

Oxygen concentrator

Oxygen therapy is life saving in several respiratory and non-respiratory illnesses in both neonates and children. The most common indication of oxygen therapy in newborns is pneumonia, which is one of the leading causes of death in children less than five years old in most of the developing countries. Most of these deaths are associated with hypoxemia, and oxygen therapy thus is an essential component of therapy. In developing countries, at district level, the source of oxygen is often the oxygen cylinder, and in some places liquid oxygen, but these are heavy, transport is cumbersome and need reliable distributing systems for refilling each time. The Oxygen concentrator (OC) comes as a welcome change in place of these cylinders. Oxygen concentrators were first used in the 1960s to provide home oxygen therapy for patients with chronic lung disease. A time tested device, mostly used in developed countries for domiciliary oxygen therapy, it has been actively promoted and field tested by WHO in developing countries as a source of readily available oxygen. They are 25-50% more cost effective than cylinders in resource poor settings. Although the initial expenditure of an oxygen concentrator is higher, in the long term it is cost-effective and though the initial cost of oxygen cylinders is low the cumulative cost of refilling and maintenance is higher depending on transport and service costs in any given area.

Clinical uses of the oxygen concentrator

1. As a source of oxygen in small hospitals for respiratory infections requiring oxygen therapy. At a time four children /neonates can be treated using flow splitters.
2. In preterm neonates with chronic lung disease; who are oxygen dependent at discharge, with all other problems having resolved.
3. In older children with chronic obstructive pulmonary disease/ emphysema.
4. In children with ARDS with extensive fibrosis who may continue to require oxygen therapy for prolonged periods.

Principle of oxygen concentrator: Air contains a mixture of oxygen and nitrogen. The Oxygen Concentrator is about the size of a small refrigerator in which the air is forced

under pressure through molecular sieve beds filled with Zeolite which binds the nitrogen, and separates it from air as in gas chromatography, thus increasing the proportion of oxygen from about **21%** to about **90%** (*listen to podcast*). This is how it works:

1. The air first passes through the four filters (explained below) which remove bacteria and dust.
2. The air is then forced by a compressor into canisters.
3. The canisters contain molecular sieve beds filled with zeolite (**aluminium silicate**) which binds the nitrogen and separates it from oxygen, thus increasing the oxygen concentration to as high as 90%.
4. Two canisters are used, the period of oxygen outflow from one coinciding with the discharge of nitrogen from the other, so that a continuous supply of oxygen-enriched gas is delivered to the storage vessel.

Components and accessories of the device

- There are three major controls—a power switch, an oxygen cock, and a valve for adjustment of flow. The power is supplied from mains, the consumption being 1 kW (240 V, 50 Hz).
- The concentrator (*see figure 2 below*) has three filters. 1) The “External Coarse Filter” 2) The “Pre Filter” and 3) The “Inlet Filter”. The different concentrator companies have named the filters differently but standard names for the filters can be found in brackets beside the companies filter name.
- The air inlet and waste outlet are inside the cabinet and require adequate ventilation while the machine is running.
- Four children may be treated with oxygen at one time (at preset flows of 0.5 and/or 1litre per minute) using an oxygen flow splitting device.
- A “flow-splitter” (see figure 3 below) is a device connected to the outlet of an oxygen concentrator which provides four patients with oxygen at the same time. In order to provide oxygen to four babies it is necessary to set up four different nozzles (black arrows) for 1 litre/min flow and yellow (white arrows) for 0.5

litre/min flows. When less than 4 children are receiving oxygen then the unused outlets should be closed with blanking plugs. The oxygen is delivered through 10 to 15 metres of plastic tubing connecting the outlet nozzle and the nasal prongs fixed to the patient.

Instructions of use of the oxygen concentrator

1. Plug in the power supply cable
2. Switch on the concentrator using ON/OFF button. Green power light will come on.
3. Adjust the flow rate to “4 litres per minute”
4. Adapt the flow-splitter and the calibrated nozzles or use blanking plugs as required.
5. The OSD (oxygen sensor device if present) should show a green light to indicate a normal concentration of oxygen (>90%).
6. Ensure that there are no air leaks
7. Make sure the nose is clear (saline nose drops)
8. Check the O₂ flow
9. Ensure that the nasal prongs are well fitted to the patient
10. If pulse oximeter is available, monitor SPO₂ along with other vitals