

# Instructions for Using the RAND Critical Care Surge Response Tool

An Excel-Based Model for Helping Hospitals Respond to the COVID-19 Crisis

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## About This User Guide and Tool

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The COVID-19 pandemic is placing extraordinary strains on the U.S. medical system, most especially hospitals. Hospitals are searching for ways to ramp up their surge capacity to provide critical care for the sickest COVID-19 patients. A team of RAND researchers undertook a quick-turnaround study to examine a variety of strategies for creating critical care surge capacity in the nation’s hospitals. As part of the project, they developed 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 Excel tool and this user guide are available at [www.rand.org/t/TLA164-1](http://www.rand.org/t/TLA164-1). The full report documenting their research and the development of the tool, *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, Santa Monica, Calif.: RAND Corporation, 2020), is available at [www.rand.org/t/RRA164-1](http://www.rand.org/t/RRA164-1).

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# How to Use the RAND COVID-19 Critical Care Surge Tool

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Inputs to this Microsoft Excel spreadsheet model for managing critical care surge include (1) baseline number of beds, (2) critical care doctors and nurses, (3) respiratory therapists, and (4) ventilators. The model also allows users to set baseline numbers of intensive care unit (ICU) doctors, ICU nurses, and respiratory therapists per shift and ratios of these providers to patients (shift lengths are defined by the user and require no additional inputs). Further, it allows users to input information related to how critical care physicians, critical care nurses, and respiratory therapists might act as supervisors for “extender” care providers—including ICU doctors supervising hospitalists, ICU nurses supervising floor nurses, and respiratory therapists supervising nurse anesthetists; users set the ratios of supervisor-to-extender and extender-to-patients. Users can also specify additional spaces that can be created and used as ICU space (e.g., through doubling patients in ICU rooms or using post-anesthesia care unit [PACU] space) and additional ventilators (e.g., through purchasing or sharing with other facilities) that can be added to create critical care surge capacity. The model then estimates the number of patients who can be cared for. It also identifies which among the three **staff** (critical care doctors, critical care nurses, and respiratory therapists), **space** (beds), and **stuff** (ventilators) resources is the limiting factor in increasing capacity.

On the *Model* tab, users enter their inputs and will see the outputs. Note that the numbers populating the *Model* tab when the tool is first launched are merely examples: Users should adjust them per the instructions below.

No macros are used; this spreadsheet should work on any version of Microsoft Excel running on any operating system.

The columns in the *Model* tab represent the five resources considered: critical care doctors, critical care nurses, respiratory therapists, ventilators, and beds. Moving down through the rows of the spreadsheet takes the user step-by-step through the calculations.

## Starting Numbers

In the first line of input (row 3), enter the patient-to-staff or patient-to-resource ratio. For staff, this is the staffing ratio. For example, a “2” entered in the “Critical care nurses” column would mean that each critical care nurse could care for two patients. The patient-to-staff ratio is a value that the user will want to adjust and experiment with when examining different scenarios.

For ventilators and beds, the ratio is most likely to be “1.” For example, each bed can only support one patient. However, that can also be changed by the user.

Next, in row 5, enter the number of staff and/or resources that are available. This represents the baseline quantities *before additional resources are brought in*. **For staff, the number entered should be the number available per shift.**

In row 6, enter the percentage of staff in each category who are absent (if you have not already accounted for absences when entering the number of staff in row 5).

## Augmentation by Fully Capable Personnel or Equipment

The next set of inputs allows the user to enter the number of additional fully capable (i.e., not an extender) personnel or equipment that might be brought in. By *fully capable personnel*, we mean individuals who have the necessary training and licenses so that they can provide critical care independently.

In row 9, enter the number of newly hired staff per shift and/or the number of ventilators or beds that are newly purchased or set up.

In row 10, enter the number of staff or resources borrowed from other departments (e.g., from outside the ICU) to care for critical care patients. For staff, this should be on a per-shift basis. The staff should be fully capable personnel. For nurses, for example, this might mean borrowing emergency department nurses or PACU nurses to function as ICU nurses. For beds, this might mean doubling up patients in ICU rooms, using PACU beds and available operating rooms.

In row 11, enter the number of resources, per shift. For staff, this could mean personnel from other hospitals, including federal facilities (such as those belonging to the military and other agencies). For ventilators, this could be items from the Strategic National Stockpile or other stockpiles.

## Augmentation by Extenders Needing Supervision

There might not be enough fully capable personnel who can be brought in to meet the needs of the hospital. In that case, the hospital might want to consider personnel who are not fully capable but who would serve as extenders under the supervision of someone who is. For critical care physicians, this might mean using hospitalists as extenders. For critical care nurses, this might mean using floor nurses as extenders. For respiratory therapists, this might mean using nurse anesthetists. Use of such resources of course implies altered standards of care.

Each fully capable staff member can only supervise a certain number of extenders. In row 14, enter the extender-to-supervisor ratio (i.e., the maximum number of extenders that each supervisor could supervise). For example, a “3” in the “Critical care nurses” column would mean that each critical care nurse could supervise three floor nurses.

Each extender can only care for a certain number of patients. This is likely a smaller number of patients than a fully capable staff member could handle. In row 15, enter the patient-to-

extender ratio. For example, a “3” in the “Respiratory therapists” column would mean that each respiratory therapist extender could, with proper supervision, handle three patients.

Finally, in row 16, enter the number of extenders who could potentially be brought in, per shift, assuming there were enough fully capable staff to supervise them. (The spreadsheet will compute whether there are enough supervisors and determine whether all of those extenders can be brought in.)

## Calculations

The remaining rows of the *Model* tab report the following output of calculations and do not require user input:

- Row 17 computes the number of supervisors who would be needed to supervise all the extenders who could potentially be brought in, for each type of staff.
- Row 18 flags whether there are enough supervisors for that type of staff. This will help the user know when a lack of supervisors impedes the use of more extenders.
- Row 19 computes the number of extenders who will be employed, given the limited number of supervisors available. These are the extenders who will be available, per shift, to do patient care.
- Row 21 is the number of patients who can be cared for by fully capable staff of each type. This figure is computed by multiplying the number of fully capable staff (row 12) by the patient-to-staff ratio (row 3). Note that we assume supervisors will care for patients in addition to supervising extenders.
- Row 22 is the number of patients who can be cared for by extenders of each type. This figure is computed by multiplying the number of extenders (row 19) by the patient-to-extender ratio (row 15).
- Row 23 is the total number of patients who can be cared for by each type of staff or resource. This figure is the sum of line 21 and 22. These figures are also displayed in a bar chart to the right of the table (you may need to scroll to the right in the spreadsheet).

## How Many Patients Can We Care For?

The overall number of patients who can be cared for is determined by whichever resource—staff, space, or stuff—that is most limited. Row 23 flags the resource that is the limiting factor by highlighting the cell in yellow. The overall number of patients who can be cared for is thus the minimum of the numbers in row 23. That answer is reported at the top of the bar chart, in cell M3.

## Examining Different Scenarios

After entering an initial set of inputs and seeing how many patients can be cared for, you should use the tool to examine different scenarios. In particular, you may want to adjust the

various ratios to better understand their effect on outcomes: the patient-to-staff ratio, the patient-to-extender ratio, and the extender-to-supervisor ratio.

As you change the number of resources and the patient ratios, the flag in row 23 indicating which resource is the limiting factor might move from one resource to another. For example, increasing the number of physicians or the patient-to-physician ratio might change the limiting factor from physicians to respiratory therapists. The bar chart showing the number of patients who can be cared for by each resource will also change as resources and ratios change. Keep in mind that the total number of patients who can be cared for will be limited to the smallest of these numbers.