As the COVID-19 pandemic continues, policy makers are seeking to expand ventilator capacity to address the anticipated surge in patients with severe respiratory failure. Without enough ventilators, rationing measures that triage ventilators in order to save the most lives could be necessary.\(^1\)

According to media reports, the federal government’s Strategic National Stockpile has \(\text{almost 13,000 ventilators}\) to be released in emergencies. In addition to any existing state stockpiles, states have started purchasing additional ventilators. As multiple states seek new orders, ventilator manufacturers in the United States report not being able to prioritize where ventilators are most needed given limitations in how quickly ventilators can be produced.

State and regional leaders face critical decisions about how to efficiently and ethically allocate additional available ventilators to health care facilities. These choices require understanding how facilities use existing ventilator resources. Policy makers and clinical leaders must recognize essential components of ventilator management, including skilled staffing support, differences in ventilator model capacity, and supply and training needs. In responding to the COVID-19 pandemic, policy makers must also consider key factors when allocating ventilators across facilities, such as anticipated patient need, facility capacity to use additional ventilators, and supporting residents in areas without critical care services.

**Staff Availability—A Critical Factor in Ventilator Access**

The Society for Critical Care Medicine has warned that even after distributing additional ventilators, the nation’s capacity to treat a surge of patients may be limited by the number of critical care physicians, nurses, and respiratory therapists trained to treat ventilated patients.\(^2\) These concerns apply to patients who need ventilation for COVID-19 or other conditions, such as stroke or chronic obstructive pulmonary disease. State initiatives to increase provider availability include extending medical licenses and broadening the scope of practice. Accepting out-of-state licenses may have a limited effect as more states seek qualified providers for pandemic response.

To address these challenges, professional societies have provided resources for cross-training other providers to support ventilated patients with oversight by more experienced critical care providers.\(^3\)\(^4\) Telehealth for training or consultation may extend staffing resources.\(^5\) Providing personal protective equipment is also paramount to maintain the capacity of this highly trained workforce.

**Ventilator Models Vary**

Ventilators supplied from the Strategic National Stockpile or from emergency purchases may be more basic models than a typical, full-featured intensive care unit (ICU) ventilator. For example, the Strategic National Stockpile includes some portable ventilator units more commonly used in home settings. Ventilator deployment plans should include assessing which types of available ventilators are best suited to handle anticipated patient needs. Basic ventilator models may not provide optimal long-term support for the most critically ill patients with severe acute respiratory failure\(^6\) or may require more staff expertise to operate. Basic ventilator models can still be used to support more stable patients and expand overall ventilator capacity in facilities. The Federal Drug Administration

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has issued recommendations for alternatives to full-featured ventilators for certain patient needs, including leveraging anesthesia gas machines that may be available from outpatient surgery centers.

**Importance of Ventilator Supplies and Training**

Ventilator models vary in the type of tubing, filters, valves, and supplies needed for use. Supplies are not necessarily interchangeable between different models, so purchasing appropriate parts for each model is important. Access to these supplies may be limited given increases in demand. Additional patient monitoring and ventilator-related supports, such as suctioning and sedation supplies, will be needed. Ventilators need to be decontaminated before reusing between patients.

Because emergency-supplied ventilators may be more basic models, even experienced clinicians will need training resources that are tailored to the model being deployed, such as online training videos available for the Strategic National Stockpile models.

**Allocating Ventilators Within States and Regions**

In addition to managing their own ventilator resources, states are responsible for requesting and distributing within the state any ventilators received from the federal Strategic National Stockpile. The CDC's guidance to policy makers and health care system leaders recommends considering the following 4 key factors when allocating ventilators across facilities during a pandemic:

1. Assess the number of patients expected to need ventilation given surveillance data, and separately identify the number of ventilators available and in use at local facilities.
2. Determine whether facilities will be able to use additional ventilators based on staffing, physical space, and equipment capacity.
3. Ensure equitable access by considering whether facilities are a referral hospital or serve vulnerable or high-risk populations.
4. Apply an ethical framework that focuses on saving as many lives as possible with limited resources and provides transparent, consistent criteria for distributing ventilators.

Assessing whether a facility is able to use additional ventilators effectively is a key step in allocation decisions. A hospital may not be able to use an additional ventilator without the necessary supports in place. If ventilators are distributed within states based on population size or on a first-come, first-served basis instead of facility capacity, then additional ventilators may not be used efficiently to save as many lives as possible. To inform regional planning, facilities should communicate in real time about the availability of ICU-capable staff, beds, supplies, and equipment. Predictive models can provide forecasts to better understand capacity and anticipated needs.

Several management responsibilities are critical for ensuring ventilators can be used, including tracking availability, coordinating with facilities, acquiring supplies, providing training, arranging transport, and evaluating which patient needs can be best met by available ventilator models. These responsibilities should be managed with the input of front-line clinicians experienced in ventilator care.

Because almost all (94%) ICU beds in the United States are located within metropolitan hospitals, those who live far from critical care facilities may have particularly limited access to ventilator services. Existing strategies for delivering emergency care to remote areas, including teleICUs and telestroke networks, may provide access to existing specialty consultation networks that could be adapted for pandemic response. Special attention should be paid to the needs of COVID-19 patients who require transfers, including oxygen supplies, infection control, and portable ventilators.

Long-term, acute-care hospitals and select nursing homes may be able to lessen the burden on ICUs by treating stable, ventilated patients in the recovery phase of their illness, especially since Medicare has waived some regulations to broaden access to these facilities. As there are many frail or older patients in these settings, strict safeguards would be necessary to prevent discharge of
COVID19 patients to these settings or to consider designating facilities that exclusively treat COVID19 patients.

The United States will continue to face an unprecedented need for ventilator services in the coming months. State and regional planning for all the components needed to support ventilator services—staffing, supplies, training, monitoring patient needs, and assessing facilities’ capacity to use extra ventilators—is critical for saving lives.

ARTICLE INFORMATION
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REFERENCES