Process Documentation

Oxygen Skill Labs

PATH

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15th Floor, Gopal Das Bhawan
28 Barakhamba Road
New Delhi 110001
www.path.org

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PATH is a global nonprofit dedicated to achieving health equity. With more than 40 years of experience forging multisector partnerships, and with expertise in science, economics, technology, advocacy, and dozens of other specialties, PATH develops and scales up innovative solutions to the world's most pressing health challenges.

Acknowledgements

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Acronyms

BME	Bio Medical Engineer
DHS	Director of Health Services
HEMR	Health Equipment Maintenance and Repair
HFNC	High-Flow Nasal Cannula
HIS	Hospital Information System
IPHL	Integrated Public Health Laboratories
LIMS	Laboratory Information Management System
LMO	Liquid Medical Oxygen
LMS	Learning Management System
MoHFW	Ministry of Health And Family Welfare
MGPS	Medical Gas Pipeline Systems
NCCRC	National Cold Chain Resource Centre
NIHFW	National Institute of Health and Family Welfare
NOSP	National Oxygen Stewardship Program
NRBM	Non-Rebreather Mask
OC	Oxygen Concentrator
OSCE	Objective Structured Clinical Examination
PHI	Public Health Institute
PSA	Pressure Swing Adsorption
SOP	Standard Operative Procedures
TMIS	Training Management Information System
ToT	Training of Trainers
USAID	United States Assistance for International Development

Section 1:

Introduction

COVID-19 proved to be one of the biggest pandemics in global history. Just as the countries were trying to recover from the disaster of its first wave that started in early 2020, the disease came back with an even stronger second wave, leaving the entire world gasping for breath. Medical oxygen, a key factor in treatment of delta variant led COVID-19 , became a scarce commodity in many parts of the world.

In India, many states struggled to produce, procure and supply enough for their hospitals to meet the rising demand. The state of Maharashtra, situated in western India, was one of the worst-hit by the second wave of the COVID-19 pandemic. By August 2021, the state accounted for nearly one of every five of the 32 million cases and around one of every three of the 430,000 COVID-19 related deaths in India. Given the unprecedented scale of spread during the second wave, the state's efforts were inadequate to rapidly scale up its oxygen supplies to meet the spike in demand for medical oxygen in many public health facilities. Thus, as part of its preparations for the anticipated third wave for COVID-19, the state government planned significant improvements in its oxygen infrastructure and started installing various oxygen systems – liquid medical oxygen (LMO), pressure swing adsorption (PSA) oxygen generation plants and oxygen concentrators – across government health facilities, in addition to improving availability of oxygen supply systems through medical gas pipeline systems (MGPS), manifold systems and oxygen cylinders.

Although these oxygen sources helped to bridge the demand-supply gap, the challenge was getting oxygen to the patients. Oxygen therapy for patients is a critical care intervention that requires appropriate knowledge and skills. Despite oxygen therapy being a very old treatment modality, many of these oxygen systems seemed fairly new to the public health system. Except for large teaching hospitals and tertiary healthcare facilities, other public health facilities have historically relied on oxygen cylinders to meet their medical oxygen demands. As a result, there were very few trained personnel in the public health system, especially at district and sub-district level facilities, who understood the complexity of the integration and maintenance of these newly installed oxygen systems and knew how to manage them. Most of the states across the country faced similar challenges.

To overcome this issue, various state governments and central government came up with training strategies, which mainly included virtual and in-person class-room trainings and in some cases practical demonstration of the oxygen systems. Such trainings were necessary for improving knowledge, sharing field experiences, and solving doubts.

At the national level, the Union Health Ministry launched the ‘National Oxygen Stewardship Programme’(NOSP) to empower all healthcare workers engaged in oxygen management and administration with essential knowledge and skills to ensure rational utilization and avoid any wastage of medical oxygen. The program envisaged identifying and training at least one “Oxygen Steward” in each district across the country. These trained professionals would be responsible for leading the training on oxygen therapy and management in their respective districts and also supporting audit of oxygen delivery and preparedness for a surge scenario. PATH, through its Technical Support Units (TSUs) in the six USAID supported NISHTHA states coordinated with NOSP and circulated the guidelines and training materials for the same. Furthermore, the TSUs assisted in the compilation of reports, ensuring that stewards attended the launch and training programs, and improving communication between the state and national governments, as well as between the state government and district administration, in order to facilitate the NOSP.

Additionally, the Ministry of Health and Family Welfare, along with the Ministry of Skill Development and Entrepreneurship also organized 10 hour of training for operators of PSA plants for day-to-day operations, 40 hours of training for Master Trainers and 180 hours of training on trouble shooting of PSA to a considerable number of health care personnel in all states. PATH TSUs supported the state in overall coordination for the training, including the nomination of participants, scheduling, coordinating with districts and the participants, and reporting to the Government of India upon completion of these trainings.

In Maharashtra, the state government built the capacity of BMEs working with the state's health department's Health Equipment Maintenance and Repair (HEMR) division to strengthen the health human resource capacity in oxygen systems.. The BMEs and other technicians of the HEMR division have been involved in managing, operating, and maintaining the vaccine cold chain system. The Public Health Department, in collaboration with the Deputy Director, Health Services (Transport Division), Pune and PATH, organized a training on the oxygen management system for the BMEs and technicians of the HEMR division between June 28, 2021 and July 6, 2021. Thirty-three BMEs were trained in three batches at the National Cold Chain Resource Centre Training Center in Pune, Maharashtra. The training covered technical specifications, installation, commissioning, operation, maintenance, safety. It also included oxygen audit of LMO, PSA oxygen generation plants, oxygen concentrators, oxygen cylinders, MGPS, and manifold systems. After the trainings, the state allocated districts to groups of trained BMEs. The BMEs of the HEMR division are functioning as master trainers and mentors to the district staff of their assigned districts.

Nonetheless, all of these trainings had limitations due to information gaps between theoretical classrooms and real-world equipment. This caused confusion and inefficiency in the management of oxygen equipment in facilities. To bridge the theoretical-practical training gap, the concept of a "oxygen skill lab" was developed, in which trainees can be taught the fundamentals of oxygen management skills in a laboratory or training center

environment before going on to manage the operations of various oxygen systems in the field.

Section 2:

Oxygen Skill Lab

A lab for hands-on training on oxygen equipment

An oxygen skill lab is a environment set up for providing specific skills and hands-on training to personnel working in the oxygen ecosystem, such as technicians, health professionals, service providers, and administrative staff. The training will be imparted for carrying out efficient operations, troubleshooting maintenance, and safe handling of various oxygen systems along with the rational use of oxygen in healthcare settings.

Stations in an oxygen skill lab

Oxygen skill labs will employ an interactive and participatory teaching mechanism for training. Different skill stations are set up to demonstrate clinical and technical oxygen management processes for the trainees' better understanding.. These skill stations can help the trainees learn by practicing skills using mannequins, models, simulation exercises, demonstration videos and presentations.

Following are the skill stations that are commonly set up in an oxygen skill lab:

1. Beds (an ICU bed and an oxygen bed outside ICU) with mannequins for demonstrating oxygen therapy.
2. MGPS with oxygen, suction and vacuum lines
3. Manifold system
4. Oxygen cylinders (as connected with manifold)
5. Models for PSA plants and LMO tanks with its accessories and tools
6. Model for Dura cylinder (or non-working dummy dura cylinder).
7. Oxygen concentrators – 1 functioning and other for cross section
8. Fire extinguishers and other fire safety related tools
9. Oxygen delivery devices (Face mask, Nasal cannula, etc.)

Need for Oxygen Skill Lab and USAID NISHTHA partner PATH's objective for setting up the Skill Lab

As mentioned in the above section, when the oxygen systems were installed across the country during the second wave of COVID-19, there was a dearth of skilled staff to operate and manage these systems. The sporadic virtual and in-person trainings conducted were not enough to fill the gap for skilled healthcare workers completely. Thus, there was a felt need across healthcare fraternity for providing a comprehensive hands-on training to health human resources for efficient operation and maintenance of these newly installed oxygen systems.

In this context, the Director of Health Services (DHS) and Deputy Director of Health Services (Transport Division) of the Public Health Department of Maharashtra, in collaboration with USAID's NISHTHA project partner PATH, decided to set up the first-ever Oxygen Skill Labs in the state. The goal of establishing these skill labs was to provide a laboratory/training center environment in which health professionals could receive theoretical oxygen management training as well as hands-on experience with the entire oxygen ecosystem. .

Services provided at the Oxygen Skill Lab

The oxygen skill lab established under this project will be used for providing both theoretical and practical hands-on training about various oxygen systems and the clinical management of oxygen.

Following is some of the services provided at the lab-

- Training of trainers and supervisors on oxygen systems and oxygen therapy.
- Training of facility-based oxygen system handlers and HEMR technicians and health professionals working in the field of oxygen management including staff nurses, ICU staff, medical officers, biomedical engineers, ITI technicians, oxygen program managers and hospital administration staff on oxygen systems and oxygen therapy
- Training of support staff at the facilities on oxygen systems management and safety related issues, including fire safety.
- Refresher trainings for both the trainers and facility-level staff

"The second wave of COVID-19 saw a drastic increase in oxygen demand, a shortage of hospital beds, and large-scale morbidities and mortalities in the state. It was found that on several occasions, causalities occurred due to lack of trained technicians, who are proficient in operating oxygen cylinders at Community Health Centres or oxygen manifolds at district hospitals. Sometimes even the medical staff/doctors/nurses were not familiar with the oxygen systems and couldn't operate equipments if the trained attendant went off duty. Thus, training of both medical and non-medical staff is absolutely necessary for the effective operation of oxygen systems and the provision of oxygen therapy!"

***-Dr Yogendra Sawai**,*
Professor, State Institute of Health and Family Welfare (SIHFW/PHI), Nagpur, Maharashtra

Beneficiaries of the oxygen skill labs

Oxygen skill labs can be used to impart training to a host of professionals involved in the operations and management of oxygen systems. The likely beneficiaries of oxygen skill labs will include the following –

- Facility based oxygen system handlers
- Health Equipment Maintenance and Repair (HEMR) technicians

- Technicians in the Cold Chain
- Biomedical engineers and supervisors
- Staff involved in maintenance activities of the oxygen systems
- Physicians and staff nurses in the ICU
- Oxygen Program Managers
- Non-technical and administrative staff at the facility such as security guards, fire safety officers, among others.
- Any other individual involved in the operations and maintenance of oxygen systems

Places where oxygen skill labs are being set up

The two skill labs are being established at-

1. The National Cold Chain Resource Centre (NCCRC), Pune, Maharashtra
2. The Public Health Institute (PHI), Nagpur, Maharashtra.

Key stakeholders and their roles

As discussed in previous sections, the two oxygen skill labs currently being developed are in the state of Maharashtra, with the help and support of the state government. The key stakeholders are –

- The Director Health Services (DHS), Deputy Director Health Services (Transport division) of Public Health Department of Maharashtra, and
- USAID's NISHTHA project partner PATH

The state department will extend administrative and infrastructural support along with providing overall guidance and support for establishing these skill labs.

PATH is extending their role in providing technical and financial support for the establishment of the skill lab. PATH will

- Ensure the approvals required from government officials and will support in documentation required for setting up the skill lab
- Guide and explain to the vendor the overall project activity and deliverables along with timelines
- Communicate with the government officers as and when required about project activities and share progress reports
- Supervise the overall progress of the work and hold meetings with the vendor to ensure that the project is completed on time. Ensure that the activity is completed as per the scope of work and requirements of the project

The PATH team is working towards completing the procurement of equipment/accessories, assembling, and setting up a demonstration room, developing the chart/line diagrams/protocols, developing models, renovating space provided, and branding necessities, etc., as per the required specifications. PATH, in collaboration with Public Health Department, will organize trainings for various cadres on the management of oxygen systems at these skill labs.

These skill labs will act as model for other states and also for the country, where the progress and impact results from them could be replicated at the divisional level.

"I would like to extend my sincere thanks to PATH and its team for helping us realize the dream of Oxygen Skill Lab in Pune. Although the state government understood the need for these labs and agreed to the idea of establishing Oxygen Skill Labs in the state, it would not have been possible for us to complete this task without the technical and financial support from PATH. The continuous support of PATH's highly dedicated and competent team was instrumental in the rapid operationalization of the Oxygen Skill Lab in Pune. ."

***-Mr Jayant Muley**,*
Deputy Director, Transport Department,
Pune, Maharashtra

Section 3:

Setting up of Oxygen Skills Labs

The Oxygen Skills Labs will have a set of structured skill stations and classrooms with the objective of imparting competency in skills related to oxygen management systems. As the teaching and training at the Skill Lab will be through interactive learning, they will therefore have a range of infrastructural and human resource requirements.

Components of an Oxygen Skill Lab

The infrastructural and human resource requirements of an Oxygen Skill Lab will include the following-

Infrastructure

- Training Hall: For conducting class room sessions
- Furnitures: Tables, chairs etc
- Medical oxygen sources: PSA, Dura cylinders, LMO tanks, oxygen concentrators, oxygen cylinders
- Medical Gas Pipeline System (MGPS) and Manifold system
- Oxygen delivery devices: to simulate a situation of patient needing oxygen
- Training knowledge resources: Charts, checklists, posters, SOPs
- Audio-visual tools and equipments to conduct trainings
- Hostel accommodation facility for trainees

Human Resource

- Training coordinators
- Trainers pool
- Biomedical engineers
- Oxygen Program Managers
- Service providers of oxygen systems
- Cold chain technicians
- Equipments maintenance and repair staff
- Staff for conducting reporting and other support
- Administrative staff

Infrastructural Specifications

a. Site preparation:

Specifications with respect to site preparation for oxygen lab will include:

- Painting
    - Plastic Emulsion Paint on all Walls - Scrubbing of existing wall paint & providing and applying two coats of Plastic Emulsion Paint – Asian/Nerolac/Burger, of approved color (2 finishing coats) with a brush and a roller finish including scaffolding, cleaning the surface with broom coir sand papering etc., to make the entire surface smooth on walls in skill lab hall.
    - Acrylic Washable Distemper Paint on ceiling - Providing and applying two coats of acrylic washable distemper paint on ceiling of the skill lab hall.
    - White-wash in External corridor walls - Providing and applying two coats of white-wash and white color paint (or already applied color) on walls of corridor, in cutouts area and ceiling of corridor in front of the entrance of skill Lab & classroom.

Colors are to be decided in consensus with the facility head and matched to the existing color codes of the facility.

- Electrical fittings-wiring

Three phase electrical connection is available at both the sites, internal wiring should be extended within the room with appropriate (6) number of electric connection boards (4 sockets of 10 AMP and 1 socket of 15 AMP size in each).

- Lights and fans

6 tube lights and 6 ceiling fans at each site.

- **Furniture:**
    - Tables for arranging the skill lab components- This needs to be decided in consensus with the PATH team and the site owners. The components and materials need to be arranged in the best possible and logical way of training flow and within the space provided by the health department.
      The tables should be of good quality with sturdy material that can hold the weight of the material and have good finishing. The material used should be of plywood sheets of 18 mm, covered with sun mica sheets of 1 mm with wooden frame (timber or equivalent).
    - Chairs/benches for seating of trainees and trainers

b. Oxygen system specifications:

- Beds with mannequins for oxygen therapy demonstration (2 beds)
    - An ICU bed with bed head panel with outlets for oxygen, suction, vacuum; different stands and dummy equipment – this is to simulate an ICU situation for connecting various lines and equipment.
        - ICU Bed (3 function) with manually operated - back rest 0-75º, knee rest 0-35°

        - Size: L 2030mm × W 900mm × H 550-750mm (adjustable height).
        - ABS removable & interchangeable head and foot panel, with safety lock and roller bumpers.
        - Epoxy coated mild steel framework and 4 section mattress platform made up of CRCA M.S. Sheet
        - Provision for I.V. Rod on four locations.
        - Collapsible Side Rails on each side, which are safe and reliable
        - 125mm diameter castors with diagonal locking
        - Protective corner bumpers
    - An oxygen bed (outside ICU), with oxygen outlets (4 different types) – this is to demonstrate connections on the oxygen bed with different types of connectors.
        - Fowler bed with tubular head and foot bows of unequal height.
        - Size: L 2060mm × W 900mm × H 600mm
        - Back rest 0-75º, Knee rest 0-35°
        - Epoxy coated mild steel structure with 4 section mattress platform made up of CRCA M.S. Sheet.
        - 2 separate crank mechanisms for back rest and knee rest respectively.
        - Provision for I.V. Rod on four locations.
        - Legs fitted with PVC stumps.
    - Pulse oximeter devices
    - Various delivery devices (masks, tubes, HFNC) with both these beds for oxygen therapy demonstration on mannequin and its accessories with different types of regulators and flow meters, humidifiers, flow splitters etc.
        - High flow o2 therapy equipment, multi para monitor, pulse oximeter, nasal canula-5, catheter-5, NIV mask-5, spirometer-1

- MGPS with oxygen, suction, and vacuum lines

MGPS with different sizes of pipes to demonstrate- standards of pipes, principles of setting up MGPS (deciding sizes, beds, brazing, connections), pressure drop issues and maintenance and trouble shooting and safety precautions. Suction and vacuum lines with pumps are needed to demonstrate its set up and functioning.

- Medical Grade Copper pipe with EN ISO 7396-1 standard with 3rd party lyods/DNV certification (O2, vacuum, medical air, surgical air, nitrous oxide/CO2).
- Accessories- 24-volt DC Alarm System, Saddles, SS316 pressure gauges (4 inch- Wika/Baumer), vacuum gauge (4 inch), Isolation Valves with Pipe Color Coding As per EN ISO 7396-1standard & copper pipe & copper accessories shall comply with EN 13348 standard.

- Manifold system (2 manifolds)
    - One regular manifold 2x2 size (including Copper Flexible Tail Pipes, NRV, Automatic Control Panel and Isolation Valve etc. complete & With Cylinder Mounting Bracket and chaining arrangement)

- One emergency manifold 1x1 size (including Double Gage Double Stage regulator, NRV, SS double braided Flexible hose Pipe with 300 bar working pressure, SS/brass Isolation ball Valve etc Complete with fittings for 300 bar rating)

- Oxygen cylinders (as connected with manifold) –
  - Oxygen, NO2 cylinder Jumbo Cylinders (D Type)- 4
    - Refillable cylinders with ability to attach with flowmeter, with water capacity 46.7 lits, gas capacity 7.1 CuM, pressure 150 bargs, with ISI mark, With Explosive safety certificate for each cylinder, compressed gas association (CGA) approved material (certificate should be submitted). Capable of being stored in ambient temperature of at least 5-50 degree C, Relative humidity of at least 15-95% non-condensing, to be supplied with 10 keys for cylinder operations
    - With standardized colour coding according to ISO/ANSI/CGA/NFPA, ISO/US
    - If the cylinder is manufactured from outside India thread size must be suitable for Indian flow meters and manifolds

  - B Type Cylinders- 2
    - Refillable cylinder with ability to attach with flowmeter, with water capacity 10.2 litres, gas capacity 1.5 CuM, pressure 150 bargs, with ISI mark, With Explosive safety certificate for each cylinder, compressed gas association (CGA) approved material (certificate should be submitted). Capable of being stored in ambient temperature of at least 5-50 degree C, Relative humidity of at least 15-95% non-condensing, to be supplied with 10 keys for cylinder operations,
    - With standardized colour coding according to ISO/ANSI/CGA/NFPA, ISO/US
    - If the cylinder is manufactured from outside India thread size must be suitable for Indian flow meters and manifolds
  - Combine Spanner set - 6
  - Cylinder trolley- 2
  - Double Gage Double Stage regulator, single Gage single Stage regulator, FA valve with flow meters, humidifiers, PVC pipes/ tubes- 2 each

- Models for PSA plants and LMO tanks with its accessories and tools

- Model for Dura cylinder (or non-working dura from somewhere)
  - Dura Cylinder with vaporizer
  - Water Capacity – Min 200 (litres) and Max 250 (liters) with Pressure Rating of Min 17 Barg – Max 23 Barg. NER (% of Capacity/Day) – Max 1.4, Gas Withdrawal Capacity–35 Sm^3/Hr, with 2 PRV and 2 BD Relief Devices. Warranty of 12

months, Vacuum Warranty of 36 months. Design Code Compliance - DOT/ASME/PESO/GCR/ EN/CGA. Material (Inner Shell + Outer Shell) - SS304 with PB Circuit (Pressure Building + Vaporizer + Economizer), with Trolley on wheels and Lifting Hooks for Chain Block for handling.

- Along with mandatory accessories -
  - Inlet & Outlet End-Connections as per CGA LOX Std (India)
  - Flexible SS wire-braided hose-connections
  - Commissioning Spares
  - 3-years Capital Spares
  - Decals/Hazchems as per CGA LOX Std

- Oxygen concentrators - 2 concentrators (5 and 10 LPM Each)- 1 functioning and other for cross section
  - Sound level <50 dB, Superior grade of lithium-based zeolite sieve, Maintenance free valve
  - Oxygen purity: 90% (approx.),
  - Pressure: 8 psi (approx.),
  - Double/Single outlet for oxygen delivery, Oxygen tube of 2m length must be provided with facility for nebulization with tube & mask, With one humidifier bottle and one cabinet filter.
  - The equipment should function with 200-240Vac, 50 Hz input power supply, it should have safety certificate from a competent authority CE/FDA (US)/STQCCB certificate /STQCS Certificate or valid detailed electrical functional test report from ERTL.
  - Each equipment should bear sr. no. of product / sr. no. as per manufacturer's protocol and nomenclature
  - The equipment should be factory calibrated and calibration certificate should be submitted along with each equipment
  - All additional spares & consumables like humidifier, bottles, nasal cannulas, etc. should be a part of the supply.

- Fire extinguishers and other fire safety related tools

- Adult Mannequin for Airway Management
  - Feature to demonstrate opening of airway, head tilt/chin lift and /or jaw thrust technique.
  - Removable, reusable faces.
  - Different types of masks – 2 sets (Nasal prongs, Nasal masks, NRBM Masks, NIV Masks, Venturi masks) and 1 ambu bag - with each mannequin
  - Additional accessories:
    - 6 reusable manikin faces
    - 6 airways

        - 50 manikins' wipes

- Personnel Protective Equipments

c. Training resources:

Along with these components, the lab can use learning aids (in appropriate language) like–

- Fixed printed charts, posters, and display boards for
    - Demonstrating functioning, standards etc.
    - Safety precautions along with dos and don'ts
    - Inventory management calculations
    - Duties of staff related to maintenance of oxygen equipment
    - Oxygen gas cylinder rules 2016
    - Troubleshooting and maintenance of oxygen equipment
    - Audit tools

- Reference books and learning material- Book- ISO 7396, HTM 02, PESO books, Indian Pharmacopeia 2018 (IP 2018), Guidebook on medical oxygen management system guidelines and training material, other relevant training material, and books published by PATH on oxygen management

- Audio-visual presentation device for playing training videos- 1 computer along with projector, speakers, and screen

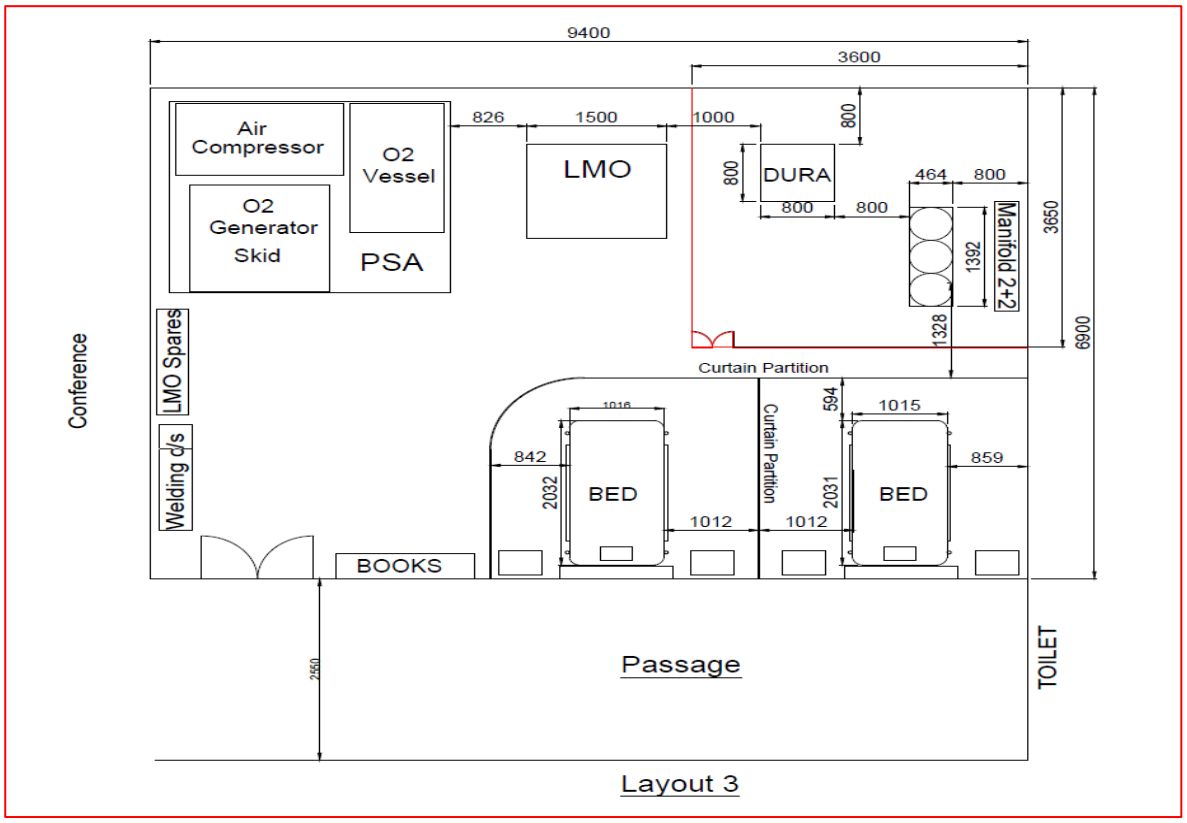
Setting up of infrastructure for training

- Ensure installation of functional MGPS, manifold, oxygen delivery devices along with oxygen flow until the 2 beds and mannequins in the skill lab
- Ensure functioning of the vacuum, suction, medical air gas pipelines along with its necessary pumps/systems for demonstration
- Set up all the display boards for models, oxygen system components along with cross sections of MGPS and various tools for operations-maintenance and trouble shooting
- Print and set up charts/posters, etc. on operations, maintenance, troubleshooting, fire-electrical safety, inventory management, etc. All these charts will be printed, framed with glass covering and set up in the lab.
    - 9 posters – 3x2 feet
    - 2 posters – 6x4 feet
- Set up the reference book and audio-visual library along with aids for audio-visual projection.
- Ensure that all systems are functional by dry run and demonstrating it to PATH team and Government officers.

Layout of the skill labs

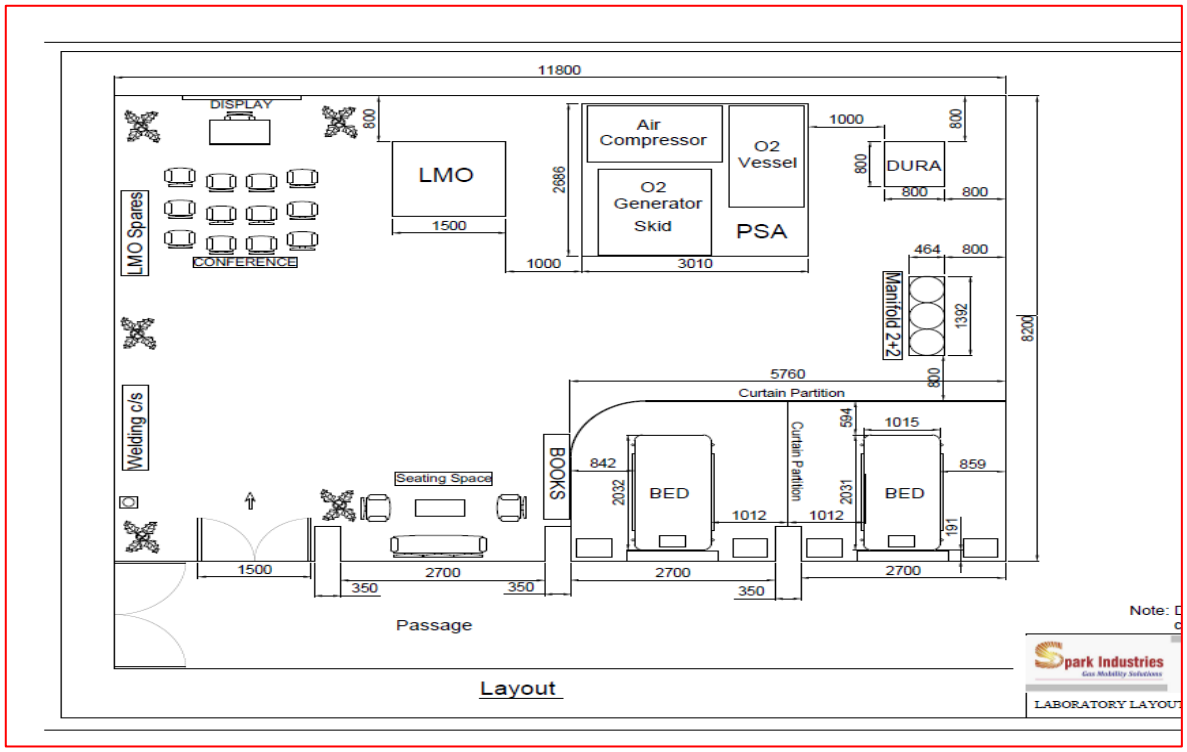
Below are the spatial layouts of the two skill labs currently being established.

1. **Layout of Oxygen Skill Lab at Nagpur**



Layout: SIHFW (PHI) Nagpur

2. **Layout of Oxygen Skill Lab at Pune**



Layout: NCCRC Pune

Current Status of the Oxygen Skills Labs

The two sites at which the oxygen skill labs are being established in Maharashtra are the National Cold Chain Resource Centre (NCCRC) Pune, and the Public Health Institute (PHI), Nagpur. The infrastructure and civil work are almost complete at both the sites. The procurement of oxygen equipment is also nearly done. At both skill labs, the first batch of supervisors is recruited and trained.. Recruitment of other cadres, such as oxygen equipment technicians are underway. The training plan, the training calendar, and the required training resources and tools, such as training modules, charts, posters, guidebooks, standard operative procedure (SOPs), checklists are all ready to be used and circulated among the trainees. It is estimated, at the time of writing this document, that within one month both skill labs will be entirely ready to start their operations imparting the required oxygen training to the participants.

Glimpse of current work at Oxygen Skill Lab at PHI Nagpur, Maharashtra

Glimpse of current work at Oxygen Skill Lab at NCCRC Pune, Maharashtra

Digital database related requirements

In addition to the above-mentioned infrastructure and human resource requirement, the Oxygen Skill Labs will also need a digital platform or software capable of capturing the data generated at the Oxygen Skill Labs. The database can be used to document the data points related to both the trainees and the trainers and can include areas such as -

- Details of trainees, including names, contact details, their qualifications, number, and details of training sessions attended, number and details of training sessions left, their training schedules, training load, competency and proficiency status
- Details of trainers, such as names, contact details, their qualifications, areas of expertise, and number and details of the training sessions conducted, number and details of sessions left, details of own orientation and reorientation sessions, mentoring visits etc.

The National Institute of Health and Family Welfare (NIHFW) has a digital platform known as Training Management Information System (TMIS), which is currently used by the Government of Maharashtra to collate the training data, such as how many people have been trained, how many training sessions they attended , training batch details- names and contact details, number of trainers currently available, their cadres, batches pending for trainings etc. However, the system doesn't have provisions to capture many areas, such as those related to mentoring and supervisory visits of trainers. Also, details about the equipment procurement and management at the Oxygen Skill Labs and other inventory and

logistics data cannot be captured using this software. Thus, for comprehensive data collation, management and analysis the skill lab will need a separate database along with TMIS.

Oxygen skill labs can have two integrated computer-based information management systems, similar to the data management system of the Integrated Public Health Laboratories (IPHL) network. The IPHL network uses two types of Laboratory Information Management System (LIMS), (1) a module within a Hospital Information System (HIS) and (2) a stand-alone LIMS. A LIMS within HIS serves mostly as a means to capture results and a few key elements of data. The second system—a dedicated LIMS—shares a larger range of components and can support all the laboratory functions.
Similarly, the oxygen skill labs can also have a separate MIS for capturing a few specific data points related to training and logistics management as their in-house data management system, along with uploading the broader and more common training data points using the TMIS. This way, the skill labs will have a more accurate, comprehensive, and integrated information system which can help in improved data analysis and management across regions.

As a backup, the skill labs may also choose to keep paper-based records (in case a computerized information system is not available) to prevent any possible loss of data. Further, the skill labs should have a documented procedure for capturing data and uploading it on the MIS for standardization and uniformity.

Section 4:

Training at Oxygen Skill Labs

The Oxygen Skill Labs can be used to provide training to different cadres of professionals working in the oxygen ecosystem.

Trainers and Supervisors

First and foremost, the objective of setting up a skill lab is to train and develop a pool of master trainers who can impart training to others working in oxygen ecosystem. These master trainers can be service providers, biomedical engineers, and cold chain technicians working in the oxygen ecosystem. They are trained using Training of Trainers (ToT) sessions and are skilled in the operation and maintenance of different types of oxygen system, the rational use of oxygen, troubleshooting, among others.

Apart from training other healthcare service providers, these trainers will undertake supervisory and mentoring visits to the facilities to assess the skills of the trainees and provide the necessary support.

Training duration and calendar

At present, the training is planned to be a two day residential program where trainees will have half a day of classroom sessions and one and-half days of demonstrations and hands-on exercises. One trainer will be assigned to train at least four trainees. There will be a provision of training for both the trainers and the trainees to provide them with an opportunity to refresh their knowledge and skills, and stay up to date with newer developments.

The Oxygen Skill Lab in Pune, Maharashtra anticipates training at least 200 oxygen equipment operators in its first batch. A total of 50-60 batches with 15-16 people in each batch are estimated to be trained at these Oxygen Skill Labs.

Training content and methodology

It is planned to provide training on a wide variety of issues related to oxygen systems, their operation, maintenance and repair, using relevant training tools and aids. There will be four training modules that will be used for imparting training to the three broad categories of trainees-medical staff, program managers, and technicians and oxygen device operators.

1. **Module on Basics for Medical Oxygen Management System** have been designed to orient various stakeholders on the oxygen ecosystem (sources, supply, safety, maintenance, operations, costing, specifications, conversion factor, vendor landscaping, among others). It can be delivered in a day-long session and the recipients of this module will include technicians, medical personnel, and oxygen program managers at national, state and district levels.
2. **Module on Rational and Hygienic Use of Oxygen** is a one-day training session designed for key personnel in hubs and spokes who handle and operate various oxygen

equipment in the facility.. The trainees will include medical professionals, technicians/engineers and oxygen program managers. This training will provide the trainees with all the essential information on devices for oxygen therapy and the process of optimal oxygen delivery to patients.

3. **Module on Operations and Maintenance of Oxygen Equipment** is intended for biomedical engineers and master trainers who are responsible for training oxygen equipment operators. The module covers content on oxygen cylinders, oxygen concentrators, liquid medical oxygen, medical gas pipeline systems, PSA plants, other oxygen equipment, and medical oxygen handling and safety. It can be delivered in three days or in smaller modules over three days.
4. **Module on Quality Testing Protocols** is a day-long module designed to familiarize various stakeholders with quality testing protocols. The end recipients of this module will include, but not be limited to, oxygen program managers at state or district levels, and biomedical engineers..

All learning resource packages include session-specific presentation decks and facilitator guides to assist trainers in planning their sessions.. The package also consists of participant handouts, pre- and post-tests, training simulation exercises, on-site visits and various demonstrations on oxygen equipment. It also includes additional reference materials which includes SOPs, checklists, Guidelines, DO letters, Guidebook, posters, and a toolkit for assessment etc. The content developed is available in English, however subject matter expert can also deliver it in regional language, provided they are conversant in it. The modules are technically reviewed by PATH's team of engineers, master trainers and state leads, and has been shared with external experts from renowned institutes, such as AIIMS WHOCCET, AIIMS Rishikesh, among others.. Depending on the training objective, these modules can be further customized as per the requirements of the Oxygen Skill Lab curriculum .

The modules are designed to ensure effective knowledge transfer to trainees on suggested topics, and they are supplemented with practical training and mentoring sessions to ensure skill transfer from practicing subject matter experts..

Following are some of the training tools used for providing practical and hands-on training on the topics mentioned above:

- Medical oxygen sources: setting up and functioning of various systems such as PSA plants, Dura cylinders, LMO tanks, oxygen concentrators, oxygen cylinders needed to provide oxygen therapy.
- Medical Gas Pipeline System (MGPS): Installation, Extension and Maintenance of MGPS. Using a model (demonstration of MGPS fitting on wall with bed side outlet), different sizes and types of pipes, fittings, and fixtures.
- Manifold system: One regular manifold (2x2 size) and one emergency manifold (1x1 size) with auto control panel to demonstrate its functioning, emergency situations, auto switchover, cylinder changing, etc.

- Oxygen therapy: administration of oxygen therapy and devices for the same, simulating a situation of a patient (mannequin) needing oxygen and using various oxygen delivery devices.
- Preventive maintenance and troubleshooting: through using charts, checklists, spares and tools.
- Fire and Safety: Charts, posters and audio-visual simulation.
- Oxygen calculation and inventory management: Charts, posters and Audio-visual simulation.

"In addition to providing on-site training and distributing learning resources to the trainees, we must develop a comprehensive online knowledge platform that can function as a knowledge repository for all oxygen systems related resources. The portal should be made accessible to all. It willprove to be immensely helpful as a ready reference for people managing and operating oxygen systems or for anyone who is interested in gaining or refreshing their knowledge about the oxygen ecosystem."

***-Mr Yogesh Bhamre**,*
Coordinator and Team Lead,
National Cold Chain Resource Centre (NCCRC)
Pune, Maharashtra

Section 5:

Monitoring, Evaluation and Certification

As with every training, it is imperative to have a monitoring and evaluation mechanism established for trainings conducted at Oxygen Skill Labs as well. The performance of trainees needs to be evaluated using well defined and quantifiable parameters in order to assess the training impact. Currently the processes that are followed for monitoring and assessment at these labs include-

- **Pre- and post-tests:** All trainees are given a pre-training questionnaire to assess the level of their knowledge before the start of the sessions. Their marks for the same are recorded. Then, after the completion of all the training sessions another questionnaire is provided as a post-training test related to what they learned in their training course. Such assessments can help in looking at the difference in their learning statuses and the extent of knowledge gained post session.
- **Objective Structured Clinical Examination (OSCE):** Training assessments are also planned to be done using OSCE formats used in clinical settings. In the OSCE training components are assessed in a planned or structured way, with attention being paid to the objectivity of the examination which is basically an organizational framework consisting of multiple stations around which participants rotate and at which participants perform and are assessed on specific tasks. Participants who lack skills and knowledge are then planned to be re-trained by their trainers until they become competent and skilled in that particular task.
- **Supervisory and mentoring visits:** After participants have completed their trainings, they are to be sent to their duty stations at the health facilities. The supervisors will then make visits to these facilities to observe and assess the trainees skills and knowledge as they perform their duties. Any lacunae observed will then be noted, and necessary trainings and handholding will be provided to the trainees.

The aim of the training evaluation mechanisms is to help trainees overcome their gaps in knowledge and skills and support them in performing their responsibilities competently and efficiently. The plan is to impart trainings to two batches every week, training being provided for the first three weeks and the fourth week will be kept for mentoring visits to their duty stations. Thus, a total of six batches will be trained in one month. Every three months a video conference can be done to re-orient them, and every six months refresher or re-orientation training can be scheduled in-person. With the experience of the first few batches, the assessment processes can be further modified to suit the monitoring and evaluation requirements.

Certification of the trainees

At present, the plan is to issue training completion certificates to all participants who attend the Oxygen Skill Lab trainings. PHI and NCCRC will give these certificates to the trainees. Certificates will also be provided to all the trainers who attend the TOTs.

Section 6:

Potential challenges and their mitigation

As the oxygen skill labs are still getting established, it is too early to assess and document all the challenges that these labs can and will face when they become fully functional. Nonetheless, the early experiences suggest a few potential challenges that can come in the way of operationalizing these skill labs, along with their possible mitigation mechanism.

- Administrative and bureaucratic hurdles can arise in getting consent and approvals from the state government and its departments for establishing these skill labs. These can be addressed by establishing an efficient coordination mechanism for sensitizing government officials about the concept and project details. All relevant documentation required at every step of the approval process must also be completed diligently by the project team.

- Infrastructural issues can occur in getting a space with required area and operational needs, for establishment of these labs. On some occasions, it was seen that the skill labs had to be shifted to another place due to some civil or electrical issues at the existing space. To avoid such inconvenience, detailed site assessments must be conducted before the site is finalized using a standard pre-site assessment tool. The tool must be developed to cover all relevant areas or infrastructural prerequisites of an oxygen skill lab site.

- Issues with the sustainability of the trainings can arise due to a lack of adequate trainers, trainees, and/or updated teaching materials. To address this challenge proper plan should be put in place for regular recruitment and training of trainers. The training materials used for teaching should be regularly updated using a feedback mechanism specifically designed for the purpose of course evaluation and revision.

- Financial issues can pose challenges if appropriate funds are not channelized in time for smooth operation of labs and continuous management of infrastructure and human resource requirements. A part of the project team must be specifically dedicated and focused on addressing any current or future financial crises and roadblocks. A robust financial plan should be developed for maintaining efficient stakeholder coordination and streamlining the flow of funds for the project to avoid and mitigate any financial challenges.

Section 7:

Conclusion

COVID-19 made us realize the importance of having skilled and competent human resource for providing oxygen therapy and management, especially in times of crisis. According to past experiences, the trainings and capacity-building efforts have fallen short of providing trainees with a practical environment, which can make a significant difference in their performance. In response to this challenge, an oxygen skills lab can prove to be a better and more viable option for developing the capacities of health human resources. They can be a one-stop destination for learning about all types of oxygen systems available, that can be used and updated as the newer ones come along. Like other skill labs in the country, oxygen skill labs, will help in building a cadre of skilled professionals who are trained in a specialized domain, i.e., oxygen systems, and who can be channelized and leveraged whenever a need for their special skills arise. Thus, in addition to improving the operation of existing oxygen systems, the oxygen skill labs are intended to emerge as an effective, scalable, and sustainable method of developing competencies in health human resources capable of handling oxygen equipment and effectively providing oxygen therapy, thereby assisting the country in future preparedness for any unforeseen crises such as natural disasters.

As the establishment and operation of these skill labs is fairly new and still in the nascent stages, the experiences of the two skill labs in Maharashtra can prove to be extremely vital in understanding their impact, challenges and the upgradation needed for their betterment.

"In addition to these physical Oxygen Skill Labs, Mobile Oxygen Skill Lab could be explored. These mobile skill labs can cater to the needs of hard-to-reach areas by providing training, re-orientation, and handholding through the trainers. Such a skill lab will be especially helpful for the 4 tribal districts and blocks in the state."

***- Dr Yogendra Sawai**,*
Professor, State Institute of Health and Family Welfare(SIHFW/PHI),
Nagpur, Maharashtra