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# Potential Solutions to the COVID-19 Oxygen Crisis in the United States

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Healthcare system, state, and national leaders need to act now to avoid medical oxygen shortages in the weeks and months ahead. Medical oxygen supplies are already at crisis levels in some cities and states due to severe surges in coronavirus disease 2019 (COVID-19) hospitalizations. In Southern California, the shortages have affected not only hospitals and other health facilities but also emergency medical transportation practices.[1] These shortages apply to wall oxygen in hospitals as well as portable oxygen (cylinders and concentrators) in hospitals and medical facilities and for at-home and emergency use. Oxygen shortages were also reported in New York City[2] (March 2020) and Texas[3] (November 2020) during the COVID-19 hospital surges last year and are occurring in other countries.[4,5] Hospitals and health systems everywhere should begin to prepare now for potential oxygen shortages. As hospitals reach capacity due to surges in COVID-19 patients, this crisis is likely to be repeated in other locations. If enough areas are severely affected concurrently, a national crisis could ensue.

In January 2021, discussions took place with frontline clinicians and public health officials in California, Minnesota, and New York. The following descriptions of and lessons learned from oxygen supply shortages and the suggested solutions derive from those discussions.

Oxygen shortages are occurring because a large number of patients require oxygen therapy as part of their COVID-19 treatment. Over the course of the pandemic, medical providers have seen the survival benefits of providing high flow nasal oxygen, rather than mechanical ventilation, to many COVID-19 patients. The challenge is that high flow oxygen therapy uses roughly 5 to 10 times the amount of oxygen as a mechanical ventilator. The resulting high flow of oxygen through hospital oxygen systems is causing liquid oxygen vaporizers to freeze over. These vaporizers, which convert a hospital's stored liquid oxygen to gas for the hospital's oxygen systems, are located outside of the building next to tanks where bulk liquid oxygen is stored. Additionally, oxygen pipes in many older hospitals are not able to accommodate the increased flow demands due to design limitations. To reduce the draw on the wall oxygen in hospitals, portable oxygen is being used, especially in alternate treatment sites; however, the increased use of portable oxygen is contributing to a shortage of oxygen cylinders of all sizes. Timely oxygen delivery to hospitals has also been a problem, and oxygen flow regulators, which are needed for both wall oxygen and portable oxygen tanks, are in critically short supply.

Hospital systems, state officials, and the federal government must act now to avert these problems in additional hospitals.

## Applying Lessons from Other Hospitals: Solutions Currently Being Implemented

- Some hospitals have added secondary oxygen supply lines that bypass the existing oxygen delivery systems, allowing more oxygen to flow without freezing the vaporizers. These secondary systems can connect directly to trucks or tanks carrying bulk liquid oxygen.

- Some hospitals have improvised warm water sprinkler systems to keep the external vaporizers from freezing.
- Oxygen concentrators are being used as much as possible in place of oxygen cylinders. These draw oxygen from the air and do not need oxygen resupply or flow regulators.
    - Some providers are splitting the tubing from 1 concentrator to supply 2 patients at once; conversely, sometimes 2 concentrators are being used on a single patient to provide higher oxygen concentrations than a single concentrator can provide.
- Oxygen is being conserved by lowering the saturation threshold for deemed adequate patient oxygenation.
- Large H oxygen cylinders are being fitted with manifolds to service multiple patients simultaneously.
- The state of California has augmented both bulk oxygen delivery and portable oxygen supply. It is also working with vendors and authorities to remove regulatory barriers to oxygen transport and ensure cooperation among oxygen vendors.

## Healthcare System, State, and Federal Leaders Need to Act Now: Where Solutions Are Still Needed

- **Improve awareness of potential oxygen shortages.** Clinicians need to be more aware of shortages and the need to conserve oxygen. Health systems, public health departments, professional organizations, and federal agencies should raise awareness of this issue by communicating the risks consistently. Hospitals should provide frequent updates to their staff on the status of their oxygen system and oxygen availability.
- **Develop operational plans to share resources between states.** Oxygen-related equipment such as tanks, regulators, and liquid oxygen delivery trucks may need to be shared across states. The plans should be developed now so states can efficiently share resources based on patient surges.
- **Relax enforcement of certain state and federal regulations pertaining to the transport of oxygen** at state and federal levels to allow for easier sharing of resources, as needed. This might include, for example, regulations that limit who can drive trucks carrying oxygen and how long drivers can work.
- **Conduct rapid research into the manufacturing capacity and supply chain of oxygen cylinders, concentrators, regulators, and associated supplies.** Determine if use of the Defense Production Act—which has already been involked to increase production of masks, testing kits, and vaccine materials[6]—could help to boost production quickly. The Department of Health and Human Services (HHS) should consider this a priority as many products are now unavailable commercially.
- **Commission a broad-based committee of experts**, led by HHS, to advise the Department on the multifaceted issues related to oxygen supply and delivery for current and future disasters.

We need to act now to ensure that oxygen supply shortages will be proactively addressed so that all patients can get the life-sustaining care they need throughout the course of the pandemic.

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