

Standard Operating Procedures

on

Use of Oxygen Concentrator at Health and Wellness Centre (HWC) for Management of Hypoxia

CONTENTS

ABBREVIATIONS.....	3
INTRODUCTION.....	4
PURPOSE AND USE OF OXYGEN CONCENTRATOR.....	4
WHY IS OXYGEN THERAPY REQUIRED?.....	5
HOW TO DIAGNOSE LOW LEVELS OF OXYGEN?	7
CLINICAL CONDITIONS REQUIRING OXYGEN THERAPY.....	7
INDICATIONS FOR PLACING PATIENTS ON OXYGEN CONCENTRATOR	10
USE OF OXYGEN CONCENTRATOR AT HWC	10
IMPORTANT CONSIDERATIONS TO BE TAKEN WHILE USING OXYGEN CONCENTRATOR	12
REFERENCES	13
ANNEXURE	14

ABBREVIATIONS

COPD	Chronic Obstructive Pulmonary Disease
COVID 19	Coronavirus Disease 2019
HWC	Health and Wellness Centre
LPM	Litre Per Minute
MGPS	Medical Gas Pipeline System
OC	Oxygen Concentrator
PHC	Primary Health Centre
PM- CARES	The Prime Minister's Citizen Assistance and Relief in Emergency
PSA	Pressure Swing Adsorption
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SC	Sub-Centre
SOP	Standard Operating Procedures
SpO ₂	Oxygen Saturation in Blood

INTRODUCTION

During the coronavirus disease 2019 (COVID-19) pandemic, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus infected patient's respiratory systems, causing a drop in blood oxygen levels and shortness of breath. As the infection level in the community soared and demand for medical oxygen increased, patients sought oxygen therapy from nearby hospitals and healthcare centres, resulting in dwindling oxygen supplies. The Government of India revised its in-patient strategies for tertiary care hospitals and medical colleges by admitting patients with severe symptoms only, and in line with the guidelines of the World Health Organization (WHO), the government advised patients with mild to moderate symptoms to isolate at home or Primary Health Centre (PHC) and Health and Wellness Centre (HWC). The government swiftly stepped up and implemented a series of measures to support patients requiring oxygen. One of the many measures includes establishing oxygen concentrators (OCs) at peripheral healthcare facilities such as HWC, Sub-Centre (SC), and PHC. Under the Prime Minister's Citizen Assistance and Relief in Emergency (PM-CARES), approximately one lakh OCs have been distributed to states/union territories as per the Ministry of Health and Family Welfare distribution plan. The pandemic led to an unprecedented surge in demand for oxygen supply, given its crucial role in treating COVID-19 patients however it emerged that oxygen is also an essential element of basic emergency care required for surgery and the treatment of several respiratory diseases, both chronic and acute. This Standard Operating Procedure (SOP) documents the usability of oxygen concentrators at the HWCs required in medical conditions beyond COVID-19.

Purpose of the SOP

The document, titled "Use of Oxygen Concentrator at Health and Wellness Centre (HWC) for Management of Hypoxia", details the purpose and use of an OC at a HWC. The SOP covers multiple components including purpose and use of an OC, need for oxygen therapy, diagnosing low levels of oxygen, clinical conditions requiring oxygen therapy, indications for placing patients on an OC, use of OC at HWC, transferring patients from HWC to higher centres and important considerations to be taken while handling OCs, etc.

The SOP intends to bridge the knowledge gap among health care facility staff by providing in-depth information on the usability of OC beyond COVID-19.

PURPOSE AND USE OF OXYGEN CONCENTRATOR

Globally, patients with mild to moderate long-term respiratory distress are primarily treated at home. These home-based patients require continuous oxygen supply for extended periods. To assist these home-based patients, oxygen through OCs is an important early-stage intervention to reverse hypoxia.

An OC, as the name implies, concentrates oxygen from ambient air by selectively removing nitrogen, thereby supplying oxygen to patients that suffer from respiratory or breathing-related disorders. OCs filter surrounding air, compressing it to the required density and then delivering purified medical grade oxygen into a pulse-dose delivery system or continuous stream system to the patient. It is also

equipped with special filters and sieve beds which help remove nitrogen from the air to ensure the delivery of completely purified oxygen to the patient. These devices also come with an electronic user interface to adjust the levels of oxygen concentration and delivery settings. Patients access oxygen provided through the concentrator by a cannula and oxygen mask.

There are different types of OCs based on transferability such as stationary and portable; flow - continuous and pulse mode; capacity – 5 litres (L), 8L, and 10L.

An OC is used as a preferred method for oxygen therapy at home and in health facilities where the requirement for oxygen is for a shorter duration and limited quantities. OCs provide a sustainable and cost-effective source of medical oxygen to health facilities in developing countries and similar settings, especially where cylinders and piped systems are inappropriate or unavailable.

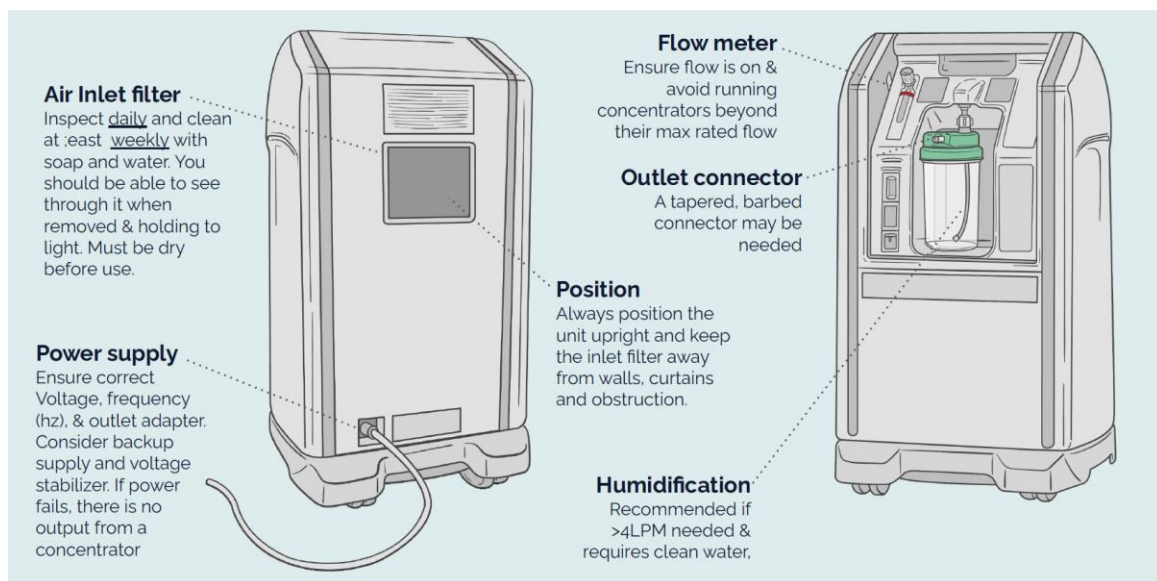





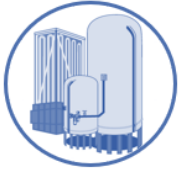
Figure 1: Components of an OC

WHY IS OXYGEN THERAPY REQUIRED?

Oxygen therapy is an essential component of medical care. Oxygen therapy or supplemental oxygen is the provision of medical oxygen as a healthcare intervention to patients whose oxygen concentration in their blood is lower than normal level caused by disease, trauma, or other health conditions. Oxygen is an essential element of basic emergency care required for surgery and the treatment of several respiratory diseases, both chronic and acute. Respiratory distress including COVID-19 can lead to hypoxemia in patients, a condition when the oxygen level in the blood is abnormally low. In such a condition, a patient requires oxygen therapy and access to quality-assured medical oxygen. Oxygen therapy can be used for a short period, a long time, or even a lifetime for low oxygen blood levels.

Oxygen therapy is required at various levels of health care facilities across all levels including SC, PHC, community health centres, district hospitals, tertiary care hospitals, and medical colleges. Different types of medical devices are used to deliver oxygen to patients at different levels of the health care

system, for example, at a HWC, OCs are available to deliver oxygen; at a PHC, two sources of oxygen are available such as OC and oxygen cylinder; and similarly at the district level or above, multiple sources of oxygen are available such as OCs, oxygen cylinders, pressure swing adsorption (PSA)/vacuum swing adsorption (VSA) plants, medical gas pipeline system (MGPS), and liquid medical oxygen tanks.

Type of Sources	Oxygen Concentrator	Oxygen Cylinder	Pressure Swing Adsorption Plant	Liquid Medical Oxygen Tank
				
Level of Health System	Primary, secondary, possibly tertiary (any medical unit requiring oxygen)	Primary, secondary, possibly tertiary (any medical unit requiring oxygen)	Secondary and tertiary	Secondary and tertiary

The conditions requiring oxygen therapy are listed below:

Hypoxia

Hypoxia is defined by a reduced level of tissue oxygenation and can be due to either defective delivery or defective utilization of oxygen by the tissues.

Symptoms: The most common symptoms are coughing, wheezing, increased heart rate, increased respiratory rate, headache, and bluish colour in the skin, lips, or fingernails (called cyanosis).


In severe cases, it might even cause fainting, seizures, confusion, difficulty speaking, temporary memory loss, difficulty moving, and coma.

Causes: Lung disease, asthma attacks, heart problems, anaemia, and COVID-19.

Dyspnea

Dyspnea is the medical term used for shortness of breath.

Symptoms: The most common symptoms are cough, dizziness, fainting, fatigue, and heart palpitations.



Not having enough blood oxygen levels results in inadequate oxygen supply to the organs and other structures of the body. If left untreated for a long time, it can end up damaging the brain or heart.

Causes: The most common causes are anxiety, chest pain, chest tightness, high altitude with low oxygen levels, aerobic exercise or intense physical activity, obesity, and poor cardiovascular fitness.

HOW TO DIAGNOSE LOW LEVELS OF OXYGEN AT HWC?

- ▶ Oxygen saturation (SpO₂) can be checked by pulse oximetry, a non-invasive test used for measuring oxygen saturation, or the percentage of haemoglobin saturated with oxygen in the blood. It measures SpO₂ using a device called pulse oximeter that is attached to a fingertip. Normal value falls between 94 and 100 percent.
- ▶ Evaluation for P/F ration of hypoxemia.
- ▶ Check for other vital signs like pulse rate, blood pressure, temperature, and respiratory rate.



CLINICAL CONDITIONS REQUIRING OXYGEN THERAPY

Oxygen therapy can be used for acute conditions as well as chronic conditions. Acute conditions normally run for a short period and usually require short-term oxygen therapy. They may have a sudden onset of symptoms versus chronic conditions where things occur gradually. However, some respiratory or chronic conditions require long-term oxygen supplementation. The table below represents the clinical parameters where supplemental oxygen is required:

- ▶ Critical illness requires high levels of supplemental oxygen
- ▶ Serious illnesses requiring moderate levels of supplemental oxygen if the patient is hypoxemic
- ▶ Conditions for which patients should be monitored closely but oxygen therapy is not required unless the patient is hypoxemia
- ▶ Chronic Obstructive Pulmonary Disease (COPD) and other conditions requiring controlled or low-dose oxygen therapy

Type of Illness	Medical Condition	Type of Medical Condition (Acute/Chronic)	Required Oxygen Flow Rate	Type of Oxygen Source to be Used
Critical	Cardiac arrest or resuscitation*	Acute	The initial oxygen therapy is a reservoir mask at 15 litres/min (LPM) pending	Oxygen cylinder or PSA

	Shock	Acute	the availability of reliable oximetry readings.	
	Sepsis	Acute		
	Anaphylaxis	Acute	For patients with spontaneous circulation and a reliable oximetry reading, it may quickly become possible to reduce the oxygen dose while maintaining a target saturation range of 94%–98%.	
	Pulmonary Haemorrhage	Acute		
	Status epilepticus	Acute		
	Emphysema	Acute		
	Major head injury	Acute		
	Carbon monoxide poisoning	Acute	<i>In critical illness deliver oxygen with devices providing highest FiO2 and then increase or decrease FiO2 according to saturation and clinical condition of the patient.</i>	
	Snake bite with respiratory failure	Acute		
	Trauma with excessive blood loss	Acute		
	Chest injuries	Acute		
Serious	Acute hypoxemia	Acute	The initial oxygen therapy is a nasal cannula at 2–6 LPM (preferably) or a simple face mask at 5–10 LPM unless stated otherwise.	Oxygen concentrator if oxygen therapy required is <= 10 LPM, if > 10 LPM is required switch to oxygen cylinder
	Asthma	Acute/Chronic		
	Pneumonia	Acute		
	Lung cancer	Chronic		
	Lung fibrosis	Chronic	Maintain the recommended target saturation range of 94%–98%.	
	Pneumothorax	Chronic		
	Pleural effusions	Acute		
	Pulmonary embolism	Acute		
	Pulmonary fibrosis	Chronic		
	Acute respiratory distress syndrome	Acute		
	Pulmonary hypertension	Chronic		
	Acute heart failure	Acute		
	Severe anaemia	Chronic		

	Post operative breathlessness	Acute		
Close monitoring (Oxygen therapy is not required unless patient is hypoxemic)	Myocardial infarction	Acute	If hypoxemic, the initial oxygen therapy is nasal cannula at 2–6 L/min or simple face mask at 5–10 LPM and if not maintaining saturation use reservoir bag mask. Maintain the recommended target saturation range of 94%–98%.	OC if oxygen therapy required is \leq 10 LPM, if $>$ 10 LPM is required switch to oxygen cylinder
	Acute coronary syndromes	Acute		
	Stroke	Acute		
	Hyperventilation	Acute		
	Poisonings or drug overdoses	Acute		
	Medications, such as certain narcotics and anaesthetics, that depress breathing	Acute		
	Metabolic or renal disorders	Chronic		
	Pregnancy and obstetric emergencies	Acute		
	Pulmonary oedema	Chronic		
	Viral infections such as COVID-19 with ARDS and an inability to maintain O ₂ saturation	Acute		
	Sleep apnea	Chronic		
Conditions requiring controlled or low dose oxygen therapy	COPD	Chronic	Use 24% Venturi mask at 2–3 LPM or 28% Venturi mask at 4 LPM or nasal cannula at 1–2 LPM and aim for an oxygen saturation of 88%–92% for patients with risk factors for hypercapnia but no prior history of respiratory acidosis. Maintain the recommended target	OC if oxygen therapy required is \leq 10 LPM, if $>$ 10 LPM is required switch to oxygen cylinder
	Exacerbation of cystic fibrosis	Chronic		

**saturation range of
94%–98%.**

INDICATIONS FOR PLACING PATIENTS ON OXYGEN CONCENTRATOR

Indications to initiate oxygen therapy include hypoxia and hypoxemia but oxygen is sometimes prescribed for non-hypoxemic patients to relieve dyspnea. Oxygen therapy will be commenced when:

- ▶ Any COVID-19 patient with oxygen saturation less than 94%.
- ▶ Oxygen supplementation is required when the respiration rate is more than or equal to 24 per minute.
- ▶ If SpO₂ is dropping from 94%, one should start oxygen either through a cylinder or concentrator at 5 LPM and achieve target SpO₂ to 96% and target SpO₂ between 88% to 90% for patients with COPD and tele-consult a doctor.

USE OF OXYGEN CONCENTRATOR AT HWC

Medical oxygen is required across many levels of the health system for various services at HWC ranging from:

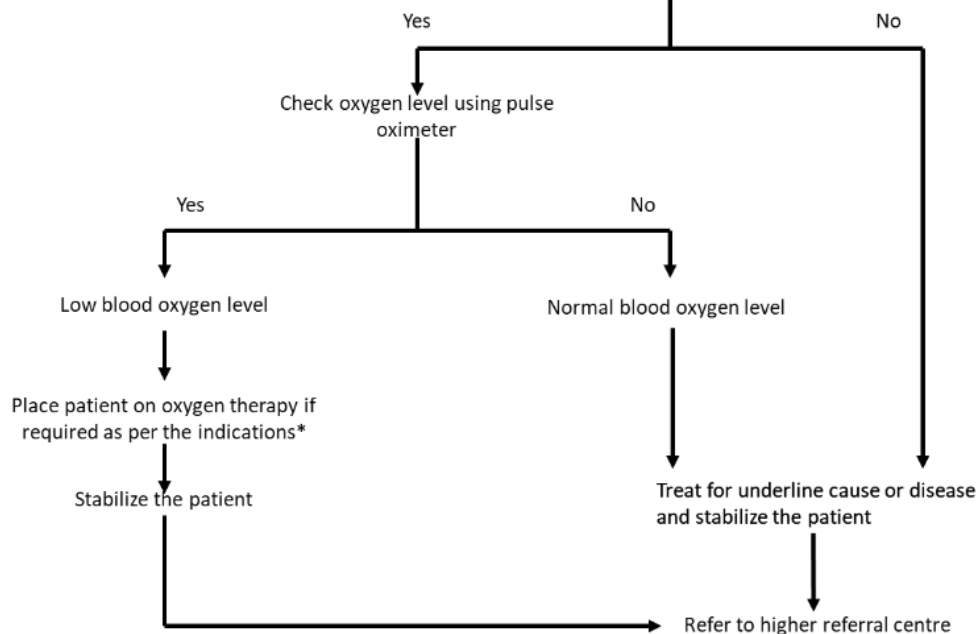
- ▶ Labour Unit- The use of oxygen has been recommended during many obstetric emergencies and for collapse related to haemorrhage, pulmonary embolism, eclampsia, or amniotic fluid embolism. The causes of maternal hypoxemia may include trauma, pre-existing, or new medical conditions as well as pregnancy-specific complications. In all these situations the aim should be normoxaemia (saturation 94%–98%).
- ▶ Neonatal resuscitation corner
- ▶ Outpatient department area (OPD), inpatient department area (IPD)
- ▶ Referral transport - Patient transport service ambulances are equipped with oxygen supply, normally an oxygen cylinder, delivering the oxygen via a flow meter attached directly to the cylinder. Such vehicles also tend to carry basic hand-held suction devices, and oxygen masks and should also carry oximeters to ensure the appropriate use of oxygen



Patient arrived at HWC for seeking health service

Do they have symptoms?

Headache/ shortness of breath/ dizziness/ coughing/ wheezing/ confusion/ rapid heartbeat/ cyanosis/ fatigue/ insomnia



IMPORTANT CONSIDERATIONS TO BE TAKEN WHILE USING OXYGEN CONCENTRATOR

- ▶ The maximum concentration of oxygen that can be achieved with the OC is up to 95%.
- ▶ OCs come with a lifecycle of 5-7 years.
- ▶ The life of the zeolite crystals can be expected to be at least 20,000 hours, which in most situations would give about 10 years of use.
- ▶ Oxygen concentrators are available as 5, 8, and 10 LPM units. An OC unit that delivers 10 LPM would be the most versatile for surgical care applications.
- ▶ Availability of power backup, as OC require a continuous uninterrupted power supply to work. There should be a UPS or voltage stabilizer for smooth operations and surge protection.
- ▶ Run portable OC for at least four hours each month even if it is not needed to use this often. Just like most electronics with a rechargeable battery, it can prolong its life to run it consistently and not let it sit unused.
- ▶ Battery life, on the rechargeable batteries, for the OC is roughly 3.5 hours for a full charge. However, that is at an oxygen flow setting of two. The higher the oxygen setting, the more of the batteries power it'll require to run, therefore, shortening the battery life.
- ▶ OC generates pure oxygen which is highly inflammable. Do not keep the OC near curtains/ cloth screens as it may be fire risk.
- ▶ The OC is designed for continuous operation, however, in case getting heated up, it should be switched off and given rest. It is recommended to switch off the machine for cooling down after continuous operation for 18 to 20 hrs.
- ▶ Change water in the humidifier bottle after every use by the patient and once in 24 hours.
- ▶ Use clean filter water for the humidifier bottle.
- ▶ Clean the body of the OC and its accessories with disposable moist tissue/cloth or with disinfectant as per the manufacturer's instruction.
- ▶ Humidification is not required when oxygen is used at low flow rates up to two LPM with nasal prongs or nasal catheters in children under five years of age.
- ▶ Humidification may not be necessary when oxygen is delivered in tropical climates by a concentrator rather than a cylinder.
- ▶ Humidification may be required for high-flow oxygen needs greater than two LPM or if oxygen bypasses the nose, such as when nasopharyngeal catheters or tracheal tubes are used.
- ▶ High-pressure oxygen is available from cylinders and piped oxygen systems, but not from OCs (<140 kPa).

REFERENCES

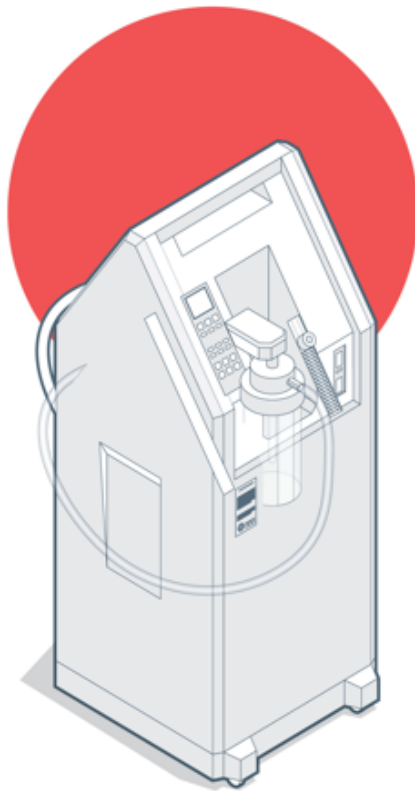
- ▶ Standard Operating Procedures guidelines for Medical Oxygen use and Fire Safety at public and private hospitals of Madhya Pradesh, Bhopal
- ▶ Training Manual on Management of Common Emergencies, Burns and Trauma for Community Health Officer at Ayushman Bharat - Health and Wellness Centres
- ▶ Mechanisms of hypoxemia - PubMed (nih.gov)
- ▶ Oxygen for end-of-life lung cancer care: managing dyspnea and hypoxemia - PubMed (nih.gov).
- ▶ Hypoxemia Versus Hypoxia and How Oxygen Therapy Can Help Treat These Conditions (lptmedical.com).
- ▶ Hypoxemia (low blood oxygen) Causes - Mayo Clinic.

ANNEXURE

Posters on Oxygen Concentrator

Oxygen Concentrator

Troubleshooting and Corrective Maintenance



Unit not operating, power failure alarm ringing



No power from mains socket

- Check whether the main switch is on and if the cable inserted properly.
- Replace the fuse with correct voltage / current if blown.
- Check if there is power supply in the mains using appropriate equipment.
- Contact the electrician for repair if required.



Concentrator circuit breaker has set off

- Press reset button if present.



Fault in the electrical cable

- Test the cable for its functioning by attaching to another equipment.
- Contact the electrician for repair if required.

No oxygen flow



Flow is not visible

- Place the tube in a container filled with water and check for bubbles.
- If bubbles emerge steadily, the gas is flowing.



Tubes are not connected tightly

- Check the tubing and connectors to see if they are fitted tightly.



Water or matter blocking the oxygen tubing

- Remove the tubing, flush through and dry out the tubing before replacing.



Blocked flow meter or humidifier bottle

- Replace meter / bottle or refer to biomedical technician.

No power failure alarm but unit not operating



Alarm battery is dead

- Replace battery and test as above

Temperature light or low oxygen alarm is on



Unit is overheated or obstructed

- Remove any obstruction caused by drapes, bedspread, wall, etc.
- Clean the filters.
- Turn the unit off and use standby oxygen system.
- Restart unit after 30 minutes.
- Call biomedical technician if the problem is not solved.

Disclaimer : This poster has been adapted and customized from PATH's Oxygen Delivery Toolkit.



Tips to Improve Life of Oxygen Concentrators



Daily Checks



Cleaning

Remove any dust/dirt with damp cloth and dry it off.

Ensure delivery tubes and masks are decontaminated.



If humidifier bottle is used, disinfect and refill with clean water.



Visual Checks

Check all parts (screws, connectors, tubes, etc.) are fitted tightly and correctly.



Function

Ensure flow is sufficient before intended clinical use.



Weekly Checks



Cleaning

Wash filter in warm water and dry. Replace the filter if damaged.

Clean the humidifier bottle thoroughly and dry it off.



Visual Checks

Replace the humidifier bottle if covered with limescale.

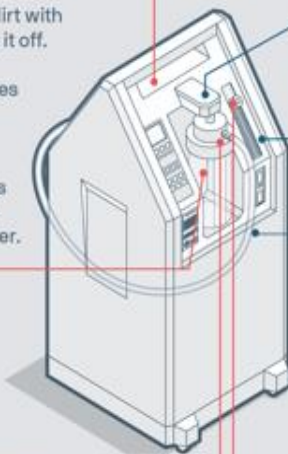
Replace mains plug, cable or socket if damaged.



Function

Run the machine for 2 minutes and ensure no alarm sounds.

Check the flow control function by checking the bubbles.



Ensure a technical check by a biomedical technician is done every six months.

Disclaimer : This poster has been adapted and customized from PATH's Oxygen Delivery Toolkit.