

Letters

RESEARCH LETTER

Characteristics and Outcomes of COVID-19 Patients During Initial Peak and Resurgence in the Houston Metropolitan Area

Texas is experiencing resurgence of coronavirus disease 2019 (COVID-19). We report sociodemographic, clinical, and outcome differences across the first and second surges of COVID-19 hospitalizations at Houston Methodist, an 8-hospital health care system in Houston, Texas.¹

Methods | From electronic health records, we identified patients with positive reverse transcriptase–polymerase chain reaction (RT-PCR) nasopharyngeal swab test results for severe acute respiratory syndrome coronavirus 2. We extracted age, sex, race/ethnicity, comorbidity, medication, intensive care unit (ICU) admission, and mortality information. The assessment of race/ethnicity was driven by prior analyses of our data that demonstrated higher SARS-CoV-2 infection rates among racial and ethnic minorities.² We tracked daily total, ICU, and non-ICU (medical/surgical units) hospital census across the reporting period. We categorized patients into surge 1 for admissions between March 13 and May 15, 2020, and surge 2 between May 16 and July 7, 2020. Surge 2 started 2 weeks after a phased statewide reopening.³

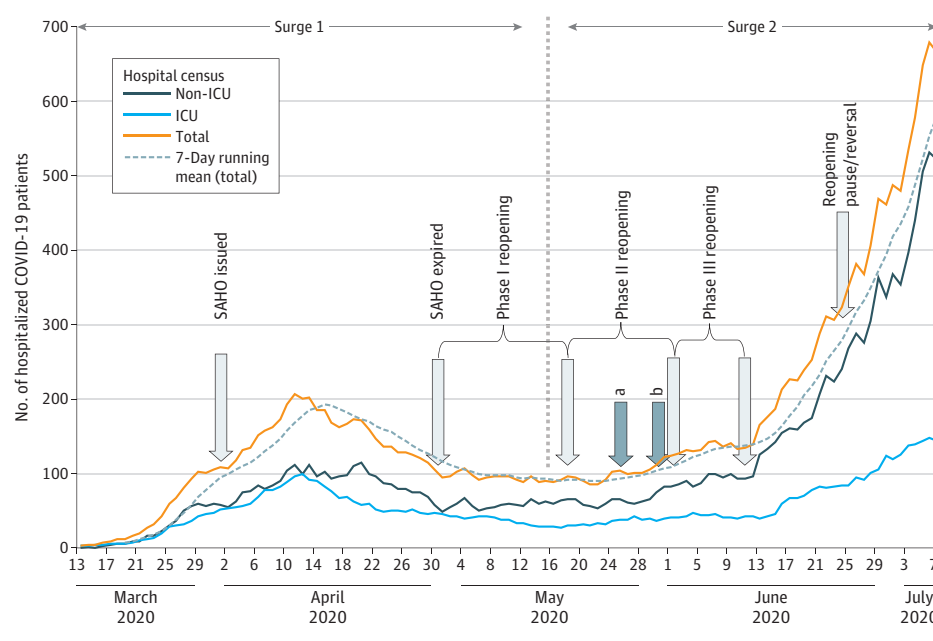
We provided summary statistics as means or medians and proportions for various sociodemographic, clinical, and outcome characteristics of hospitalized COVID-19

patients. Proportional differences with 95% CIs are provided for bivariable comparisons across surges 1 and 2. Extraction and reporting of these data were not deemed human subjects research by the Houston Methodist Institutional Review Board. Analyses were performed with Stata version 16. *P* values were 2 sided, with statistical significance set at *P* < .05.

Results | As of July 7, 2020, 2904 unique COVID-19 patients had been hospitalized, representing 774 and 2130 patients during surge 1 and 2, respectively. The **Figure** presents total, ICU, and non-ICU daily hospital census along with a 7-day mean across the study period. Dates corresponding to various phases of statewide reopening are also highlighted. Patients in surge 2 (vs surge 1) were younger (mean age, 57.3 vs 59.9 years; difference, −2.62 years; 95% CI, −4.04 to −1.20 years), the proportion identifying as Hispanic was higher (43.3% vs 25.7%; difference, 17.64%; 95% CI, 13.89%–28.79%), and the median zip code–based income was lower (\$60 765 vs \$65 805; difference, −\$5040; 95% CI, −\$7641 to −\$2439). Surge 2 patients had a significantly lower burden of overall and specific comorbidities such as diabetes, hypertension, and obesity (**Table**).

A greater proportion of surge 2 patients received remdesivir and enoxaparin. A smaller proportion of surge 2 patients were admitted to the ICU (20.1% vs 38.1%; difference, −18.07%; 95% CI, −21.89% to −14.25%). Length of hospital stay was less (4.8 vs 7.1 days; difference, −2.31 days; 95%

Figure. Daily Hospital Census of Total, Intensive Care Unit, and Non-Intensive Care Unit COVID-19 Patients Across Houston Methodist



Daily hospital census of coronavirus disease 2019 patients across all Houston Methodist hospitals is provided for total, intensive care unit (ICU), and medical/surgical (non-ICU) units. The dashed gray line represents a running 7-day mean total hospital census. SAHO indicates stay-at-home order. Various timeline markers correspond to statewide gubernatorial reopening plan: phase 1, opening of retail stores, malls, restaurants, and nail salons at 25% capacity; phase 2, opening of child care centers, massage parlors, youth clubs, bars, and nightclubs, with phase 1 reopening expanded to 50%; and phase 3, bars allowed to operate at 50% capacity.

^a Memorial Day holiday weekend.

^b Large public rallies in Houston.

Table. Sociodemographic, Comorbidity, Clinical, and Outcome Differences Between Surge 1 and Surge 2 of COVID-19 Hospitalizations at Houston Methodist, Texas

	Surge 1: March 13 to May 15 (64 d) ^a	Surge 2: May 16 to July 7 (53 d) ^a	Difference (95% CI) ^b	P value
No.	774	2130		
Demographic and social characteristics				
Age, mean (SD), y	59.9 (16.9)	57.3 (17.4)	-2.62 (-4.04 to -1.20)	<.001
Age ≤50 y, No. (%)	208 (26.9)	736 (34.6)	7.68 (3.96 to 11.40)	<.001
Non-Hispanic race, No. (%) ^c				
White	257 (45.2)	543 (46.1)	0.97 (-4.02 to 5.95)	.70
Black	256 (45.0)	534 (45.4)	0.38 (-4.60 to 5.36)	.88
Asian	46 (8.1)	83 (7.1)	-1.03 (-3.71 to 1.64)	.44
Other	10 (1.8)	17 (1.4)	-0.31 (-1.59 to 0.96)	.62
Hispanic or Latino, No. (%) ^c	196 (25.7)	910 (43.3)	17.64 (13.89 to 28.79)	<.001
Insurance, No. (%)				
Commercial	305 (39.4)	769 (36.1)	-3.30 (-7.30 to 0.70)	.10
Medicare	333 (43.0)	774 (36.3)	-6.69 (-10.73 to -2.64)	.001
Self-pay	88 (11.4)	423 (19.9)	8.49 (5.68 to 11.30)	<.001
Medicaid	32 (4.1)	141 (6.6)	2.49 (0.73 to 4.24)	.01
Other	16 (2.1)	23 (1.1)	-0.99 (-0.21 to -0.11)	.04
Zip code income, median (IQR), \$	65 805 (48 790 to 86 034)	60 765 (46 300 to 76 163)	-5040 (-7641 to -2439)	<.001
Comorbidity profile ^d				
Charlson Comorbidity Index, median (IQR) score	3 (1 to 6)	2 (1 to 4)	-1 (-1.30 to -0.71)	<.001
Diabetes (with or without complications), No. (%)	312 (40.3)	475 (32.0)	-8.34 (-12.54 to -4.15)	<.001
Hypertension, No. (%)	427 (55.3)	583 (38.8)	-16.52 (-20.81 to -12.24)	<.001
Obesity (BMI ≥30), No. (%)	261 (33.9)	383 (25.7)	-8.19 (-12.20 to -4.18)	<.001
Therapies, No. (%)				
Remdesivir	87 (11.2)	472 (22.2)	10.92 (8.08 to 13.76)	<.001
Convalescent plasma therapy	89 (11.5)	235 (11.0)	-0.47 (-3.08 to 2.15)	.72
Enoxaparin	494 (63.8)	1546 (72.6)	8.76 (4.88 to 12.64)	<.001
Hydroxychloroquine	436 (56.3)	11 (0.5)	-55.81 (-59.32 to -52.31)	<.001
Other anticoagulants	333 (43.0)	635 (29.8)	-13.21 (-17.20 to -9.22)	<.001
Pulmonary diagnoses, severity of care indicators, and outcomes, No. (%) ^d				
Pneumonia	658 (85.3)	1435 (87.8)	2.53 (-0.43 to 5.50)	.09
Acute respiratory distress syndrome	146 (18.9)	76 (5.1)	-13.81 (-16.79 to -10.84)	<.001
Lower respiratory tract infection	23 (3.0)	13 (0.9)	-2.11 (-3.41 to -0.82)	<.001
Acute bronchitis	20 (2.6)	24 (1.6)	-0.98 (-2.27 to 0.32)	.11
ICU admission	295 (38.1)	427 (20.1)	-18.07 (-21.89 to -14.25)	<.001
Invasive mechanical ventilator use	186 (24.0)	230 (10.8)	-13.23 (-16.52 to -9.95)	<.001
Ventilation days, median (IQR) ^e	13 (5 to 26)	5.7 (3 to 10.3)	-7.31 (-9.58 to -5.05)	<.001
Extracorporeal membrane oxygenation	15 (1.9)	6 (0.3)	-1.65 (-2.65 to -0.66)	<.001
Currently hospitalized	0	652 (30.6)	30.61 (28.65 to 32.57)	<.001
Died	94 (12.1)	75 (3.5)	-8.62 (-11.05 to -6.19)	<.001
Died (excluding currently hospitalized) ^d		75 (5.1)	-7.07 (-9.63 to -4.51)	<.001
Died (ICU admissions excluding currently hospitalized) ^{d,f}	81 (27.5)	49 (22.9)	-4.56 (-12.15 to 3.03)	.24
Length of hospital stay, median (IQR), d ^d	7.1 (3.9 to 14.4)	4.8 (2.8 to 7.8)	-2.31 (-2.78 to -1.84)	<.001

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); COVID-19, coronavirus disease 2019; ICU, intensive care unit; IQR, interquartile range.

^a Missing by variable No. (%): race, 129 (4.4); Hispanic, 41 (1.4); and median zip income, 23 (0.8).

^b Differences calculated as surge 2 - surge 1. Negative values represent decrease in surge 2. Null value = 0.

^c Self-reported in accordance with predefined categories. Hispanic ethnicity excluded and analyzed separately. Non-Hispanic race total n: surge 1 = 569; and surge 2 = 1177.

^d Among discharged patients (n = 2252).

^e For nonzero ventilator days.

^f Among patients who received care in the ICU.

CI, -2.78 to -1.84 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.

Farhaan S. Vahidy, PhD, MBBS, MPH
Ashley L. Drews, MD
Faisal N. Masud, MD
Roberta L. Schwartz, PhD
Belimat “Billy” Askary, MA
Marc L. Boom, MD
Robert A. Phillips, MD, PhD

Author Affiliations: Center for Outcomes Research, Houston Methodist Research Institute, Houston, Texas (Vahidy, Phillips); Department of Medicine, Houston Methodist, Houston, Texas (Drews, Boom); Department of Anesthesiology and Critical Care, Houston Methodist, Houston, Texas (Masud); Houston Methodist Academic Institute, Houston Methodist, Houston, Texas (Schwartz); System Quality and Patient Safety, Houston Methodist, Houston, Texas (Askary).

Corresponding Author: Robert A. Phillips, MD, PhD, Houston Methodist, 6565 Fannin St, Dunn 200, Houston, TX 77030 (raphillips@houstonmethodist.org).

Accepted for Publication: July 28, 2020.

Published Online: August 13, 2020. doi:10.1001/jama.2020.15301

Author Contributions: Dr Vahidy and Mr Askary had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Vahidy, Drews, Masud, Boom, Phillips.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Vahidy, Schwartz, Phillips.

Critical revision of the manuscript for important intellectual content: Vahidy, Drews, Masud, Askary, Boom, Phillips.

Statistical analysis: Vahidy.

Administrative, technical, or material support: Drews, Masud, Schwartz, Boom, Phillips.

Supervision: Drews, Boom, Phillips.

Conflict of Interest Disclosures: Dr Masud reports being a consultant for Portolla. No other disclosures were reported.

Additional Contributions: We thank Sayali Kelkar, MPH, Houston Methodist, for help with data curation and assimilation for this analysis. Ms Kelkar did not receive financial compensation for her contribution.

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/>