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Income Disparities In Access To Critical Care Services

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ABSTRACT **The coronavirus disease 2019 (COVID-19) pandemic has highlighted the importance of intensive care unit (ICU) beds in preventing death from the severe respiratory illness associated with COVID-19. However, the availability of ICU beds is highly variable across the US, and health care resources are generally more plentiful in wealthier communities. We examined disparities in community ICU beds by US communities' median household income. We found a large gap in access by income: 49 percent of the lowest-income communities had no ICU beds in their communities, whereas only 3 percent of the highest-income communities had no ICU beds. Income disparities in the availability of community ICU beds were more acute in rural areas than in urban areas. Policies that facilitate hospital coordination are urgently needed to address shortages in ICU hospital bed supply to mitigate the effects of the COVID-19 pandemic on mortality rates in low-income communities.**

The coronavirus disease 2019 (COVID-19) pandemic has highlighted the importance of intensive care unit (ICU) beds as a critical resource to prevent death from the severe respiratory illness that frequently occurs in COVID-19 cases. Although the total number of ICU beds in the US has grown in recent years,[1] the availability of ICU beds is highly variable across the country,[2,3] and health care resources are generally more plentiful in wealthier communities.[4] Inadequate access to ICU beds in low-income areas would exacerbate the health effects of COVID-19 on vulnerable populations that have disproportionately higher rates of SARS-CoV-2 infection through greater job-related exposures, higher population density, more frequent use of mass transit, and less ability to quarantine.[5–7] The combination of high infection rates, high rates of chronic health conditions, low access to testing, and inadequate critical care supply could result in very high COVID-19 death rates in low-income communities. The current and potential seasonal resurgences of COVID-19 cases threaten to strain existing critical care infrastructure.

We examined the relationship between local community income and ICU bed availability in the US. More thorough understanding of the income gradient associated with the supply of ICU beds and identification of the areas with the worst access will help policy makers optimally deploy scarce resources to support communities at the highest risk for high COVID-19 mortality.

Study Data And Methods

DATA We obtained information on the ICU bed capacity of each US hospital from the Centers for Medicare and Medicaid Services' Healthcare Provider Cost Reporting Information System.[8] The system reports the number of (medical) ICU beds, coronary care unit beds, and surgical

ICU beds for each hospital. Because all of these beds potentially can be deployed for the care of critically ill patients with COVID-19, we calculated the total number of available ICU beds as the sum of these three bed types.

Our sample included short-term and critical access hospitals in the fifty states and Washington, D.C., reporting to the Healthcare Provider Cost Reporting Information System in either 2017 or 2018 (we used each hospital's most recent year of data). The sample excluded military, Veterans Affairs, and specialty hospitals because beds in these facilities would not normally be accessible to the general population for COVID-19 care. We also obtained data on the percentage of hospital discharges attributable to Medicaid and Medicare beneficiaries from the Healthcare Provider Cost Reporting Information System.

We used 2018 five-year American Community Survey estimates to obtain information on population, age distribution, racial distribution, population density, and median household income at the ZIP code level. These estimates were aggregated at the level of the hospital service area (HSA). The HSA, as defined by the Dartmouth Atlas of Health Care, is a set of ZIP codes corresponding to the area in which residents receive most of their hospital care.[9] Typically, an HSA has only one hospital, so the HSA can be used to identify the hospital where residents in a particular ZIP code would most likely seek emergency care.

The urbanicity of each HSA was determined from the urbanicity of that HSA's constituent ZIP codes, based on the Rural-Urban Commuting Area Code assigned to that ZIP code, using the most recent (2010) Census Bureau classification.[10] To simplify the rural/urban classification, metropolitan and micropolitan (suburban) areas were classified as urban; all other areas were classified as rural. If there were both urban and rural ZIP codes within an HSA, the HSA was considered urban.

STUDY VARIABLES Access to ICU services in each HSA was defined as the number of ICU beds per ten thousand inhabitants age fifty or older—that is, the population at greatest risk of hospitalization from COVID-19.[11] Access in each HSA was categorized as zero, more than zero to four, more than four to seven, or more than seven beds per ten thousand HSA residents age fifty or older. The cutoffs represent the twenty-fifth, fiftieth, and seventy-fifth percentiles of the distribution of the ICU bed availability variable (see below).

Each HSA was assigned to one of four income groups based on the median household income in the HSA ($0–$34,999, $35,000–$49,999, $50,000–$89,999, and $90,000 or more). The cutoffs represent the fifteenth, fiftieth, and ninetieth percentiles of median household income.

METHODS The percentage of HSAs in each ICU access category was calculated for each HSA income group, as well as for the urban and rural HSA subgroups. Because HSAs can vary widely in population size, we also calculated the population-weighted percentage of HSAs in each ICU category.

We then estimated ordinary least squares models of the relationship between HSA household income and the natural log of ICU beds per ten thousand HSA residents age fifty or older. The ICU measure was logarithmically transformed because of the right-skewness of the ICU distribution (0 values were replaced with 0.01 to retain all observations). We estimated unadjusted and adjusted models for all HSAs combined and separately for urban and rural HSAs. Covariates used in the adjusted models include the mean percentage of hospital discharges attributable to Medicare beneficiaries at hospitals in each HSA, the mean percentage of hospital discharges attributable to Medicaid beneficiaries at hospitals in each HSA, and the percentage of residents in the HSA who are African American.

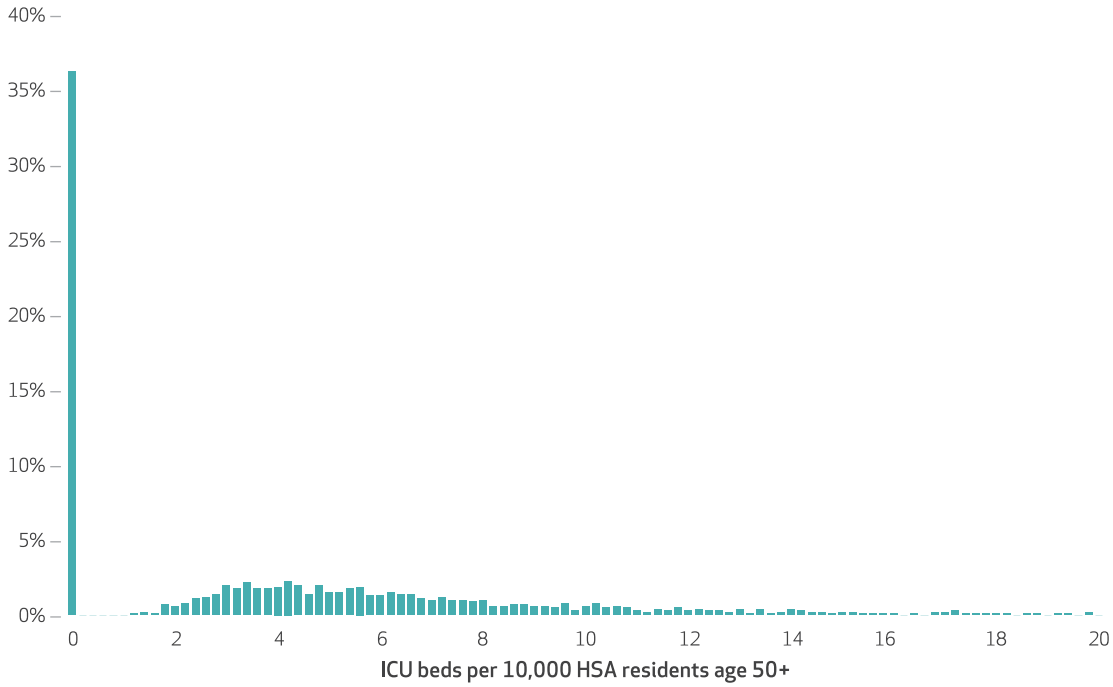
LIMITATIONS A limitation of the study is that we conducted our analysis at the HSA level. This unit of analysis has the advantage of being defined by the actual use of hospital services by patients based on their location, and patients seriously ill with COVID-19 infection who are transported to hospitals by emergency medical services are likely to be hospitalized near their homes.[12] However, it is possible that some patients will obtain care outside their HSA; thus, ICU bed availability in low-income HSAs might not fully reflect access in low-income communities. In addition, our focus on median household income might not fully capture all socioeconomic factors that could be correlated with ICU bed supply.

Study Results

The sample consisted of 4,518 short-term and critical access hospitals in the fifty states and Washington, D.C. Across the 3,160 HSAs, the mean number of ICU beds per ten thousand HSA residents age fifty or older was 4.97 (standard deviation: 11.1); the median ICU bed count was 3.82 per 10,000 (interquartile range: 3.82–6.91) (data not shown). The distribution of ICU beds across HSAs was bimodal: 37 percent of HSAs had zero ICU beds per ten thousand HSA residents age fifty or older, whereas 62 percent had two or more (exhibit 1). About 5 percent of US residents age fifty or older reside in HSAs with no ICU beds, whereas 51 percent reside in HSAs with more than seven ICU beds per ten thousand residents age fifty or older (data not

EXHIBIT 1

Distribution of intensive care unit (ICU) beds per 10,000 hospital service area (HSA) residents age fifty or older, 2017–18



SOURCE Authors' analysis of data from the 2017 and 2018 Centers for Medicare and Medicaid Services Healthcare Provider Cost Reporting Information System and five-year estimates from the 2018 American Community Survey. **NOTES** Distribution shown is truncated at 20 ICU beds per 10,000 HSA residents age fifty or older. Percentages are the percent of HSAs having a given number of ICU beds. *N* = 3,160 HSAs.

shown).

ICU access varied considerably across the country (exhibit 2). Fifty-two percent of HSAs in the Northeast census region and 54 percent in the South had more than four ICU beds per ten thousand residents age fifty or older. Half of HSAs in the Midwest and 34 percent of HSAs in the West had zero ICU beds per ten thousand residents age fifty or older.

Access to ICU beds varied significantly by median household income (exhibit 3). Approximately half of HSAs with the lowest median household incomes (less than $35,000) had zero ICU beds compared with just 3 percent of HSAs with household incomes of at least $90,000. Conversely, although only a total of 46 percent of the lowest-income HSAs had an ICU bed supply of more than four beds per ten thousand residents age fifty or older, a total of 59 percent of the highest-income HSAs had an ICU bed supply of more than four beds per ten thousand residents age fifty or older. A similar pattern can be seen with a population-weighted HSA measure (online appendix A1).[13]

In urban areas, the income gradient was less pronounced than in rural areas (exhibit 4). Whereas 31 percent of urban low-income HSAs had no access to ICUs, 55 percent of rural low-income HSAs had zero access. Similar proportions of low-, middle-, and high-income HSAs in urban areas had access to more than seven ICU beds per ten thousand residents age fifty or older compared with HSAs in rural areas.

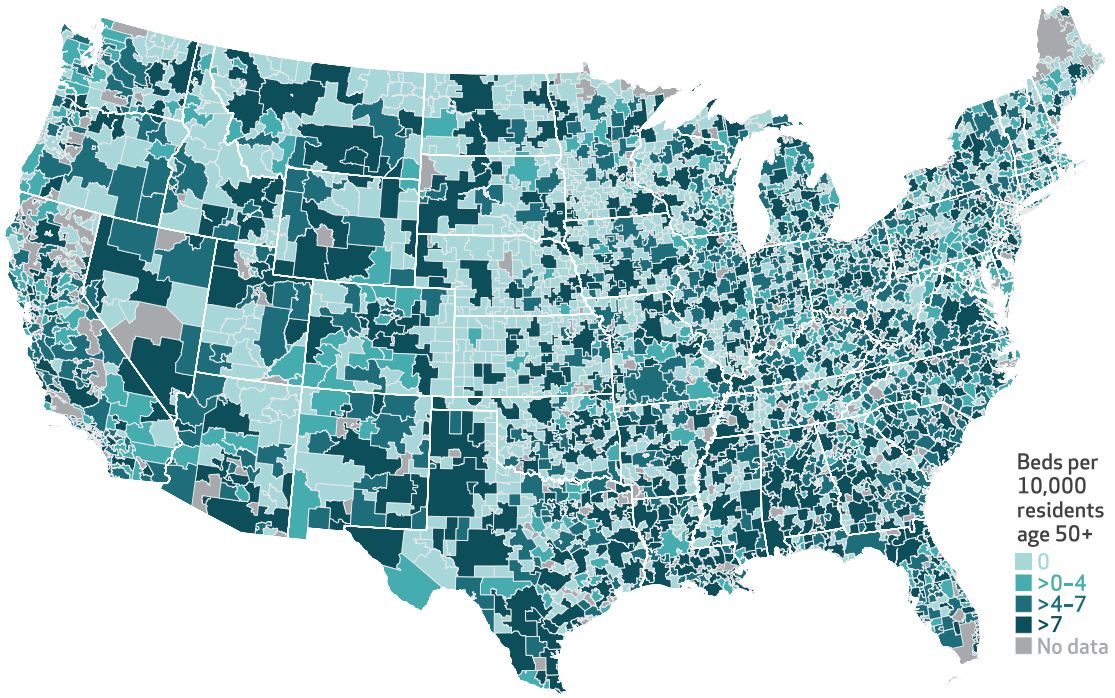
Unadjusted ordinary least squares models indicated that in urban areas an increase of $10,000 in an HSA's median household income was associated with a 15.5 percent increase in ICU beds per ten thousand residents age fifty or older (95% confidence interval: 10.1, 21.0; $p < 0.001$). In rural areas, each $10,000 increase in median income was associated with an 18.0 percent increase in ICU bed rates (95% CI: 5.9, 30.2; $p < 0.001$). In adjusted models, a $10,000 increase in income was associated with an 11.8 percent increase in ICU beds per ten thousand residents age fifty or older (95% CI: 6.5, 17.1; $p < 0.001$) in urban areas and a 13.4 percent increase in rural areas (95% CI: 1.2, 25.7; $p = 0.032$) (data not shown).

Discussion

Low-income communities have far fewer ICU beds per capita than wealthier communities. Be-

EXHIBIT 2

Intensive care unit (ICU) bed availability in hospital service areas (HSAs) across the United States, 2017–18



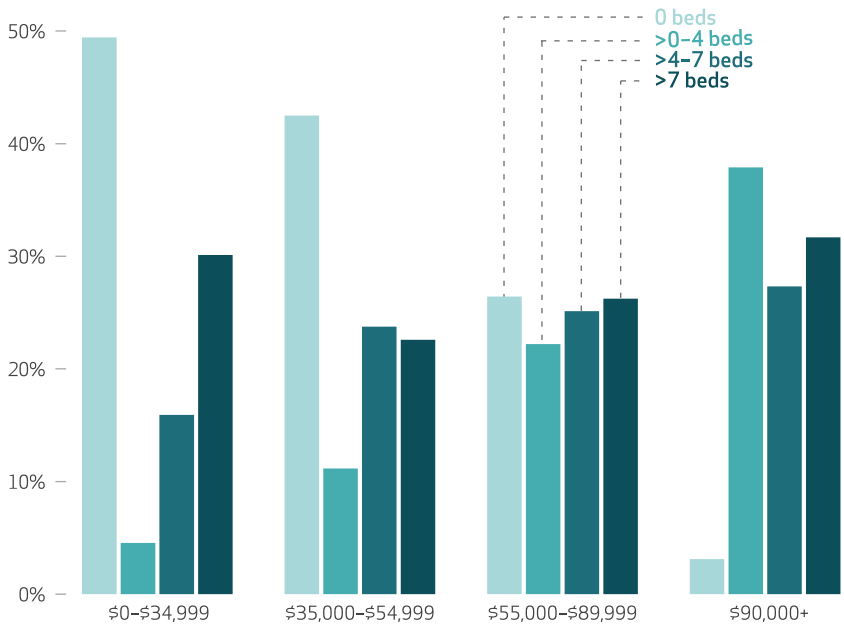
SOURCE Authors' analysis of data from the 2017 and 2018 Centers for Medicare and Medicaid Services Healthcare Provider Cost Reporting Information System and five-year estimates from the 2018 American Community Survey. **NOTES** Availability is measured as number of ICU beds per 10,000 HSA residents age fifty or older. *N* = 3,160 HSAs.

cause low-income communities are also likely to have higher incidence of COVID-19[7,14] and higher prevalence of the chronic medical conditions that increase the probability of life-threatening illness among people with COVID-19,[15] the adverse effects of the low supply of ICU beds in low-income communities may be compounded by disproportionately high demand for ICU care in the COVID-19 pandemic. This gap in ICU bed availability is more pronounced in rural areas than in urban areas, but income disparities still exist in dense, urban areas.

In light of these income disparities in community ICU bed supply, there are several steps that policy makers might take to mitigate potential harms. First, state and municipal policy makers need to coordinate the emergency expansion of ICU capabilities at hospitals to ensure that all communities have sufficient access to ICU care. Individual hospitals facing severe COVID-19-related financial losses have little incentive to attract critically ill patients with COVID-19 from underserved areas, as these patients often lack extensive insurance coverage, and the costs of their care often exceed reimbursement rates.[16] Higher-level coordination is needed at the county, state, and federal levels to facilitate hospital sharing of the demand for care and to publicly

EXHIBIT 3

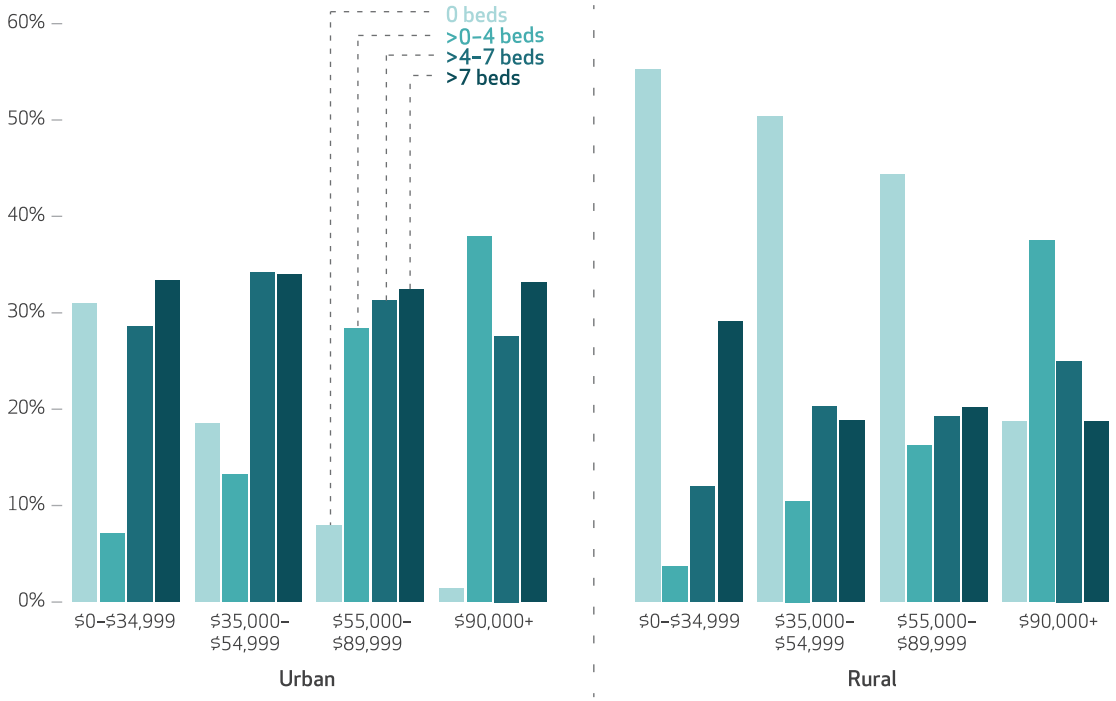
Intensive care unit (ICU) bed availability in hospital service areas (HSAs), by median household income, 2017–18



SOURCE Authors' analysis of data from the 2017 and 2018 CMS Healthcare Cost Report Information System and five-year estimates from the 2018 American Community Survey. **NOTES** Availability is measured as number of ICU beds per 10,000 HSA residents age fifty or older. Percentages are the percent of HSAs having a given number of ICU beds.

EXHIBIT 4

Intensive care unit (ICU) bed availability by median household income in urban versus rural hospital service areas (HSAs), 2017–18



SOURCE Authors' analysis of data from the 2017 and 2018 CMS Healthcare Cost Report Information System and five-year estimates from the 2018 American Community Survey. **NOTES** Availability is measured as number of ICU beds per 10,000 HSA residents age fifty or older. Percentages are the percent of HSAs having a given number of ICU beds.

finance the specialized resources (for example, ICU beds, ventilators, specialized health care workers) needed to optimally deliver critical care.

Second, the typical emergency medical system guideline to "transport to the nearest hospital" should be revisited under these new pandemic conditions. The demand for COVID-19 and other care in low-income areas, whose residents are most adversely affected by SARS-CoV-2, is straining hospitals in low-income areas. Plans should be made for how and under what conditions patients can be transported to hospitals outside their immediate communities and how these transport protocols will be communicated to the public.

Third, emergency funds need to be directed toward hospitals lacking sufficient ICU resources, especially those caring for large older populations that are more likely to be hospitalized for COVID-19. Appendix A2 lists the lowest-income HSAs (fifteenth household income percentile or below) with zero or minimal supplies of ICU beds that are most at risk.[13]

As the COVID-19 pandemic progresses, coordinated policy responses are urgently needed to prevent preexisting socioeconomic disparities from exacerbating the harms already being done by COVID-19. ■

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NOTES

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13 To access the appendix, click on the Details tab of the article online.

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