

### Introduction

From the earliest days of the COVID-19 pandemic, a key policy goal has been to slow the spread of the virus to (among many other reasons) avoid a rapid influx of patients entering hospitals at levels that would overwhelm the healthcare system. As such, our [six prior briefs](#) have largely focused on measuring and forecasting hospital demand and capacity as the pandemic evolves in North Carolina.

As of December 5, North Carolina hospitals had enough beds and staff to treat patients who need inpatient services. There are many contributing factors, but we believe early action by North Carolina leaders, extensive planning by health care leaders, and daily actions by North Carolina citizens have together made an important difference in helping us avoid the [experiences](#) of some other regions.

However, the daily COVID-19 case<sup>1</sup> count continues to rise in North Carolina; the seven-day average number of new cases has risen by 30 percent in the last week. With it, the number of people hospitalized has grown as well. This raises important questions about the adequacy of North Carolina hospital capacity over the next several weeks and months.

In this brief, we estimate the COVID-19-related hospitalization growth rate that the state’s hospitals can effectively manage over the next few weeks given recent trends.

Specifically:

- We calculate the hospital “runway” at statewide and regional levels. By “runway,” we mean the amount of time (measured in weeks) until hospitals may reach or exceed their acute or intensive care unit (ICU) capacity if present conditions continue.
  - For example, a hypothetical runway of 4 weeks means that if the rate of increase in hospitalizations stays consistent, within a month there may be an insufficient number of staffed beds for patients requiring hospitalization.
- Since hospitalization growth rates change over time, we also estimate statewide hospital runways associated with other realistic but hypothetical growth rate scenarios.

Of course, conditions change, sometimes dramatically, and there are “safety valves” that hospitals can release to give them additional resources. However, the method in this brief provides a simple quantitative approach to interpret the data reported daily on the North Carolina COVID-19 dashboard and other sources. This analysis is particularly important given reports about overwhelmed hospitals in other states and several factors suggesting that trends could worsen here before they get better.<sup>2</sup> As we illustrate in the following pages, the situation is deteriorating, and it is also dynamic; we will need to watch these trends carefully over the next several weeks.

Importantly, as we described in our [last brief](#), beyond the supply of hospital “beds,” concerns continue to rise about potential workforce shortages, particularly among nurses in both acute care and long-term care settings. In this brief, we also highlight several other factors that are important for interpreting the hospital capacity results.

<sup>1</sup> Note that all references to COVID-19 “cases” in this brief refer to laboratory-confirmed cases, not the higher total number of underlying infections in the population, including those that are unobserved/undiagnosed.

<sup>2</sup> See our [Brief 6](#) for a more comprehensive review of key positive and negative factors influencing COVID-19 trends over the next several weeks.

## Available Hospital Capacity and “Runway” in North Carolina

### Methods

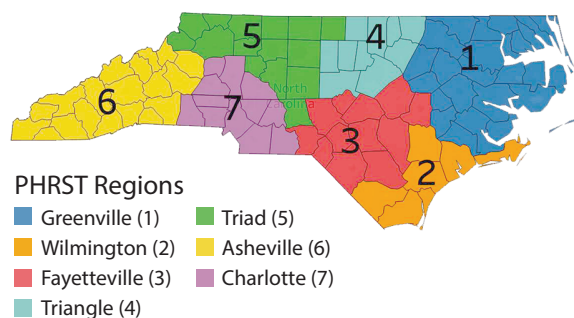
We use hospital census, acute bed, and ICU bed capacity data<sup>3</sup> furnished by the NC DHHS through Saturday, December 5, 2020. We measure “recent hospitalization growth rates” as the percentage increase in daily hospitalized COVID-19 patients in the previous two-week period, converted to a weekly rate. We use this information in conjunction with reported hospital staffed bed capacity information to project the “runway” (i.e., the number of weeks) until hospital demand may meet or exceed reported hospital capacity.

We use a simple method to guide our forecasts: **Future Occupied Beds = Current Occupied Beds (1 + g)<sup>w</sup>** where **g** is the weekly growth rate and **w** is the number of weeks. We can take the current growth rate as given and solve for the number of weeks that gives the future bed use, or we can assume a specific number of weeks and solve for the growth rate that would lead to occupancy meeting capacity in that number of weeks. This method assumes exponential growth in the hospitalization rate and uses current NC DHHS data (current beds in use, current staffed beds available, and acute and ICU utilization growth rates) to make projections. The method is simple enough that the statewide results can be replicated using data available to the public via the NC DHHS dashboard.

Because hospitalization growth rates are likely to continue to change over time, in our statewide analysis (Exhibits 2 and 3, next page), we also illustrate other potential scenarios with higher or lower hospitalization growth rates compared to the current rate, and their corresponding runway estimates: shorter runways if the hospitalization growth rate were to increase, and longer runways if the hospitalization growth rate were to decrease. Our findings include both acute and ICU beds at the statewide and regional levels.

For purposes of public health planning and response, the State has historically divided North Carolina’s 100 counties into seven Public Health Regional Surveillance Team (PHRST) regions, which we characterize here using the largest city (e.g., “Charlotte” and “Wilmington”) or set of cities (e.g., “Triangle” and “Triad”) in each region. The map in Exhibit 1 (at right) displays and defines each of the PHRST regions.

### Exhibit 1 Public Health Regional Surveillance Team (PHRST) Regions



### Results

#### Acute beds

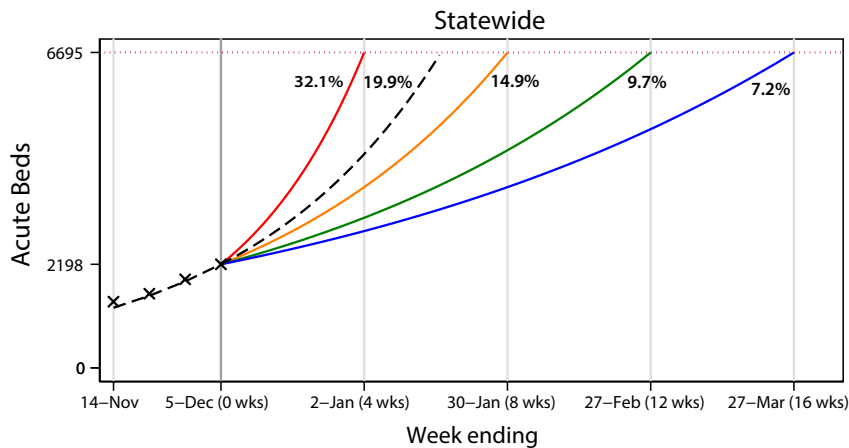
The current statewide acute bed capacity situation is illustrated in Exhibit 2, next page.

- As of December 5, 2020, there were 20,784 acute hospital beds reported to be staffed statewide. Of these, 14,089 were occupied by non-COVID-19 patients, 2,198 were occupied by COVID-19 patients, and 4,497 beds were reported to be available for new patient admissions. Aggregate “COVID-19 capacity” was 6,695 beds, that is, all the available beds, plus the beds already occupied by COVID-19 patients (4,497 + 2,198) (see Y-axis).
- The black dashed curve in the graph assumes the recent hospitalization growth rate of approximately 19.9 percent is maintained into the near future from the current starting point of 2,198 hospitalized COVID-19 patients.
- From the starting point of today’s 2,198 COVID-19 patients, the X-axis shows the number of weeks that would elapse before the total number of hospitalized COVID-19 patients fills the aggregate COVID-19 capacity of 6,695 beds at the recent hospitalization growth rate.
- At a faster hospitalization growth rate, it would take less time to reach full capacity, as illustrated by the curves to the left of the black dashed curve. For example, at the current rate, we project hitting capacity in just over six weeks. A faster rate of increase (32 percent) would mean hitting capacity in 4 weeks, and a slower growth rate (9.7 percent) would mean hitting capacity in 12 weeks.
- The number of beds in use for the three previous weeks are also plotted on Exhibits 2 and 3, each denoted with an X before December 5.

<sup>3</sup> For this brief, we use data furnished through a data use agreement with the North Carolina Department of Health and Human Services. The authors of this brief conducted this work independently, on a volunteer basis. The findings and conclusions in this brief are those of the authors and do not necessarily represent the views of the North Carolina Department of Health and Human Services or the authors’ institutions.

## Available Hospital Capacity and “Runway” in North Carolina

**Exhibit 2** Acute beds; statewide - growth curves required to hit capacity within various weeks



Growth rate that would lead to bed shortage in...

- 4 weeks
- 8 weeks
- 12 weeks
- 16 weeks
- Previous values (X)
- Current weekly growth rate (19.9%) (dashed line)

Exhibit 2 (above) also illustrates how other potential acute bed hospitalization growth rates would increase or decrease the hospital capacity runway. These alternative hospitalization growth rate scenarios can be seen in the solid lines to either side of the black dashed line.

Given the current numbers as of December 5, the hospitalization growth rate necessary to exceed current acute bed capacity within 4 weeks would be a 32 percent weekly growth rate (red curve). This would represent a substantial acceleration of growth, but is similar to the recent growth in confirmed COVID-19 cases of approximately 30 percent.

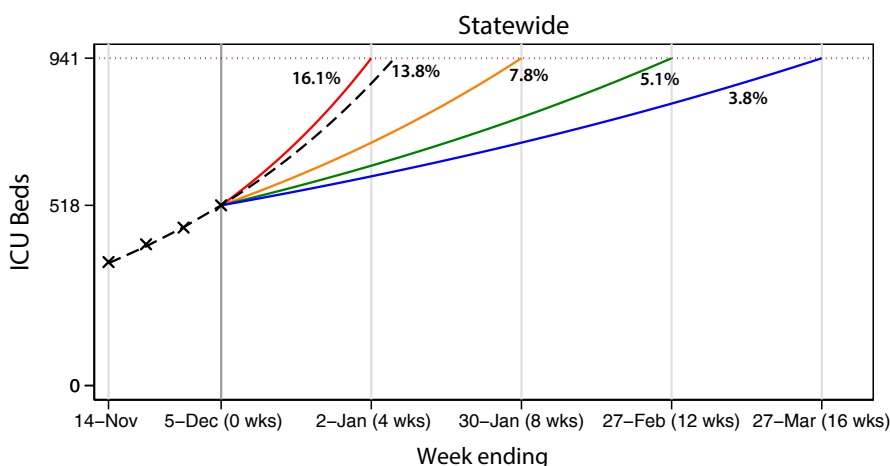
By contrast, at a slower growth rate of 7.2 percent, it would take about 16 weeks to reach hospital capacity.

### Intensive Care Unit Beds

Exhibit 3 (below) reports similar statewide results for ICU bed capacity. ICU use has grown more slowly than acute bed use, with a statewide weekly growth rate of 13.8 percent over the past two weeks (compared to 19.9 percent for acute bed use).

That slower growth, however, is in the context of tighter availability; we project hitting ICU capacity in just less than 5 weeks if current trends persist. If the growth rate were to increase just slightly to 16 percent and hold there, then four weeks would bring us to the edge of ICU capacity.

**Exhibit 3** ICU beds; statewide - growth curves required to hit capacity within various weeks



Growth rate that would lead to bed shortage in...

- 4 weeks
- 8 weeks
- 12 weeks
- 16 weeks
- Previous values (X)
- Current weekly growth rate (13.8%) (dashed line)

## Available Hospital Capacity and “Runway” in North Carolina

### Regional Trends

The above figures refer to North Carolina as a whole, but health care is local, and these trends are particularly important at the regional level. Exhibits 4 and 5, below, report the current runway results at a regional level.

#### Exhibit 4 Acute beds - regional runway



Region	No.	Color in exhibit 1	Runway (weeks)	Recent hospitalization growth rate	Acute beds occupied by COVID-19 patients	Available acute beds
Greenville	1	Navy	9.5	14.3	229	590
Wilmington	2	Orange	11.9	12.3	71	210
Fayetteville	3	Red	6.7	17.6	277	541
Triangle	4	Lt. blue	5.6	18.6	335	545
Triad	5	Green	6.1	21.9	460	1,075
Asheville	6	Yellow	5.3	31.9	149	488
Charlotte	7	Purple	4.9	20.8	677	1,048
<b>Statewide</b>			6.1	19.9	2,198	4,497

#### Exhibit 5 ICU beds - regional runway



Region	No.	Color in exhibit 1	Runway (weeks)	Recent ICU occupancy growth rate	ICU beds occupied by COVID-19 patients	Available ICU beds
Greenville	1	Navy	3.3	23.7	56	56
Wilmington	2	Orange	8.8	14.3	18	40
Fayetteville	3	Red	3.7	20.8	51	52
Triangle	4	Lt. blue	5.5	11.2	98	78
Triad	5	Green	6.3	9.0	105	75
Asheville	6	Yellow	3.0	25.7	56	56
Charlotte	7	Purple	4.3	9.8	134	66
<b>Statewide</b>			4.6	13.8	518	423

### Note

The purpose of the brief is to provide a simple, unambiguous method to help public officials and the public interpret recent case growth and hospitalization trends in the context of available hospital capacity. Our intention is not to declare a precise date on which hospital capacity will be reached; as noted repeatedly, conditions can change.

### Key Takeaways

- Should present conditions continue, North Carolina currently has about a 6-week runway of available acute hospital beds.
- ICU beds are in shorter supply than acute beds. Statewide, we project hitting ICU capacity in about 4.6 weeks if current trends were to continue.
- Several regions have shorter acute and ICU bed runways than the others. Some regions (e.g., Asheville) are facing larger hospitalization growth rates, while others (e.g., Charlotte) have tighter capacities. In Charlotte, twice as many ICU beds are currently filled by COVID-19 patients as there are ICU beds staffed and available for new patients. In contrast, the Wilmington region currently appears to be in the best shape within the state, as its current relative capacity is larger than in other regions.
- Although very near-term trends are largely unchangeable (those hospitalized today were generally infected more than a week ago), we can change trends in the medium-term. Indeed, when North Carolina has faced the prospect of large case counts in the past, we have managed to slow case growth and reduce pressure on hospitals. While we hope we can achieve another reduction in case and hospitalization growth, the recent rapid growth in cases and high testing positivity ratios (see Brief 6) makes us less optimistic than in the past.
- There are ways to flex hospital capacity somewhat (e.g., by making more beds and staff available, cancelling or modifying elective procedures, transferring patients from low-capacity institutions to higher-capacity institutions, or adjusting thresholds for admitting or discharging COVID-19 or other patients). Many factors, such as these flex options, influence hospital capacity, but they are not sustainable in the long term and some come with important tradeoffs.
- Whereas this brief focuses on hospital “beds” as the limited resource, we continue to believe a healthy, qualified health care workforce (particularly nurses) supporting those beds to be in shorter supply. Moreover, shifting available personnel from one region to another is an infeasible strategy if all regions face workforce shortages at the same time.
- Finally, the best way to ensure adequate healthcare capacity for COVID-19 and other patients is to reduce the number of people requiring hospitalization for conditions related to COVID-19 and, of course, to reduce the number of people who become infected by the virus.