Solve Long Covid INITIATIVE

Long Covid Impact on Adult Americans:
Early Indicators Estimating Prevalence and Cost

A Solve Long Covid Initiative White Paper

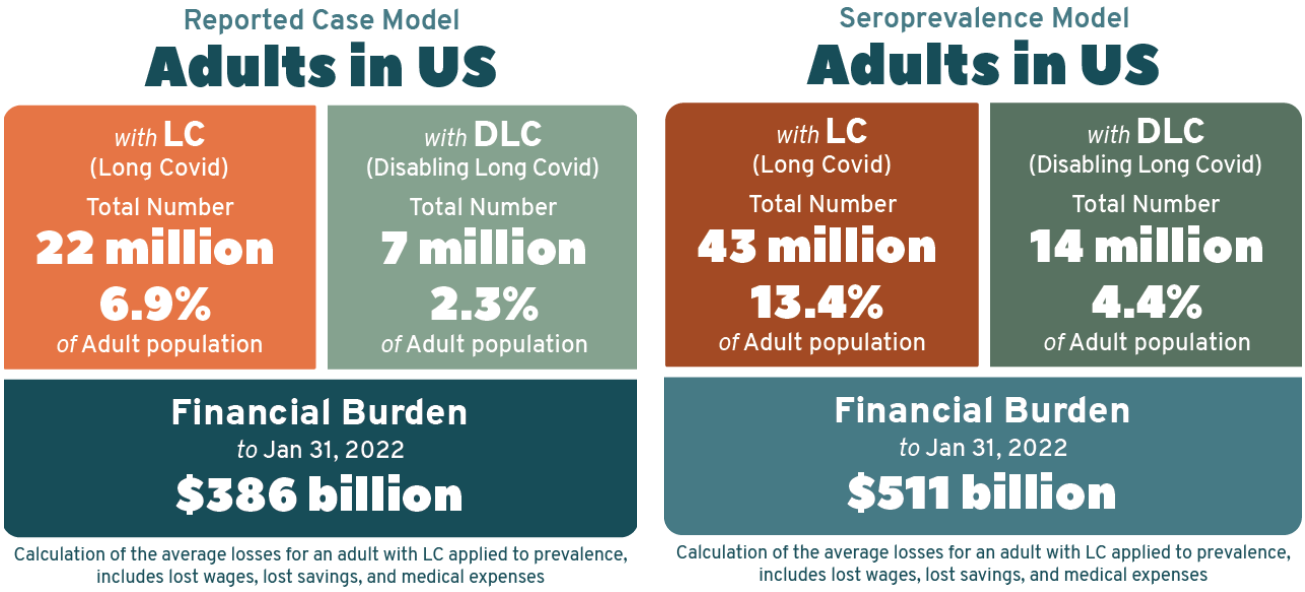
April 5, 2022

CONTENTS

EXECUTIVE SUMMARY

While most patients recover from COVID-19, as many as half experience lingering symptoms six or more months after their initial infection.[1] Long Covid is the patient-preferred term used to describe this experience of post-infection illness. Long Covid includes a broad range of symptoms that can be disabling, prevent the patient's recovery to pre-infection health, and thwart the patient's return to the workforce.

Using mathematical models, publicly available data, patient-led research, and the published natural histories of other post-infection illnesses, specifically myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), Solve M.E. estimates the prevalence and cost of Long Covid on adult Americans, presented here. Most importantly, these estimates differentiate between persons with milder symptoms and those experiencing disability or inability to work. While noting limitations of population and serology data, including under-reporting and gender bias, these mathematical models and analyses were developed with a specific emphasis on the impacts of this mass disabling event on American labor markets and labor shortages. Among the key findings, our models estimate:



The significant numbers of those impacted by Disabling Long Covid (DLC) highlight the need for changes to the structure of US disability benefit programs as demand exponentially increases. Particularly, there is a growing need for a scaled approach that reflects a spectrum of disability to replace the current "one-size-fits-all" approach. Additionally, employers will need to make significant, sustained efforts to accommodate their workers with post-infection illness.

While the overwhelming scale of COVID-19 and its estimated impacts on the labor force are the focus of this analysis, it is important to note that prior to the current pandemic, there was and remains an existing group of people who experience the long-term impacts post-infection diseases. These conditions include ME/

CFS, which was already costing the US economy up to $51 billion annually[2] and postural orthostatic tachycardia syndrome (POTS), which costs 51% of patients over $10,000 or more,[3] prior to the exponential growth caused by Long Covid. These should serve as a sobering reminder and a call to action to urgently address this looming public health crisis.

BACKGROUND

Post-infection illness is not new. It is a documented, yet still misunderstood medical and research challenge. Two years ago, the Solve ME/CFS Initiative (Solve M.E.) estimated the potential impact and cost of the inevitable post-infection chronic illnesses expected to follow just behind the COVID-19 pandemic. Drawing from the collected clinical and research knowledge of ME/CFS, Solve M.E. suggested that 3.5 million Americans may never return to health, resulting in $48 billion in economic cost.[4] Other Post-infection illnesses that exhibit many of the same symptoms as Long Covid include; myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), postural orthostatic tachycardia syndrome (POTS) and other forms of dysautonomia, and mast cell activation syndrome (MCAS). Several studies have found biological and clinical similarities between ME/CFS,[5] [6] POTS,[7] [8] and Long Covid. The Government Accountability office also recently concluded that between 7.7–23 million Americans have Long Covid.[9]

"The ME/CFS research community is an untapped scientific resource that will be vital to existing COVID-19 scientific, diagnostic, and treatment efforts."

– "America's Looming Health Crisis: COVID Patients Who Never Recover,"
Solve M.E. Whitepaper, April 21, 2020

To create these models, Solve M.E. applied the extensive knowledge base of ME/CFS in conjunction with mathematical modeling, threatcasting, and new information published over the past two years, including information on other post-infection illnesses. Like other post-infection illnesses, Long COVID is a complex, multi-system illness that increases medical needs. Patients with these illnesses require additional services, testing, visits, and specialists. The complexity of these illnesses is a contributing factor to increased healthcare expenses and costs for this patient population.[10]

It is critical to acknowledge the partnership, research, and expertise of the Long Covid patient-led organizations and recognize these predictive models would not exist without their contributions. The majority of these insights and data were published by the Long Covid patients themselves. Additionally, it's important to note the limitations of these mathematical models, especially when utilizing data that is known to potentially undercount cases and disproportionately exclude women and under-served communities (see Methodology pg 14).

The information presented in this publication represents early indications of prevalence and financial burden of "Long Covid," the patient-preferred term, alternatively labeled Post-Acute Sequelae of COVID-19 or (PASC) by some government and research bodies. Long Covid refers to individuals who experience new or worsening symp-

toms following a confirmed or suspected infection with SARS-Cov-2. PASC is an umbrella term, including those with Long Covid, in addition to other post-infection experiences, such as tissue damage or post-ICU syndrome. These terms embody the collection of post-infection symptoms, experiences, and challenges beyond the medical condition. What this paper hopes to capture are the extensive life-altering ramifications for adult Americans[11] struggling with Long Covid, both as a consequence of financial hardship, but also on communities collectively as reflected in labor markets and workforce.

What is Long Covid / PASC?

Long Covid / PASC describes a collection of lingering symptoms devastating the lives of many COVID-19 survivors. The most frequent prolonged symptoms—persistent fatigue, brain fog, and depleted energy after even a minimal effort—have a profound impact on everyday functioning. Penn State College of Medicine researchers found that over half of COVID-19 patients experience lingering symptoms six or more months after their initial infection.[12] Our models reflect that Long Covid affects an estimated 10-30% of people infected with SARS-CoV-2, including those who were asymptomatic.[13] [14] Researchers anticipate that millions of patients could have this disease for their lifetime.[15]

> "The Centers for Disease Control and Prevention (CDC) calls such cases 'post-COVID conditions,' an umbrella term that refers to a range of 'new, returning, or ongoing health problems' experienced by people four or more weeks after initial coronavirus infection. Post-COVID conditions also go by several other names, including long COVID, Long COVID, chronic COVID, and post-acute COVID-19."
>
> *—Yale Medicine. (2021, August 6). Long COVID (Post-Acute sequelae of SARS COV-2 infection, PASC). Yale Medicine. Retrieved March 18, 2022, from* **https://www.yalemedicine.org/conditions/long-covid-post-acute-sequelae-of-sars-cov-2-infection-pasc**

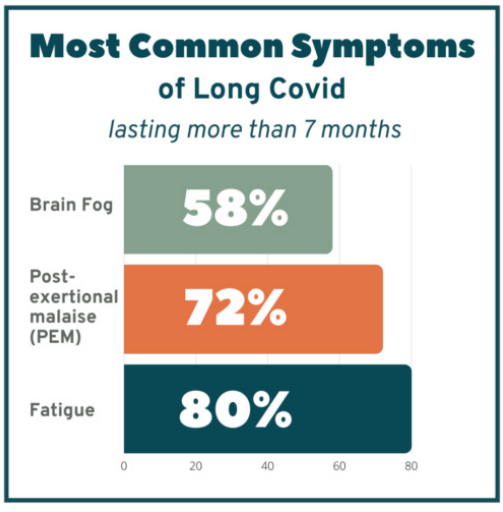


Figure 1. Most Common Symptoms of Long Covid.

Characterizing Long Covid in an international cohort: 7 months of symptoms and their impact. Davis et al, Lancet Jul. 2021

> "Researchers have identified several possible causes of Long Covid and have suggested that causes may vary from person to person (see fig. 2). For some, COVID-19 may cause the body to produce an antibody that mimics SARS-CoV-2 and triggers an autoimmune response in which the immune system attacks its own antibodies. For others, SARS-CoV-2 virus may persist in the body and cause symptoms. Another possible cause is organ damage from COVID-19. Research also suggests that microclots may form in blood vessels, blocking blood flow and causing tissue damage. And COVID-19 may disrupt the immune system and reactivate other previously contracted viruses, such as Epstein-Barr."
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> *—Science, Technology, Assessment, and Analytics, Science & Tech Spotlight: Long COVID (2022). US Government Accountability Office. Retrieved from* **https://www.gao.gov/assets/gao-22-105666.pdf**

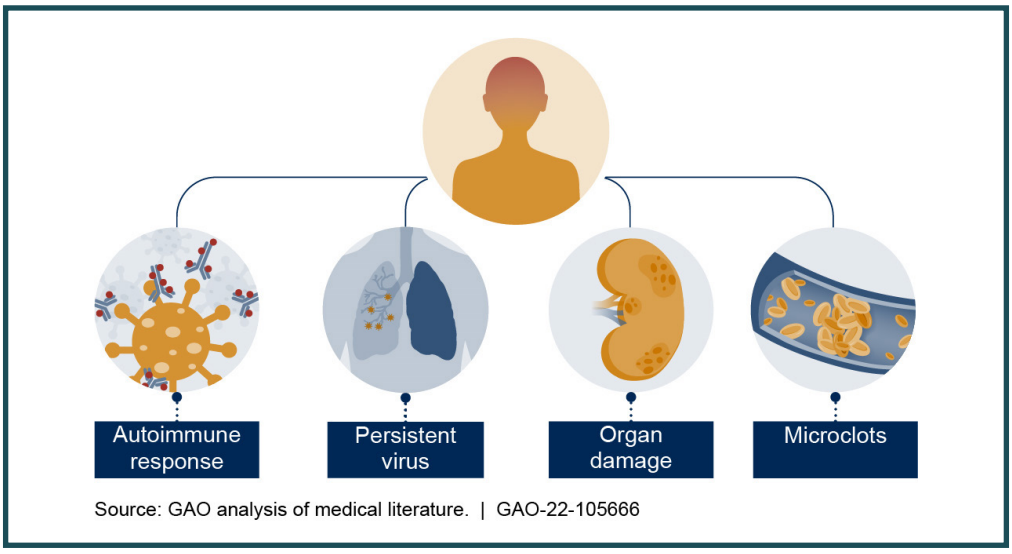


Figure 2. Some possible causes of Long Covid as suggested by researchers.

Science & Tech Spotlight: Long Covid (2022). US Government Accountability Office.

Long Covid (LC) in this paper is defined as a patient's experience of lingering or new symptoms following a suspected or confirmed case of COVID-19. These symptoms may or may not be causing work loss, disability, or disruption to daily life. Disabling Long Covid (DLC) in this paper is defined as a patient's experience of disabling or disruptive symptoms following a suspected or confirmed case of COVID-19. Those experiencing DLC are unable to fully function at their pre-infection level and the experience of lingering or new symptoms results in disability or reduced ability to work. Individuals experiencing DLC are assumed to be unable to work full-time or unable to work at their pre-illness working level.

About Solve Long Covid Initiative

Based on more than 30 years of research and advocacy experience advancing the understanding of post-infection diseases, the Solve Long Covid Initiative takes a strategic approach to integrating pre-pandemic and post-pandemic knowledge and community insights. Our work in the post-infection disease space has allowed us to create connections and build partnerships with researchers, clinicians, patients, government, and industry leaders. The Solve Long Covid Initiative represents a collection of new and expanded Solve M.E. programs in research, advocacy, and education that will improve outcomes for the millions suffering from poorly understood, chronic diseases.

SUMMARY OF KEY FINDINGS

Long Covid is a pervasive economic and healthcare concern following the spread of COVID-19 that affects every state in the nation. The Solve Long Covid Initiative models estimate that through January 31, 2022, the COVID-19 pandemic has potentially caused, at minimum, **22 million cases of Long Covid**, with a higher estimate model suggesting **more than 43 million cases**. This caseload includes **7 to 13%** of the total population of the United States. Of these cases, **7 to 14 million (2–4% of the total U.S. population) are expected to result in long-term disability**—placing individuals at risk of lifelong complex health problems and economic ruin from healthcare costs, unemployment, denied benefits, eviction, and homelessness.

The states carrying the highest total caseload of Long Covid cases are, unsurprisingly, those with the largest populations:

Table 1: Reported Case Model. Top 5 states for total Long Covid prevalence.

Ranking	State	LC Cases	DLC Cases
1	California	2.47 million	817,000
2	Texas	1.84 million	611,000
3	Florida	1.64 million	543,000
4	New York	1.40 million	464,000
5	Illinois	860,000	285,000

Table 2: Seroprevalence Model. Top 5 states for total Long Covid prevalence.

Ranking	State	LC Cases	DLC Cases
1	California	4.76 million	1.58 million
2	Texas	4.37 million	1.45 million
3	New York	2.83 million	936,000
4	Florida	2.49 million	828,000
5	Illinois	2.06 million	684,000

However, a more important statistic may be the proportion of a state's population that is afflicted by post-COVID symptoms; an area of concern due to many inequalities. People in states with high rates of COVID infection were disproportionately affected by poverty, chronic illness, and healthcare inequality prior to the pandemic. Pandemic response, testing and vaccination rates also impacted Long Covid outcomes. A high disease burden inflicted by elevated rates of post-COVID illness threatens to further entrench these inequalities:

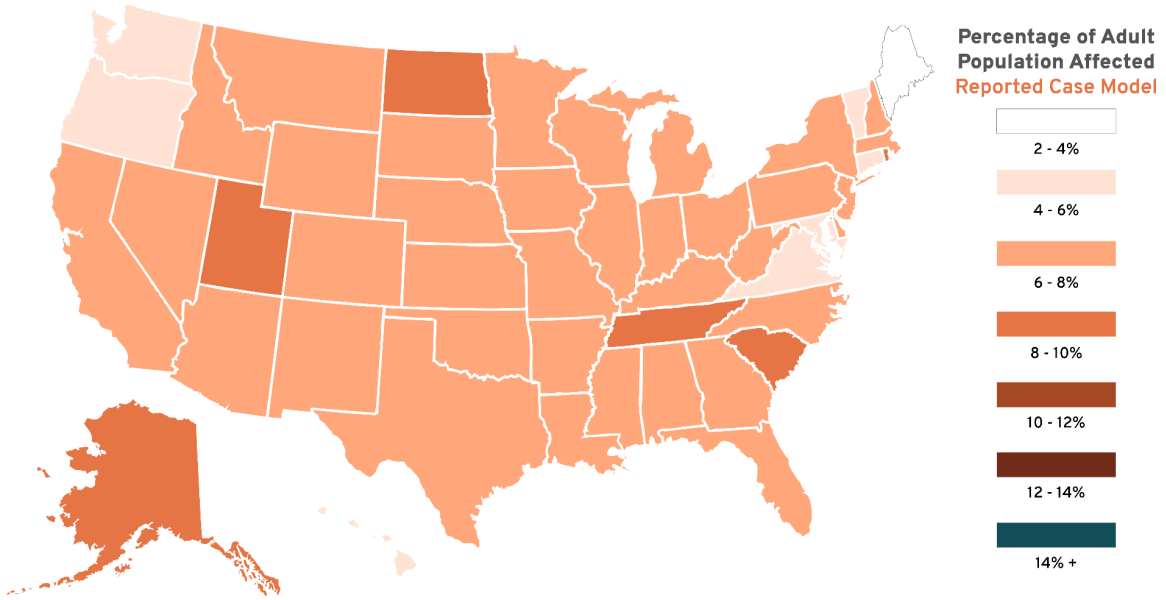
Table 3: States with the highest percentage of population affected by Long Covid.

Ranking	Reported Case Model			Seroprevalence Model		
	State	% LC	% DLC	State	% LC	% DLC
1	Rhode Island	9.5%	3.1%	North Dakota	16.7%	5.6%
2	North Dakota	8.8%	2.9%	Wisconsin	16.6%	5.5%
3	Utah	8.6%	2.9%	Iowa	16.2%	5.4%
4	Alaska	8.4%	2.8%	Illinois	16.1%	5.3%
5	Tennessee	8.3%	2.8%	Wyoming	15.9%	5.3%

The widespread disability and economic loss caused by Long Covid has inflicted a significant cost on the United States and its citizens. When the estimated cost of healthcare expenses, lost savings, and lost income are combined for the full estimated long-hauler population, *it is estimated that disability caused by Long Covid has cost over $386 billion since the pandemic began until January 31, 2022*. However, this statistic only captures the financial burden currently experienced by individuals—it does not begin to assess the long-term and indirect effects of this disease on businesses, communities, and federal, state, and local budgets.

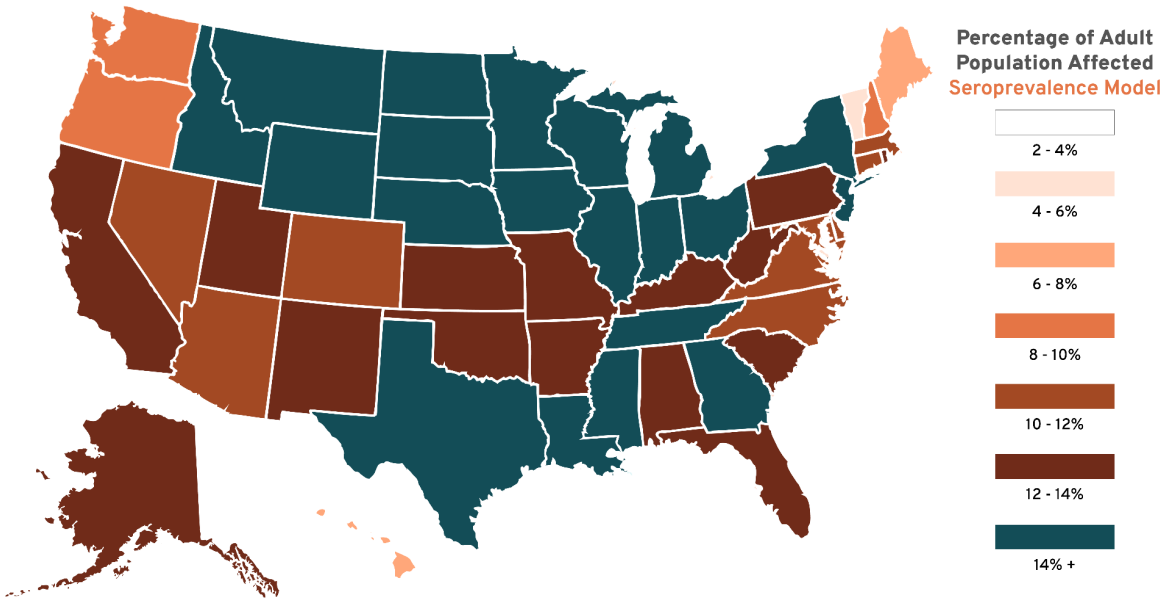
The disability caused by Long Covid greatly expands the pool of people experiencing long-term complex disability from illnesses such as ME/CFS, POTS and other forms of dysautonomia, and other post-infection illnesses. Prior to the pandemic, it is estimated that 2.5 million Americans live with ME/CFS, creating a $51 billion annual cost.[16] **The number of people experiencing disability from Disabling Long Covid (7–14 million) could be 3–5 times the total number of pre-pandemic ME/CFS patients—with over 7 times the cost**.

Map 1: Reported Case Model. Estimated total number of Long Covid (LC) cases in the United States as a percentage of each state's total population



CDC Case Task Force (2022). United States COVID-19 Cases and Deaths by State over Time [Dataset]. Centers for Disease Control and Prevention.
Whitaker, M. et al. (2021). Persistent symptoms following SARS-CoV-2 infection in a random community sample of 508,707 people. MedRxiv [Preprint].

Map 2: Seroprevalence Case Model. Estimated total number of Long Covid (LC) cases in the United States as a percentage of each state's total population



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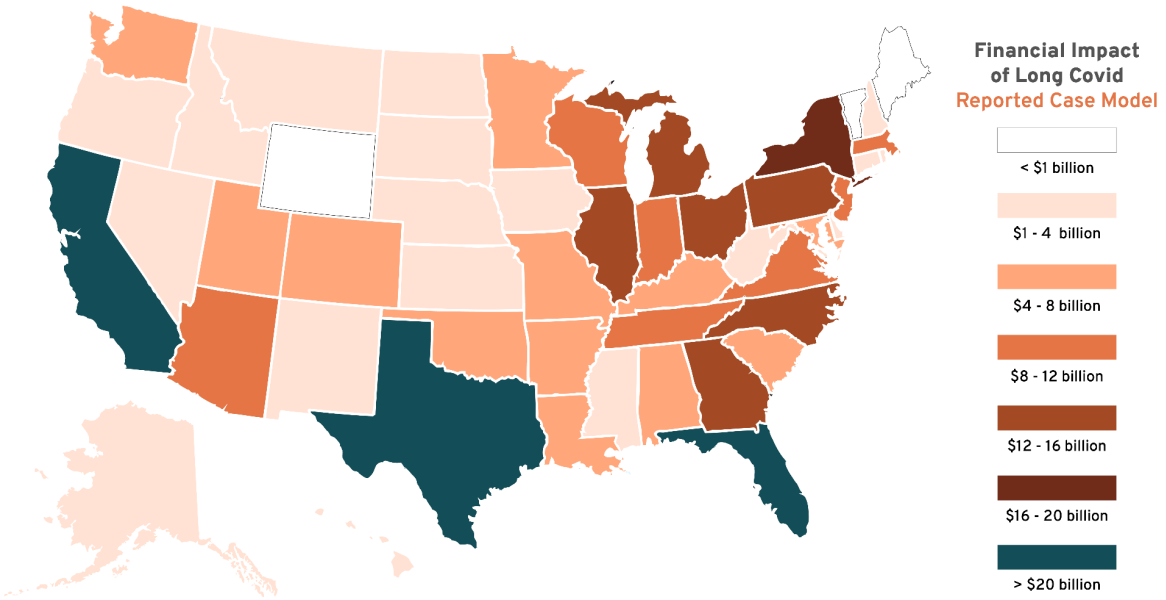
Map 3: Financial Burden of Long Covid (Reported Case Model). Estimated cost in lost wages, lost savings, and medical expenses to Disabled Long Covid (DLC) patients in the United States to January 31, 2022, broken down by state. This map uses the DLC estimates from the Reported Case Model.



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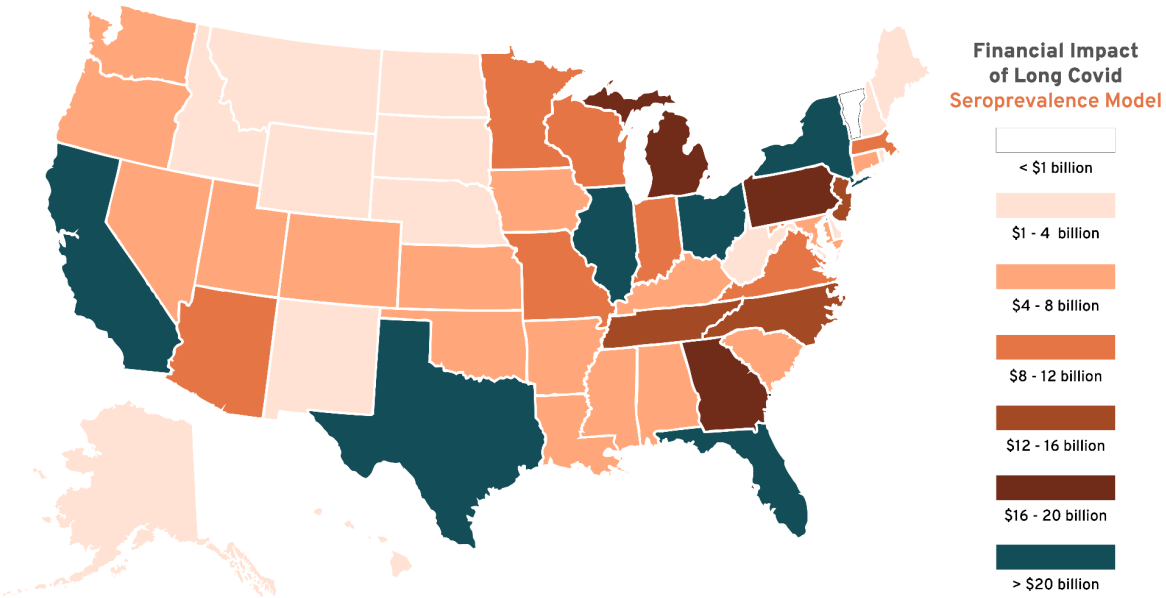
Whitaker, M. et al. (2021). Persistent symptoms following SARS-CoV-2 infection in a random community sample of 508,707 people. MedRxiv [Preprint].

Map 4: Financial Burden of Long Covid (Seroprevalence Model). Estimated cost in lost wages, lost savings, and medical expenses to Disabled Long Covid (DLC) patients in the United States to January 31 2022, broken down by state. This map uses the DLC estimates from the Seroprevalence Model.



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CDC Case Task Force (2022). United States COVID-19 Cases and Deaths by State over Time [Dataset]. Centers for Disease Control and Prevention.
Whitaker, M. et al. (2021). Persistent symptoms following SARS-CoV-2 infection in a random community sample of 508,707 people. MedRxiv [Preprint].

Table 4: Reported Case Model. Estimated number of Long Covid (LC) cases in the United States, broken down by state. Estimates for this model are based on the number of surviving COVID cases reported by the CDC. The number of LC cases is calculated at 30% of unvaccinated cases, with LC severe enough to cause disability being calculated as 10% of unvaccinated cases. A modified calculation is used for vaccinated breakthrough cases.

State	Number of LC Cases	Number of Disabling LC Cases	LC as Percent of State Population	DLC as Percent of State Population	Cumulative Cost to Jan 31, 2022
Alabama	363,000	121,000	7.5%	2.5%	$6.5 billion
Alaska	62,000	20,500	8.4%	2.8%	$1.1 billion
Arizona	554,000	184,000	8%	2.7%	$9.8 billion
Arkansas	230,000	76,500	7.7%	2.6%	$4.1 billion
California	2,470,000	817,000	6.3%	2.1%	$43.2 billion
Colorado	370,000	123,000	6.7%	2.2%	$6.7 billion
Connecticut	205,000	68,000	5.7%	1.9%	$3.7 billion
Delaware	73,000	24,000	7.7%	2.6%	$1.3 billion
District of Columbia	38,000	13,000	5.6%	1.8%	$700 million
Florida	1,640,000	544,000	8%	2.6%	$29.8 billion
Georgia	702,000	233,000	6.8%	2.3%	$12.6 billion
Hawaii	62,000	20,500	4.4%	1.4%	$1.1 billion
Idaho	113,000	37,500	6.7%	2.2%	$2 billion
Illinois	859,000	285,000	6.7%	2.2%	$15.5 billion
Indiana	481,000	160,000	7.3%	2.4%	$8.7 billion
Iowa	214,000	71,000	6.8%	2.3%	$3.9 billion
Kansas	216,000	72,000	7.4%	2.3%	$3.9 billion
Kentucky	344,000	114,000	7.8%	2.6%	$6.1 billion
Louisiana	330,000	110,000	7.1%	2.4%	$6 billion
Maine	52,000	17,000	3.9%	1.3%	$940 million
Maryland	281,000	93,000	4.7%	1.6%	$5.2 billion
Massachusetts	472,000	156,000	6.9%	2.3%	$8.6 billion
Michigan	669,000	222,000	6.7%	2.2%	$12 billion
Minnesota	391,000	130,000	7.1%	2.4%	$7 billion
Mississippi	216,000	72,000	7.2%	2.4%	$3.9 billion
Missouri	394,000	131,000	6.5%	2.2%	$7.1 billion
Montana	72,000	24,000	6.9%	2.3%	$1.3 billion
Nebraska	131,000	43,500	6.9%	2.3%	$2.3 billion
Nevada	195,000	64,500	6.7%	2.2%	$3.5 billion
New Hampshire	82,000	27,000	6.1%	2%	$1.5 billion
New Jersey	619,000	205,000	7%	2.3%	$11.3 billion
New Mexico	142,000	47,000	6.8%	2.3%	$2.5 billion

State	Number of LC Cases	Number of Disabling LC Cases	LC as Percent of State Population	DLC as Percent of State Population	Cumulative Cost to Jan 31, 2022
New York	1,400,000	464,000	7.2%	2.4%	$17.5 billion
North Carolina	716,000	238,000	7.1%	2.3%	$12.6 billion
North Dakota	66,500	22,000	8.8%	2.9%	$1.2 billion
Ohio	763,000	253,000	6.6%	2.2%	$14 billion
Oklahoma	290,000	96,000	7.4%	2.5%	$5.1 billion
Oregon	187,000	62,000	4.6%	1.5%	$3.3 billion
Pennsylvania	783,000	260,000	6.1%	2%	$14.2 billion
Rhode Island	100,000	33,000	9.5%	3.1%	$1.8 billion
South Carolina	410,000	136,000	8.3%	2.7%	$7.2 billion
South Dakota	67,000	22,000	7.8%	2.6%	$1.2 billion
Tennessee	555,000	184,000	8.3%	2.8%	$10 billion
Texas	1,840,000	611,000	6.6%	2.2%	$33 billion
Utah	262,000	87,000	8.6%	2.9%	$4.7 billion
Vermont	28,000	9,000	4.5%	1.5%	$500 million
Virginia	457,000	151,000	5.4%	1.8%	$8.2 billion
Washington	394,000	130,000	5.4%	1.8%	$6.7 billion
West Virginia	132,000	44,000	7.2%	2.4%	$2.3 billion
Wisconsin	449,000	149,000	7.8%	2.6%	$8.1 billion
Wyoming	43,500	14,500	7.5%	2.5%	$775 million
TOTAL & Average USA	**22 million**	**7.3 million**	**6.9%**	**2.3%**	**$386 billion**

Table 5: Seroprevalence Model. Estimated number of Long Covid (LC) cases in the United States, broken down by state. Estimates for this model are based on the average seroprevalence of the nucleocapsid antibody (indicating natural infection) in community surveys conducted in each state between 12/27/21 and 1/29/22. The number of LC cases is calculated at 30% of unvaccinated cases, with LC severe enough to cause disability being calculated as 10% of unvaccinated cases. A modified calculation is used for vaccinated breakthrough cases.

State	Number of LC Cases	Number of Disabling LC Cases	LC as Percent of State Population	DLC as Percent of State Population	Cumulative Cost to Jan 31, 2022
Alabama	639,000	213,000	13.1%	4.4%	$8.1 billion
Alaska	91,000	30,000	12.3%	4.1%	$1.3 billion
Arizona	818,000	272,000	11.8%	3.9%	$11.3 billion
Arkansas	396,000	132,000	13.3%	4.4%	$5.1 billion
California	4,760,000	1,580,000	12.2%	4%	$56.7 billion
Colorado	622,000	207,000	11.2%	3.7%	$8.2 billion
Connecticut	409,000	135,000	11.4%	3.8%	$4.9 billion

State	Number of LC Cases	Number of Disabling LC Cases	LC as Percent of State Population	DLC as Percent of State Population	Cumulative Cost to Jan 31, 2022
Delaware	109,000	36,000	11.5%	3.8%	$1.5 billion
District of Columbia	86,500	29,000	12.6%	4.2%	$990 million
Florida	2,490,000	828,000	12.1%	4%	$34.8 billion
Georgia	1,520,000	503,000	14.7%	4.9%	$17.4 billion
Hawaii	89,500	29,500	6.3%	2.1%	$1.2 billion
Idaho	237,000	79,000	14.1%	4.7%	$2.8 billion
Illinois	2,060,000	684,000	16.1%	5.3%	$22.6 billion
Indiana	1,030,000	342,000	15.5%	5.2%	$11.9 billion
Iowa	506,000	168,000	16.2%	5.4%	$5.6 billion
Kansas	364,000	121,000	12.5%	4.2%	$4.7 billion
Kentucky	579,000	192,000	13%	4.3%	$7.5 billion
Louisiana	703,000	234,000	15.1%	5%	$8.2 billion
Maine	90,000	30,000	6.8%	2.2%	$1.2 billion
Maryland	679,000	225,000	11.3%	3.8%	$7.5 billion
Massachusetts	735,000	243,000	10.8%	3.6%	$10 billion
Michigan	1,500,000	499,000	15.1%	5%	$17 billion
Minnesota	790,000	262,000	14.3%	4.7%	$9.3 billion
Mississippi	462,000	154,000	15.5%	5.1%	$5.3 billion
Missouri	779,000	259,000	12.8%	4.3%	$9.4 billion
Montana	148,000	49,000	14.2%	4.7%	$1.7 billion
Nebraska	292,000	97,000	15.3%	5.1%	$3.3 billion
Nevada	350,000	116,000	12%	4%	$4.4 billion
New Hampshire	131,000	43,000	9.7%	3.2%	$1.7 billion
New Jersey	1,330,000	441,000	15%	5%	$15.6 billion
New Mexico	253,000	83,000	12.1%	4%	$3.2 billion
New York	2,830,000	936,000	14.4%	4.8%	$26 billion
North Carolina	1,200,000	401,000	11.9%	3.9%	$15.5 billion
North Dakota	125,000	42,000	16.7%	5.6%	$1.5 billion
Ohio	1,840,000	612,000	15.8%	5.3%	$20.3 billion
Oklahoma	532,840	177,000	13.6%	4.5%	$6.6 billion
Oregon	340,000	113,000	8.3%	2.8%	$4.2 billion
Pennsylvania	1,720,000	570,000	13.5%	4.5%	$19.7 billion
Rhode Island	138,000	46,000	13.1%	4.3%	$2 billion
South Carolina	666,000	222,000	13.4%	4.5%	$8.7 billion
South Dakota	127,000	42,000	14.7%	4.9%	$1.6 billion
Tennessee	1,000,000	333,000	15.1%	5%	$12.5 billion
Texas	4,370,000	1,500,000	15.7%	5.2%	$48 billion

State	Number of LC Cases	Number of Disabling LC Cases	LC as Percent of State Population	DLC as Percent of State Population	Cumulative Cost to Jan 31, 2022
Utah	389,000	130,000	12.7%	4.2%	$5.4 billion
Vermont	32,000	11,000	5.2%	1.7%	$524 million
Virginia	860,000	285,000	10.3%	3.4%	$10.6 billion
Washington	668,000	222,000	9.2%	3%	$8.3 billion
West Virginia	230,000	76,500	12.6%	4.2%	$2.9 billion
Wisconsin	957,000	317,000	16.6%	5.5%	$11.1 billion
Wyoming	92,000	31,000	15.9%	5.3%	$1.1 billion
TOTAL & Average USA	**43 million**	**14.3 million**	**13.4%**	**4.4%**	**$511 billion**

METHODOLOGY

Our group's models of estimated Long Covid cases in the United States are derived from prior population-level research on the prevalence of post-COVID symptoms combined with data on the number of COVID-19 cases in each state collected through January 31, 2022. Our model estimates that of all people infected with COVID-19, 30% will develop at least one lingering symptom, and 10% will develop a disabling case of Long Covid (DLC) severe enough to interfere with employment or activities of daily living. These rates are derived from Whitaker et al (2021), a community sample of 500,000 people[17] that explores the prevalence of post-COVID symptoms in a general, non-hospitalized population.

Although a consensus is emerging that Long Covid can develop in between 10 to 30% of COVID cases, determining how many people have had COVID-19 in the first place is a much less certain question due to the persistent undercounting of cases throughout the pandemic. To address this uncertainty, we developed two models:

1) A model using the reported COVID case numbers from each state to give a low estimate
2) A model using the CDC's community seroprevalence survey to give a higher estimate that includes unreported COVID cases

Model #1: Reported Case Model

This model uses the cumulative number of surviving COVID cases reported in each state until January 31, 2022, as reported by the CDC, to calculate the estimated number of Long Covid cases per state.[18] Using the rates from Whitaker et al (2021), we calculate that 30% of COVID cases in each state will develop at least one long-term symptom, with one third of these cases (10% of the overall case numbers) developing a disabling case of Long Covid. Dividing each state's estimated number of Long Covid cases by the population gives an estimate of what percentage of each state's population will be affected by long-term post-COVID symptoms (See Table 4).

Of the two models, the Reported Case model provides the most up-to-date information on COVID case numbers. This allows the model to reflect recent changes in case data—like was observed with the rapid spread of the Omicron variant. The main limitation of this model is its inability to account for unreported cases of COVID. COVID cases have been under-reported throughout the pandemic,[19] and this is a worsening problem during the Omicron surge due to strains on test availability, and the widespread use of at-home Rapid Antigen Tests that are not included in official case counts. The Reported Case Model should therefore be used as a floor, or a low estimate, when trying to estimate the prevalence of Long Covid.

Model #2: Seroprevalence Model

Our group's second model attempts to compensate for the Reported Case Model's main limitation by using a metric that is more inclusive of unreported COVID cases—the CDC's Community Seroprevalence Survey. The Seroprevalence Survey looks for the prevalence of the nucleocapsid antibody, which is a marker of natural COVID infection as opposed to vaccine-induced immunity, within community samples gathered in each state.[20] The average seroprevalence reported in each state is interpreted as the percentage of the population in that state with prior COVID-19 infection. The Long Covid prevalence rates are then applied to this number of estimated COVID infections (See Table 5).

The Seroprevalence model should be used as a higher estimate of the prevalence of Long Covid, due to its inclusion of unreported cases not included in official case counts. However, we do so recognizing several limitations that also contribute to its undercounting and inaccuracy. First, a significant limitation of this model is its reliance on averages of community sampling from which total case counts are extrapolated, instead of being a true tallying of cases. This method of data collection makes the Seroprevalence model more vulnerable to uncertainty and data artifacts than the reported case model. For example, it is possible for estimated cases in states with high baseline infection rates to remain relatively static between months if community sampling rounds return high-but-consistent seroprevalence rates. Secondly, using antibodies to confirm past COVID infection is known to disproportionately exclude three groups; 1) women (who are 4x less likely to retain antibodies than men),[21] [22] 2) mild cases (65% of mild cases serorevert in the first two months),[23] [24] and 3) Long Covid cases (who have low or no antibodies).[25]

The Seroprevalence model makes the assumption that all people with prior COVID infection possess detectable COVID antibodies. However, this is not always the case—emerging research has found that 24–36% of people infected with COVID-19 lose antibodies in the months following infection (seroreversion),[26] or do not create detectable antibodies at all.[27] People who experience seroreversion may be at higher risk of developing Long Covid—recent research indicates that low antibody and immune response during acute COVID infection is correlated with a higher risk of persistent symptoms and Long Covid.[28] [29] Although the seroprevalence model used in this paper does not take seroreversion into account, it is important to acknowledge that the case counts predicted by this model—as high as they seem—*still* may not capture some cases of Long Covid.

The model is also not sensitive to reinfections—a recent and emerging concern from the B.A. 1 and B.A. 2 Omicron variants.[30] However, despite these limitations, the Seroprevalence model returns a consistently higher case count in proportion to the Reported Case model that can help fill in the gaps caused by under-testing, under-reporting, and other limitations of the official COVID case counts.

Updating to the Omicron model

Our first Long Covid models were produced in November 2021—after mass vaccination campaigns but prior to the emergence and rapid spread of the Omicron variant around the world. The Omicron surge beginning in December 2021 required us to re-evaluate our Long Covid model due to significant rates of breakthrough infection among vaccinated individuals that had been relatively rare in previous surges. Due to the protective effect of vaccines against severe illness and some protection against Long Covid, the previous base rate of 30% Long Covid prevalence can no longer be assumed for the entire infected population.

After the start of the Omicron surge in each state—December 25th, 2021 or earlier, depending on state-level positivity and case data—the Long Covid model shifts from the earlier model assuming a 30% prevalence of Long Covid for all COVID cases to a modified model that separates unvaccinated and vaccinated breakthrough cases based on state-level vaccination rates. The Omicron model uses two variables to account for uncertainty surrounding the level of protection that vaccination provides against infection and long-term symptoms from Omicron:

1) The percentage of total Omicron cases occurring in vaccinated people. Data released by the New York City Department of Health indicates that during New York City's Omicron surge in early December, unvaccinated individuals were 8 times more likely to test positive for COVID-19 than vaccinated individuals.[31] Therefore, in this model, breakthrough cases accounted for 1 in 9—or 11% of total cases.

2) The reduction in risk against Long Covid for breakthrough infections, compared to unvaccinated cases. An Israeli study found that vaccinated individuals with breakthrough cases were 54—68% less likely to report four of the most common post COVID symptoms (fatigue, weakness, headache, and muscle pain) than unvaccinated individuals.[32] For this model, we assumed that vaccination provides 66% protection against the development of any long-term COVID symptom—giving a 10% risk of developing LC from a breakthrough infection compared to the 30% risk from an unvaccinated infection. This risk profile mirrors the findings of emerging cohort studies on the prevalence of LC in vaccinated people with breakthrough infections.[33]

   The risk of disabling Long Covid from breakthrough infections is still unknown. For the purposes of this model, we are assuming that vaccination provides strong protection (90%) against severe long-term illness, giving vaccinated breakthrough cases a 1% chance of developing disabling

Long Covid, compared to the 10% risk posed for unvaccinated cases. Recognizing this assumption represents a conservative estimate, time and further study will determine if vaccination proves to be so effective against Omicron.

Economic Impact

The COVID Longhauler Advocacy Project (C-19 LAP) conducted a survey on the economic and labor market impact of Disabling Long Covid.[34] Their model assumes a 10% prevalence rate of Long Covid among COVID survivors, and focuses on people experiencing substantial disruption to their employment and daily functioning from their illness. This 10% prevalence rate corroborates with the 10% of post-COVID patients in the Whitaker study that described their symptoms as disabling.

The C-19 LAP's models estimate the current costs of Long Covid from two sources—healthcare costs and lost earnings. Their survey found that the average healthcare costs accumulated by people disabled by Long Covid are $17,776 per person annually, and multiplying this figure by the number of disabled long-haulers in a given state gives an estimate of the accumulated healthcare costs by state. The lost earnings model looks at the 44% of the long-hauler sample that is unemployed and the 51% who are only able to work part-time, and calculates the total amount of lost income based on the duration of lost work capacity.

Our team created an interactive version[35] of these models that could be used to calculate state-level data. The combination of healthcare costs and lost earnings gives a glimpse into the economic impact of Long Covid on a state-by-state basis.

Impact of Long Covid on the Labor Force

To assess the impact of LC on the labor force, our team used statistics on state-level labor force participation released by the Bureau of Labor Statistics (BLS).[36] The number of expected DLC cases in each state were taken as a percentage of that state's total labor force. This highlights the differential impact of DLC among states with similar populations, but different infection rates and baseline levels of workforce participation. This calculation also helps determine which states may experience the greatest economic impact from COVID infection in working-age people.

INSIGHTS

State Employment Metrics and Burdens

This table is intended to provide a snapshot of state employment trends to put infection rates around the country in perspective. As you might guess, under the national aggregates are real disparities. For example, in the first column of Table 6, we show state Labor Force Participation Rates (LFPR), the labor force as a percentage of the non-institutionalized civilian population over sixteen. Although the national LFPR was 62.2% in January, 2022, around the country rates ran from lows of 55% in Mississippi and West Virginia to the high 60% range in North Dakota and Nebraska, on to 72% in Washington, DC. Among the nine Census Divisions the LFPR runs from a low of 58% in the East South Central Division, to 64% in New England, and up to 66% in the West North Central. The labor force includes both those with a job and those looking for work, and it's important to policy makers as a measure of worker engagement.

Table 6: State Employment Metrics and Burdens (Reported Cases). This matrix presents the estimated number of Disabling Long Covid (DLC) cases and costs shown in Table 4 in the context of selected labor-force metrics for each state. The size of the labor force relative to the population is shown in column 1, and the job opening rate, unfilled positions as a share of those working, in column 2. Column 3 calculates the number of infections as a percent of the labor force, and column 4, calculates the burden per worker by dividing the cumulative cost by labor-force levels. Column 5 ranks these burdens against the national average. All labor force data taken from the Bureau of Labor Statistics databases.

State	LFPR	Openings	DLC % LF	Burden	Rank
Alabama	56.4	6.4	5%	$ 2,882	119%
Alaska	66.0	8.7	6%	$ 3,006	124%
Arizona	60.7	7.4	5%	$ 2,760	114%
Arkansas	56.3	6.4	6%	$ 3,093	128%
California	61.5	6.3	4%	$ 2,266	94%
Colorado	68.5	7.6	4%	$ 2,098	87%
Connecticut	63.6	6.7	4%	$ 2,004	83%
Delaware	61.3	7.9	5%	$ 2,659	110%
District of Columbia	71.7	5.3	3%	$ 1,825	76%
Florida	58.6	7.3	5%	$ 2,851	118%
Georgia	61.8	7.5	5%	$ 2,424	100%
Hawaii	60.4	6.9	3%	$ 1,596	66%
Idaho	61.8	7.2	4%	$ 2,200	91%
Illinois	63.7	7.6	5%	$ 2,437	101%
Indiana	61.9	7.4	5%	$ 2,618	108%

State	LFPR	Openings	DLC % LF	Burden	Rank
Iowa	66.8	7.2	4%	$ 2,302	95%
Kansas	66.1	6.4	5%	$ 2,586	107%
Kentucky	58.0	8.0	6%	$ 2,952	122%
Louisiana	58.0	6.8	5%	$ 2,895	120%
Maine	59.3	8.8	3%	$ 1,388	57%
Maryland	65.6	7.5	3%	$ 1,613	67%
Massachusetts	65.8	7.1	4%	$ 2,270	94%
Michigan	59.4	7.8	5%	$ 2,510	104%
Minnesota	67.6	8.1	4%	$ 2,282	94%
Mississippi	54.9	6.4	6%	$ 3,094	128%
Missouri	63.1	7.5	4%	$ 2,304	95%
Montana	62.1	7.5	4%	$ 2,301	95%
Nebraska	69.7	7.8	4%	$ 2,223	92%
Nevada	59.5	6.7	4%	$ 2,338	97%
New Hampshire	65.2	8.8	4%	$ 1,932	80%
New Jersey	62.7	6.7	5%	$ 2,444	101%
New Mexico	56.6	7.7	5%	$ 2,649	110%
New York	59.1	5.9	3%	$ 1,867	77%
North Carolina	59.7	7.2	5%	$ 2,524	104%
North Dakota	68.8	7.6	5%	$ 2,911	120%
Ohio	61.5	7.0	4%	$ 2,423	100%
Oklahoma	60.1	6.6	5%	$ 2,767	115%
Oregon	62.6	7.0	3%	$ 1,506	62%
Pennsylvania	61.1	8.3	4%	$ 2,233	92%
Rhode Island	63.2	7.6	6%	$ 3,195	132%
South Carolina	57.1	7.7	6%	$ 3,043	126%
South Dakota	68.4	6.9	5%	$ 2,601	108%
Tennessee	60.3	7.6	6%	$ 2,956	122%
Texas	63.3	6.3	4%	$ 2,302	95%
Utah	67.5	7.3	5%	$ 2,769	115%
Vermont	60.9	8.0	3%	$ 1,522	63%
Virginia	62.9	7.2	4%	$ 1,924	80%
Washington	64.2	5.8	3%	$ 1,686	70%
West Virginia	55.0	7.1	6%	$ 2,941	122%
Wisconsin	66.4	7.0	5%	$ 2,596	107%
Wyoming	63.7	7.2	5%	$ 2,674	111%
Total US	**62.2**	**7.2**	**4%**	**$ 2,417**	**100%**

The Bureau of Labor Statistics also produces a monthly survey of labor churn, the Job Openings and Labor Turnover Survey (JOLTS), which is the source of the job openings rate shown in column 2. (JOLTS also tracks quits, layoffs and hires.) These metrics run in long-term trends, with some states generally having less labor churn, and others having more. The number of job openings are commonly considered as a share of total employment and the national average, 7.2% in January, floats on a good deal of churn. For example, in January, Washington DC, 5.3%, and New York and Washington state, 6%, reported the lowest rates, while rates rounded up to 9% in Alaska, New Hampshire, and Maine.

This table presents the more conservative case counts generated by the Reported Case Model, and includes only Disabling Long Covid cases. Considering cases as a percentage of the labor force, instead of the general population, captures the differences in labor force participation around the country. Rhode Island, which has the highest DLC infection rate, also has a low participation rate, and infections as a share of the labor force total to 6%, double the shares in states with low infection and/or high participation rates. In North Dakota, which has a strong participation rate and the second highest infection rate, the labor-force share of infections is 5%.

Table 4 sets out cumulative costs of Long Covid by state, but to make that meaningful in a country where state labor forces run from about three-hundred thousand in Wyoming and Vermont to fourteen million in Texas, and nineteen million in California, we calculated the share of that cost per labor force participant. For the tightest metric, DLC taken from the Reported Case Model, the national average is $2,417, but within that Maine's share per participant, $1,388, is just 57% of the national average, and Oregon's 62%. The shares in five states running above $3,000.00, Alaska, Arkansas, Mississippi, Rhode Island and South Carolina, run from 124% to 132% of the national average. These calculations illustrate the disproportionate economic burdens different states will carry in the coming years.

We've included the national averages across the bottom of the table as a frame for the rates among the states. For example, although the DLC infection rate for California is average, the openings rate is lower than the national average, which suggests less difficulty filling positions, whereas in other states, including Rhode Island, South Carolina and Tennessee the openings rate is above average, as is the infection rate, suggesting a higher hurdle. We did not show the serology model estimates due to the limitations of this data (see Methodology pg 14), but they tell the same story at higher percentages.

ANALYSIS

Long Covid: A Tragic Opportunity

The significant numbers of those impacted by Disabling Long Covid (DLC) highlight the need for changes to the structure of US disability benefit programs, as demand exponentially increases. “One study of nearly 4,000 Long Covid patients found that 45 percent reduced their work hours. For some, the change in job status can affect health insurance, which can further complicate treatment options.” [37] It’s also important to note that a disproportionate number of Long Haulers are people who work in health care; first responders, doctors, nurses, hospital staff, home-health care, and clinic support teams, all of which are areas experiencing labor shortages. Additionally, a disproportionate share of health-care workers in high contact positions are people of color.[38] Given this reality, Long Covid is forcing us to recalibrate how we value our care workers.

The undercounting of COVID-19 cases has been a persistent issue throughout the pandemic that creates uncertainty around the true number of people who may experience post-COVID symptoms. An analysis by the CDC from November 2021 estimates that only 1 in 4 COVID cases have been reported, putting the total COVID case count for this estimate at 146.6 million cases.[39] If this figure is correct, this rate of infection would result in 44 million cases of LC, 14.6 million of which result in significant disability. This projection estimates a similar caseload to that given by our team’s Seroprevalence model–except the CDC’s estimate was made prior to the Omicron surge. The projections of the number of both LC and DLC included in this paper, therefore, may be an underestimate and so provide a floor. Remembering that the floor rests at approximately seven million potential workers who are suddenly unable to work full time, or at all, may give us the commitment and courage to tackle these long-running imbalances.

A cursory review of scholarship related to people working with a disability makes it clear that the first priority is keeping workers on the job. That is underscored by recent Bureau of Labor statistics data: 31.4% for those with a disability aged 16 to 64 are employed, as are 72.5% without a disability. The unemployment rate for those with a disability (10.1%), twice the rate of those without a disability (5.1%).[40]

Using somewhat different metrics, the Centers for Disease Control and Prevention (CDC) reports that 26% of Americans, or 61 million people, have some kind of disability.[41] However, these statistics fail to capture the plight of many working with disabilities or chronic illness, who maintain their employment by utilizing sick leave, seeking accommodations, passing on potential opportunities, or sacrificing other parts of their lives. Many of those newly disabled by DLC held productive jobs and have been fully attached to the labor force, but their illness still plagues them in immeasurable ways. Being creative about how to retain those with DLC in the workforce will help others in the disability spiral to get back to work as well.

A Ragged Map

It is useful to separate the overall prevalence of LC—the experiencing of any lingering post-COVID symptom—from the impact of disability caused by LC on specific states and regions. Many of the states with the highest rates of COVID infection and projected Long Covid rates, such as Southern states, suffer from long-running economic and healthcare disparities. This is especially the case for the rural, working-poor within these states. The long-term impacts of COVID will exacerbate existing disparities in states that experienced higher levels of disability and poverty and lower levels of healthcare access prior to the pandemic. It is important to note that states and regions more heavily affected by COVID were more likely to experience lower vaccination rates and a slower uptake of vaccines, further increasing the risk of Long Covid.[42]

Firstly, labor force participation rates – the share of the population over the age of sixteen who are working or looking for work – varies by state. As mentioned above, the lowest rates, in the mid-50%, are in Alabama, Arkansas, Mississippi, and West Virginia. While the highest rates, around seventy percent, are in Nebraska, South Dakota, Minnesota and Iowa. (A **searchable database**[43] from the very useful Federal Reserve Economic Data engine maintained by the Saint Louis Fed that presents these trends over time.)

The trajectory of DLC cases will play out within the varying economic conditions of each state. Although we cannot know if the people sidelined by DLC were in the labor force prior to diagnosis, the share of the population working or willing to work provides a useful economic frame. For this reason, we calculated the projected case numbers as shares of the labor force for each state. A snapshot of the disparities visible in two states with populations of similar size is a comparison between Kentucky and Oregon. Kentucky's population is just 6% larger than that of Oregon, and the labor force participation rate in Kentucky is 57%, compared to 62% in Oregon. The projected number of DLC cases in Kentucky, however, is 114,276, about twice the expectation in Oregon, 61,860. Kentucky's share would amount to 6% of the labor force, twice Oregon's projected rate of 3%.

In their latest report on disability outlays and rates, the **CDC reported** that Kentucky spent about 41% of their health care budget on persons with a disability, or $14 billion, at a level of $15,177 per person, and persons with disabilities make up 35% of the over-18 population.[44] In Oregon, the share drops to 26% of the over-18 population, with spending running at 40% of the health-care budget, or $11.9 billion, and $16,127 per recipient. The higher rate in Kentucky would consume about twice the share of the budget as would the lower rate in Oregon. At $17,776 per LC patient, this is a painful stressor on an already overextended system.[45]

Since previous employment rates among those impacted by Long Covid remain a true "known unknown," these estimates are limited in predicting the true impact across various regions. Nevertheless, these models serve as a loud wake-up call for policy makers in each state.

Put Work-First Strategies First

In a seminal paper written in 2014, Richard Burkhauser, Mary C. Daly, Duncan McVickar, and Roger Wilkins tracked work strategy reforms in three Organization for Economic Co-operation and Development (OECD) countries, looking for clues for policy makers in the United States.[46] They documented how, despite the gatekeeper standards here in the United States being quite strict compared to other countries, rates of those receiving benefits did rise when Congress raised wage replacement rates. Then, these same rates fell in late 1970s as gatekeepers were urged to interpret rules more strictly, and, again, in the 1980s when Congress mandated the Social Security Administration to recheck recipients and confirm that they still qualified. These changes, "rigorously enforced by the SSA at the start of the Reagan administration," resulted in a "substantial drop" in those receiving benefits in spite of a major recession. Later, in 1984, policymakers responded to backlash against an unrealistically high bar for disability qualification and moved toward a more organic evaluation of individual workers' abilities to work, allowing mental health and physical pain to be considered.

Two things jump out from our clouded past that are crucial to any current Long Covid disability discussion. First, early reports indicate that a number of people suffering from LC will be able to work on some days and not on others. There is growing research showing that people who live with chronic illness in which there is no timeline for recovery, or those with similar disabilities, with appropriate medical care and accommodations may, over time, increase their energy envelope and accomplish an increasing number of tasks each day. As a care provider in the field noted in an informal meeting, "When your husband is sitting there with his head in his hands, he may be thinking through what he can do that day…."

That dovetails with major lessons cited by the research team Burkhauser et al mentioned above: disability is not an "immutable state," but depends on the health as well as the economic, cultural and social environment of the worker. When disability payments are restricted to those with total and permanent impairments, the impact is a system that lacks the agility needed to support the reality of many illnesses that ebb and flow. Johnson et al's next point is that disability programs must reflect the true spectrum of disability. Programs that sought to keep those with impairment in the labor force led to better outcomes for the system and the individual. Programs that reflect multiple levels of disability are better suited for keeping those with mild or moderate disability in the workforce. Creating disability categories for those needing partial assistance would make it possible for those with partial impairment to stay in the labor force.

Enabling people with LC to remain in the labor force without sacrificing their remaining health is the current pre-eminent challenge and one thing is clear: employers themselves are going to have to make real efforts to accommodate their workers. In many cases, this will require a change in workplace culture that may ultimately prove beneficial and be embraced by workers and employers alike. Creating a path to the workplace for individuals with disabilities and chronic illness will be part of the solution to labor shortages.

A Carrot & A Stick

Shifting the focus to the employer is in line with the new definition of "work disability" advanced by the World Health Organization over the last decades, an evolving codex of the identified impairment, workplace accommodations, and the financial benefits of staying in or leaving the workforce. Elsewhere Mary Daly and Richard Burkhauser argue that "experience ranking" disability contributions ultimately means that the full cost of individual employers' unwillingness to accommodate and rehabilitate employees is borne by the employers themselves.[47] They suggest offering a "carrot" to employers who make accommodations for workers in the form of reduced Social Security Disability Insurance taxes. This makes financial sense since keeping workers who have developed a disability employed makes them less likely to move into long-term disability. And the "stick" for those who don't? Of course, a higher contribution.

Let's take one example, the Netherlands. In 2002, after decades of trying to rein in their disability system, previously considered by some the worst in the industrialized world, the Dutch fundamentally transformed their system by replacing work itself as the expectation in lieu of cash transfers. They increased incentives for both employers and employees to use accommodations and rehabilitation in order to get back to work following the onset of disability. Workers were now the responsibility of the employer for two years, and during that period of time could only be dismissed if they refused "reasonable work requirements." Firms were given best practices to implement and paid premiums covering the first ten years of a partial disability benefit. Long considered out-of-control, the Dutch system became an example of how a country could learn from mistakes, one that other countries could follow.

Sweden instituted similar changes in 2000, bringing rehabilitation and vocational trainers in early, and requiring checkpoints at three, six and twelve months. These early interventions and accommodations stemmed the flow of new applicants into long-term disability. In other words, many of those with new disabilities wanted to work, were capable of work, and worked when given appropriate support and accommodations. Employers should investigate providing similar rehabilitation and vocational support services to newly disabled employees to potentially prevent the loss of valuable talent.

Table 7. Partial List of Potential Modifications for Workers with Post-infection Illness By Symptom. The possible modifications listed below are from the **U.S. Department of Labor's Job Accommodation Network**'s chronic fatigue syndrome webpage. This table identifies a selection of accommodation ideas, presented here by overlapping symptoms with Long Covid.

Decreased Stamina/Fatigue	Memory Loss/Brain Fog	Light Sensitivity
• Scooters • Ergonomic and Pneumatic tools, assessments and equipment • Flexible schedule • Job restructuring / medical leave • Periodic rest breaks • Telework, working from home, working remotely • Stand-lean stools • Wheelchairs • Modified Workplace • Aide/Assistant/Attendant	• Additional training time / training refreshers • Electronic organizers • Job coaches • Professional organizers • Recorded directives, messages materials • Reminders • Support Person • Visual schedulers • Written instructions • Memory software • Timers and watches	• Alternative lighting • Anti-glare filters • Additional shields, shades • LED light filters • Lighting gel filters • Non-fluorescent lighting • Personal visors • Telework, working from home, working remotely • Simulated skylights or windows

Disability Benefits

The convoluted requirements of our current system have the unintended consequence of discouraging disabled workers from staying in the labor force and creating disproportionate barriers for those with complex, invisible disabilities, like post-infection illnesses. First, they don't recognize partial disability, which is already emerging as a common characteristic of Long Covid. Second, by capping what someone drawing disability benefits can earn in the market, by definition, prevents people from working if and when they can. Counterproductively, these caps create a barrier for those who are able and willing to contribute to the workforce part-time or with accommodations when their symptoms are less severe. Administering a system that makes up a percentage of lost wages was once an overly complicated process of algorithms, but advances in technology have made it simpler and attainable. And third, although those who receive disability benefits have work options, the pages on which the Social Security Administration outlines the steps required to return to the disability system after a failed work stint are littered with "you may be able," not you "will" be able. Thus, recipients are penalized *just for trying to work* since a job that doesn't work out can cause a recipient to lose all support.

Burkhauser et al also push back against the most common opposition to reform—that millions of disabled workers rely on disability transfers to stay out of poverty—with evidence from European experiments. Specifically, prioritizing accommodations for disabled workers can increase employment and improve personal outcomes, especially when they replace programs, like ours, that create barriers to working. Their "most important" lesson is that policies that encourage employers and employees to work together, especially with government programs that guide employers with best practices, can lower long-term costs and simplify the assessment process. Beyond the cost savings, such reforms of our disability system improve opportunities for those with disabilities.[48]

Wages Are Values

Dr. Mary Daly, a Professor of Social Policy at Templeton College in Oxford, has related insights into this topic. Dr. Daly studies the value of undervalued care work, whether paid or unpaid, and her work focuses on care economy, distinct from other research that advances care as a social good. She notes that in the United States, the U.K. and less so in Australia, care work tends to be underpaid, with training limited, and as a "poor sector" or even an "unproductive" sector of the economy, is easily ignored. Dr. Daly sees the Long Covid crisis as an opportunity to rethink this, and one that has yet to be fully put to use.[49]

Leisure and hospitality workers have received substantial and appropriate pay increases since the onset of the pandemic. As a reminder of the promises we made to our essential workers at the beginning of the pandemic, among production and nonsupervisory workers, overall private-sector earnings have increased 12% since February 2020, with wages of bar and restaurant workers rising 16%, and a 15% rise among health care and private education. But home-health care workers' earnings are up just 10% over this span, lagging behind the average. That gets them to 80% of total private wages, better than restaurant workers' 61%, but for a sector with an outsized share of women and minority workers, this is an underpinning of inequality.

The persistent low wages of home healthcare workers are not a smart move. In September 2021, the Bureau of Labor Statistics projected home health and personal care aides to be the sector with the largest numerical growth over the next decade, making them both the most in demand and among the lowest paid. Home-health care workers have been the subject of several inquiries into the use of certain labor practices to depress wages, including by the Treasury Department, and academics.[50]

Considering the increase in demand created by newly disabled Long Covid patients, shortages in the home health and personal care sector will ripple through the economy, as families will increasingly rely on them as they go back to work. We will need to support workers and patients who need help here, remembering that communities of color bear a disproportionate burden of Long Covid home-health care.

If Forecasts Matter…

If the number of DLC working age Americans ends up topping seven million (as suggested by our reported case model estimate), it will be in range of the close to eight million workers who lost their jobs by the lowest point of the Great Recession of 2008. Such an impact is crushing even when compared to the more severe, if partially preventable, losses of the pandemic. Additionally, the projected number of those who will be affected by LC, even if of a more transitory nature, already meets that bar. If the number of working age Americans disabled by Long Covid ends up topping 14 million (as suggested by our seroprevalence model estimate), the impact will be seismic in scope and scale.

According to the Bureau of Labor Statistics, there are currently about 11 million unfilled jobs in the United States.[51] While that figure may be inflated by window-shopping employers, to say that's an all-time high doesn't do it justice. The current "openings rate," the number of openings as a share of total employment,[52] stands at 7%, more than double the average of 3.1% before the pandemic. State job opening rates run in long-term trends, but it's worth noting that some large states with smaller shares of their labor forces affected by DLC, like California and Washington, have job opening rates lower than the national average, while some states, especially Alaska and South Carolina, face the challenge of both an infection and a job opening rate above the national average. In reality, the post-infection illness' impact may lack the drama of sudden declines, but even the dragged out effects on personal well-being will almost certainly depress the productive side of the economy, while raising wages.

If there is any value to trying to predict demographic trends, it's to bring the outcomes in line with our values. Strengthening supply chains while keeping workers attached to the labor force is a goal we all agree on. As Long Covid patients become commonly recognized in society, employers will need to take an active role supporting the workers they need, being flexible, and trusting them to work from home when necessary and working with patients to find appropriate accommodations to their workplace needs. Public/private partnerships will need to be strengthened, and short-term support for those recently affected by DLC will need to be flexible. Help with child and elder care; job sharing, a successful strategy that can be a partnership among workers in recovery, may need to be broadened and restructured to remove barriers for people with Long Covid and other post-infection illnesses.

CONCLUSIONS

Post-infection illness is not new and insights drawn from both pre-pandemic knowledge of post-infection illnesses and post-pandemic knowledge of Long Covid can be incredibly helpful to analyzing early indicators to estimate prevalence and financial burden. Utilizing two models of Long Covid cases in the United States, derived from prior population data and serology data, our modeling predicts a range of cases between 22 to 43 million American adults at a potential cost to adult Americans with Long Covid ranging from $386 billion to $511 billion through January 31, 2022.

If these models prove accurate, Long Covid will have a potentially catastrophic impact on disability systems, workplaces, and millions of families across America. These models may have limited use, but their message is clear; 'There is no realistic scenario in which the Long Covid impact on American systems, workplaces, and families is small.' Instead, these models provide a first glimpse, like the tip of an iceberg, of a massive incoming systemic shock that urgently needs to be addressed by business and government leaders.

On top of the challenges posed by Long Covid itself, the Urban Institute recently projected that thirteen to fourteen million Americans are likely to lose Medicaid coverage in the coming year.[53] *The challenges presented by post-infection syndromes are not demand issues and can't be resolved by the market alone.* It's a colossal challenge for a fractured nation, but working together can improve the outlook for many of our co-workers, friends, and family while shoring up the market economy. With these considerations, we draw these key conclusions:

- Government and business leaders should prioritize policies, guidelines, and programs that keep workers on the job through workplace accommodations and vocational support programs.
    - » This includes: part-time, flexible, and/or reduced hours, reasonable accommodations (including telework), assistive technologies, and medical leave.
- Disability is not an "immutable state;" Invest in short-term and mid-term disability programs designed to empower a patient to return to work as they heal, rather than creating barriers to working
- Stop approaching disability payments exclusively as a payment of last resort for those with total and permanent impairments. This limits what can be done within the system. Instead, reduce barriers for accessing disability, returning to work, and returning back to disability as needed.
- Employers themselves will need to make sincere efforts to accommodate their workers with post-infection illness, something that for many may be new.
- Special consideration should be given to communities of color, disproportionately impacted by the pandemic, Long Covid, and post-infection illnesses.
- Key workers, like home-care and nursing, must be valued more highly and will face significant increases in demand as a result of Long Covid.

ACKNOWLEDGMENTS

A special thanks to COVID-19 Longhauler Advocacy Project, whose economic impact work as part of "**An Open Letter to President Biden, Cabinet and Congressional Leadership and Key Government Agencies**" published the financial calculations utilized here.

The authors would like to acknowledge the Patient Led Research Collaborative for their exceptional work "**Characterizing long COVID in an international cohort: 7 months of symptoms and their impact**" which has educated and informed so many.

With heartfelt gratitude, we'd like to thank our reviewers for their insights and input; Oved Amitay, Karyn Bisoff, Jessica Brown-Clark, Hannah Davis, Stewart Gittleman, Leslie Phillips, Reva Singh, and Lauren Stiles.

Deepest thanks to Stephanie Mackay, a true pioneer in bringing those with disabilities into the labor force, both her generosity in discussing impediments outlined in this paper, and for her decades of invaluable work.

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