

# Patient adverse financial outcomes before and after COVID-19 infection

Nora V. Becker MD, PhD<sup>1,2</sup>   | Erin F. Carlton MD, MSc<sup>2,3,4</sup> |  
Theodore J. Iwashyna MD, PhD<sup>5</sup> | John W. Scott MD, MPH<sup>2,6</sup> |  
Michelle H. Moniz MD, MSc<sup>2,7</sup> | John Z. Ayanian MD, MPP<sup>1,2</sup>

<sup>1</sup>Division of General Medicine, University of Michigan Medical School, Ann Arbor, Michigan, USA

<sup>2</sup>Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, Michigan, USA

<sup>3</sup>Division of Pediatric Critical Care Medicine, University of Michigan Medical School, Ann Arbor, Michigan, USA

<sup>4</sup>Department of Pediatrics, Susan B. Meister Child Health Evaluation and Research Center, University of Michigan Medical School, Ann Arbor, Michigan, USA

<sup>5</sup>Department of Medicine, School of Medicine, Department of Health Policy and Management, School of Public Health, Johns Hopkins University, Maryland, Baltimore, USA

<sup>6</sup>Department of Surgery, University of Michigan Medical School, Ann Arbor, Michigan, USA

<sup>7</sup>Department of Obstetrics and Gynecology, University of Michigan Medical School, Ann Arbor, Michigan, USA

## Correspondence

Nora V. Becker, MD, PhD, Division of General Medicine, University of Michigan Medical School, 2800 Plymouth Rd, Bldg 16, Room 430W, Ann Arbor, MI, USA.

Email: [beckernv@med.umich.edu](mailto:beckernv@med.umich.edu)

Twitter: @NoraBeckerMD

## Funding information

National Heart, Lung, and Blood Institute, Grant/Award Number: K12-HL138039; Agency for Healthcare Research and Quality, Grant/Award Numbers: K08-HS025465, K08-HS028672, K08-HS028817

## Abstract

Adverse financial outcomes after COVID-19 infection and hospitalization have not been assessed with appropriate comparators to account for other financial disruptions of 2020–2021. Using credit report data from 132,109 commercially insured COVID-19 survivors, we compared the rates of adverse financial outcomes for two cohorts of individuals with credit outcomes measured before and after COVID-19 infection, using an interaction term between cohort and hospitalization to test whether adverse credit outcomes changed more for hospitalized than nonhospitalized COVID-19 patients. Covariates included age group, gender, and several area-level social determinants of health. Adverse financial outcomes were significantly more common after COVID-19 infection than before COVID-19 infection, with greater increases among those hospitalized with COVID-19 (5–8 percentage points) than among nonhospitalized patients (1–3 percentage points). Future work examining longitudinal financial outcomes before and after COVID-19 infection is needed to determine the causal mechanisms of this association to reduce financial hardship from COVID-19 and other conditions.

## INTRODUCTION

Survivors of COVID-19 infection may experience financial hardship,<sup>1</sup> and early data suggest that hospitalized COVID-19 survivors may be particularly vulnerable to financial distress. In a recent national survey of COVID-19 survivors who had been hospitalized, half reported that their hospitalization had been a strain on their finances and 23%

reported having used all or most of their savings.<sup>2,3</sup> Research examining patients' out-of-pocket costs for COVID-19 hospitalization and postdischarge care have also found that some patients experience a significant burden of out-of-pocket spending for their care.<sup>4–6</sup> However, objective measurements of patients' financial outcomes after COVID-19 infection and hospitalization have not yet been examined, particularly studies that can distinguish the impacts

of individuals' COVID-19 infection from broader economic disruptions during the pandemic.

Credit outcomes are increasingly recognized as a powerful way to assess patients' financial well-being.<sup>7</sup> Having a low credit score can reduce access to housing, transportation, and insurance, and medical debt in particular has been associated with foregone medical care and worsened physical and mental health.<sup>8,9</sup> Prior work with credit data has demonstrated that hospital admissions are associated with adverse credit outcomes,<sup>10,11</sup> and prior survey work has found that hospital admissions increase patient out-of-pocket costs and decrease patient-reported income.<sup>10</sup> However, to our knowledge, no studies have directly examined the impact of COVID-19 infection—with or without hospitalization—on credit outcomes, despite the fact that half of the US population has experienced COVID-19 infection and over 6 million have been hospitalized for COVID-19 since the start of the pandemic.<sup>12,13</sup> Our objective was to compare credit outcomes between two cohorts of COVID-19 survivors, the first with credit outcomes measured before their infections, and the second with credit outcomes measured after their infections, stratified by whether or not they were hospitalized for their COVID-19 infections. By comparing patients who all developed COVID-19 during a 2-year period, we are able to reduce confounding related to the strong association of COVID-19 infection with social determinants of health.

## METHODS

We utilized medical claims data from adult enrollees in the commercial preferred provider organization (PPO) network of Blue Cross Blue Shield of Michigan (BCBSM), a large state-level insurance network with approximately 3.5 million enrollees. These claims data were linked to enrollees' Experian credit report data in January 2021. The data were accessed via the Michigan Value Collaborative, a partnership between Michigan hospitals and BCBSM. BCBSM and its employees were not involved in any aspect of the study design or implementation. The project was reviewed and approved by the University of Michigan Institutional Review Board with a waiver of patient informed consent.

As we had longitudinal claims for these individuals but only a single cross-sectional measurement of credit outcomes, we identified two cohorts of COVID-19 survivors: a "post-infection" cohort with infections diagnosed during March–July 2020 (credit outcomes observed  $\geq 6$  months after infection), and a "comparison" cohort with infections diagnosed during February–October 2021 (individuals with credit outcomes observed before infection). The comparison cohort therefore included individuals who had a COVID-19 infection, but whose credit outcomes could not have been affected by their infection because these outcomes were measured before infection. The postinfection cohort was limited to  $\geq 6$  months after infection because medical debt in collections does not appear on credit reports until it is past due for  $\geq 6$  months. All patients with identified COVID-19 infections (ICD-10 diagnostic code U071) were characterized as either nonhospitalized (no inpatient claims with COVID-19 infection as a diagnosis) or hospitalized for COVID-19 (patients with

COVID-19 infection listed as a diagnostic code on at least one inpatient claim during the study period).

Logistic regression models were used to compare financial outcomes between the postinfection and comparison cohorts. Primary outcomes included having any medical debt in collections, any nonmedical debt in collections, or a low credit score ( $< 660$ , range 300–850). All models adjusted for age group, gender, COVID-19 hospitalization, four zip-code level covariates (median household income, Gini index of income inequality, percentage of owner-occupied housing units, and percentage of limited English speaking households), county-level social vulnerability index (SVI) quartile, and county-level October 2021 vaccination rate (defined as the percentage of county residents age  $> 12$  who had completed a primary vaccine series as of October 2021). All models also included an interaction term between cohort and COVID-19 hospitalization to test whether changes in proportions of individuals with adverse credit outcomes between cohorts differed among patients who were hospitalized versus not hospitalized for their COVID-19 infection. To aid in interpreting the results of the interaction term between postinfection cohort and COVID-19 hospitalization, adjusted probabilities of outcomes by cohort and hospitalization status were calculated using the *postestimation margins* command in Stata. Analyses were performed using Stata-MP statistical software (version 17.0; StataCorp LLC). Additional details regarding the data linkage and cohort construction are available in the Supporting Information: Appendix.

## RESULTS

The study cohort included 132,109 patients with COVID-19 infections. In the postinfection cohort, there were 18,507 nonhospitalized and 2512 hospitalized patients, while the comparison cohort included 99,975 nonhospitalized and 11,115 hospitalized patients. Hospitalized patients in either cohort were more likely to be male and older compared with nonhospitalized patients. While zip-code median income and Gini index were similar across cohorts, individuals in the postinfection cohort were more likely to come from counties in higher quartiles of SVI and higher eventual COVID-19 vaccination rates, and from zip-codes with fewer owner-occupied housing units and greater percentages of limited English-speaking households, although the absolute differences were small (Table 1).

In logistic regression analyses, the adjusted odds ratios (aORs) of all outcomes for postinfection cohort, COVID-19 hospitalization, and the interaction term between cohort and hospitalization were all positive and statistically significant (*Medical debt in collections*: postinfection cohort: aOR 1.09, hospitalization aOR 1.25, postinfection  $\times$  hospitalization aOR 1.44; *nonmedical debt in collections*: postinfection cohort: aOR 1.14, hospitalization aOR 1.26, postinfection  $\times$  hospitalization aOR 1.29; *low credit score*: postinfection cohort: aOR 1.18, hospitalization aOR 1.32, postinfection  $\times$  hospitalization aOR 1.28; all  $p < .001$ ; Supporting Information: Table A1).

The adjusted probabilities of all three primary adverse financial outcomes were significantly more common in the postinfection

**TABLE 1** Characteristics of commercially insured adults in Michigan with a COVID-19 diagnosis.

|   | Nonhospitalized patients             |                                   | Hospitalized patients                |                                   | Total N (%)      |
|---|--------------------------------------|-----------------------------------|--------------------------------------|-----------------------------------|------------------|
|   | Comparison cohort N (%) <sup>a</sup> | Postinfection cohort <sup>b</sup> | Comparison cohort N (%) <sup>a</sup> | Postinfection cohort <sup>b</sup> |                  |
| Total individuals                                       | 99,975 (100)                         | 18,507 (100)                      | 11,115 (100)                         | 2512 (100)                        | 132,109 (100)    |
| <b>Gender</b>   |                                      |                                   |                                      |                                   |                  |
| Male  | 46,423 (46.4)                        | 7805 (42.2)                       | 5850 (52.6)                          | 1282 (51.0)                       | 61,360 (46.5)    |
| Female  | 51,103 (51.1)                        | 10,252 (55.4)                     | 5100 (45.9)                          | 1192 (47.5)                       | 67,647 (51.2)    |
| Unknown   | (0.0)                                | 1 (0.0)                           | (0.0)                                | (0.0)                             | 1 (0.0)          |
| Missing/inconsistent                                    | 2449 (2.5)                           | 449 (2.4)                         | 165 (1.5)                            | 38 (1.5)                          | 3101 (2.4)       |
| <b>Age group</b>  |                                      |                                   |                                      |                                   |                  |
| Age 20–24   | 8572 (8.6)                           | 1498 (8.1)                        | 196 (1.8)                            | 32 (1.3)                          | 10,298 (7.8)     |
| Age 25–34   | 19,482 (19.5)                        | 3067 (16.6)                       | 816 (7.3)                            | 155 (6.2)                         | 23,520 (17.8)    |
| Age 35–44   | 21,342 (21.4)                        | 3235 (17.5)                       | 1295 (11.7)                          | 229 (9.1)                         | 26,101 (19.8)    |
| Age 45–54   | 23,546 (23.6)                        | 4369 (23.6)                       | 2284 (20.6)                          | 480 (19.1)                        | 30,679 (23.2)    |
| Age 55–64   | 20,168 (20.2)                        | 4108 (22.2)                       | 2949 (26.5)                          | 647 (25.8)                        | 27,872 (21.1)    |
| Age 65–74   | 3722 (3.7)                           | 1078 (5.8)                        | 1313 (11.8)                          | 354 (14.1)                        | 6467 (4.9)       |
| Age ≥75   | 3100 (3.1)                           | 1142 (6.2)                        | 2259 (20.3)                          | 614 (24.4)                        | 7115 (5.4)       |
| Missing/inconsistent                                    | 43 (0.0)                             | 10 (0.1)                          | 3 (0.0)                              | 1 (0.0)                           | 57 (0.0)         |
| <b>Credit outcomes</b>                                  |                                      |                                   |                                      |                                   |                  |
| Any medical debt in collections                         | 16,587 (16.6)                        | 3230 (17.5)                       | 1859 (16.7)                          | 593 (23.6)                        | 22,269 (16.9)    |
| Any nonmedical debt in collections                      | 13,886 (13.9)                        | 2903 (15.7)                       | 1535 (13.8)                          | 528 (21.0)                        | 18,852 (14.3)    |
| Low credit score  | 29,802 (29.8)                        | 5997 (32.4)                       | 3161 (28.4)                          | 966 (38.5)                        | 39,926 (30.2)    |
| <b>County social vulnerability index (SVI) quartile</b> |                                      |                                   |                                      |                                   |                  |
| 0–25th percentile                                       | 25,361 (25.4)                        | 4113 (22.2)                       | 2455 (22.1)                          | 516 (20.5)                        | 32,445 (24.6)    |
| 25.01–50th percentile                                   | 26,589 (26.6)                        | 4069 (22.0)                       | 3245 (29.2)                          | 517 (20.6)                        | 34,420 (26.1)    |
| 50.01–75th percentile                                   | 24,429 (24.4)                        | 4201 (22.7)                       | 2991 (26.9)                          | 582 (23.2)                        | 32,203 (24.4)    |
| 75.01–100th percentile                                  | 16,119 (16.1)                        | 4706 (25.4)                       | 1797 (16.2)                          | 758 (30.2)                        | 23,380 (17.7)    |
| Missing/inconsistent/unmatched zip-code                 | 8108.0 (8.1)                         | 1720.0 (9.3)                      | 695 (6.3)                            | 162 (6)                           | 10,685 (8.1)     |
|   | <b>Mean (SD)</b>                     | <b>Mean (SD)</b>                  | <b>Mean (SD)</b>                     | <b>Mean (SD)</b>                  | <b>Mean (SD)</b> |
| Zip-code median household income                        | 67,238 (23,251)                      | 67,836 (25,795)                   | 63,398 (21,461)                      | 62,048 (25,200)                   | 66,891 (23,548)  |
| Zip-code Gini index                                     | 0.42 (0.04)                          | 0.43 (0.05)                       | 0.42 (0.04)                          | 0.43 (0.05)                       | 0.42 (0.04)      |
| Zip-code % of owner-occupied housing units              | 74.0 (13.5)                          | 70.6 (14.9)                       | 73.2 (13.6)                          | 66.9 (15.6)                       | 73.4 (13.9)      |
| Zip-code % of limited English-speaking households       | 1.7 (2.8)                            | 2.5 (3.8)                         | 1.7 (2.8)                            | 2.5 (3.6)                         | 1.8 (3.0)        |
| Oct 2021 county-level COVID-19 vaccination (%)          | 59.5 (9.2)                           | 61.4 (9.2)                        | 58.8 (9.2)                           | 61.1 (9.1)                        | 59.8 (9.3)       |

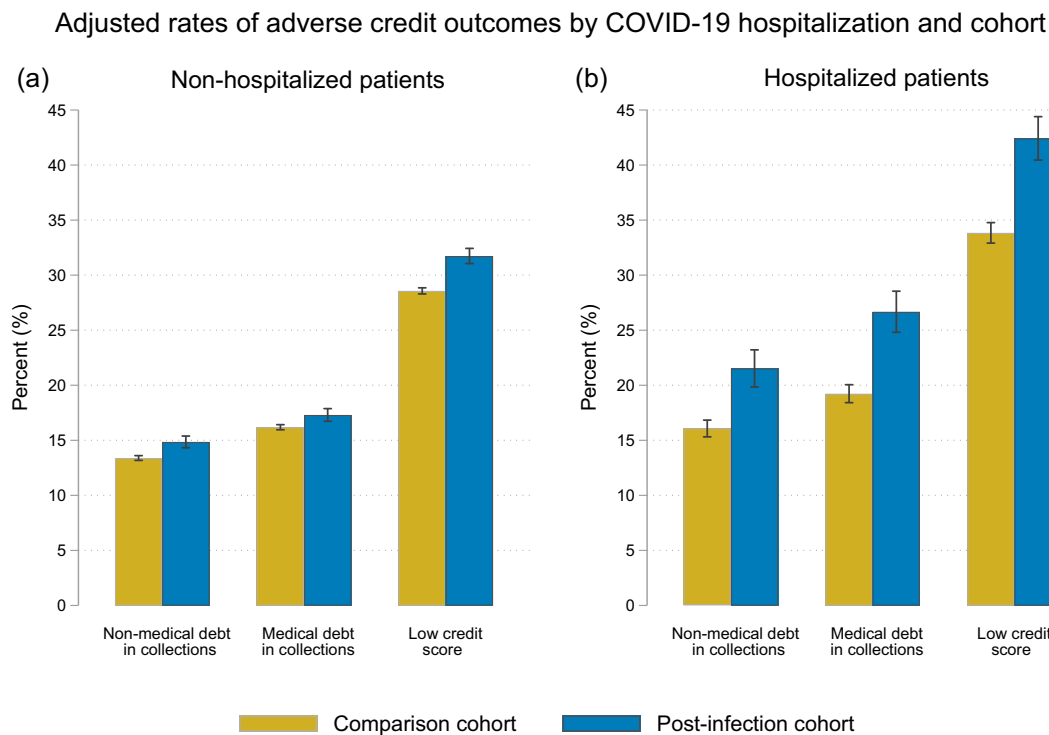
Note: The SVI quartiles plus the unmatched zip-code categories sum to greater than 100 because small numbers of zip-codes matched to the county-level database that did not match to the zip-code database. Descriptive statistics for continuous zip-code and county-level covariates omit observations with missing/inconsistent/unmatched zip-codes.

<sup>a</sup>Infections between February–October 2021 (credit outcomes observed before infection).

<sup>b</sup>Infections between March–July 2020 (credit outcomes observed ≥6 m after infection).

cohort compared with the comparison cohort. COVID-19 hospitalization significantly moderated the association between adverse credit outcomes and cohort, with hospitalized COVID-19 patients experiencing a substantially greater increase in rates of all three

adverse outcomes between the comparison and postinfection cohorts (*Medical debt in collections*: nonhospitalized patients: comparison cohort 16.2% vs. postinfection 17.3%, hospitalized patients: comparison cohort 19.2% vs. postinfection 26.7%; *nonmedical debt in*



**FIGURE 1** Adjusted rates of adverse credit outcomes by COVID-19 hospitalization and cohort. This figure displays adjusted rates of adverse credit outcomes in January 2021 (low credit score, medical debt in collections, and nonmedical debt in collections) by COVID-19 hospitalization and cohort ([a], nonhospitalized patients; [b], hospitalized patients). The comparison cohort includes individuals with COVID-19 diagnoses during February–October 2021 (credit outcomes observed before infection) and the postinfection cohort includes individuals with COVID-19 diagnoses during March–July 2020 (credit outcomes observed after COVID-19 diagnosis). The adjusted rates displayed here are predicted using the postestimation margins command in Stata from logistic regressions for each adverse credit outcome, adjusting for gender, age band, and county social vulnerability quartile fixed effects, county-level COVID-19 vaccination rate in October 2021, zip-code median income, zip-code Gini index of income inequality, and percentage of zip-code owner-occupied housing units and limited English-speaking households. All models also include an interaction term between COVID-19 hospitalization and cohort. Odds ratio coefficient estimates from these regressions are available in Supporting Information: Table A1.

*collections*: nonhospitalized patients: comparison cohort 13.4% vs. postinfection cohort 14.9%, hospitalized: comparison cohort 16.1% vs. postinfection cohort 21.5%; *low credit score*: nonhospitalized patients: comparison cohort 28.6% vs. postinfection 31.7%, hospitalized patients: comparison cohort 33.8% vs. postinfection 42.4%) (Figure 1).

## DISCUSSION

To our knowledge, our study is the first to use credit report data to examine objective patient financial outcomes before and after COVID-19 infection and hospitalization. We demonstrate that among commercially insured adults, adverse financial outcomes were significantly more common among individuals after COVID-19 infection compared with individuals before COVID-19 infection. This change was larger in magnitude for individuals who were hospitalized for COVID-19 (5–8 percentage point increases) than for individuals who were not (1–3 percentage point increases). Given that half of US residents report having experienced COVID-19 infection,<sup>12</sup> even

small changes in these rates could represent millions of people newly experiencing adverse credit outcomes.

Several potential mechanisms may explain this association, including potentially significant direct out-of-pocket costs of medical care for COVID-19 hospitalization and postacute care, as well as indirect effects of income loss from both short- and long-term disability. It is striking that these associations were detectable despite multiple temporary policy interventions in 2020–2021 that might have minimized effects on debt but have subsequently expired, including cost-sharing waivers for COVID-19 hospitalizations, rent freezes, eviction moratoriums, and student loan repayment holds. Our results are consistent with prior work showing that hospital admissions more generally are associated with increased rates of adverse credit outcomes,<sup>10,11</sup> and whether or not COVID-19 hospitalizations impact patients differently than hospitalizations from other causes is not yet known and an important area for future study.

Our study has limitations. Our results are subject to residual confounding, as our data lack individual characteristics such as individuals' race, ethnicity, income, and employment status to control more fully for demographic differences between our two cohorts.

The postinfection cohort also experienced their infections before the introduction of COVID-19 vaccines, and therefore may have been more likely to suffer from more severe illness. We therefore interpret our results as suggestive, but not conclusive, evidence that COVID-19 infections, and particularly hospitalizations for COVID-19 infection, are associated with financial distress. Further research using longitudinal patient financial outcomes is essential to confirm this association, define its mechanisms, and design health and social policies to improve financial outcomes for COVID-19 survivors.

### ACKNOWLEDGMENTS

The authors wish to thank the staff and analysts at the Michigan Value Collaborative (MVC), a Collaborative Quality Initiative under Blue Cross Blue Shield of Michigan's (BCBSM) Value Partnerships program, as well as Cathy Kelmar at Experian, for their assistance facilitating the data linkages and providing access to the data used in this study. Support for the Michigan Value Collaborative is provided by BCBSM as part of the BCBSM Value Partnerships program; however, the opinions, beliefs, and viewpoints expressed by the authors do not necessarily reflect those of BCBSM or any of its employees. This study was funded by grants K08-HS028817 (Dr. Becker), K08-HS025465 (Dr. Moniz), K08-HS028672 (Dr. Scott) from the Agency for Healthcare Research and Quality, and K12-HL138039 from the National Heart, Lung, and Blood Institute (Dr. Carlton).

### CONFLICT OF INTEREST STATEMENT

Drs. Becker and Carlton report receiving grants from the University of Michigan Department of Pediatrics outside of the submitted work. Dr. Scott reports receiving salary support from Blue Cross Blue Shield of Michigan (BCBSM) through the Michigan Social Health Interventions to Eliminate Disparities initiative outside the submitted work. Dr. Moniz reports receiving grants from the Michigan Department of Health and Human Services and the Food and Drug Administration, and salary support from the BCBSM Women's Health Initiative outside of the submitted work. Dr. Ayanian has received grant funding from the Blue Cross Blue Shield of Michigan Foundation outside of the submitted work.

### DATA AVAILABILITY STATEMENT

Dr. Becker had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

### ORCID

Nora V. Becker  <http://orcid.org/0000-0001-5232-8663>

### TWITTER

Nora V. Becker  @NoraBeckerMD

### REFERENCES

1. Graves JA, Baig K, Buntin M. The financial effects and consequences of COVID-19: a gathering storm. *JAMA*. 2021;326(19):1909-1910. doi:10.1001/jama.2021.18863
2. Iwashyna TJ, Kamphuis LA, Gundel SJ, et al. Continuing cardiopulmonary symptoms, disability, and financial toxicity 1 month after hospitalization for third-wave COVID-19: early results from a US nationwide cohort. *J Hosp Med*. 2021;16(9):531-537. doi:10.12788/jhm.3660
3. Admon AJ, Iwashyna TJ, Kamphuis LA, et al. Assessment of symptom, disability, and financial trajectories in patients hospitalized for COVID-19 at 6 months. *JAMA Netw Open*. 2023;6(2):e2255795. doi:10.1001/jamanetworkopen.2022.55795
4. Chua KP, Conti RM, Becker NV. Assessment of out-of-pocket spending for COVID-19 hospitalizations in the US in 2020. *JAMA Netw Open*. 2021;4(10):e2129894. doi:10.1001/jamanetworkopen.2021.29894
5. Chua KP, Conti RM, Becker NV. Trends in and factors associated with out-of-pocket spending for COVID-19 hospitalizations from March 2020 to March 2021. *JAMA Netw Open*. 2022;5(2):e2148237. doi:10.1001/jamanetworkopen.2021.48237
6. Chua KP, Conti RM, Becker NV. Out-of-pocket spending for health care after COVID-19 hospitalization. *Am J Manag Care*. 2022;28(8):398-402. <https://www.ajmc.com/view/out-of-pocket-spending-for-health-care-after-covid-19-hospitalization>
7. Kluender R, Mahoney N, Wong F, Yin W. Medical debt in the US, 2009-2020. *JAMA*. 2021;326(3):250-256. doi:10.1001/jama.2021.8694
8. Kalousova L, Burgard SA. Debt and foregone medical care. *J Health Soc Behav*. 2013;54(2):204-220. doi:10.1177/0022146513483772
9. Sweet E, Nandi A, Adam EK, McDade TW. The high price of debt: household financial debt and its impact on mental and physical health. *Soc Sci Med*. 2013;91:94-100. doi:10.1016/j.socscimed.2013.05.009
10. Dobkin C, Finkelstein A, Kluender R, Notowidigdo MJ. The economic consequences of hospital admissions. *Am Econ Rev*. 2018;108(2):308-352. doi:10.1257/aer.20161038
11. Scott JW, Scott KW, Moniz M, Carlton EF, Tipirneni R, Becker N. Financial outcomes after traumatic injury among working-age US adults with commercial insurance. *JAMA Health Forum*. 2022;3(11):e224105.
12. Schulman J, Lazer D, Perlis R, et al. The COVID states project #96: state of the COVID-19 pandemic. Published online December 8, 2022. doi:10.31219/osf.io/tz3a4
13. CDC. COVID data tracker. Centers for disease control and prevention. 2020. Accessed March 7, 2023. <https://covid.cdc.gov/covid-data-tracker>

### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Becker NV, Carlton EF, Iwashyna TJ, Scott JW, Moniz MH, Ayanian JZ. Patient adverse financial outcomes before and after COVID-19 infection. *J Hosp Med*. 2023;18:424-428. doi:10.1002/jhm.13105