



## Ventilator Stockpiling and Availability in the US

September 3, 2020

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Mechanical ventilation is a vital component of critical services for patients with severe acute respiratory failure. Based on the most recent publicly available data (from 2010), 1 study estimated that US acute care hospitals owned approximately 62,000 full-featured mechanical ventilators before the pandemic started.<sup>1</sup> Calculations suggest that about 28,883 of these ventilators (46.4%) could be used to ventilate pediatric and neonatal patients. The study also reported an additional 98,000 ventilators that are not full-featured but could still provide basic functions in an emergency if crisis standards of care were invoked.<sup>1</sup> However, the need for ventilation services during COVID-19 quickly overwhelmed many day-to-day operational capabilities. One study investigated intubation and invasive ventilation in approximately 80,000 COVID-19 patients from Wuhan, China in the earlier months of the pandemic. Their results indicated that ventilation was required in 3.2% of all confirmed COVID-19 cases, but closer to 50% of cases admitted to the intensive care unit required some form of mechanical ventilation.<sup>2</sup>

To meet this potential surge in demand, the CDC Strategic National Stockpile (SNS) stores and maintains mechanical ventilators that can be deployed on request through appropriate channels.<sup>3</sup> The SNS stockpiles 3 specific types of ventilators: the LP10 (Covidien), the LTV1200 (CareFusion), and the Uni-vent Eagle 754 (Impact Instrumentation).<sup>4,5</sup> It is unclear whether these machines are manufactured in the United States or elsewhere. On March 13, 2020, Seema Verma, Administrator for the Centers for Medicare and Medicaid Services, reported to CNN that the SNS has between 12,000 and 13,000 ventilators stored.<sup>6</sup> This estimate was later confirmed by Dr. Anthony Fauci, Director of the National Institute of Allergy and Infectious Diseases of the NIH.<sup>7</sup> Malatino reports that shipments from managed inventory “could arrive within 24-36 hours of the Federal decision to deploy them.”<sup>8</sup>

There are several steps that must be taken in order for the SNS to fulfill a hospital's request for additional ventilators.<sup>8</sup> First, local hospitals and treatment centers must make their initial request through their incident command system. This request is then received by the local health department and emergency management agency. The governor's approval is sought before an official request is made to HHS or CDC. However, in times of crisis, the request can be initiated at the federal level. During a national-level emergency, the CDC SNS would determine allocation strategies for ventilators, likely using criteria such as population size, number of patients, and standing capacity.<sup>9</sup>

Various other factors constrain the capacity of the US healthcare system to provide ventilation therapy. Using mathematical models, 1 study found that the limiting factor during a pandemic-level crisis would be the number of respiratory therapists rather than ventilators.<sup>10,11</sup> To combat this problem,

the American Association for Respiratory Care (AARC) has partnered with the SNS to train respiratory therapists on operating stockpiled mechanical ventilators during a public health emergency.<sup>5</sup> The AARC also provides information on the SNS allocation process, training manuals for the 3 stockpiled mechanical ventilator types, and regular online learning sessions.<sup>12</sup>

Manufacturers of ventilators ramped up production to meet increased demand, and companies such as GM, Ford, Dyson, Rolls-Royce, and Tesla made efforts to shift their manufacturing facilities to create ventilators.<sup>13</sup> It has been learned over the course of the pandemic that some patients with respiratory failure do not require invasive mechanical ventilation. This has led to the use of several forms of innovative noninvasive ventilation equipment. For example, a helmet-shaped apparatus has shown promise for providing patients with non-invasive bi-level ventilatory support that is better tolerated than traditional face-mask style BiPAP.<sup>14</sup> This helmet-style patient interface was trialed in Italy during their COVID-19 experiences in April/ May of 2020 and one study found that 18.2% of patients who used these helmets required intubation and mechanical ventilation while 61.5% of mask-wearers required intubation and mechanical ventilation.<sup>15</sup> One small-business helmet-style ventilator manufacturer in Texas is already registered by the US FDA to distribute their product. Their model costs less than \$200 to make and they hope to increase production capacity to 50,000 per week.<sup>15</sup>

In July and August of 2020, hospitals and state and local health departments began to track and publicly display the number of ventilators available in their facilities or jurisdictions. Following an increase in ventilator production under the Defense Production Act, HHS reported that the SNS ventilator stockpile had been replenished. HHS stated that SNS had approximately 120,000 ventilators to distribute as needed.<sup>16</sup> Additionally, the United States was able to donate 250 ventilators to the Government of Egypt.<sup>17</sup>

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