Formulation of an oxygen policy to ensure adequate supply of oxygen reserves during the second wave of COVID-19 pandemic

The second wave of the coronavirus disease 2019 (COVID-19) pandemic has wreaked havoc with healthcare systems in India as well as in other parts of the world. The health care systems across the world were suddenly overburdened, due to the rapidly increasing oxygen demand for supporting COVID-19 patients who could not maintain their blood oxygen saturation on their own. Majority of the institutions, states, and countries could not keep up with this sudden surge in oxygen demand and found themselves face to face with an oxygen crisis of epic proportions.

Oxygen is critically important for saving lives in emergencies, resuscitation of critical patients, trauma settings, and diseases that primarily affect the respiratory system, like pneumonia. Despite being in the list of essential medicines by World Health Organization,[1] the importance of oxygen is usually forgotten due to it being easily available naturally in the environment. Eighty percent of the patients admitted in the United Kingdom due to COVID-19 required supplemental oxygen at higher-than-normal doses.[2]

The mere thought of oxygen being in short supply, and requiring rationing is alarming, but this is exactly what several health systems had to undergo during this pandemic.

The combined efforts of the union government, local administration, and health institutions to maintain adequate supplies of medical grade oxygen during this pandemic proved fruitful, but the demand supply ratio was always under pressure.[3] These strenuous circumstances have taught us that even with our best efforts the supply of oxygen would always be precarious, if healthcare providers, individually and collectively, do not find solutions to our increasing demands by implementing protocols for the judicious usage of oxygen.

Being a large public sector hospital in the most populous state (Uttar Pradesh) of India, with a bed capacity of more than 3000 beds, and a dedicated COVID-19 facility of more than 900 beds, managing oxygen supplies was not easy during the recently crested second wave of the COVID-19 pandemic.

The primary supply of oxygen in our institution is through a vacuum insulated evaporator liquid medical oxygen (LMO) vessel system, with cylinder manifolds as the secondary and backup (reserve) supply. During the second wave of the pandemic, the increasing demands of oxygen at our institution were maintained with the collective efforts of the hospital administration and government agencies.[4] Additionally, efforts were done to formulate an "oxygen policy" to check the rising demands, and ensure judicious use of the rapidly diminishing oxygen reserves that we had at our disposal. Here, we try to highlight some of our oxygen conservation strategies that helped us achieve a state of balance in terms of demand and supply of oxygen during the stressful time of the second wave of this pandemic.

- Daily oxygen consumption details were traced, and analyzed for the last few months and anticipatory storage of LMO was done to tackle the peak of the pandemic.
- Estimation of predicted oxygen requirement, which depends upon several factors, was done daily by collecting the following data -

a) Number of oxygen beds (isolation and intensive care unit beds);
b) Total occupancy of beds (Total number of patients on oxygen support);
c) Oxygen devices used on patients (like Nasal cannula/prong, Facemask, non-rebreathing mask, non-invasive ventilation, high flow nasal cannula, and invasive ventilation) which give an idea of oxygen consumption in liters per minute (LPM);
d) Number of hours per day on oxygen support.

Total usage of oxygen per day = number of patients on oxygen × flows (LPM) × 60 × 24

For preparation for the second wave of the pandemic, we calculated the peak demand by using the maximum possible flows with the maximum number of patients for 24 hours, and supplies were ensured depending upon the peak demands.

- All the stakeholders involved in the smooth functioning of the oxygen supply from production to patient's bedside availability (LMO production plants, cryogenic transport vessels fleet, oxygen cylinder filling stations, medical gas pipeline maintenance department, biomedical engineers, and paramedical staff) were briefed regularly, and their due support was sought.
- High powered internal oxygen monitoring committee comprising of various heads of department, nursing superintendent, medical superintendent, and mechanical, electrical, and biomedical engineers was created to help the hospital function like a well-oiled machine in terms of judicious oxygen usage. The said committee "monitored and audited" the daily oxygen supplies, and predicted and actual consumption figures, and reported any major discrepancies directly to government and administrative agencies. Such discrepancies were investigated at the institutional level daily, and remedies sought and their application ensured.
- The said committee also ensured daily physical inspection, and maintenance of all equipment related to oxygen storage, distribution, and administration to the patients. Thus daily reports of LMO vessels, oxygen cylinders, and manifolds, oxygen pipeline, wall mounted humidifiers, and oxygen flow meters were generated and filed with the said committee leading to accountability, and raising sensitivity towards non-wastage of precious oxygen.
- Training of doctors, nurses, and paramedical staff involved with oxygen therapy was done for the "Do's & Don'ts" of oxygen usage. Salient features included:

a) Compulsory monitoring of oxygen saturation by pulse oximeter round the clock, all oxygen therapy patients had access to pulse-oximeter. Pulse-oximeter was made available in all wards compulsorily.
b) Target oxygen saturation was set at 94% with the minimal possible flows, any reading above 94% warranted a quick titration of oxygen flows by the medical staff.
c) Oxygen is a drug, use it judiciously campaign was floated to sensitize the importance of oxygen.
d) Doctors were advised to "prescribe" oxygen on the patient treatment chart, with clear instructions for the oxygen device for the nursing staff to follow (for example, flows of 10 L per minute by non-rebreathing mask).
e) The patients were counseled not to change the bedside flow meter settings on their own without informing the staff on duty.
f) A Zero Tolerance policy for any leakages (leakages from cylinders, medical gas pipelines, bedside flow meters, and around the patient's face mask or device was rectified at the earliest) was enforced, to prevent any losses of oxygen. 24 × 7 helpline number and help desk was dedicated for this purpose.
g) The use of high flow nasal cannula was replaced by the use of non-invasive ventilation as it consumes more oxygen.
h) Use of Yoga, naturopathy, incentive spirometry, and awake self-proning[5] was started invariably in all improving patients to reduce their oxygen requirements.

As the impact of the second wave wore off slowly, we were able to manage the oxygen supplies for our hospital by incorporating the above-mentioned points.

In the coming times, we plan to further strengthen our oxygen supplies by incorporating oxygen generation plants at multiple locations. The oxygen that we breathe is free, and is thus mostly taken for granted, but any shortage in supplies of this "free" oxygen can be a matter of life and death for serious patients. If the majority of the hospitals adapt Good Oxygen Practices, which focus on judicious and safe use of oxygen, then more and more patients can be served within the available resources. We should, save oxygen to save more lives.

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