



## Perspective

### Critical Supply Shortages — The Need for Ventilators and Personal Protective Equipment during the Covid-19 Pandemic

Megan L. Ranney, M.D., M.P.H., Valerie Griffith, M.D., Ph.D., and Ashish K. Jha, M.D., M.P.H.

**O**n March 11, 2020, the World Health Organization designated “coronavirus disease 2019” (Covid-19) a global pandemic. As the number of cases in the United States continues to

grow, political leaders are encouraging physical (or “social”) distancing to slow the rate of transmission. The goal of this practice is to flatten the curve of new infection, thereby avoiding a surge of demand on the health care system, but the effects of physical distancing may take weeks to appear. U.S. hospitals are already reporting shortages of key equipment needed to care for critically ill patients, including ventilators and personal protective equipment (PPE) for medical staff. Adequate production and distribution of both types of equipment are crucial to caring for patients during the pandemic.

There is a broad range of estimates of the number of ventilators we will need to care for U.S. patients with Covid-19, from several

hundred thousand to as many as a million.<sup>1</sup> The estimates vary depending on the number, speed, and severity of infections, of course, but even the availability of testing affects the number of ventilators needed: without adequate testing, the number increases because patients who are traditionally treated with noninvasive positive-pressure ventilation (NIPPV) for conditions such as chronic obstructive pulmonary disease exacerbations may need to instead be presumptively intubated while awaiting Covid-19 testing results (using NIPPV is contraindicated for patients with Covid-19 because of aerosolization of the virus under positive pressure). Current estimates of the number of ventilators in the United States range

from 60,000 to 160,000, depending on whether those that have only partial functionality are included.<sup>2</sup> The national strategic reserve of ventilators is small and far from sufficient for the projected gap.<sup>2</sup> No matter which estimate we use, there are not enough ventilators for patients with Covid-19 in the upcoming months.

Equally worrisome is the lack of adequate PPE for frontline health care workers, including respirators, gloves, face shields, gowns, and hand sanitizer. In Italy, health care workers experienced high rates of infection and death<sup>3</sup> partly because of inadequate access to PPE. And recent estimates here in the United States suggest that we will need far more respirators and surgical masks than are currently available.<sup>4</sup>

The U.S. shortage has multiple causes, including problems with the global supply chain. Before this pandemic, for instance, China produced approximately half the world’s face masks.<sup>5</sup> As the infec-

tion spread across China, their exports came to a halt. Now, as the infection spreads globally and transmission in China slows, China is shipping masks to other countries as part of goodwill packages. The United States has not been a major recipient.<sup>5</sup>

The shortages have led to pleas from individual U.S. health care providers trying to secure adequate supplies of PPE. The situation has become so dire that some providers are using social media (with tags like #GetMePPE) and have even set up websites to obtain PPE directly. The Centers for Disease Control and Prevention (CDC) recommends that during crisis situations, N95 respirator masks be used only during aerosol-generating procedures, but that means risking exposure of health care workers using less protective surgical masks around patients with confirmed or suspected Covid-19 infection. Additional guidelines from the CDC include reusing masks and respirators intended for one-time use and, if stocks are fully depleted, using scarves or bandanas. The evidence to support these recommendations is thin.

What can we do to close the gap between the need and the availability of ventilators and PPE? We need a multipronged strategy. First, the Defense Production Act (DPA) allows the President to direct private companies to produce equipment needed for a national emergency. The President should use this power to begin to close the gap. But simply demanding more ventilators won't be enough — there are only a few companies that have the expertise to make these devices. The federal government should not only direct these companies to maximize production, but should also order their

suppliers and others to maximize the availability of raw materials. Finally, the federal government needs to bring other industries into this effort. Automakers, for instance, have said they might have the capacity to make ventilators. It would be helpful to engage them to see whether and how quickly they can contribute to boosting ventilator supply.

For PPE, the solutions are somewhat different. While the DPA is important for directing private-sector companies to make more PPE, there are additional options as well. U.S. factories, for instance, already produce millions of N95 respirators each month, but most of these are produced under standards not approved by the Food and Drug Administration (FDA). The government recently lifted the FDA standards, stating that N95s approved by the National Institute for Occupational Safety and Health could be used by health care workers. Nevertheless, few state health departments or hospital systems have been able to procure this PPE.

State governments could encourage companies in their communities that might be able to shift production to making this equipment to do so. The elements of PPE are complicated but don't require the intensive capital that ventilator manufacture demands, so smaller regional companies can play a key role in filling the gap. State partnerships with these companies will take ingenuity, meaningful resources, and a relaxation of less essential regulatory requirements.

Another role for government and the health care system must be to reduce hoarding of PPE and to tap into already existing

stockpiles. Masks and gloves are used in many nonmedical settings — construction companies, laboratories, artists, and even the sets of some television shows have stores of these items. Though there has already been a grassroots effort to donate this PPE to health care workers, a coordinated effort by local governments to collect these supplies would be helpful.

Beyond increasing the supply, a crucial role for the government is to coordinate efforts to ensure that the areas hardest hit at any given time are receiving needed equipment. Individual state governments and health care systems are currently competing for resources, and those resources are not necessarily being distributed on the basis of need. Surges of Covid-19 cases are unlikely to happen in all parts of the country at once, so there is an opportunity to coordinate the filling of gaps. As New York City, for instance, sees a surge of Covid-19 cases, other communities with few cases could share their supplies; New York could then pass equipment on when its surge subsides. Although such sharing can happen informally, some degree of federal coordination would be helpful from government agencies such as the CDC or the Centers for Medicare and Medicaid Services. Partnering with technology companies to track the availability of and projected needs for equipment in real time, ensuring that there is a close match between supply and demand, would also be helpful. Ultimately, this type of coordination could also help in identifying other anticipated supply-chain issues, such as threats to access to pharmaceuticals. A coordinated, nationwide

response is not something that individual states have the resources or legal authority to accomplish; thus, the federal government, in partnership with technology companies, could play a critical role.

As the United States braces for a growing wave of patients with Covid-19 in our hospitals and ICUs, we must ensure that we have the key equipment needed to care for patients and to keep our health care workforce safe. Achieving this goal will require a concerted approach from all sectors, from local and national government to the private sector and health care providers themselves. Failure to act in a coordinated manner would keep many patients from getting the care they need and would lead to the situation

we see in Italy, in which frontline clinicians are making difficult decisions about who will and who won't receive care. Furthermore, without adequate PPE, health care workers will get sick, endangering the functioning of the entire health care system. The human and economic costs of that scenario should not be underestimated.

Disclosure forms provided by the authors are available at NEJM.org.

From Alpert Medical School, Brown University, Providence, RI (M.L.R.); Oregon Health and Science University, Portland (V.G.); and the Harvard Global Health Institute, Cambridge, MA (A.K.J.).

This article was published on March 25, 2020, at NEJM.org.

1. Fink S. Worst-case estimates for U.S. coronavirus deaths. *New York Times*. March

18, 2020 (<https://www.nytimes.com/2020/03/13/us/coronavirus-deaths-estimate.html>).

2. Johns Hopkins Center for Health Security. Ventilator stockpiling and availability in the US. 2020 (<http://www.centerforhealthsecurity.org/resources/COVID-19/200214-VentilatorAvailability-factsheet.pdf>).

3. Balmer C, Pollina E. Italy's Lombardy asks retired health workers to join coronavirus fight. *World Economic Forum, Reuters*. 2020 (<https://www.weforum.org/agenda/2020/03/italys-lombardy-etired-health-workers-coronavirus-covid19-pandemic>).

4. Jacobs A, Richtel M, Baker M. 'At war with no ammo': doctors say shortage of protective gear is dire. *New York Times*. March 19, 2020 (<https://www.nytimes.com/2020/03/19/health/coronavirus-masks-shortage.html>).

5. Bradsher K, Alderman L. The world needs masks. China makes them — but has been hoarding them. *New York Times*. March 16, 2020 (<https://www.nytimes.com/2020/03/13/business/masks-china-coronavirus.html>).

DOI: 10.1056/NEJMp2006141

Copyright © 2020 Massachusetts Medical Society.