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Hospital and ICU patient volume per physician at peak of COVID pandemic: State-level estimates

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ABSTRACT

Background: In anticipation of patient surge due to COVID-19, many states are working to increase the available healthcare workforce. To help inform state policies and initiatives aimed at physician deployment during COVID-19, we used predictions of peak patient volume for hospitals and intensive care units (ICU) and regional physician workforce estimates to measure patient to physician ratios at the peak of the pandemic for each state.

Methods: We estimated the number of potentially available physicians based on Medicare Part B billings for the care of hospitalized and critically ill patients in 2017, adjusted for attrition due to exposure to SARS-CoV-2 and relevant experience. We used estimates from the Institute of Health Metrics and Evaluation to determine the number of hospitalized and ICU patients expected at the peak of the pandemic in each state. We then determined the expected ratio of patients per physician for each state at the peak of the pandemic.

Results: The median number of hospitalized patients per physician was 13 (low estimate) to 18 (high estimate). At the high estimate of hospitalized patients, 35 states would have a patient to physician ratio of more than 15:1 (patient to physician ratios above 15:1 have been associated with poor outcomes). For ICU patients, the median number of patients each physician would treat across states would be 8–11 patients. Nine states would experience patient to physician ratios above 15:1 at the higher end of estimates. Patient-physician ratios decreased if the available physician pool was broadened to include physicians without recent experience treating hospitalized patients, and physicians in surgical specialties with experience treating acutely hospitalized patients.

Conclusions/implications: We estimate that most states will have sufficient physician capacity to manage hospitalized patients at the peak of the pandemic. However, at the high estimates of hospitalized patients, some Midwestern states will experience high patient to provider ratios that may adversely affect patient outcomes.

Level of evidence: State.

1. Introduction

At its peak, the surge of COVID-19 patients during the first wave of the pandemic overwhelmed hospital capacity in parts of the US. Anticipating an estimated 20% of infected individuals needing hospital care, and approximately 5% in critical care, many states worked to increase hospital bed capacity, procure equipment, and deploy staff, including physicians.¹ Some states implemented strategies such as early graduation for medical students, deploying retired physicians, and recruiting volunteers from other states to increase the number of available physicians to manage the anticipated surge of COVID patients.² To help inform state policies and initiatives aimed at physician deployment during COVID-19, we used projections of peak patient volume for hospitals and intensive care units (ICU) and physicians potentially available for deployment to estimate patient to physician ratios at the peak of the pandemic for each state. This approach could be used by states as a way to quickly measure physician capacity in a future health crisis (e.g.,

COVID, influenza).

2. Methods

We first determined the services provided to Medicare fee-for-services beneficiaries by physicians in 2017 using Provider Utilization and Payment Data files.³ Healthcare Common Procedure Coding System (HCPCS) codes (99,217–99226, 99,231–99236, 99,238, 99,239) were utilized to identify those physicians with experience treating hospitalized adults. HCPCS codes were used to identify physicians with experience managing critical care (99,291, 99,292), and ventilated (94,002–94005, 94,660–94662) patients. The files excluded physicians that billed for less than 10 services in a year. Physicians with limited direct contact or management of hospitalized patients (dermatology, nuclear medicine, ophthalmology, psychiatry, pathology, radiology, and their subspecialties) and emergency medicine physicians (who are likely to be needed in the emergency department) were excluded. We used the

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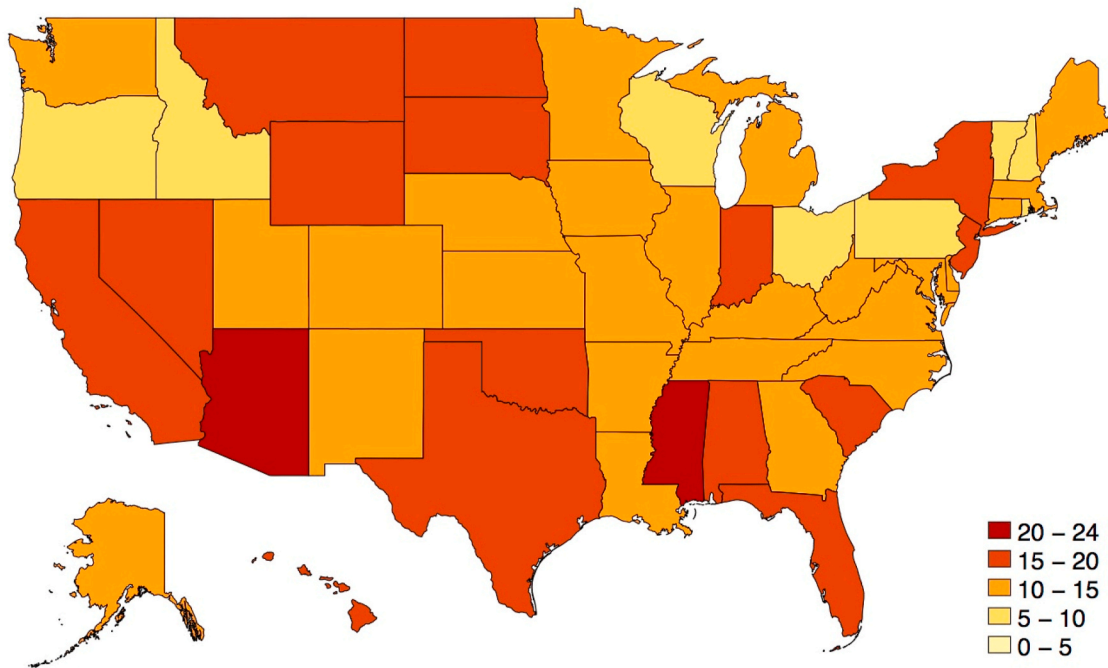
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A) Low Estimates of Patients per Medicine Provider with Hospital Experience at the Peak of Pandemic



B) High Estimates of Patients per Medicine Provider with Hospital Experience at the Peak of Pandemic

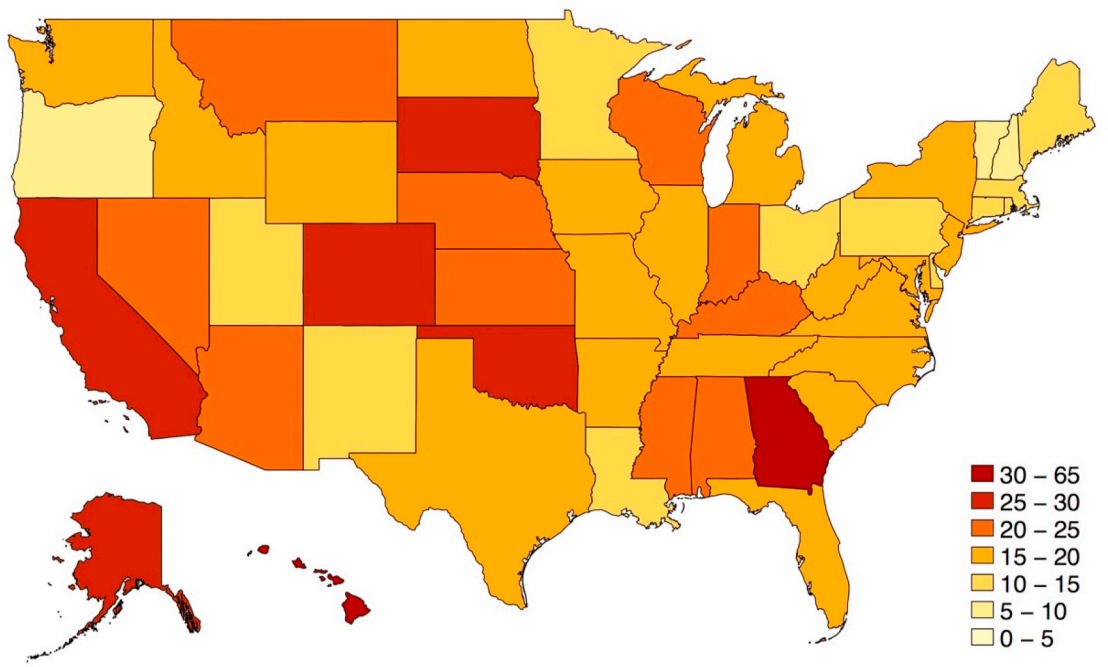


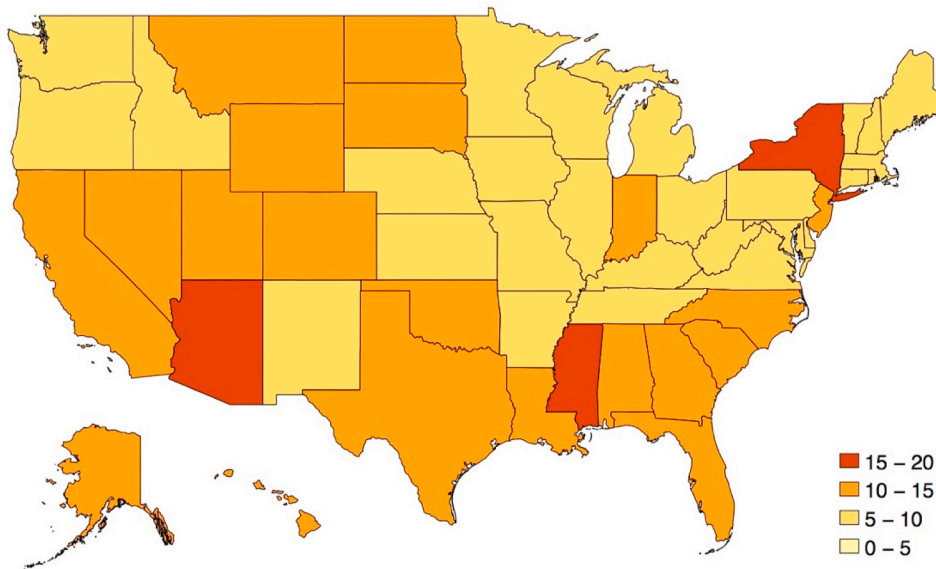
Fig. 1. A) low estimates of patients per medicine provider with hospital experience at the peak of pandemic. B) High estimates of patients per medicine provider with hospital experience at the peak of pandemic.

primary physician specialty to categorize physicians into three categories (1) anesthesia, pulmonology, and critical care medicine, 2) medical generalists and specialists (e.g., internal medicine, family practice, neurology, and their subspecialties), and 3) surgeons (urology,

thoracic surgery, vascular surgery etc).

We made the following assumptions to estimate the number of available physicians. Based on the available literature on healthcare worker exposure and disease risks,⁴ we estimated that 18% of the all

A) Low Estimates of Patients per Medicine/Surgical Provider with Hospital Experience at the Peak of Pandemic



B) High Estimates of Patients per Medicine/Surgical Provider with Hospital Experience at the Peak of Pandemic

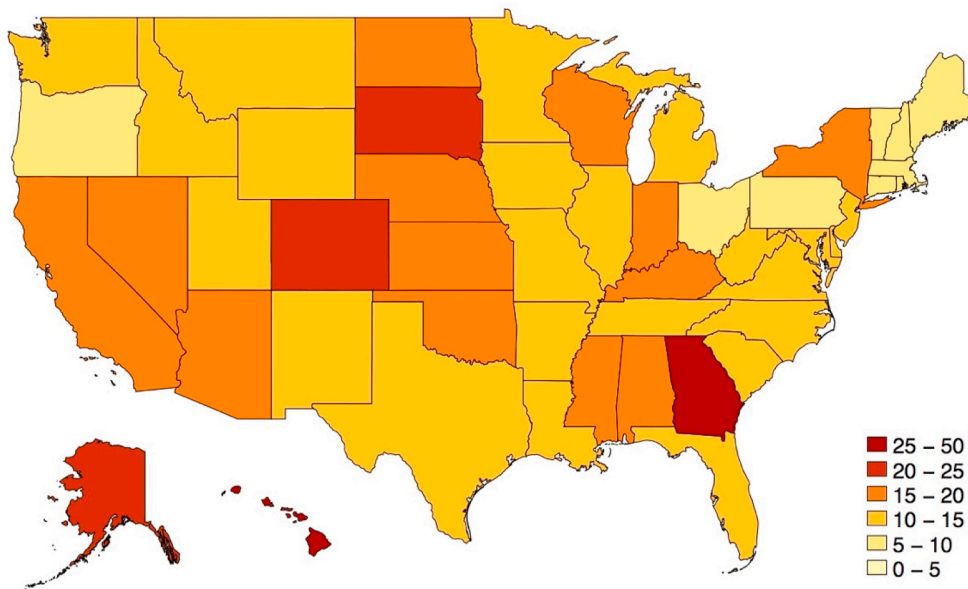


Fig. 2. A) low estimates of patients per medicine/surgical provider with hospital experience at the peak of pandemic. B) High estimates of patients per medicine/surgical provider with hospital experience at the peak of pandemic.

physicians would be quarantined. We used a conservative estimate of reasonable physician work schedules to account for self-care and other physician responsibilities - we estimated that each physician would work every 4th shift. Thus, 25% of all physicians would be on service in the hospital during any given shift at the peak of the pandemic.

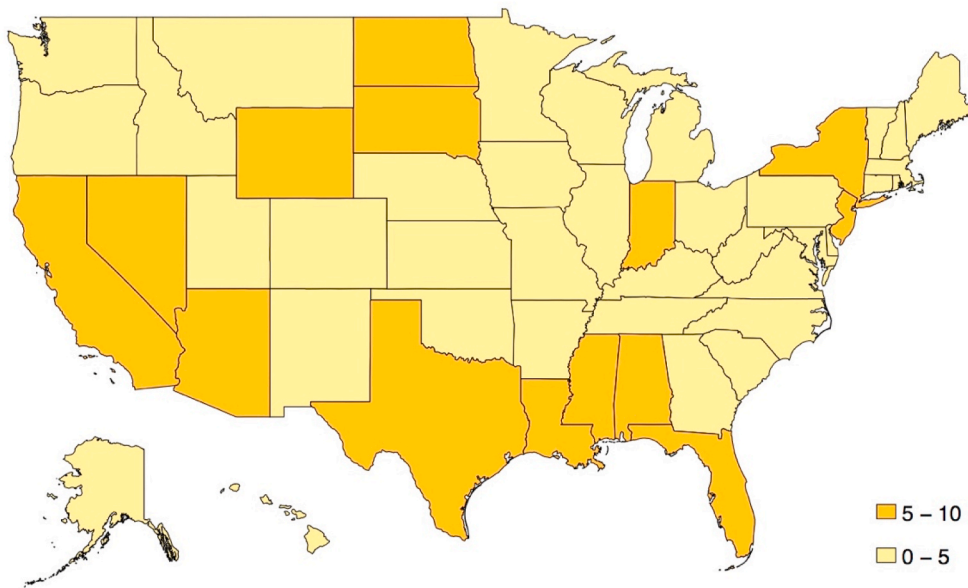
American Hospital Association data was used to determine the number of patients hospitalized and requiring ICU care at the peak of the pandemic.⁵ To do so, we multiplied the number of hospital and intensive care unit (ICU) beds available in each state by the average occupancy rate of those beds. We assumed a 38% reduction from historical hospitalization rates to estimate the number of hospitalized non-COVID patients, based on reported reduction in all-cause hospitalizations.⁶ We did

not adjust the ICU bed occupancy rate when estimating the number of non-COVID patients requiring critical care, because critically ill patients are unlikely to avoid hospitals. To determine the number of COVID patients in the hospital and ICU in each state at the peak of the pandemic, we used the Institute for Health Metrics and Evaluation (IHME) Covid-19 state projections (released on October 2, 2020), which assumed continued easing of current social distancing guidelines.⁷

2.1. Analysis

IHME COVID projections were added to the estimates of the number of non-COVID patients to determine how many patients would be

A) Low Estimates of Patients per Medicine/Surgical Provider Regardless of Experience at the Peak of Pandemic



B) High Estimates of Patients per Medicine/Surgical Provider Regardless of Experience at the Peak of Pandemic

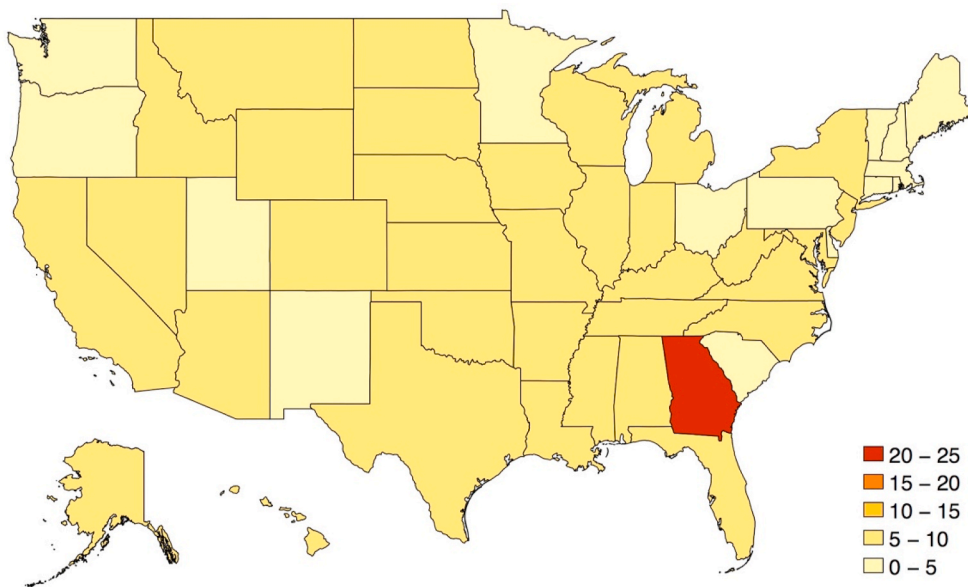


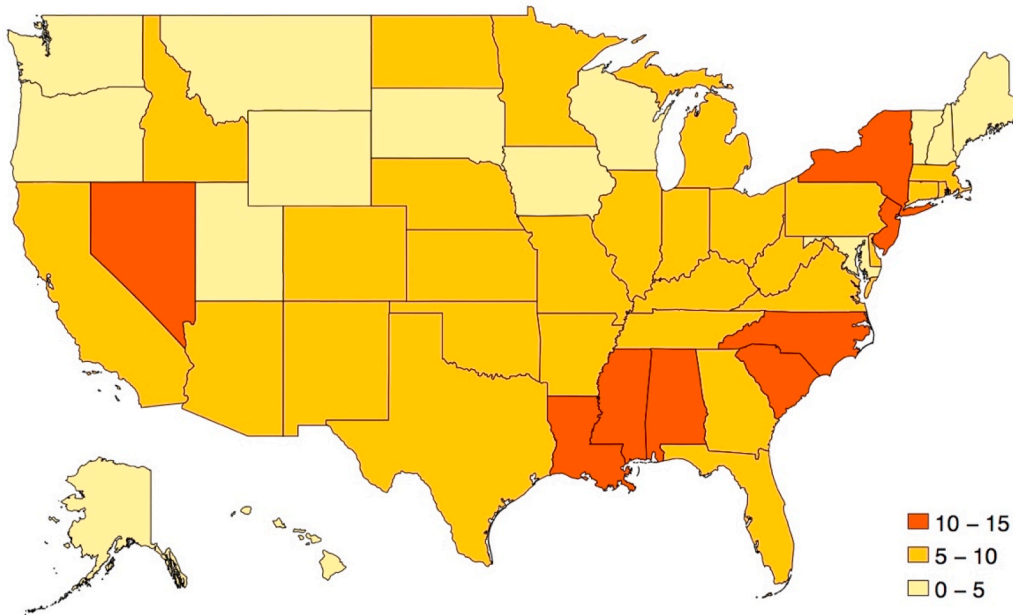
Fig. 3. A) low estimates of patients per medicine/surgical provider regardless of experience at the peak of pandemic. B) High estimates of patients per medicine/surgical provider regardless of experience at the peak of pandemic.

hospitalized (on the floor or in the ICU) at the peak of the outbreak. Using the estimated number of physicians available and the high and low estimates of patients requiring hospitalization, we were able to determine best- and worst-case scenarios of how many hospitalized patients each physician would be expected to manage at the peak of the outbreak under three different scenarios. First, we assumed that only medicine physicians (generalists and specialists) with recent experience treating hospitalized patients would be available for deployment to the hospital. Second, we considered all medicine and surgeon providers

with recent experience treating hospitalized patients be available for deployment to the hospital. Third, we considered all medicine and surgeon providers (regardless of experience) as potentially available for deployment.

To estimate the best- and worst-case scenarios of how many ICU patients each physician would be expected to manage at the peak of the outbreak, we considered the following two categories of physicians. First, we considered all anesthesia, pulmonary, and critical care physicians to be potentially available to manage critically ill patients. Second,

A) Low Estimates of ICU Patients per Anesthesia/Critical Care Provider at the Peak of Pandemic



B) High Estimates of ICU Patients per Anesthesia/Critical Care Provider at the Peak of Pandemic

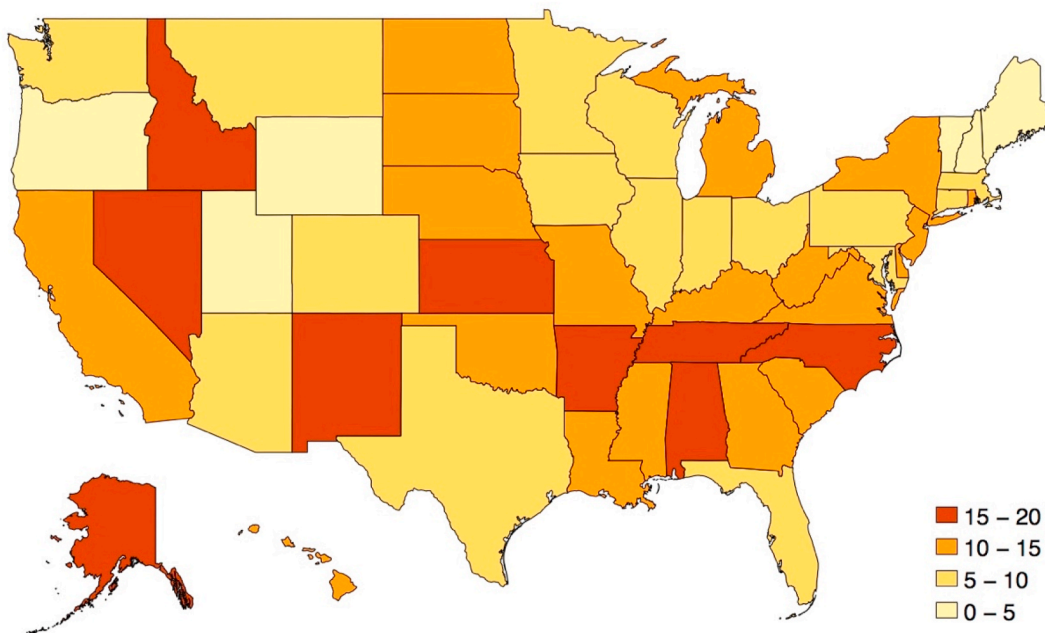


Fig. 4. A) low estimates of ICU patients per anesthesia/critical care provider at the peak of pandemic. B) High estimates of ICU patients per anesthesia/critical care provider at the peak of pandemic.

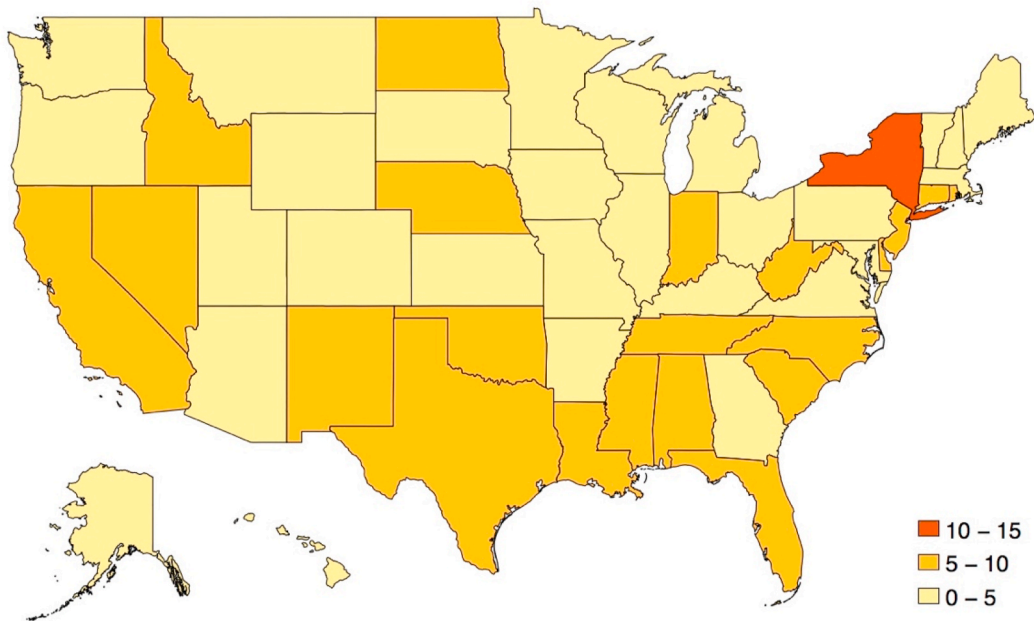
we considered all anesthesia, pulmonary, and critical care physicians as well as any medicine and surgery physicians who billed for management of critically ill patients. We did not exclude anesthesia, pulmonary, or critical care physicians who did not bill for critical care visits because physicians in these specialties who work in non-ICU settings (such as operating rooms) are also trained and experienced in managing critically ill intubated patients.

3. Study results

Of the 438,345 physicians in the sample, medicine generalist and specialist physicians were the most common (65.4%), followed by surgeons (23.8%) and anesthesiologists (10.8%).

If only those medicine generalist and specialist physicians with recent experience treating hospitalized patients are utilized, physicians would need to treat a median of 13–18 patients across all states. Using higher estimates, 35 states would have a provider to patient ratio of more than 15 at the peak of the outbreak (Fig. 1). If surgeons and

A) Low Estimates of ICU Patients per Anesthesia/Critical Care, and other Physicians with ICU Experience at the Peak of Pandemic



B) High Estimates of ICU Patients per Anesthesia/Critical Care, and other Physicians with ICU Experience at the Peak of Pandemic

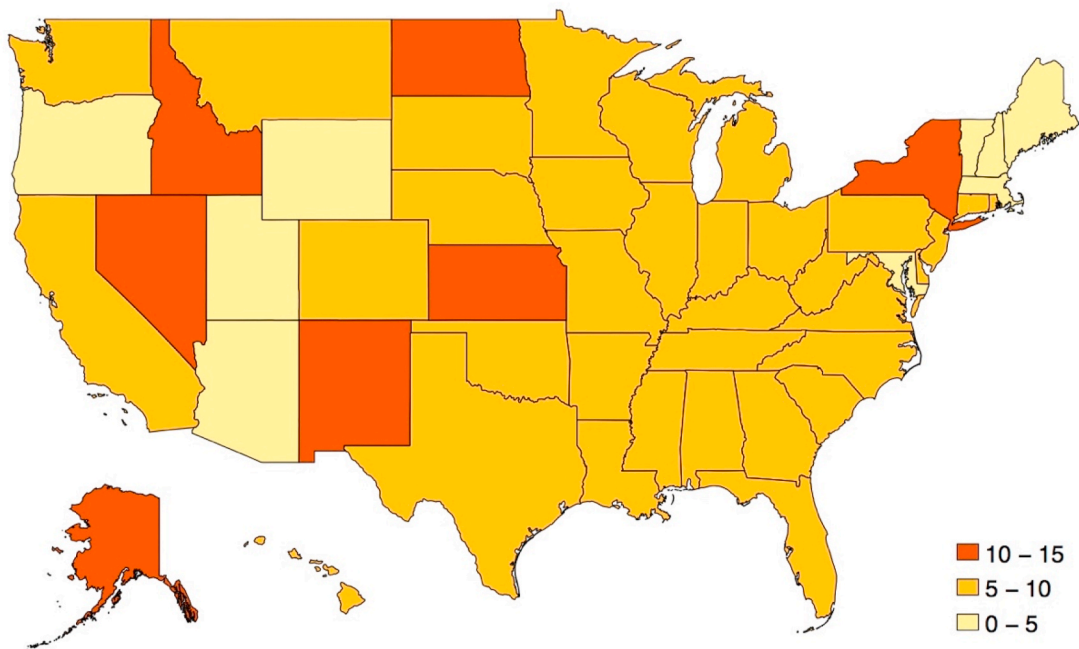


Fig. 5. A) Low Estimates of ICU Patients per Anesthesia/Critical Care, and other Physicians with ICU Experience at the Peak of Pandemic. B) High Estimates of ICU Patients per Anesthesia/Critical Care, and other Physicians with ICU Experience at the Peak of Pandemic.

medicine physicians with experience treating hospitalized patients are utilized, physicians across states will need to treat a median of 10–13 patients (Fig. 2). If all medicine and surgery physicians across the states were used, each provider would need to treat a median of 5–6 patients, with only one state (Georgia) exceeding 15 patients per provider

(Fig. 3).

Patient to physician ratios for critically ill patients in ICUs were generally lower across all scenarios. If all anesthesiology and critical care physicians are deployed to care for ICU patients at the peak of the pandemic, the median number of patients each physician would treat

would be 8–11 patients (Fig. 4). Nine states would experience patient to physician ratios above 15:1 at the higher end of estimates, and some states (such as Kansas, Alaska, and Idaho) will experience more than a 2-fold higher patient ratios at the higher end of estimates. If any physician with experience treating critically ill patients is deployed to manage ICU patients, physicians would have to care for a median of 5–8 patients, with no states exceeding 15 patients per physician in a worst-case scenario (Fig. 5).

4. Discussion

Studies linked adverse events and poor patient outcomes for hospitalized and critically ill patients at patient-physician ratios greater than 15.^{8,9} As states plan for a surge in COVID patients, utilizing physicians across various specialties and previous experience can allow for reasonable patient volume per physician in most states. Physicians treating hospitalized patients who do not require ICU level care are more likely to have a high patient census than physicians treating ICU patients. These findings may inform health systems plans for deploying physicians during the pandemic, including providing additional training to physicians who may not typically practice in a hospital setting. Furthermore, states may consider focusing recruitment internally rather than seeking out-of-state volunteers who may not have appropriate credentialing and may be needed in their own state.

These findings contrast reports of shortages of ICU physicians nationwide.^{10,11} Using the statewide projections from the IHME model, we did not evaluate local geographic variations in physician supply. Rural areas, for example, may be more susceptible to physician shortages during an epidemic since physicians tend to live in urban areas.¹² Depending on the physician distribution within states, regional shortages could occur if available physicians cannot be readily relocated to areas experiencing a spike in infections. Nevertheless, our approach incorporates the IHME model projections and, since states play key role in occupational regulation, for example, could be used to inform future planning for healthcare workforce deployment during a state or national health emergency. In fact, as of October 2, 2020, the IHME model projected a peak of COVID-19 cases still to come for 34 states, with 21 states' projections peaking in January 2021. Consistent with other studies, our findings of higher than recommended patient to physician ratios at the high estimates of hospitalizations highlight the importance of continued strict social distancing guidelines in order to avoid overwhelming the healthcare system.

4.1. Limitations

This study has several limitations. First, the IHME projections used in this study may under- or overestimate the surge of patients with COVID at the peak of the pandemic. We used the low and high estimates of patients per state to provide a range of possible scenarios based on the projections. Furthermore, policy makers could vary the assumptions we applied to derive these estimates to better customize these findings to local conditions. For example, our assumption of one in five physicians requiring quarantine may be too high in some settings and should be observable to many health systems. Lower rates of exposure among physicians would result in lower patient to physician ratios. Similarly, more aggressive work schedules (more frequent deployment to work in the hospital) would result in lower patient to physician ratios. Second, we did not account for residents, fellows, and advanced practitioners who provide direct patient care in many hospitals. On average, including residents would increase the number of available physicians by about 15%, ranging from less than 5% in the Mountain states to 30% in New York.¹³ While residents require attending physician supervision, fellows may practice independently in certain situations. Furthermore, some states have relaxed scope of practice regulations for advanced

practitioners reducing or eliminating supervisory requirements for practice for those clinicians.

5. Conclusion

Despite reports of physician shortages in some areas, our study suggests that most states have enough physicians within the state to provide hospital and ICU-level care during the pandemic. This information is valuable not only in planning for the ongoing COVID pandemic but also potential future health emergencies that require hospital care. In fact, current policies that mobilize out of state physicians or early medical school graduates for patient care may cause harm. For example, states may cause shortages in neighboring states or recruit inexperienced physicians not yet ready for independent practice. In addition, efficient deployment of practicing physicians within states should obviate the need for recruitment of physicians who retired, which may be particularly salient since age over 65 years is a risk factor for more severe COVID infection.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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