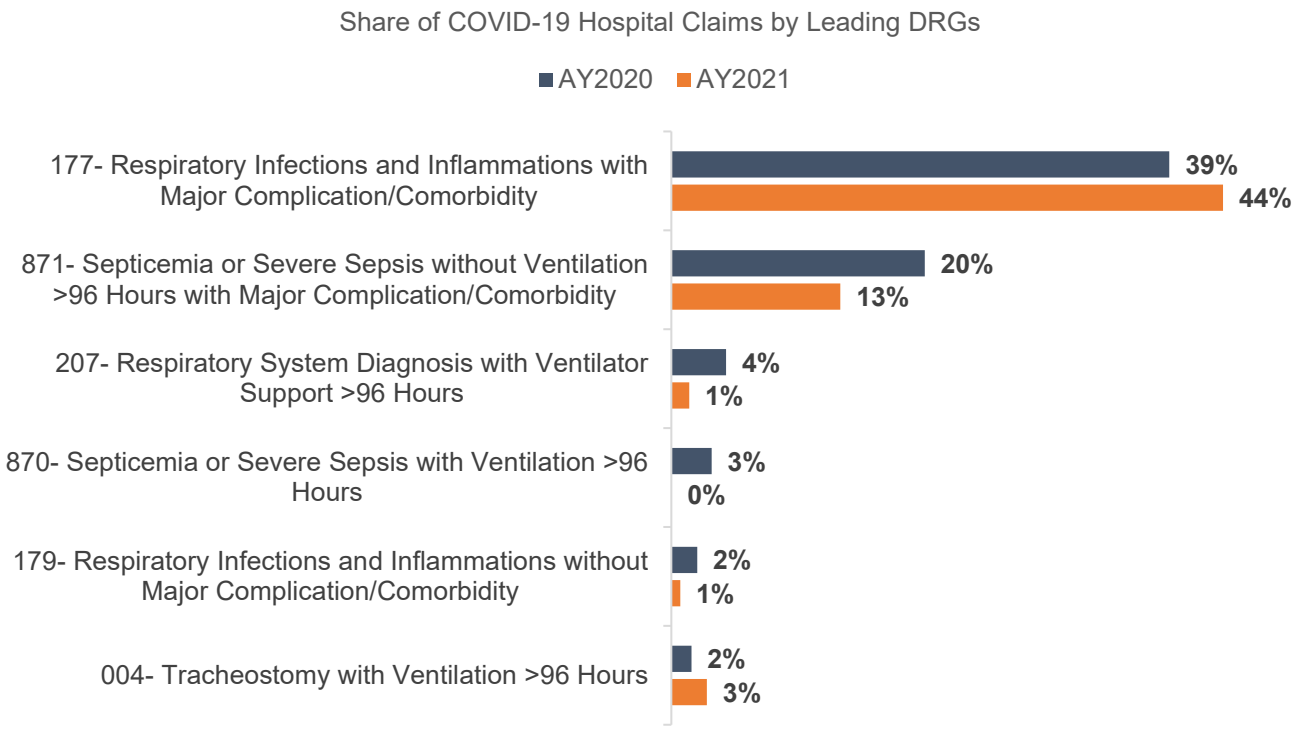
44 These ICD codes were used to identify continued treatment for post-COVID-19 conditions in the post-acute care period without the reporting of any specific symptoms. For the purpose of this study, claims that involved any treatment with one of these ICD codes were counted as those with long COVID.

Figure A1. Leading Pre-Existing Comorbidities among COVID-19 Patients Treated in the Group Health Insurance System[45]



45 CDC. Underlying Medical Conditions Associated with Higher Risk for Severe COVID-19: Information for Healthcare Professionals. https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html. The categories of comorbidities are not mutually exclusive (e.g., one patient can have multiple comorbidities). The pre-existing comorbidities are those treated between January 2018 and February 2020 in the California group health insurance system.

Figure A2. Leading Inpatient Procedures (Diagnostic-Related Group (DRG) for COVID-19 Hospital Claims in the Workers' Compensation System



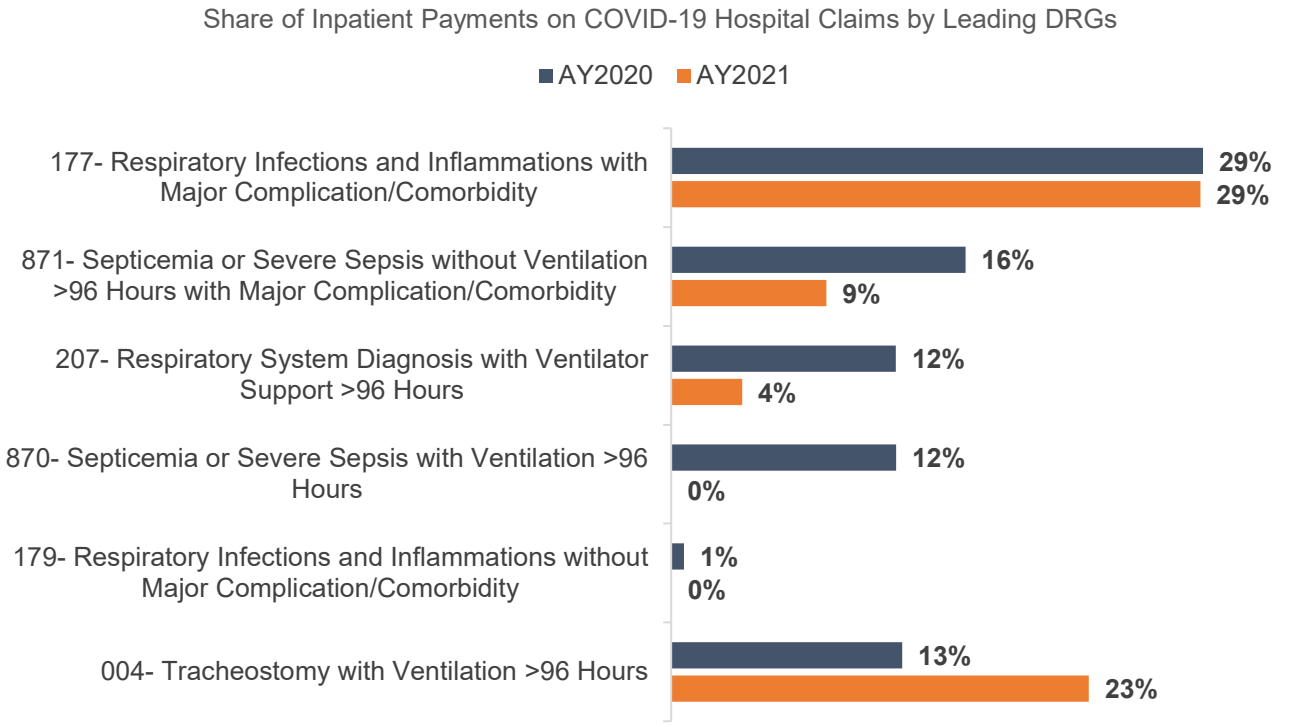


Table A3. Percentage of COVID-19 Patients with Long COVID Symptoms and of Matched Non-COVID-19 Patients with Persistent Symptoms in the Group Health Data (Accident Year 2020)

Initial Clinical Severity	No. of Patients (column %)		No. of Patients with ≥ 2 Persistent Symptoms[46] Treated during the 12-Month Post-Acute Care Period (% relative to all patients)		Absolute Risk Difference[47]
	Case Patient Group: COVID-19	Matched Control Group: Non-COVID-19	Case Patient Group: COVID-19	Matched Control Group: Non-COVID-19	
Mild	18,648 (91.4)	37,296 (90.2)	4,695 (25.2)	4,811 (12.9)	12.3%
Hospitalized	924 (8.6)	1,848 (9.8)	443 (47.9)	524 (28.4)	19.6%
Overall	**19,572 (100)**	**39,144 (100)**	**5,138 (26.3)**	**5,335 (13.6)**	**12.6%**

Table A4. Percentage of COVID-19 Patients with Long COVID Symptoms and of Matched Non-COVID-19 Patients with Persistent Symptoms by Comorbidity Status in the Group Health Data (Accident Year 2020)

	Share of Patients with ≥ 2 Persistent Symptoms Treated during the 12-Month Post-Acute Care Period				Absolute Risk Difference[48]	
Initial Clinical Severity	No Comorbidity Treated during the Two Years Prior to the Pandemic		With Any Comorbidity Treated during the Two Years Prior to the Pandemic		No Comorbidity	With Any Comorbidity
	Case Patient Group: COVID-19	Matched Control Group: Non-COVID-19	Case Patient Group: COVID-19	Matched Control Group: Non-COVID-19		
Mild	21%	13%	30%	13%	8%	17%
Hospitalized	38%	27%	55%	29%	10%	26%
Overall	**22%**	**13%**	**31%**	**15%**	**9%**	**16%**

46 Group health claims with at least 2 persistent symptoms were those that involved treatment with the reporting of two distinct ICD codes for symptoms.

47 The absolute risk difference between COVID-19 patients and matched non-COVID-19 patients was calculated as a percentage point difference (e.g., 12.3% for the mild group is calculated as 25.2% minus 12.9%).

48 The absolute risk difference between COVID-19 patients and matched non-COVID-19 patients by comorbidity status was calculated as a percentage point difference for those with any comorbidity (e.g., 8% for the mild group is calculated as 21% minus 13%) and those without any comorbidity (e.g., 17% for the mild group is calculated as 30% minus 13%).

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