

Webinar 2 - Oxygen Concentrators:
Distribution, Maintenance and
Decontamination

16th September 2021

Technical Assistance for National Capacity-Building and Enhancing the Oxygen Logistics and Supply Management System to the states of West Bengal, Meghalaya, Uttarakhand, and Andhra Pradesh

The World Bank
September 2021



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WEBINAR SERIES

BUILDING SUSTAINABLE MEDICAL OXYGEN SYSTEMS: EXPERIENCES AND LESSONS FROM INDIA'S COVID-19 RESPONSE

WEBINAR #2

OXYGEN CONCENTRATORS: DISTRIBUTION, MAINTENANCE AND DECONTAMINATION

September 16, 2021, Thursday | 04:30 PM to 06:00 PM

Agenda

04:30 – 04:40 PM Welcome and Context Setting

Mr. Mohammad Ameel, Head – Primary Healthcare, Technology & Innovations, PATH

04:40 – 04:50 PM Keynote Address

**Distribution, maintenance, and sterilization of oxygen concentrators:
Experiences of India**

Mr. Vishal Chauhan, Joint Secretary (Policy), National Health Mission, Government of India

04:50 – 05:00 PM Spotlight Address

Improving availability of oxygen concentrators: Lessons from Rajasthan

Mr. Siddharth Mahajan, Secretary – Medical and Health, Government of Rajasthan, India

05:00 – 05:10 PM Question and Answers with the Keynote and Spotlight Speakers

05:10 – 05:40 PM Panel Discussion

Lessons on distribution, operations, and sterilization of oxygen concentrators after use

Dr. Vinod Kumar, Project Director, Andhra Pradesh Health Systems Strengthening Project (APHSSP), Government of Andhra Pradesh, India

Dr. Arun K Singh, Professor, Department of Neonatology, AIIMS Jodhpur

Mr. Sudhakar Mairpadi, Head – Quality, Regulatory and Government Affairs, Phillips India Limited

Dr. Gaurav Thukral, Executive Vice President and Chief Operating Officer (Services), HealthCare at Home

05:40 – 05:55 PM Open House

Questions and answers from the audience

05:55– 06:00 PM Summary and Closing Remarks

Mr. Mohammad Ameel, Head – Primary Healthcare, Technology & Innovations, PATH

Background

The second wave of covid-19 has had dreadful consequences pertaining to increase in the number of cases, inadequate treatment facilities, and shortage of the most important drug - oxygen. Oxygen proved to be a life-saving drug for the treatment of COVID-19 patients. However, with the sudden surge in cases and a fragile medical oxygen management infrastructure, most of the COVID-19-related deaths in India occurred due to mere lack of oxygen supply. In the peak, reported daily new infections in India crossed 410,000 with daily reported deaths were more than 6,100¹. The demand for medical oxygen peaked to around 11,000 metric tons (MT) per day by the beginning of May from around 3,800 MT per day in the mid-May 2021², an increase of four times as compared to the levels prior to the second wave. All these factors led to overburdening of the country's healthcare system.

Since medical oxygen is the single most important intervention for moderate and severe cases of COVID-19, it is pertinent to strengthen our oxygen management ecosystem in a sustainably. More importantly than ever, there is a need to ramp up the production and supply infrastructure before the unpropitious third wave, as predicted by many experts. The Government of India is implementing numerous evidence-based strategies from our learnings from the second wave, as a preparation for the future surge in cases. Several corporates, philanthropic foundations, and friendly governments have stepped up, offering to build the PSA oxygen generation plants at various hospitals, across many states. Government hospitals up to primary healthcare facilities are setting up oxygen concentrators to prepare for the next wave.

The medical oxygen infrastructure in the country is rapidly evolving. As many states move towards strengthening their oxygen production and supply chain, there is an increased demand for support in designing, evaluating, regulating, maintaining, and managing medical oxygen devices and systems, and on training on their safe use. To achieve this, standard procedures/ guidelines are being released and emphasis is on not only oxygen generation but also prevention of oxygen wastage. Efforts are on to deploy advanced technology to track performance and functioning of these oxygen plants at the local and national level, and to track oxygen concentrators and cylinders from the point of production to the end use.

Considering the anticipated third wave and the benefits of knowledge-sharing in the present times of crisis, the World Bank, in collaboration with PATH, is conducting a five-part regional webinar series to share the challenges faced, best practices identified, lessons learnt, and insights on India's evolving oxygen ecosystem in the context of the COVID-19 pandemic. The second of the five webinars was organized on **Thursday, September 16, 2021** and attended by 280 subject matter experts, government officials, development partners, healthcare professionals and private-sector representatives from India and South Asian, North Africa, and Middle Eastern countries. The speakers of this second webinar on "**Oxygen Concentrators: Distribution, Maintenance and Decontamination**":

- Shared the experiences of state and non-state stakeholders on improving availability of oxygen concentrators,
- Exchanged best practices in operations and maintenance of oxygen concentrators, and
- Deliberated on ways of promoting effective and safe use of oxygen concentrators with single and multiple users.

This report provides a summary of key discussions, lessons learnt, and recommendations that emerged from the webinar.

¹ Source: <https://www.mohfw.gov.in/>

² Source: <https://www.orfonline.org/research/preventing-a-repeat-of-the-covid-19-second-wave-oxygen-crisis-in-india/>

Distribution, Maintenance, and Sterilization of Oxygen Concentrators: Experiences of India

Mr. Vishal Chauhan, Joint Secretary (Policy), National Health Mission, Government of India, shared insights on India's experience with respect to distribution, operations and decontamination of oxygen concentrators. Oxygen, being a key component of primary respiratory care management, the Government of India devised some innovative ideas to improve nation-wide oxygen delivery.

- The initiative of oxygen response, including oxygen concentrators, was centrally owned and led.**

For bringing critical resource of oxygen closer to the public for management of COVID-19 in rural, peri-urban and tribal areas, the government is distributing 1 lac oxygen concentrators (of 5-10 LPM capacity) all over the country under the PM CARES fund.

- The criteria to allocate oxygen concentrators was applied at various levels**

- From national to state:

- Priority was given to peripheral health facilities (Health and Wellness Centres [HWCs], Community Health Centres [CHCs], Primary Health Centres [PHCs], and Sub-Health Centres [SHCs]) located in the states and districts that were not close to the sources of liquid medical oxygen or in hard-to-access regions, while allocating oxygen concentrators.
 - Oxygen concentrators already supplied to states/union territories through foreign donation and other routes were factored-in and reduced from the total requirement.

- From state to districts:

- The states, in addition to the criteria used by the central government, also used other criteria, like stage of pandemic, test positivity rate, caseload, and resources to further decide allocation to the districts. Oxygen concentrators were first allocated to CHCs, then to PHCs and SHCs.

- From districts to facilities:

- The decision on the number and capacity of oxygen concentrators to be placed in each of these facilities were based on the size and type of the facilities and availability of functional oxygen cylinders.
 - Among facilities, allocation was done based on number of facilities for COVID-19 management, distance and travel time from district hospitals, volume of case load, infrastructure to support oxygen concentrators with uninterrupted power supply, and flexibility to move oxygen concentrators across public health facilities as per need.

- Coordination between various stakeholders is critical**

- Central and state government coordinated on rational distribution of concentrators, consumables, and accessories.
 - Various agencies coordinated to ensure annual maintenance contracts for the supplied oxygen concentrators.
 - Guidelines were established for operation and maintenance of oxygen concentrators.
 - It is also essential to track the transportation once the concentrators are dispatched.

- Use of digital tools to improve monitoring and data-based decision-making**

India's experience of using platforms like OxyCare- Management Information System (OC_MIS) that tracked deployment and functionality of oxygen concentrators from the national to facility levels, demonstrates the capability multiplier effect of technology for healthcare.

Improving Availability of Oxygen Concentrators: Lessons from Rajasthan

Mr. Siddharth Mahajan, Secretary – Medical and Health, Government of Rajasthan, shared the state's experience in improving accessibility and availability of oxygen concentrators. During the second wave of COVID-19, the medical oxygen requirement of Rajasthan increased two-fold. The state government adopted various strategies to maintain adequate oxygen supply to the health facilities. One of these was large-scale procurement of oxygen concentrators.

- **Socio-economic factors assessed during allocation of oxygen concentrators:**
 - It is important to consider social and economic factors while allocating oxygen concentrators such as facility case load and travel costs. It is often not feasible to supply liquid medical oxygen due to cost of transportation and time taken.
 - It is essential to enable access to oxygen in PHCs and CHCs in order to reduce the load on the tertiary health facilities.
- **Procurement of oxygen concentrators: involvement of a reliable procurement agency**
 - It is good to involve a reliable procurement agency to ensure timely supply of equipment.
 - Certain modifications could be made in tender process such as global bidding, simplifying tender process, and advance payments to encourage faster delivery.
 - Periodic quality checks should be done at various levels to avoid future malfunctions.
- **Operation and maintenance of oxygen concentrators: benefits from digital tools and training programs**
 - Use of digital tools such as E-Upkaran (a web-based maintenance application) is beneficial for providing guidelines and training for efficient operation and maintenance of oxygen equipment.
 - This platform is also used to track details of all available oxygen concentrators in the state.
 - The app also manages repair and maintenance which is done by a centralised repair system.
 - Training programs on operational management and decontamination are vital for systematic use of oxygen concentrators.
 - These could be provided via virtual/ e-learning, Skill India, or classroom and practical learning platforms.
 - Strong human resource team by training students from nursing colleges, paramedical staff and also ward boys across the state. ITI instructors and students could also be trained to provide assistance with minor repair and maintenance of oxygen concentrators.
 - The state government is also in touch with vendors and service delivery centres for high-level repair or maintenance.

Lessons on Distribution, Operations, and Sterilization of Oxygen Concentrators after Use

Lessons from Andhra Pradesh

Dr. Vinod Kumar, Project Director, Andhra Pradesh Health Systems Strengthening Project (APHSSP), Government of Andhra Pradesh, shared some insight on sustainable strategies on distribution criteria of oxygen concentrators in Andhra Pradesh. A basic principle followed in the state was building redundancies in oxygen supply.

- **The strategy of building redundancies:**
 - Every facility should have multiple sources of oxygen delivery such that if one or two fail, there still is an uninterrupted supply of life-saving medical oxygen.
 - Placement of oxygen concentrators in a facility with pipeline system would act as an emergency reserve for times with high peak in cases. However, the treatment primarily would be using pipeline system.

- It is essential to keep minimum 8 hours of oxygen backup at every facility, which could be done using D-type cylinders.
- Adequate training is necessary for effective management.
- **Government's focus on providing quality training**
 - The state started to also invest in human resource. Training was provided to all the professionals involved in oxygen delivery in the form of an 8-week long session- "Covinar". It is also essential to provide trainings in native languages, to eliminate linguistic barriers.
 - Recently passed ITI students were also trained who further contributed as human resource assets in the fight against COVID-19.

Oxygen Concentrators in Low-Resource Settings

Dr. Arun K Singh, Professor, Department of Neonatology, AIIMS Jodhpur while sharing some insights on his experience of introduction of oxygen concentrators in low-resource setting of West Bengal, explained the importance of judicious use of oxygen.

- **Oxygen with 100% purity can prove to be toxic to the body, oxygen concentrators can be beneficial**
 - We should be extremely careful while administering pure oxygen, 100% pure oxygen can cause eye damage or even brain damage.
 - Oxygen concentrators provide a purity of 93%-95%, which is good for survival and health of a new born. After increasing the usage of oxygen concentrators, a significant decrease was observed in eye damage or brain damage in newborns.
- **Factors such as uninterrupted power supply should be ensured prior to installing oxygen concentrators:**
 - Additional compressor should be sought from manufacturer as the oxygen concentrators are used 24*7. Other modalities should also arrange for support, in case of lack of power supply. Maintenance is another important aspect for efficient working of oxygen concentrators.
 - Precautions must be taken regarding temperature of oxygen given. Oxygen cylinders provide cold oxygen thereby requiring additional cost to adjust temperature required in low resource setting whereas, oxygen from oxygen concentrators is warm and thus could be directly administered.
- **Home-based ICU care should be encouraged to prevent excessive workload and panic in the hospital settings**
 - Home-based oxygen concentrators should while ensuring daily monitoring by volunteers and provision of appropriate equipment for monitoring. All this should be done under the supervision of a doctor.
 - Decontamination strategies such as:
 - Changing water at least 3 to 4 times a day. If that is not possible, use silver nitrate or home-based vinegar.
 - Tubing must be washed with mild detergent and have an extra piece to replace.
 - General filters must be cleaned.

- For usage of oxygen concentrators in ICU, it is important to engage a person with overall technical knowledge and train them for oxygen concentrators as well, rather than hiring personal with expertise exclusively in oxygen concentrators. This would be beneficial in the long run.

Specifications of a Good Quality Oxygen Concentrator

Mr. Sudhakar Mairpadi, Head – Quality, Regulatory and Government Affairs, Phillips India Limited shared his experiences on overcoming challenges pertaining to installation of oxygen concentrators. India being a country with extreme variations in landscapes and fluctuating power supplies, it is vital to install oxygen concentrators in appropriate settings as oxygen concentrators require uninterrupted access to power.

- Precautions, planning, and preparations for manufacturing, user, as well as procurement domains are essential learnings from the first and second wave. We must learn from the past experiences and produce best-in-class facilities with existing equipment.
- It is a fundamental requirement for oxygen concentrators to comply with specific standards. Manufacturer should adhere to their claims as well as specifications prescribed by international standards such as ISO. One must check with biomedical engineers or officials to ensure if manufacturers are actually sticking to these standards.
- One must use available infrastructure rather than buying individual oxygen concentrators. Many people were buying oxygen concentrators during the second wave merely out of panic, this led to shortage for those who were actually in need. It is necessary to create awareness, take expert's advice, release guidelines to create awareness and address the panic.

Using Oxygen Concentrators for Healthcare at Home

Dr. Gaurav Thukral, Executive Vice President and Chief Operating Officer (Services), HealthCare at Home discussed his experience of running oxygen banks for people during the pandemic.

- There was a lot of fear and uncertainty regarding the availability of oxygen and bed vacancy that led to extensive purchase oxygen concentrators. This extensive purchase came without effective operational knowledge of oxygen concentrators.
- It is extremely important to educate people regarding the use of OC. This could be done with the help of educational videos on effective use of oxygen concentrators, establishment of call centers for troubleshooting issues and appropriate training sessions for public purchasing oxygen concentrators.
- One of the solutions implemented was increasing the number of beds in hospital and hotel facilities, instead of providing individual oxygen concentrators. This ensured effective use, decontamination, and maintenance of oxygen concentrators by trained professionals.
 - One oxygen concentrators could be used for two patients whose oxygen concentration is about 80%-90%
 - Specific service lines were set up for queries on storage, maintenance, trouble shooting, and training was given.
- There are standard operating procedures for operation, repair, and decontamination of oxygen concentrators in a home-based setting. Appropriate training was provided to the family who utilising the oxygen concentrators on the operation and decontamination process. These guidelines were also accessible online.

Conclusion

- Good-quality oxygen concentrators can provide a sustainable and reliable source of oxygen to multiple patients, especially in a low-resource setting.
- Oxygen concentrators are an effective oxygen delivery device in primary care settings, more so in rural areas and geographically inaccessible regions, as shared from the experience of the Government of India and state governments of Rajasthan and Andhra Pradesh.
- Spare parts for oxygen concentrators could be manufactured and procured locally to increase the operability of the devices. Indigenous production of spares that meet global standards needs to be encouraged.
- Standardizing procedures for decontamination of oxygen concentrators, regular maintenance by clinical and technical staff, and training of a wide range of personnel for maintenance of these devices is critical to minimise overdrawing, maintaining optimal performance over time, and ensuring infection prevention.
- While using oxygen concentrators in a home-based setting, it is important to provide appropriate training to the patient's attendant or whoever is handling the oxygen concentrators on the safe use, operation, and decontamination of the device.
- Oxygen concentrators are important medical devices and systematic approaches to ensure their maintenance are vital to reducing COVID-19 mortalities.

Webinar Creatives

Agenda



A circular photograph set against a red background, showing two medical professionals in blue and green scrubs and masks working on a piece of medical equipment, likely an oxygen concentrator, in a clinical setting.

Building Sustainable Medical Oxygen Systems

South Asia Webinar Series

**Oxygen Concentrators : Distribution, Maintenance,
and Decontamination**

16 September, 2021
4:30 PM to 6:00 PM IST (GMT+5:30)

Detailed Agenda

I Welcome and Context Setting

04:30 – 04:40 PM



Mr. Mohammad Ameel

Head – Primary Healthcare, Technology & Innovations, PATH

Keynote Address

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Mr. Vishal Chauhan

Joint Secretary (Policy), National Health Mission,
Government of India

Spotlight Address

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Secretary – Medical and Health, Government of
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Project Director, Andhra Pradesh Health Systems Strengthening Project
(APHSSP), Government of Andhra Pradesh, India



Dr. Arun K Singh

Professor, Department of Neonatology, AIIMS Jodhpur



Mr. Sudhakar Mairpadi

Head – Quality, Regulatory and Government Affairs, Phillips India Limited



Dr. Gaurav Thukral

Executive Vice President and Chief Operating Officer (Services), Healthcare at Home

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05:40 – 05:55 PM

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Summary and Closing Remarks

05:55 – 06:00 PM



Mr. Mohammad Ameel

Head – Primary Healthcare, Technology & Innovations, PATH

Save the Date



Oxygen Concentrators: Distribution, Maintenance & Decontamination

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SAVE THE DATE

The second wave of the coronavirus across India saw the daily demand for medical oxygen rising to nearly 12 times the normal amount. Portable oxygen concentrators quickly became one of the most important supplies required for respiratory therapy.

Join the second webinar of the five-part series, Building Sustainable Medical Oxygen Systems.

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Dr. Gaurav Thukral
Executive Vice President and Chief Operating
Officer (Services), Healthcare at Home



Moderated By
Mr. Mohammad Ameel
Head – Primary Healthcare, Technology &
Innovations, PATH

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