

Using State Licensure Data to Assess North Carolina's Health Workforce COVID-19 Response Capacity

Heather Wilson, Evan M. Galloway, Julie C. Spero, Shikira Thomas, Julianna C. Long, Thomas C. Ricketts III, Erin P. Fraher

BACKGROUND In the early months of the COVID-19 pandemic, health care decision-makers in North Carolina needed information about the available health workforce in order to conduct workforce surge planning and to anticipate concerns about professional or geographic workforce shortages.

METHOD Descriptive and cartographic analyses were conducted using licensure data held by the North Carolina Health Professions Data System to assess the supply of respiratory therapists, nurses, and critical care physicians in North Carolina. Licensure data were merged with population data and numbers of intensive care unit (ICU) beds drawn from the Centers for Medicare and Medicaid Services (CMS) Healthcare Cost Report Information System (HCRIS).

RESULTS The pandemic highlighted how critical data infrastructure is to public health infrastructure. Respiratory therapists and acute care, emergency, and critical care nurses were diffused broadly throughout the state, with higher concentrations in urban areas. Critical care physicians were primarily based in areas with academic health centers.

LIMITATIONS Data were unavailable to capture the rapid changes in supply due to clinicians reentering or exiting the workforce. County-level analyses did not reflect individual, facility-level supply, which was needed to plan organizational responses.

CONCLUSIONS Health care decision-makers in North Carolina were able to access information about the supply of clinicians critical to caring for COVID-19 patients due to the state's long-standing investments in health workforce data infrastructure. Ability to respond was made easier due to strong working relationships between the University of North Carolina at Chapel Hill Cecil G. Sheps Center for Health Services Research, the North Carolina Area Health Education Centers Program, the health professional licensure boards, and state government health care agencies.

Background

Combatting a rapidly spreading, deadly disease requires health professionals to be available in the specialties, settings, geographies, and professions needed by patients. In early March 2020, the COVID-19 pandemic hit two unprepared US metropolitan areas: Seattle and New York City. The cities struggled to contain the outbreaks and treat an exponentially increasing number of patients with the novel coronavirus while their hospitals and health systems faced shortages of personal protective equipment, ICU beds, ventilators, and nurses and other critical care staff. Meanwhile, other jurisdictions took precautions that Washington and New York could not. While case counts were low, North Carolina put in place early social distancing and stay-at-home measures, called for volunteer health professionals to rapidly expand the workforce, and assembled a modeling team to help project COVID-19 cases and facilitate resource allocation [1, 2].

The COVID-19 model created by the Institute of Health Metrics and Evaluation (IHME) at the University of Washington initially predicted a mid-April peak in North Carolina [3]. That peak did not occur, as the state successfully "flattened the curve" from late March to late

May because of actions by state policymakers, local health departments, businesses, and health care facilities. By late June, it was apparent that the efforts to control the virus would take longer and the reopening process was delayed. As we write this manuscript, North Carolina's case count remains high and infections have spread to rural communities in the state [4]. Subsequent outbreaks will likely continue to strain the health care system's critical care and emergency medicine capacity, particularly in rural areas [5]. A *Charlotte Observer* analysis from September found that rural residents were dying at a higher rate than their metropolitan counterparts [6]. COVID-19 is a financial as well as public health challenge for rural hospitals [7]. Our state now faces a marathon in efforts to combat the virus, rather than a sprint [8].

This article describes how data were used in the early stages of the COVID-19 pandemic in North Carolina to

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Address correspondence to Heather Wilson, Cecil G. Sheps Center for Health Services Research, 725 MLK Jr Blvd, CB #7590, Chapel Hill, NC 27599 (heather_wilson@unc.edu).

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support decisions about the deployment, surge, and maintenance of necessary health care staff. These data will continue to be needed as the state wrestles to meet the demand for physical and mental health services in the coming months. Concerns remain that COVID-19 might overstretch North Carolina's health care delivery system. The pandemic could potentially overburden health care professionals or cause them to leave their work due to illness and/or burn-out [9], resulting in regional or statewide shortages. More generally, data can and should be used in the future more proactively for health workforce planning, both in preparing for pandemics and other emergencies and otherwise [10].

Health Care Workers Combating COVID-19 in North Carolina: Are There Enough and Are They in the Right Places?

To address concerns about health workforce supply in March and April 2020, researchers at the Cecil G. Sheps Center (Sheps Center) at the University of North Carolina at Chapel Hill conducted workforce analyses and released the results to the public in a series of blog posts (internal data). The goal was to provide data on the supply of these professions to state decision-makers who needed to determine how to allocate resources, redesign workflows, modify regulatory requirements, and signal managers in delivery systems where there may be a need to ramp up recruitment or shift responsibilities. The Sheps Center was able to respond quickly due to the existence of the state's Health Professions Data System (HPDS), which tracks annual data on 21 different health professional workforces in North Carolina. The HPDS is a collaboration between the Sheps Center, the health professions licensing boards, and the North Carolina Area Health Education Centers (NC AHEC) Program.

Given the lessons learned from Seattle and New York at the outset of the pandemic, policymakers in North Carolina were initially focused on "surging," or increasing workforce capacity in acute care settings focusing on pulmonary care. For this reason, Sheps Center researchers focused on describing the availability and distribution of three health professions central to treating hospitalized COVID-19 patients in critical condition: respiratory therapists (RTs), critical care physicians (CCPs), and registered nurses (RNs).

Respiratory Therapists

A mid-April 2020 study of New York City-area COVID-19 patients indicated that as many as 12% of hospitalized patients develop respiratory issues so serious that they require a ventilator [11]. Maintaining a patient on a ventilator is one of the most labor-intensive and costly activities in a hospital. RTs, trained at the associate degree level or higher, care for patients who have trouble breathing, including operating and managing ventilators. While many RTs work in hospital ICUs, about 15% of North Carolina's RTs work in other settings, such as home health and nursing homes (internal data).

Critical Care Physicians

CCPs, or intensivists, are board-certified physicians who care for complex and critically ill patients in the ICU, often coordinating a team of nurses, physical therapists, RTs, and pharmacists. An intensivist commonly completes a residency in pulmonary medicine, pediatrics, or surgery, followed by a fellowship in critical care medicine. They manage ventilator use, invasive monitoring techniques, resuscitation, life support, and end-of-life care. They are lead care managers for patients on ventilators or with breathing difficulty, a common characteristic of COVID-19-related illness.

Nurses

Critical care, or ICU, nurses closely monitor and evaluate patients, manage advanced technologies, administer treatments, assist in procedures, and collaborate with respiratory therapists and physicians to coordinate advanced care for patients with respiratory failure and other life-threatening conditions. Like CCPs, this specialized nursing workforce is needed to care for critically ill patients [12].

Methods

Data on the supply and geographic distribution of health professionals came from the HPDS. In this analysis, RT data include respiratory therapists and respiratory care assistants who had active or pending licenses in North Carolina as of March 27, 2020. The analysis for nurses included active, licensed RNs who reported a specialty of "Acute Care/Critical Care/Emergency Care" and a setting of "Hospital," and practice in North Carolina as of October 31, 2019. Due to the way nurse specialty data are collected in licensure forms, the HPDS does not hold data for critical care nurses as a distinct category. Data for hospital-based nurses with a specialty of acute care, emergency, or critical care were used as a proxy. Note that some acute care and emergency medicine nurses can be retrained or cross-trained to work in ICUs, which is further elaborated in the discussion and limitations. Critical care physicians include active, licensed physicians in practice in North Carolina as of October 31, 2019, who are not residents-in-training, not primarily employed by the federal government, and who are practicing in at least one of the following specialties: critical care medicine (internal medicine), pediatric critical care medicine, or pulmonary critical care medicine. All county-level estimates are based on primary practice location.

To assess the supply of critical care clinicians, we looked at the availability of critical care nurses, critical care physicians, and respiratory therapists per 10,000 county population and relative to ICU bed capacity in the state. Population data from 2019 were obtained from the North Carolina Office of State Budget and Management [13]. Supply and availability of ICU beds for hospitals were calculated from the CMS Healthcare Cost Report Information System (HCRIS) (via personal communication with Mark Holmes) [14]. ICU beds in this dataset include beds in ICUs, coronary care units, sur-

gical ICUs, swing beds, and may include neonatal beds. ICU bed counts exclude nursery, burn, or other.

Results

Clinician Supply

The most recent licensure data from 2019 indicated that while the critical care physician workforce was restricted to counties with large academic medical centers, hospital-based critical care, acute, and emergency care nurses were diffused widely, to all but two counties in the state. RTs show a similar diffusion pattern, with some concentrations in urban areas (Figures 1, 2, and 3).

ICU Staffing

To capture not just the supply, but the capacity of the critical care workforce in North Carolina, we compared regional differences in ratios of critical care nurses and RTs to available ICU beds by county (Figures 4 and 5). ICUs are typically staffed with one nurse for every one or two patients—in a surge situation, this ratio can increase to 1:3 [15]. Surge staffing and the shortage of trained ICU nurses could present challenges for the state if outbreaks occur in counties with few nurses. North Carolina's critical, acute, and emergency care nursing workforce is densely clustered in counties with academic health centers such as Orange, Durham, Buncombe, and New Hanover. Some rural counties—such as Swain and Mitchell—have a higher density of nurses in these specialties, despite not having an ICU. Critical, acute, and emergency care nurses in these counties likely work in step-down, post-operative, progressive care, telemetry, emergency transport, and/or rapid response.

For RT capacity, 35 counties in North Carolina have no ICU beds and/or no RTs. Eight counties have an RT-to-ICU bed ratio of less than one, meaning these counties have

more ICU beds than RTs. The number of ventilators an RT can safely manage at one time depends on patient acuity. Data suggest that for patients with highly acute illness, the safe ratio is 1 RT to 4 ventilators [16], and with less acute patient illness the ratio may increase up to 1 RT per 9 ventilators [17].

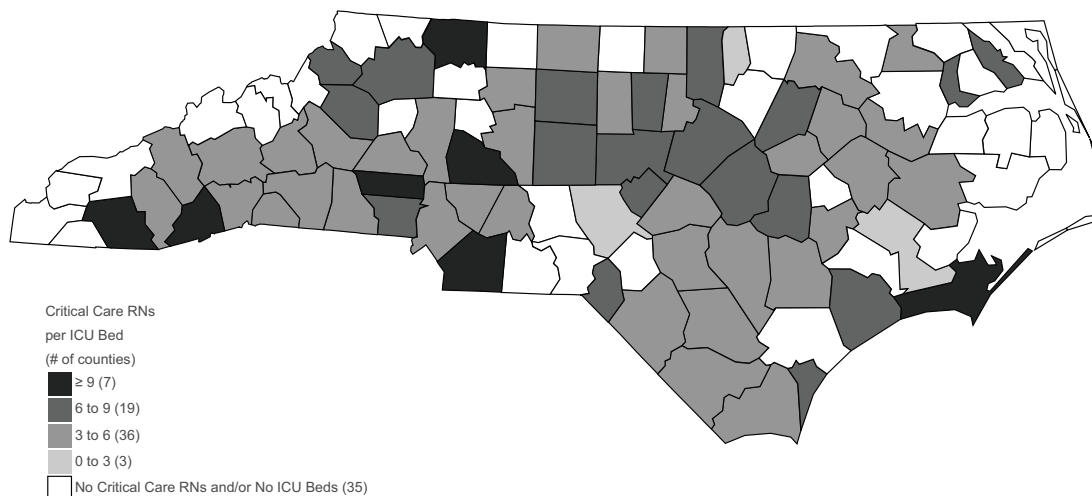
Discussion

While we know more about the epidemiology of COVID-19 than we did in the early spring of 2020, much about the pandemic and its long-term impact remains unclear. In March and April 2020, North Carolina prepared for rising demand on hospitals and health care facilities. To inform policymakers' decisions on next steps regarding the health workforce during the pandemic, several research groups created projection models [2, 18]. These projection models often focused on surging beds and ventilators despite the obvious need for data on whether there were adequate health professionals to staff them.

The pandemic has emphasized just how critical health workforce data are to public health infrastructure. The workforce research team at the Sheps Center was uniquely positioned to contribute data to inform state policymakers about the distribution of health professionals and potential gaps in access due to three factors: available data and analytic capacity, collaboration with state licensing boards and NC AHEC, and longstanding relationships with state agencies.

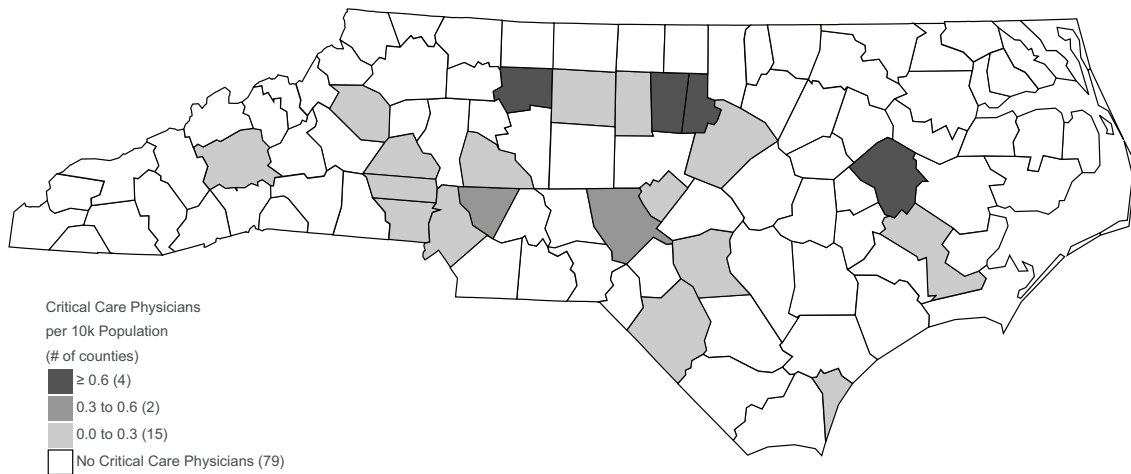
First, North Carolina has developed and invested in a state health workforce data system for decades, and already had data that were gathered, cleaned, and available when the need for information arose. The HPDS is a unique resource that provides annually updated data on licensed clinicians in active practice in North Carolina by practice location—and, importantly, filters out health professionals who may

FIGURE 1.
Critical Care Nurses per 10,000 County Population, 2019



Source. Galloway E. Observable HQ website. <https://observablehq.com/@gallowayevan/critical-care-registered-nurses-per-10k-population-north-c?collection=@gallowayevan/covid-workforce>. Published August 6, 2020.

FIGURE 2.
Critical Care Physicians per 10,000 County Population, 2019



Source. Galloway E. Observable HQ website. <https://observablehq.com/@gallowayevan/critical-care-physicians-per-10k-population-north-carolin?collection=@gallowayevan/covid-workforce>. Published August 6, 2020.

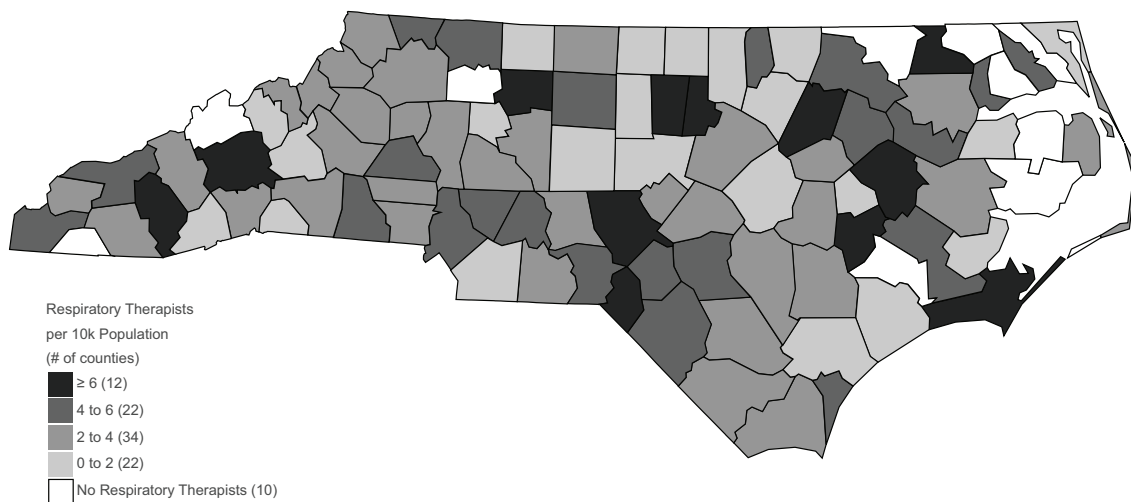
hold a license in North Carolina but practice in another state. Because the system is based on licensure data rather than survey data, the data represent a census of the state's workforce, rather than estimates. Our analyses go beyond simply providing policymakers with data. We analyze and interpret the data to identify the key, policy-relevant trends. These trends are provided in user-friendly blogs and policy briefs. This kind of interpretation and contextualization of health workforce data can be lost in the reliance on data dashboards.

Secondly, because the data system has been in place since 1976, there is a high level of trust and collaboration between the Sheps Center, NC AHEC, and health professional licensing boards. The Sheps Center has expertise

cleaning, maintaining, and analyzing the data. The NC AHEC Program has provided routine, consistent financial and logistical support for the data system. The health professional licensing boards provide annual data to feed the system and work with the Sheps Center to identify and address questions about the nuances of the data. As the pandemic progressed, Sheps Center staff were able to reach out to boards for needed information and to clarify questions about COVID-19 response planning. For example, a well-established relationship with the North Carolina Respiratory Care Board allowed staff to gain data on the current versus potential RT workforce, allowing them to deliver accurate data for pandemic response planning.

Third, the Sheps Center already had longstanding rela-

FIGURE 3.
Respiratory Therapists per 10,000 population, North Carolina, 2020



Source. Galloway E. Observable HQ website. <https://observablehq.com/d/6efc0c7a76eed9a4>. Published April 2, 2020.

tionships with the North Carolina Department of Health and Human Services (DHHS), the North Carolina Office of Rural Health (ORH), the North Carolina General Assembly, and other state agencies. As a result, DHHS was familiar with the Sheps Center, knew where to find the data, and trusted the objectivity and accuracy of the information. The Sheps Center researchers also had relationships with individual North Carolina health professionals who could provide feedback on early analyses and drafts of blog text to ensure accuracy.

At the same time, responding quickly with accurate data is challenging. For example, to estimate the ratios of RTs and nurses per ICU bed by county, Sheps Center researchers needed data on the numbers and locations of ICU beds. In response to the nationwide demand, Kaiser Health News released data on the number of ICU beds per county on March 30, 2020 [19]. However, Sheps Center researchers quickly found county-level inconsistencies in this dataset. Quantifying the number of ICU beds was also complicated by varying definitions of ICU beds and the fluctuation of ICU beds as the state sought to increase capacity in preparation for a surge in COVID-19 cases [20]. Ultimately, we decided to use HCRIS data for ICU bed counts, noting that these estimates were the best available but reflected a particular point in time, and might not reflect subsequent changes in ICU bed availability.

The difficulty of attaining accurate data was apparent in other models that had incorrect numbers and projections for North Carolina health workforce data. In a national model from late March, Array Advisor estimated that by the time of peak resource use, North Carolina would have a shortage of 329 critical care physicians, the fifth-worst shortage in the nation, which was not the case [21]. In mid-April, the

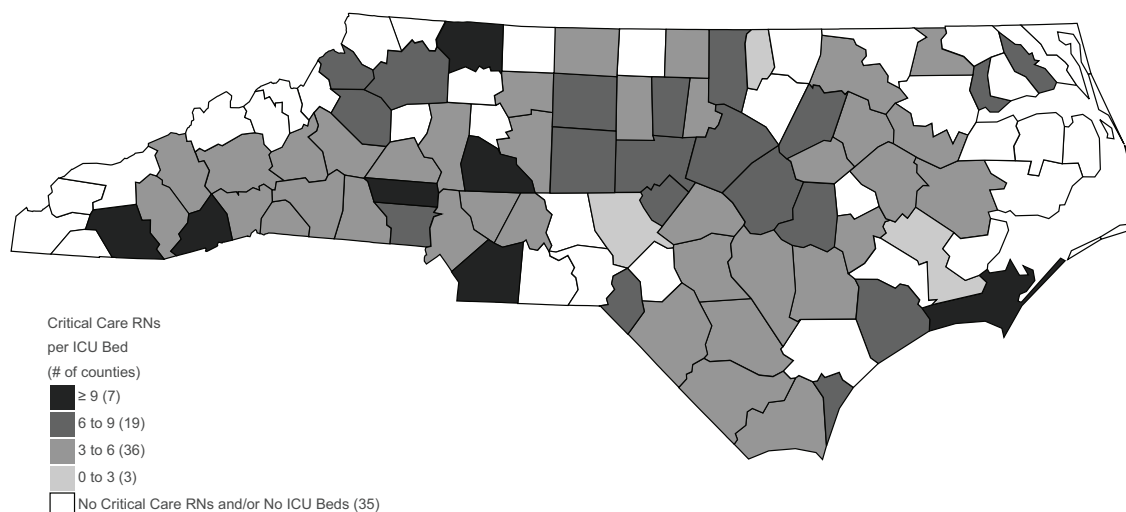
Fitzhugh Mullan Institute for Health Workforce Equity also put out a Workforce Deficit Estimator that underestimated health professionals in North Carolina and therefore overestimated health professional shortages [22]. In addition to definitional issues such as which specialties to use to define critical care physicians and nurses, national models often rely on survey data that do not represent an accurate census of the workforce of a state. The Workforce Deficit Estimator underestimated the number of RTs by nearly 2,000 in North Carolina [22], which if used as the sole data source would have led policymakers to believe the state faced a dire shortage.

Limitations

The HPDS is built on annually updated licensure data that provide a picture of the health professional workforce at a specific point in time. The data system is not built to reflect rapid changes in health workforce supply that occur during events such as a pandemic. As a result, licensure data may not indicate sudden attrition due to health professionals retiring or leaving their jobs due to the COVID-19 outbreak. Conversely, inactive licensees may have reactivated their licenses to help serve patients during the pandemic. For example, in May, DHHS put out a call for volunteers, recruiting nurses, clinicians, and non-clinical support workers to bolster the health care workforce [1]. While we did not track how HPDS data were used and by whom, we did provide DHHS with data on numbers of inactive licensees by location who might be deployed as volunteers during a surge. We also acted as a liaison between DHHS and health professional regulatory bodies regarding questions about regulatory changes that would promote workforce flexibility.

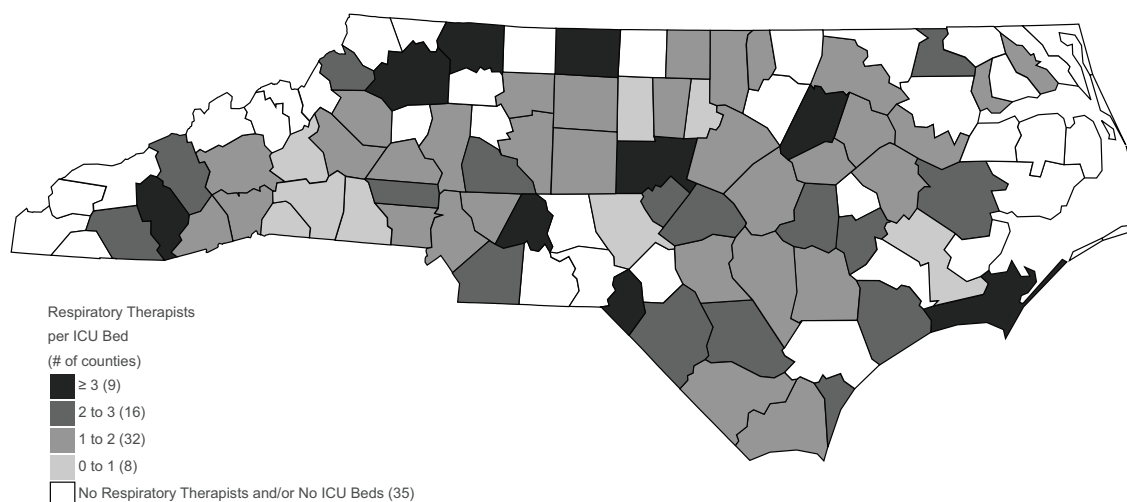
A more acute limitation of the HPDS: as noted in the

FIGURE 4.
Critical Care Nurses to ICU Beds, 2019



Source. Galloway E. Observable HQ website. <https://observablehq.com/@gallowayevan/critical-care-registered-nurses-per-icu-bed-north-carolina?collection=@gallowayevan/covid-workforce>. Published August 6, 2020.

FIGURE 5.
Respiratory Therapists to ICU Beds, 2020



Source: Galloway E. Observable HQ website. <https://observablehq.com/d/6b06e6378b147f4d>. Published April 1, 2020.

methods, critical care nurses were not a distinct category in our database, and the use of a proxy (hospital-based nurses with a specialty of acute care, emergency, or critical care) is an imperfect estimate. That said, the potential ICU RN workforce can be broadened in a surge by cross-training existing staff, such as emergency and acute care RNs, perioperative RNs (e.g., post-anesthesia care unit and operating room RNs), nurse anesthetists, and acute care nurse practitioners, to care for ICU-level patients. The Society of Critical Care Medicine (SCCM) [23], American Association of Critical Care Nurses (AACN) [24], and NC AHEC provide several resources to support cross-training non-ICU clinicians to care for patients with COVID-19.

In general, the scope of practice (SOP) of many health professionals is more flexible than license data descriptions would suggest [25]. Individual health professionals' SOP can vary based on geography, health care system, and individual preference. SOP is especially subject to flux during pandemic response [26]. In late March, the SCCM recommended hospitals adopt a tiered staffing model in which one experienced critical care physician supervises four ICU teams, better utilizing providers with less ICU training [24]. In hospitals with an "open unit,"—a model of ICU in which an intensivist consults but specialty teams have full admitting rights—hospitalists often already help cover ICU and step-down patients. Similarly, family medicine and internal medicine physicians, especially those who were recently residents, can flex as needed to work in emergency departments and inpatient and ambulatory settings. Hospitals and health facilities that canceled elective procedures and primary care visits redeployed staff to conduct COVID-19 screening and address primary care and behavioral health needs of non-COVID-19 patients. Other clinicians shifted their practices from providing in-person care to telehealth

visits. Licensure data alone do not sufficiently capture the potential workforce and how health professionals address patient demands in a health care landscape rapidly adjusting to a novel coronavirus. Neither can licensure data capture the entirety of the frontline health workforce deemed "essential workers" in addressing COVID-19, including many public health professionals [27].

Any catastrophic event requires the ability to quickly assess the adequacy of the health workforce and retrain, redeploy, and reconfigure workers as needed to meet surges in demand. This was the key lesson learned from North Carolina's pandemic response. Having a longstanding data infrastructure as well as established and trusted relationships with policymakers and state agencies, health professionals, and regulatory bodies that allow for the use of the data in decision-making is a critical asset in any response. Further expansion and resourcing of databases like the HPDS will allow researchers to anticipate and better respond to future crises. **NCMJ**

Heather Wilson, BA communications specialist and research assistant, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Evan M. Galloway, MPS research associate and data analyst, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Julie C. Spero, MSPH director, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Shikira Thomas, MSPH research associate, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Julianna C. Long research assistant, Cecil G. Sheps Center for Health Services Research; BSPH candidate, Health Policy and Management, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Thomas C. Ricketts III, PhD, MPH senior policy fellow, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Erin P. Fraher, PhD, MPP director, Program on Health Workforce Research, Cecil G. Sheps Center for Health Services Research; assistant professor, Department of Family Medicine, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

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