

STUDY ON MEDICAL OXYGEN GAS DELIVERY SYSTEM DURING COVID-19 PANDEMIC IN A TERTIARY CARE HOSPITAL OF LOWER ASSAM

Ashok Jyoti Deka¹, Diganta Das², Suresh Sharma³, Partha Pratim Talukdar⁴

Received : 14/07/2023
Received in revised form : 15/08/2023
Accepted : 29/08/2023

Keywords:
Medical Oxygen gas, COVID-19
Pandemic.

Corresponding Author:
Dr. Partha Pratim Talukdar,
Email: dr.parthatalukdar@gmail.com

DOI:10.47009/jamp.2023.5.5.54

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5(5); 272-274



¹Assistant Professor, Department of Community Medicine, Nalbari Medical College and Hospital, Nalbari, Assam, India and former Deputy Superintendent cum In charge Central Medical Gas store FAAMCH, Barpeta, Assam, India

²Professor, Department of Biochemistry, Nalbari Medical College and Hospital, Nalbari, Assam, India and former Medical Superintendent, FAAMCH, Barpeta, Assam, India,

³Associate Professor, Department of Pulmonary Medicine and Nodal Officer, Covid 19, FAAMCH, Barpeta, Assam, India,

⁴Associate Professor, Department of Pathology, Nalbari Medical College and Hospital, Nalbari, Assam, India.

Abstract

Background: Medical oxygen is a life- saving medicine used in health care systems. The onset of COVID-19 pandemic, which was a public health emergency, led to various challenges faced by our country. The unexpected surge in patients requiring oxygen, paved the way for the improvement of the existing oxygen delivery system to overcome the on-going crisis. Aim and objective: To study the medical oxygen gas delivery system during COVID-19 pandemic and to study the demand and supply gap of oxygen to patients during the pandemic. **Materials and Methods:** A hospital based retrospective study conducted over a period of one year and ten months during COVID-19 pandemic. Data obtained from COVID ward, COVID intensive care unit and Office of the Medical Gas System of FAAMCH, Barpeta. **Result:** A total number of 2,816 COVID-19 patients were admitted in the hospital during the pandemic from May 2020 to February 2022. Out of these 2,156 patients were admitted in COVID ward and 660 patients were admitted in COVID ICU. The oxygen supply in the initial stage i.e from May 2020 to July 2020 was from B type cylinders. D type cylinders were used after 3 months i.e from August 2020, when the central line was established in COVID designated areas. Two Liquid Medical Oxygen (LMO) tanks and three Pressure Swing Adsorption (PSA) plants were installed in the year 2021. Overall a total number of 1,531 B cylinders and 2,839 D cylinders were required. Total amount of liquid medical oxygen required was 153,889 kilolitres. Oxygen supply throughout the pandemic was adequate to meet the required demand. **Conclusion:** To meet the increased demand of oxygen required during the COVID-19 pandemic, the medical oxygen gas delivery system in our hospital was uplifted promptly without the shortage of oxygen throughout the span of the pandemic.

INTRODUCTION

Medical oxygen is a life- saving medicine used in healthcare systems. In June 2017, the World Health Organization included oxygen in the WHO Model list of Essential Medicines (EML) beyond use during anaesthesia, due to its proven life-saving properties, safety and cost-effectiveness.^[1] The onset of COVID-19 pandemic, which was a public health emergency led to various challenges faced by our country. As the number of cases increased, the demand for oxygen, medicines, hospital beds and other requirements grew substantially. The

unexpected surge in patients requiring oxygen, paved the way for the improvement of the existing oxygen delivery system to overcome the on-going crisis. The present study was thus undertaken with the following aim and objective:

1. To study the medical oxygen gas delivery system during COVID-19 pandemic in a tertiary care hospital of lower Assam.
2. To study the demand and supply gap of oxygen to patients during the pandemic.

MATERIALS AND METHODS

The present study was a hospital based retrospective study conducted over a period of one year and ten months starting from the first COVID 19 case admitted to the hospital till discharge of the last case i.e from May 2020 to February 2022 at FAAMCH, Barpeta, Assam. Data was obtained from COVID Ward, COVID intensive care unit (ICU) and Office of the Medical Gas System of FAAMCH, Barpeta. Data analysed using Microsoft Excel software. Ethical clearance for the study was obtained from the Institutional Ethics Committee.

RESULTS

A total number of 2,816 COVID-19 patients were admitted in the hospital during the pandemic from May 2020 to February 2022. Out of these 2,156 patients (76.56%) were admitted in COVID ward and 660 patients (23.44%) were admitted in COVID ICU. [Table 1]

The oxygen supply in the initial stage i.e from May 2020 to July 2020 was solely from B type cylinders. D type cylinders were used after 3 months i.e from August 2020, when the central line was established in COVID designated areas. [Table 1]

In the year 2020, maximum number of cases (228) was admitted in the month of August. In the month of September, maximum number of patients was

admitted in the ICU (51), thus requiring most numbers of D cylinders (894) and B cylinders (353). The demand for oxygen was met by the supplied oxygen. [Table 1]

A gradual decline in the number of cases occurred from October 2020 with no cases in the month of March 2021. Oxygen supply was adequate during the period. [Table 1]

Two Liquid Medical Oxygen (LMO) tanks were installed in the year 2021, of which the first LMO tank was installed in January 2021 and used for uninterrupted oxygen supply through central line from February 2021. In September 2021, the second LMO tank was installed.

Three Pressure Swing Adsorption (PSA) plants were also installed in the year 2021.

Cases resurged from April 2021 and continued till February 2022. In May 2021 highest number of cases (432) occurred with maximum number of ICU admission (117). A total of 133 B cylinders and 43,613 Kilolitres of LMO were required. No deficit in oxygen supply occurred during this period.

Overall, the total number of B cylinders and D cylinders required throughout the pandemic was 1,531 and 2,839 respectively. Total amount of liquid medical oxygen (LMO) required was 153,889 kilolitres [Table 1]. Oxygen supply throughout the pandemic was adequate to meet the required demand.

Table 1: Month-wise distribution of COVID-19 cases and delivery of medical oxygen gas through different devices:

Month and year	Total number of COVID- 19 cases admitted	No. of cases admitted in COVID Ward	No. of cases admitted in COVID ICU	Percentage of patients requiring ICU admission	Total no. of B-Cylinders required during pandemic	Total no. of D-Cylinders required during pandemic	Total Kilolitres of LMO required during pandemic
May 2020	73	73	0	0	61	0	0
June2020	152	151	1	0.66	65	0	0
July 2020	197	193	4	2.03	65	0	0
Aug 2020	228	190	38	16.67	280	123	0
Sep 2020	218	167	51	23.39	353	894	0
Oct 2020	74	46	28	37.84	173	789	0
Nov 2020	25	20	5	20	53	489	0
Dec 2020	16	11	5	31.25	33	381	0
Jan 2021	10	7	3	30	2	150	0
Feb 2021	1	1	0	0	3	0	273
Mar 2021	0	0	0	0	0	0	420
Apr 2021	123	87	36	29.27	16	0	7,623
May 2021	432	315	117	27.08	133	0	43,613
June2021	274	165	109	39.78	103	0	30,290
July 2021	327	237	90	27.52	112	0	28,539
Aug 2021	203	161	42	20.69	64	0	16,170
Sep 2021	87	68	19	21.84	23	0	6,528
Oct 2021	102	80	22	21.57	11	0	5,628
Nov 2021	74	52	22	29.73	9	0	5,964
Dec 2021	27	20	7	25.93	6	0	2,730
Jan 2022	148	101	47	31.76	14	0	4,284
Feb 2022	25	11	14	56	2	0	1,827
Total	2816	2156	660	--	1531	2839	153889

DISCUSSION

B type oxygen cylinders are used in places where central line for oxygen supply is not available and during transportation of the patients. D type oxygen cylinders which are also called as Jumbo cylinders are used for delivering oxygen through central line supply.

Liquid Medical Oxygen or LMO are stored in large vertical tanks where oxygen is kept in liquid and compressed form. For delivery of liquid oxygen, it is passed through vaporizers attached with LMO tanks to change it into its gaseous form. It is the best means of storing large volumes of oxygen with small footprints.^[2] One litre liquid oxygen provides approximately 860 litres of gaseous oxygen, making this the most efficient system of transportation and storage.^[3] When LMO tanks are available in hospitals, it is preferred over D type cylinders for oxygen delivery. However, D type cylinders are attached to central lines as back up of oxygen supply when LMO tanks fail to supply oxygen for various reasons.

Pressure Swing Adsorption (PSA) is the process by which ambient air passes through an internal filtration system (e.g. A molecular sieve [zeolite granules or membranes]), which has a large enough total surface area to separate nitrogen (N₂) from the air, concentrating the remaining oxygen (O₂) to a known purity.^[4]

In the present study, a total number of 2,816 Covid-19 cases were admitted in the hospital during the pandemic. Out of these 2,156 (76.56%) patients were admitted in COVID ward and 660 (23.44%) patients were admitted in COVID ICU.

The oxygen supply in the initial stage i.e from May 2020 to July 2020 was solely from B type cylinders as there was no central line in the COVID designated areas. D type cylinders were used from August 2020, when the central line to the COVID designated areas was established.

In the year 2020, maximum number of cases (228) was admitted in the month of August while in the month of September, maximum number of patients was admitted in ICU (51) which led to the use of most numbers of D cylinders (894) and B cylinders (353). The demand for oxygen was met by the supplied oxygen. From October 2020, there was a gradual decline in number of cases. There were no cases in March 2021. Oxygen supply was adequate during this period.

As a preparedness to meet future oxygen demand, the Government of Assam, in January 2021,

installed the first Liquid Medical Oxygen (LMO) tank in the hospital, which was used for uninterrupted oxygen supply through central line from month of February 2021. The D cylinders were kept as back up support. The second LMO tank was installed in September 2021.

Three Pressure Swing Adsorption (PSA) plants were installed in the year 2021, of which two numbers with a capacity of 500 Litre per minute (LPM) were supplied by the state government and one with a capacity of 1000 LPM was supplied by the Central government.

COVID cases resurged from April 2021 and continued till February 2022. In May 2021 highest number of cases (432) occurred with maximum number of ICU admission (117). A total of 133 B cylinders and 43,613 Kilolitres of LMO were required. The PSA plants were used for 6 to 8 hours a day.

No deficit in oxygen supply occurred during this period.

Overall, the total number of B cylinders and D cylinders required throughout the pandemic was 1,531 and 2,839 respectively. Total amount of liquid medical oxygen (LMO) required was 153,889 kilolitres. Oxygen supply throughout the pandemic was adequate to meet the required demand. The prompt effective measurements on medical oxygen gas delivery system implemented in our hospital with immense support from the Government of Assam and Central government of India, helped to face the menace of the pandemic.

CONCLUSION

Oxygen is a life-saving therapeutic drug. To meet the increased demand of oxygen required during the COVID 19 pandemic, the medical oxygen gas delivery system in our hospital was uplifted promptly without the shortage of oxygen throughout the period.

REFERENCES

1. WHO Model list of essential medicines (20th list, March 2017). Geneva: World Health Organisation; 2017.
2. Blakeman TC, Branson RD. Oxygen supplies in disaster management. *Respir Care*. 2013; 58:173-83.
3. Hardavella G, Karampinis I, Frille A, Sreter K, Rousalova I. Oxygen devices and delivery systems. *Breathe (Sheff)* 2019; 15:e 108-16.
4. Technical specifications for Pressure Swing Adsorption (PSA) Oxygen Plants. World Health Organization; 8 June 2020.