



## COMMENTARY

## Coping with Shortage of Ventilators in COVID-19 Pandemic: Indian Context and Exploring Effective Options in Countries with Limited Healthcare Resources

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Since the detection of first Coronavirus case in China, global burden of disease has risen to 2.47 million confirmed cases with 1.69 lakh deaths [1]. India, a 1.35 billion people nation, at present witnesses 20,711 confirmed cases with 681 deaths [2]. About 5% of Coronavirus disease 2019 (COVID-19) patients progress to critical illness including acute respiratory distress syndrome (ARDS) requiring respiratory support [3]. Respiratory failure is the main cause for mortality [4]. The case fatality rate varies from < 0.6 - 2.2% at age 60 years to over 9.3% above 80 years [5]. In spite of best efforts in dealing with this gargantuan situation, there is worldwide shortage of medical supplies. Availability of ventilators is of paramount importance. Although there is no concrete data on the number of ventilators available in India but is estimated to be less than 50,000 with additional one million units required to deal with the pandemic situation [6]. With shortage of ventilators, preemptive alternative effective measures are required to be undertaken; thus sparing ventilators for patients with utmost need. We highlight key measures that should be instituted in order to cope with shortage of ventilators in resource limited settings; a situation faced by majority

of countries with developing healthcare systems.

At the very outset, it needs to be well understood that early assessment and anticipating the need for non-invasive measures will halt progression of disease into ARDS. This will not only reduce the chances for invasive ventilation but also aid in early weaning, thereby decreasing the overall ventilator use.

COVID-19 patients should ideally be managed in negative pressure isolation rooms, but most public hospitals would not have this facility. The next best thing is to manage these patients in closed rooms [5].

There is no definitive therapy as of now, and early use of oxygen for prevention of respiratory failure remains the mainstay for management. The target of therapy is maintenance of oxygen saturation above 90% and 92-95% in pregnant women [5]. A step wise approach to deliver oxygen and choosing an appropriate delivery device would be prudent to successfully manage and hasten clinical recovery. Simple oxygen delivery devices are nasal cannula, face mask, venturi mask and non-re-breather (NRB) mask. Amongst these, NRB mask can



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provide  $\text{FiO}_2$  of 90% and maximum exhaled dispersion distance is below 10 cm at flow of 10 L/min, thereby being device of choice for patients requiring oxygen [7].

Severe ARDS requires invasive mechanical ventilation while mild to moderate ARDS in select cases can be managed with high flow nasal cannula (HFNC) or non-invasive positive pressure ventilation (NIPPV). Patients who are not maintaining oxygen saturation above 90% or who are tachypneic ( $\text{RR} > 24/\text{min}$ ) should be started on HFNC/NIPPV support [5]. HFNC improves oxygenation in Type I respiratory failure and causes less ventilator induced lung injury, thus avoiding the need for invasive ventilation [8]. However, not only does operating this equipment require skill but is also expensive. Therefore, exploring other affordable and feasible options, NIPPV is the modality of choice. It can be delivered by continuous positive airway pressure (CPAP) or bi-level positive airway pressure (BiPAP) devices. It provides  $\text{FiO}_2$  of up to 100% in closed circuits [5].

Various interface devices which can be employed with NIPPV are helmet, full face mask and oronasal mask. A helmet BiPAP with cushion in place around neck [5] would be ideal interface device but it is not available at most centers. The risk of aerosol generation and dispersion is a major concern with NIPPV. It depends on pressure settings and type of masks used. This risk can be mitigated by properly fitting masks and using full face mask instead of oronasal mask. The dispersion distance with inspiratory positive airway pressure (IPAP) of 10 cm  $\text{H}_2\text{O}$  varies from 17 to 64 cm and at IPAP of 18 cm  $\text{H}_2\text{O}$  ranges from 33 to 95 cm [5,7]. Most of this aerosol spread occurs in sagittal plane [7].

Using a viral filter in exhalation port of circuit can reduce viral shedding [5]. Using humidification in both simple oxygen devices and in NIPPV circuits avoids dryness and helps in muco-ciliary clearance [5]. It should be routinely included as part of treatment protocol.

Prone positioning is instituted after intubation in severe ARDS but not widely practiced in conscious patients. Patients with mild to moderate ARDS, whether with stable  $\text{SpO}_2$  or below 90% can be placed in prone position on HFNC or NIPPV. It improves oxygenation by recruitment of dependent alveoli and is shown to increase  $\text{PaO}_2/\text{FiO}_2$  by 25-35 mmHg compared to these used alone [8,9]. As many people sleep prone, placing conscious patients in prone position is easier. It reduces need for invasive ventilation in up to 50% patients [8].

The patients should be re-assessed half hourly for

initial two hours and hourly later on for improvement. In case of no improvement, a very low threshold for endotracheal intubation should be maintained [8].

Early oxygen therapy, early NIPPV with appropriate interface and early prone positioning can make a significant difference in the outcome of COVID-19 patients by reducing requirement of invasive ventilation and therefore making it available for severe ARDS patients. These measures will be cost-effective and less skill invasive. So, implementing these practices, physicians and intensivists can ensure an effective use of resources in developing countries.

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## Conflict of Interest

Nil.

## Authors Contribution

This is to state that all authors contributed equally.

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