days). Among dead or discharged patients (n = 2252 [77.5%] overall; n = 774 in surge 1 and n = 1478 in surge 2), surge 2 in-hospital mortality was significantly lower compared with that for surge 1 (5.1% vs 12.1%; difference, −7.07%; 95% CI, −9.63% to −4.51%). In-hospital mortality among discharged and deceased ICU-treated patients during surge 2 was not significantly lower than that during surge 1 (49/214 [22.9%] vs 81/295 [27.5%]; difference, −4.56%; 95% CI, −12.15% to 3.03%). The mean daily proportion of individuals with positive RT-PCR results during surge 1 was 13%, whereas it was 25% during surge 2.

Discussion | An increase in COVID-19 hospitalizations was observed across a major health care system in the greater Houston area, which was temporally related to phased reopening. Throughout the reporting period, hospital admission guidelines were consistently based on risk stratification by evaluation of severity of symptoms, comorbidities, diagnostic findings, and pulse oximetry. During surge 2, the absolute number of RT-PCR tests performed increased, as did the proportion of positive results. Therefore, higher hospital census likely reflects higher rates of community COVID-19 prevalence. Surge 2 data indicated a demographic shift of the pandemic toward a younger, predominantly Hispanic, and lower socioeconomic patient population with an overall lower comorbidity burden, ICU admission rate, and in-hospital mortality. The demographic and socioeconomic shift may reflect return to work and relaxation of COVID-19 transmission mitigation practices. Additionally, in-hospital mortality among ICU-treated surge 2 patients was 4.6% lower than that in surge 1. The overall better outcomes during surge 2 may be explained by a combination of lower comorbidity burden, lesser disease severity, and better medical management.

Limitations of the study include data from a single hospital system that may not be generalizable. The shift toward non-ICU resources implies that different staffing patterns and infection control practices may be needed. Lower acuity and ICU use and shorter lengths of stay may allow for increased capacity and less overall stress on health care resources.

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1. Tittle S, Braxton C, Schwartz RL, et al A guide for surgical and procedural recovery after the first surge of Covid-19. NEJM Catalyst. Published July 2, 2020. Accessed August 4, 2020. https://catalyst.nejm.org/doi/full/10.1056/cat.20.0287

2. Vahidy FS, Nicolas JC, Meeks JR, et al. Racial and ethnic disparities in SARS-CoV-2 pandemic: analysis of a COVID-19 observational registry for a diverse US metropolitan population. *medRxiv*. Preprint posted online May 12, 2020. doi:10.1101/2020.04.24.20073148

3. Office of the Texas Governor. Governor's strike force to open Texas. Published 2020. Accessed July 14, 2020. https://open.texas.gov/

Allocation of COVID-19 Relief Funding to Disproportionately Black Counties

The Coronavirus Aid, Relief, and Economic Security (CARES) Act and Paycheck Protection Program together designated $175 billion for coronavirus disease 2019 (COVID-19) response efforts and reimbursement to health care entities for expenses or lost revenues.[1]

The most important factor driving funding allocation is past revenue. However, revenue is an imperfect measure of need because it is also influenced by prices, overuse, payer mix, and market consolidation.[2] Moreover, non-White and indigent populations generate lower revenues, due to underinsurance and undertreatment,[3,4] and hospitals caring for them may receive less relief despite confronting a greater burden of COVID-19.[5]

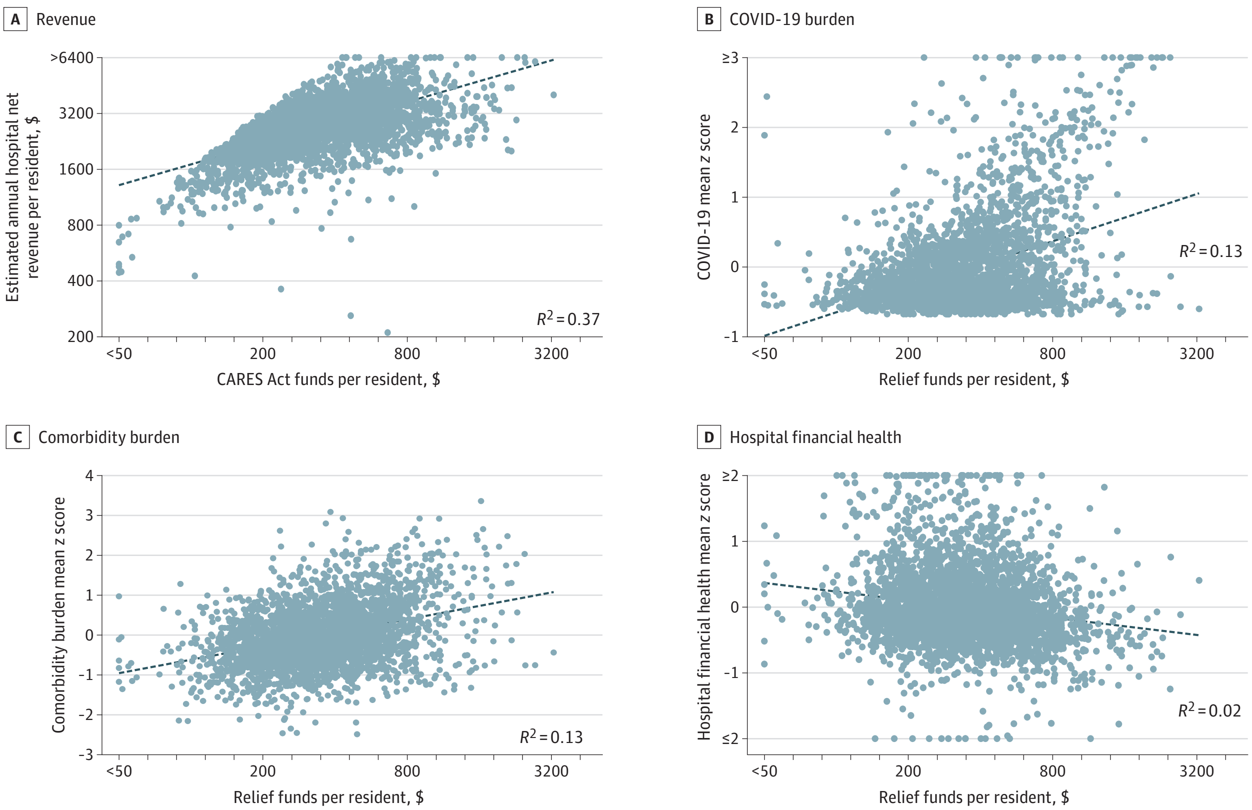
+ Supplemental content

We examined how relief funding relates to the health and financial needs of US counties, focusing on disproportionately Black counties.

Methods | Relief funding is allocated according to a complex, nonlinear formula (combining revenue, location, uninsurance, and COVID-19 hospitalizations; see eTables 1 and 2 in the Supplement for details). We measured (1) how this allocation relates to the health and financial needs of counties, and (2) whether this allocation strategy was associated with differences in funding by county racial composition. Ideally, 2 counties receiving equal funding should have equal needs, irrespective of racial composition.

To measure needs, we used county-level data to form 3 categories: COVID-19 burden (cumulative deaths and cases and cumulative severe acute respiratory syndrome coronavirus 2 case-to-test ratio as of June 28, 2020; non-COVID-19 deaths

Figure. Correlation Between County Measures of Health and Financial Need and Relief Funding



Net revenue per resident refers to the estimated annual net revenue across all hospitals. *Z* scores are calculated by subtracting the mean and dividing by the standard deviation for a given metric. The coronavirus disease 2019 (COVID-19) mean *z* score is estimated as the mean of *z* scores for the following outcomes: cumulative COVID-19 deaths per 100 000, cumulative COVID-19 cases per 100 000, non–COVID-19 deaths per 100 000, and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) case-to-test ratio. Higher COVID-19 mean *z* scores indicate higher burden of COVID-19 (higher COVID-19 cases, higher COVID-19 and non–COVID-19 deaths, higher positive SARS-CoV-2 case-to-test ratio). The mean comorbidity burden *z* score is the mean of the *z* scores among the following comorbidities, estimated using population-based data on prevalence: end-stage kidney disease, diabetes, hypertension, obesity, and smoking. Higher mean comorbidity *z* scores indicate poorer health. The mean hospital finance *z* score includes the following metrics: mean hospital operating margin and days of cash on hand across Medicare fee-for-service admissions within the county. Higher mean hospital finance *z* scores indicate better financial health. Best fit lines were fitted linearly for all panels. For each panel, more than 95% of counties are within the bounds of the axes. The remaining counties are top or bottom coded for scatterplot visualization only. The dots indicate counties and the dashed lines indicate the best fit line across all counties.

between February 1 and July 1, 2020), comorbidities exacerbating COVID-19 (hypertension, end-stage kidney disease, obesity, smoking, diabetes), and hospital financial health (mean operating margin, cash on hand, as estimated in prior research[6]). We summarized these categories with mean *z* scores (eg, for financial health: each hospital's margin and cash were converted to *z* scores by subtracting means and dividing by standard deviations [SDs], then averaged across all hospitals in the county).

We then projected anticipated relief funding for Medicare-participating entities based on announced policies as of July 5, 2020 ($120 billion) by county. We modeled allocations to acute care hospitals, the largest category of health spending, using 2015 Cost Reports. We attributed hospital funding to counties by share of 2015 Medicare fee-for-service admissions, and assumed nonhospital entities (for whom revenue data were not available) were proportional.

We regressed measures of need on relief funding and calculated R^2 to measure how needs varied with funding allocation. We repeated regressions with an indicator for counties with the largest Black population fraction (top quartile). We used Stata version 16.1 (StataCorp). Two-sided $P < .05$ defined statistical significance. This study was approved by the National Bureau of Economic Research Institutional Review Board.

Results | The **Figure** shows relief funding reflected hospital revenues (R^2 = 0.37) more than COVID-19 burden (R^2 = 0.13), comorbidities (R^2 = 0.13), or hospital financial health (R^2 = 0.02).

Across 3124 counties, mean (SD) relief funding per resident was $411 ($277). Disproportionately Black counties (29.6% Black, N = 781) received $126 more funding ($506 vs $380, $P < .001$) than other counties (2.3% Black, N = 2343).

Table. Differences in County Health and Financial Needs by Race, Holding Relief Funding Constant[a]

	No.	Overall mean across counties	Excess in top-quartile Black counties, holding funding constant (95% CI)	*P* value
Measures of health and financial need				
COVID-19				
Burden (mean *z* score)	3124	0	0.50 (0.44 to 0.55)	<.001
Cases per 100 000	3124	484.7	404.0 (346.6 to 461.4)	<.001
Deaths per 100 000	3124	16.9	17.6 (15.3 to 20.0)	<.001
Non-COVID-19 deaths per 100 000	629	385.3	33.3 (9.22 to 57.4)	.007
SARS-CoV-2 case-to-test ratio, %	1504	6.45	3.14 (2.26 to 4.02)	.02
Comorbidity burden (mean *z* score)	3124	0	0.73 (0.68 to 0.79)	<.001
Prevalence, %				
End-stage kidney disease	2679	0.22	0.10 (0.09 to 0.11)	<.001
Diabetes	3124	12.1	2.25 (1.93 to 2.57)	<.001
Hypertension	3123	39.4	4.63 (4.40 to 4.86)	<.001
Obesity	3124	32.8	2.91 (2.48 to 3.34)	<.001
Smoking	3123	17.9	1.19 (0.91 to 1.47)	<.001
Hospital financial health (mean *z* score)	3124	0	−0.12 (−0.18 to −0.06)	<.001
Operating margin, %	3124	4.97	−0.90 (−1.64 to −0.15)	.02
Cash on hand, d	3124	133.3	−15.2 (−23.9 to −6.41)	.001

Abbreviations: COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

[a] Further details on data sources are provided in eTables 1 and 2 in the Supplement. Data on COVID-19 deaths and cases and SARS-CoV-2 tests are cumulative, recorded on June 28, 2020. Data on non–COVID-19 deaths per 100 000 are recorded from February 1 to July 1, 2020.

However, among counties receiving the same funding, disproportionately Black counties had higher COVID-19 burden (mean *z* score: +0.50 SD, $P < .001$), more comorbidities (+0.73 SD, $P < .001$), and worse hospital finances (−0.12 SD, $P < .001$) than other counties (**Table**). Differences in all individual metrics were also large and statistically significant, including more COVID-19 cases and deaths (+404.0 and +17.6 per 100 000, both $P < .001$), more non-COVID-19 deaths (+33.3 per 100 000, $P < .001$), lower operating margins (−0.90%, $P = .02$), and less cash on hand (−15.2 days, $P = .001$).

Discussion | Tying relief funding to revenue resulted in allocations largely unrelated to health or financial needs. It also meant disproportionately Black communities receiving the same level of relief funding as other counties had greater health and financial needs. Although race may co-vary with socioeconomic status or education, it is unique in having special protections under the law. The findings suggest the relief funding allocation may have a "disparate impact" on Black populations, a legal concept referring to policies that negatively affect a protected group, even if they do not explicitly use information about that group.

Study limitations include that it relied primarily on estimated rather than actual disbursement, which may vary with changes in policy or COVID-19 burden, and that nonhospital revenues were not available.

Policy makers should consider aligning funding with measures of need rather than revenue, which would increase both equity and economic efficiency.

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1. Coronavirus Aid, Relief, and Economic Security (CARES) Act, Pub L No. 116-136.

2. Schwartz K, Damico A. Distribution of CARES Act funding among providers. Kaiser Family Foundation. Published May 13, 2020. Accessed July 5, 2020. https://www.kff.org/coronavirus-covid-19/issue-brief/distribution-of-cares-act-funding-among-hospitals/

3. Institute of Medicine. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington, DC: National Academies Press; 2003.

4. Lillie-Blanton M, Hoffman C. The role of health insurance coverage in reducing racial/ethnic disparities in health care. *Health Aff (Millwood)*. 2005;24(2):398-408. doi:10.1377/hlthaff.24.2.398

5. Dowling MK, Kelly RL. Policy solutions for reversing the color-blind public health response to COVID-19 in the US. *JAMA*. 2020;324(3):229-230. doi:10.1001/jama.2020.10531

6. Khullar D, Bond AM, Schpero WL. COVID-19 and the financial health of US hospitals. *JAMA*. 2020;323(21):2127-2128. doi:10.1001/jama.2020.6269

Hepatitis C–Related Hepatocellular Carcinoma Incidence in the Veterans Health Administration After Introduction of Direct-Acting Antivirals

Chronic hepatitis C virus (HCV) infection is an important cause of hepatocellular carcinoma (HCC) in the US. HCV eradication has been associated with a reduced risk of HCC.[1] Despite effective direct-acting antiviral therapies that have been available since 2013, only 14% of patients with HCV in the US were cured as of 2016.[2] In contrast, the Veterans Health Administration (VHA), the largest integrated health care system in the US, provides unrestricted access to HCV treatments and approximately 85% of its case load has achieved cure.[3] We examined trends in HCC incidence within the VHA from 2002 to 2018, according to HCV status, to determine whether the burden of HCC changed following mass HCV treatment.

Methods | We identified all patients diagnosed with HCC annually from 2002 to 2018 using electronic health record data. We defined HCC using *International Classification of Diseases, Ninth Revision* (155.0) or *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (C22.0) codes validated in VHA health records (positive predictive value, 84%-94%).[4,5] Infection with HCV was determined by any history of detectable viral load in VHA data, with cure defined as negative viral load at least 12 weeks after completion of antiviral treatment.[6] We categorized patients into 3 groups as of the time of HCC diagnosis: HCC/HCV viremic (latest HCV RNA before HCC diagnosis was positive), HCC/HCV cured (HCV eradicated before HCC diagnosis), and HCC/non-HCV (no positive lifetime HCV RNA). Total HCV-related HCC (HCC/HCV total) consisted of the sum of HCC/HCV viremic plus HCC/HCV cured.

We calculated the annual incidence of HCC among all patients receiving VHA health care each year and HCV-related HCC among patients with a history of HCV. We used interrupted time-series analysis to test whether incidence for all-cause HCC, HCC/HCV total, and HCC/non-HCV changed after 2015. We obtained the number of antiviral treatments initiated each year.

The institutional review board of the Veterans Affairs Puget Sound Healthcare System approved the study and waived informed consent. The analysis was performed using Stata, version 15.1 (StataCorp). A 2-sided $P < .05$ indicated statistical significance.

Results | The incidence of HCC/HCV total in the VHA increased from 2000 to 2015, peaked in 2015 at 31.0 per 100 000 patients receiving VHA care, then declined 29.6% to 21.8 per 100 000 patients receiving VHA care in 2018 (**Table**). Among patients with a history of HCV, HCC incidence peaked in 2015 (1061 per 100 000 patients with HCV receiving VHA care) and declined 27.2% to 773 per 100 000 patients with HCV receiving VHA care from 2015 to 2018. In an interrupted time-series analysis, incidence decreased after 2015 for both HCC/HCV total and all-cause HCC ($P < .001$) and increased for HCC/non-HCV ($P = .002$), with between-group differences in incidence after 2015 for HCC/HCV total vs HCC/non-HCV ($P < .001$).

The incidence of HCC/HCV cured increased and the incidence of HCC/HCV viremic decreased after 2013 (Table). In 2018, the number of patients with HCC/HCV cured began exceeding the number of HCC/HCV viremic. Among patients with HCC/HCV cured who were diagnosed with HCC in 2018, the mean time since cure was 2.8 (SD, 2.2) years. Annual HCV antiviral treatments peaked at 42 031 in 2016 (**Figure**).

Discussion | Incidence of HCV-related HCC among VHA patients decreased from 2015 to 2018 following viral eradication efforts from 2014 to 2016. In contrast, the incidence of non-HCV-related HCC increased after 2015. Although observational data cannot prove causation, the timing of HCV eradication and declining HCC incidence, lack of decline in non–HCV-related HCC, and prior studies demonstrating that HCV eradication reduces HCC risk[1] provide indirect evidence that this decline may be related to widespread HCV treatment.

The number of people with HCC/HCV cured increased to exceed that of HCC/HCV viremic because antiviral treatment does not completely eliminate residual HCC risk, especially in patients with advanced fibrosis.[6] Among people with HCC/HCV cured, cancer diagnosis occurred a mean of 2.8 years after HCV therapy, further suggesting that HCV will continue to be an important cause of HCC even after managing the majority of HCV infections.

Limitations of this study include the use of *International Classification of Diseases* codes to define HCC rather than chart review; the VHA population, with unknown generalizability; lack of data on liver disease severity prior to treatment; and the short term of the study. HCC incidence trends should continue to be monitored closely because patients cured of HCV may have yet to experience the full potential of risk reduction. These findings support large-scale HCV elimination campaigns, with continued vigilance for HCC in those achieving eradication.