

# Critical Care Surge Capacity in U.S. Hospitals

## Strategies for Responding to the COVID-19 Pandemic

**T**he coronavirus disease 2019 (COVID-19) outbreak is straining U.S. hospital and health care systems. In late March 2020, the United States surpassed China as the country with the most confirmed COVID-19 cases. Experiences in New York City, an outbreak epicenter, show that there will likely be high demand for critical care resources across the United States in systems that already are strained at baseline.

RAND researchers assembled a list of strategies to help U.S. hospitals create critical care surge capacity. The list was created using a review of scientific literature about past outbreaks and the current COVID-19 pandemic, a survey of frontline clinicians conducted in collaboration with the American College of Emergency Physicians, and two roundtables conducted via teleconference with leading emergency and critical care physicians and public health and preparedness experts from around the country.

The strategies are organized into two tiers:

- **Tier 1** strategies to build contingency capacity include adaptations to medical care spaces, staffing constraints, and supply shortages without significant impact on medical care delivery. Strategies might include converting stepdown, post-anesthesia care unit (PACU) or operating room beds to intensive care unit (ICU) beds, drawing on emergency department and PACU nurses not on shift for ICU care, and

### KEY FINDINGS

- RAND researchers developed a tool to help hospitals create critical care surge capacity to respond to COVID-19.
- The tool allows hospitals to assess alternative strategies for creating this capacity and to identify which factors—space, staff, and equipment (such as ventilators)—are key to increasing the number of patients hospitals can treat.
- An illustrative analysis examined critical care capacity in each of the ten FEMA regions in the United States. In most of these regions, the number of ventilators was the key limiting factor.

borrowing, purchasing, or acquiring additional ventilators from stockpiles.

- **Tier 2** strategies to build crisis capacity include changes that will have significant impact on routine care delivery and operations. Strategies might include turning regular hospital beds into ICU beds, using open ICU beds in the Veterans Health Administration and other federal or noncivilian facilities, using ICU beds in mobile hospitals, and reopening shuttered hospitals. They might also include providing just-in-time training, changing staffing and supervisory ratios, and altering standards of care.

## Estimating Surge Capacity

To illustrate the possible impact of these strategies on critical care surge capacity, we used available data to estimate how much capacity would be created by increasing the amount of the following resources, which are essential to surge capacity: *space* (existing ICUs and other spaces that could be repurposed during a crisis), *staff* (critical care doctors, nurses, and respiratory therapists), and *stuff* (equipment such as ventilators).

The report is accompanied by a user-friendly, Microsoft Excel-based tool that allows decisionmakers at all levels—hospitals, health care systems, states, regions—to estimate current critical care capacity and rapidly explore strategies for increasing it. The tool allows users to

- set baseline numbers of ICU doctors, ICU nurses, and respiratory therapists per shift and the ratios of these providers to patients
- input information related to how ICU physicians, nurses, and respiratory therapists might act as supervisors for *extender* care providers (i.e., staff who require supervision to provide care for critically ill COVID-19 patients)
- specify (1) additional spaces that can be created and used as ICU space (e.g., through doubling patients in ICU rooms or using PACU space) and (2) additional ventilators that can be added to create critical care surge capacity (e.g., through sharing with other facilities or purchasing).

The tool then estimates the number of patients who can be cared for. It also identifies which resource among space (beds), staff (critical care doctors, critical care nurses, and respiratory therapists), and stuff (ventilators) is the limiting factor for increasing capacity.

To illustrate use of the tool, we used data for each of the ten Federal Emergency Management Agency (FEMA) regions to estimate the critical care surge capacity that can be created using Tier 1 and Tier 2 strategies. Results were as follows:

- For nearly every FEMA region, the most common limiting factor for developing surge capacity was the number of ventilators.
- The other limiting factor was the number of critical care doctors. For each FEMA region, the only increase in staff capacity came from using extenders.
- The number of nurses, respiratory therapists, or beds was not the limiting factor in any FEMA region.
- As expected, moving from the first to the second tier often increased critical care surge capacity. But the degree of increase in capacity depends on available resources and on the specific combinations of those resources. In most of the FEMA regions, Tier 2 options increased the number of patients who could be treated compared with Tier 1 options, but in some cases, there was little additional gain (see Figure 1).

## Implications for Action

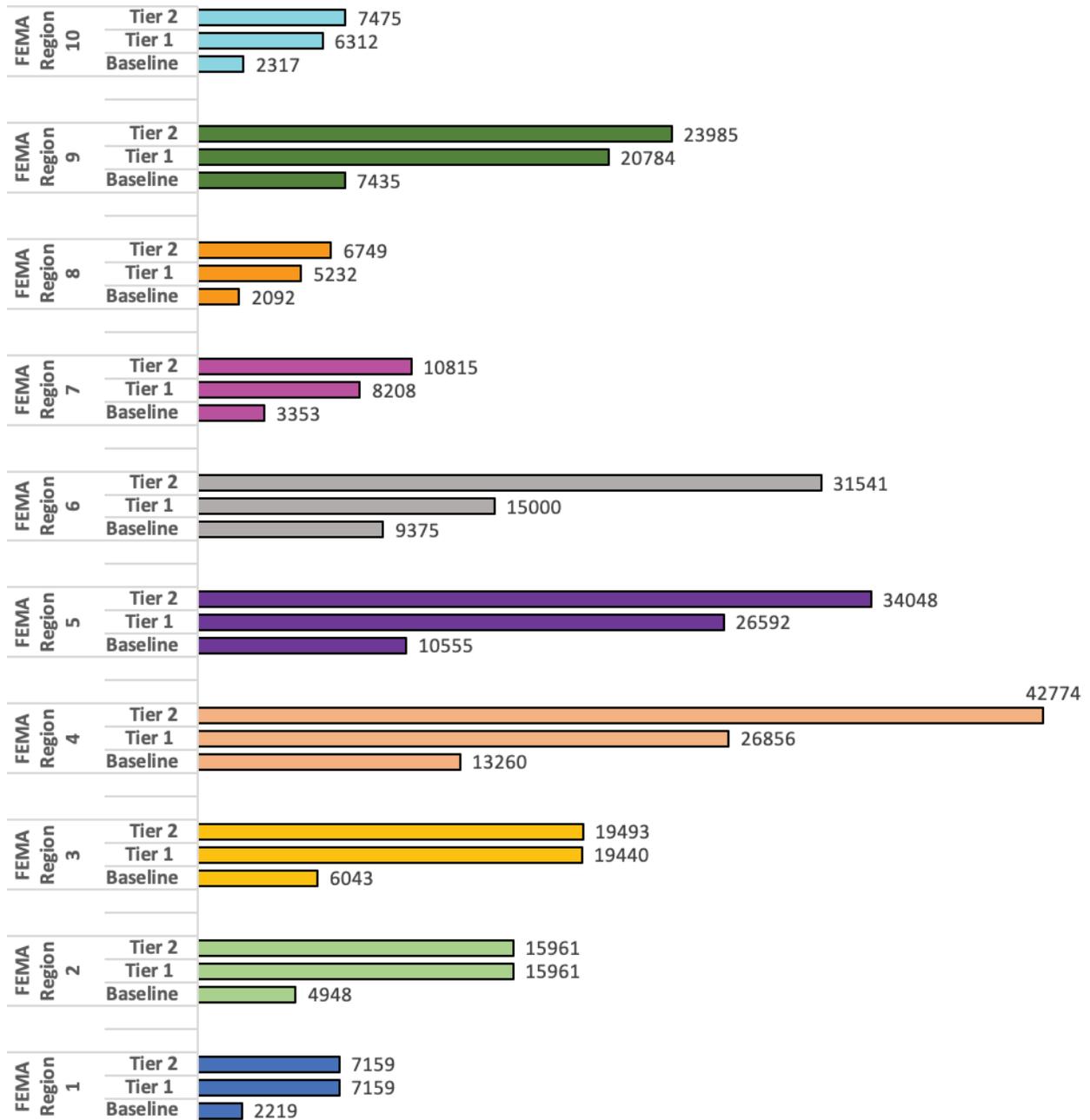
We conclude our analysis by identifying considerations and decisions for hospitals, as well as state, regional, and federal decisionmakers.

### Hospitals should consider the following recommendations:

- Use the RAND Critical Care Surge Response Tool or similar resources to assess critical care bottlenecks and shortages in space, staff, and stuff in your facility and identify the most-effective surge strategies to address those bottlenecks.
- Have tiered critical care surge capacity plans in place ahead of time so that surge capacity efforts can be escalated as indicated.
- Develop an inventory of staff who might play unconventional roles in your COVID-19 response.
- Communicate and collaborate with community (e.g., businesses, public health entities, first-responder agencies, nursing homes) and regional partners (e.g., health care coalitions) in creating critical care surge capacity.

FIGURE 1

FEMA Region–Level Estimates of Number of Patients Cared for Concurrently Under Baseline, Tier 1, and Tier 2 Scenarios



**State, regional, and federal decisionmakers should consider the following recommendations:**

- Facilitate communication and coordination among hospitals, health care systems, and public health entities.
- Develop regional resource-sharing protocols to facilitate proportional distribution according to needs.
- Maintain updated registries of resources and resource shortfalls and disseminate those data among hospitals and health systems to maintain regional situational awareness of resources.
- Institute emergency credentialing policies for health care worker volunteers (e.g., waivers).
- Identify supply chains for personal protective equipment (PPE), ventilators, and other critical care resources.
- Institute policies to combat price-gouging by suppliers of PPE, ventilators, and other critical care resources.
- Provide guidance on crisis standards of care and rationing of critical care resources.

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This brief describes work done in RAND Health Care and documented in *Critical Care Surge Response Strategies for the 2020 COVID-19 Outbreak in the United States*, by Mahshid Abir, Christopher Nelson, Edward W. Chan, Hamad Al-Ibrahim, Christina Cutter, Karishma Patel, and Andy Bogart, RR-A164-1, 2020 (available at [www.rand.org/t/RRA164-1](http://www.rand.org/t/RRA164-1)). To view this brief online, visit [www.rand.org/t/RBA164-1](http://www.rand.org/t/RBA164-1).

A companion tool intended to help hospitals, state officials, and regional decisionmakers, *RAND Critical Care Response Tool: An Excel-Based Model for Helping Hospitals Respond to the COVID-19 Crisis*, by Mahshid Abir, Christopher Nelson, Edward W. Chan, Hamad Al-Ibrahim, Christina Cutter, Karishma Patel, and Andy Bogart, TL-A164-1, 2020, is available at [www.rand.org/t/TLA164-1](http://www.rand.org/t/TLA164-1).

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