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A Queuing Model for Improving the Management of Oxygen Cylinder in COVID-19

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Abstract:- We present a queue model to inform oxygen cylinder management under different COVID-19 pandemic scenarios. Our model was used to support ventilator capacity planning during the first wave of COVID-19 pandemic in British Columbia Canada. Severe bilateral pneumonia is the main feature of severe COVID-19 and adequate ventilator support is crucial for patient survival. Key messages include that supplemental oxygen is a first essential step for the treatment of severe COVID-19 patients with hypoxemia and should be a primary focus in resource-limited settings where capacity for invasive oxygen cylinder is limited. Oxygen delivery can be increased by using a non-rebreathing mask and prone positioning. This model incorporates COVID-19 case projection along with the proportion of cases requiring oxygen cylinder, the delay from symptoms onset to oxygen cylinder, non-COVID-19 oxygen cylinder demand. Patients with fatigue and at risk for exhaustion, because of respiratory distress, will require invasive oxygen cylinder. Our model provides policy makers with a tool to measure the interaction between public health interventions, critical care resources needed and performance cues for patient access.

Keywords:- *COVID-19; Medical Oxygen; Hoarding; Fatigue; Infectious; Respiratory Syndrome; Oxygen Cylinder; Queuing Theory.*

I. INTRODUCTION

Oxygen is often used in general medicine, medical assistance and emergency medicine. The availability of medical oxygen can make the difference between life and death. For this reason, it is essential to ensure the oxygen supply at all times.

When you get a severe COVID-19, the oxygen levels in the body can get low. So, in order to keep your oxygen levels at the normal range, we have to give medical oxygen. Now, when your oxygen levels are low because of a sickness such as COVID-19, the cells in the body don't have enough oxygen to do their normal function. Every cell of the body requires oxygen for normal function. So, if the oxygen levels are low for a long time, then the cells themselves stop to work well. Then, they stop to work completely and cells can actually die. So, then what you can see is that the organs start, your organs like your brain, your heart, your lungs, your kidneys all require oxygen. So, they'll start to malfunction in very extreme cases can cause death. So, again, the lifesaving treatment here then is medical oxygen. So, medical oxygen is taking the oxygen from the air and compressing it.

The medical oxygen requirement of a serious COVID-19 is about 86000 litres per day. Medical oxygen demand has reached a record level with a steady increase in COVID-19 cases in India. Some states have started to experience a shortage of oxygen cylinder. As Covid cases continue to surge in Gurgaon, with hospital beds running short and a bulk of the patients being treated in home isolation, the district administration has announced that, beginning Sunday, a door-to-door oxygen cylinder distribution service will be started in Gurgaon.

There's a long queue outside the office of Gurgaon based on non-profit Hemkunt foundation.

II. RESEARCH METHODOLOGY

In March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, caused by the novel SARS-CoV-2 virus. Following the call from the WHO to immediately assess available data to learn what care approaches are most effective and evaluate the effects of therapies, this collection aims to report on original peer-reviewed research articles in methodological approaches to medical research related to COVID-19.

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OBJECTIVES OF THE STUDY

1. To understand the importance of oxygen in our body.
2. To appreciate why under-supply or excess-supply of oxygen is hazardous.
3. To understand the dangers involved in using oxygen cylinders at home.

III. PROVIDING CYLINDER ONLINE

Haryana has delivered ,1901 oxygen cylinders in all its districts since it launched a home delivery drive on May 9, much to relief of COVID-patients and their families. The highest number of home deliveries was made in Faridabad where 338 cylinders have reached patients. In Panipat, 325 cylinders have been delivered and 153 cylinders were delivered in Gurgaon till 12 May. The charges are different in each district.

IV. PROCESSING OF DELIVERY AT DOORSTEP

One can apply for a cylinder on http://oxygenhry.in/. by clicking on "citizen oxygen requirement form". An applicant has to select the district and fill in the patient's details, including current oxygen level with the help of oximeter. A photo of patient has to be uploaded, along with the required size of cylinder. In addition, the applicant must have an empty cylinder which can be converted into a loaded cylinder. Details include the name and age of the patient, the address where the cylinder required, the Aadhaar of the patient, as well as size of the required cylinder (small/big) and patient's oxygen level.

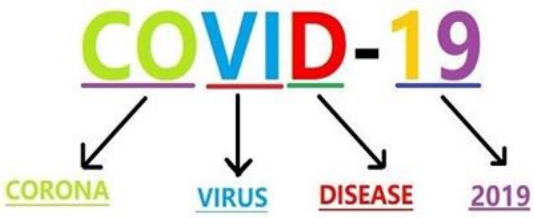
V. AUTHORITY CRACK DOWN ON HOARDING

Families of patients, who depend on oxygen cylinders at home, as well as NGOs and volunteer networks are finding it difficult to fill cylinders for individuals who provide this service.

One reason for this is the decision by authorities to crack down on people hoarding oxygen cylinder and streamlines the supply in hospitals. Oxygen plant has been told not to fill empty cylinder brought by people. COVID-19 patients have no choice but to use oxygen cylinders at home due to lack of oxygen-rich beds. Even patients who have been discharged from the hospitals but need oxygen at home facing difficulties. Steps have been taken to stop hoarding as people are selling cylinders in black market. Due to filling of cylinders, the supply in hospitals will be reduced. For those who need oxygen, it would be better to treatment in hospitals.

VI. COVID-19

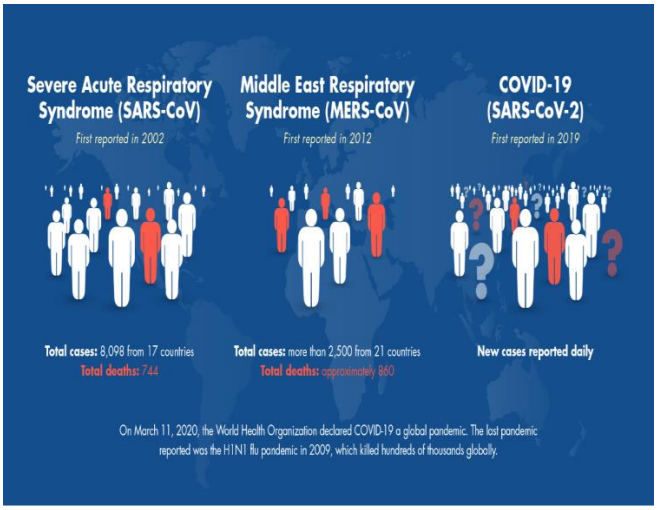
Coronaviruses are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). A novel coronavirus (nCoV) is a new strain that has not been previously identified in humans.



Coronaviruses are transmitted between animals and people. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans.

Common signs of infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death.

Standard recommendations to prevent infection spread include regular hand washing, covering mouth and nose when coughing and sneezing, thoroughly cooking meat and eggs. Avoid close contact with anyone showing symptoms of respiratory illness such as coughing and sneezing. It is very important to effectively prevent hospital infection. In this condition people should treat themselves at home.



VII. CONCLUSION

Currently, the information about the purchases of oxygen cylinders and related equipment is mostly not adequately maintained. This could become a colossal lapse if left not collected. Taking a step forward, the Divisional Clinical Management Committee of Indore, India, asked the local health department to collect information about purchasers of oximeters and oxygen cylinders from medical outlets.

Several individuals and the elderly are intending and forcing oxygen providers to provide oxygen cylinders for residence use. While this is done to avoid the rush for oxygen in case an emergency arises, particularly in the situation of COVID-19 pandemic, individuals need to

understand the various issues involved in such storage. We want to reduce the queue for oxygen cylinders through this model. In this paper we have described the online system by which we can reduce the queue.

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