In the spring of 2020, US regions impacted early by COVID-19, such as northern New Jersey and New York City, exceeded the usual mechanical ventilation capability at numerous hospitals. As COVID-19 spread to other communities with limited immunity, similar challenges to provide surge mechanical ventilation were reported. Hospitals, health care systems, and jurisdictional authorities sought to purchase more mechanical ventilators and quickly realized that the supply chain could not accommodate the perceived need. Numerous creative engineering ideas were proposed to augment the supply of resuscitators or mechanical ventilators. Tremendous public and governmental effort focused on preventing shortages of these potentially life-saving devices and on strategies to ration them should demand exceed supply. To achieve this end, accurate determination of both the quantity and geographic distribution of ventilators at US hospitals was crucial. The last comprehensive assessment of US ventilators was completed more than a decade ago during the H1N1 pandemic. In JAMA Network Open, Tsai et al provide an updated evaluation using questions added to the American Hospital Association's Annual Survey. The reported quantities, although extrapolated estimates from incomplete data and therefore subject to bias, are an important update.

Although well-intentioned, the focus on ventilation devices failed to recognize what any critical care clinician knows: mechanical ventilators do not equal mechanical ventilation, and even more importantly, critical care support. The concept of “emergency mass critical care” with specific attention to mass respiratory failure was conceived in the early 2000s after the SARS-1 epidemic and the 2001 US anthrax cases. Subsequent multiple professional expert consensus guidelines endorsed adequate supplies of mechanical ventilators—but importantly, they recognized that stockpiling these devices alone, without comprehensive strategies and tactics to increase adequately trained staff, safe treatment space, and other key equipment, would be insufficient to care for an influx of persons with severe respiratory failure.

Long before the Great Resignation of early 2021, when many workers reconsidered their occupations, critical care professionals (eg, nurses, respiratory therapists, physicians, advanced practice clinicians, pharmacists) were in short supply to meet the baseline US critical care best-practice staffing needs. Planning for treatment of mass respiratory failure proposed force-multiplier models that ensured expert oversight of all complex care and matched appropriate care functions to additional staff. Despite some excellent work on staff augmentation using tiered staffing models, work on implementation and evaluation of these models of care was limited. Not surprisingly, critical care staffing shortfalls were identified at the outset of the COVID-19 pandemic. Critical care clinicians in the US reported intensive care unit staffing as a critical challenge second only to personal protective equipment shortage. Of note, these bedside responders believed ventilator shortages were significant but were not as crucial a shortfall.

Stockpiling devices for use during mass respiratory failure has merit, but the strategy must be more than “buy X ventilators.” Factors that must be included in a stockpile strategy include the scope of functions for a given device, comfort with competent use and need for additional and repeated training among staff, storage readiness and device transport, integration with local hospital equipment, ownership, and periodic evaluations to ensure the devices remain consistent with evolving practice. The US Strategic National Stockpile had approximately 20 000 devices before the COVID-19 pandemic. The LTV-1200 (Vyaire Medical) was the most recent addition and constituted...
most of these devices. The requirements for the purchase were developed more than a decade ago and centered around being able to support hospitalized patients both inside and outside traditional intensive care units, with a capability of more than 5 kg for patients with acute respiratory distress syndrome. At present, these devices can reliably provide established ventilator modes with a range of settings that few with severe acute respiratory distress syndrome would exceed. These devices were used successfully by some hospitals that had run out of available devices, and we are not aware that respiratory failure need ever exceeded the pre-COVID quantity of stockpiled ventilators.

However, challenges were identified. As the US Strategic National Stockpile went years without use, device contracts for maintenance were modified, and some hospitals reported that the devices were not ready for use when they arrived. Also, despite attempts for years by the Society of Critical Care Medicine and the American Association for Respiratory Care to teach clinicians how to use this equipment, a number of clinicians were uncomfortable using them during the pandemic. Also, since the LTV-1200 purchase, clinical practice has evolved to use more high-flow nasal cannula oxygenation, which the device cannot provide, and noninvasive mechanical ventilation, for which this ventilator is not optimized. Finally, monitoring of waveform and other ventilator data from a distance, for which the LTV-1200 was not ideal and newer devices are better, became an important feature as staff minimized time in isolation rooms for safety and efficiency. Hence, a major stockpiling challenge is to ensure that stockpiled equipment remains relevant for responses and thus requires ongoing investment.

Although we want to inform preparedness based on historical lessons, we must be cautious to assume that all lessons from COVID-19 will be applicable to future outbreaks. During the SARS-1 epidemic, transmission was largely from symptomatic persons; community transmission was limited, and risk was highest in acute care medical settings, because contagiousness generally increased with severity of illness. Intubation was a high-risk procedure, so early intubation was used to reduce the need for emergent intubations and thus ensure a safe and choreographed environment of care. A similar strategy was considered during the initial COVID-19 surge, but this strategy was quickly abandoned because a subset of use of noninvasive oxygenation delivery coupled with self-proning allowed many patients with COVID-19 to avoid intubation and mechanical ventilation. These efforts almost certainly reduced the demand for additional mechanical ventilators; however, lessons from this specific virus on the demand for mechanical ventilators should be applied cautiously to future outbreaks.

We witnessed and benefited from many rapid and strategic scientific advancements during the COVID-19 pandemic, including the development and distribution of therapeutics and vaccines. The US government ordered nearly 200 000 additional ventilators of varying functionality. The deployment and use of this varied equipment seems unlikely to have the intended benefit because much of the investment is for procurement rather than development of pragmatic strategies to provide meaningful care for a surge of patients with critical illness. Investment for mass respiratory failure can be justified, but it should have less attention on the widget and more focus on implementable processes and innovations to safely provide meaningful surge critical care for optimal patient outcome.

ARTICLE INFORMATION
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