



# State of Art of Review on Portable Oxygen Concentrator

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**Abstract**— A mobile oxygen concentration unit (POC) is a means of treating individuals with oxygen requiring higher amounts of oxygen than environmental levels. The size and mobility of something is lesser. They are sufficiently tiny to be transported, and a large number currently have FAA approval. Of recent weeks, exponential inflation in Indian coronavirus infections has inundated the health care system, and there have been patients dying outside of hospitals in ambulances and parking lots. The supplies of medical oxygen have also been exhausted, which is essential for those sick. In the simulated aircraft environment, a case study was conducted out on the comparison of mobile oxygen concentrators. To note and observe if the difference in flight's performance has modified the POC, the various aircraft were picked. Data can assist explain device performance disparities reported in human research. Shorter, more portable oxygen than knee-height and box Concentrators are available in a range of sizes, forms and even colors. These POCs are a gadget for the future since they provide mobility.

**Keywords**—Light portable oxygen concentrator, Zen-O portable oxygen concentrator, Sequal Equinox, Oxlife portable oxygen concentrator.

## I. INTRODUCTION

A portable concentrated oxygen is a device for treating persons with higher oxygen levels using oxygen. It looks like a house in Figure 1.

In the end of the 1970s, concentrators of medical oxygen were produced. Initially, they were intended as a way to provide a permanent home oxygen source. They now create 1-6 liters of oxygen per minute, depending on the patient's breathing rate in Figure 2.

Pressure swing adsorption is based on the same idea as a home concentrate. A miniature air compressor, a cylinder full of the sieve, a pressurized equalizer of the tank as well as valves and tubing are the fundamental composition of a

POC. A POC system can regularly provide up to 90 percent medical oxygen. The atmosphere comprises some 21% oxygen and 78% nitrogen, while the 1% remaining is a blend of other gases as described in Figure 3.



Figure 1. A lightweight portable oxygen concentrator: Inogen One G3 (2,2 kg)



Figure 2. Sequal Equinox, transportable concentrator with a high oxygen flow rate

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Figure 3. A Zen-O portable oxygen concentrator, it is capable of pulse and continuous flow operation

Dose of pulses (also called intermittent-flow or on-demand) POCs are the smallest units and may only weigh 5 pounds (2.2 kg) In the case of patients who are oxygen-depleted owing to sleep apnea, on-demand machines are not recommended, nor are CPAP masks recommended for them. The U.S. Department of Transport (DOT) ordered that airline carrying more than 19 seats passenger aircraft have to permit disabled passengers to use FAA-approved POCs. Many overseas airlines have accepted the DOT guidelines and are available on the FAA website. The overnight usage of POC's is a beneficial treatment for individuals whose desaturation is caused to poor breathing. An early night oxygen mask might be an effective therapy for persons who have problems breathing in the night. Portable concentrations of oxygen can give an oxygen recovery of 10–20 percent greater compared to traditional commercial systems. These portable concentrations usually plug into a power outlet, and may operate away from home with an internal battery or external battery pack. Most of these devices can be connected to an ambulatory device and the DC outlet of a vehicle indicated in Figure 4.

Oxygen concentrators have complications when the patient is breathing. There are difficulties with oxygen concentrators. At roughly \$600, Common Models retail. Leasing agreements might be made accessible through various medical and/or insurance providers.

The four POC models we examined were of significantly variable performance. All produced a lower relative FIO<sub>2</sub> of 100% oxygen through the nasal cannula

than with constant flow. This stresses the need of adjusting the POC configuration to match the needs of the patient [1]. In chronic obstructive pulmonary disease (COPD) and other pulmonary illnesses, desaturation during exercise was reported. In comparison to traditional POCs, we tested whether our POCs are equal to oxygen in individuals with chronic lung illness [2].



Figure 4. Oxlife portable oxygen concentrator

It has been proved to be similarly effective despite its reduced size and weight. In patients with COPD who had had rest, light and while sleeping, the Fio<sub>2</sub> aperture measured in the trachea was estimated for three simulated air patterns [3].

Lightweight portable oxygen concentrators (POCs) are substituted for traditional portable systems such as compressed oxygen cylinders [4]. This study was conducted to compare POC to compressed oxygen cylinder clinical performance in ILD patients [5]. This result is in line with a comparable research carried out by Furhman et al, which examined four DODS model and a permanent oxygen system with 9 people undertaking six-minute walking experiments [6]. The incidence of hypoxemic episodes was reduced using a combination system. A single device was used for all subjects. In order to encourage mobility and physical activity, the study aimed to evaluate how beneficial was a portable oxygen concentrate [7].

Supply of oxygen is a complex issue in disaster situations and snowbound mountainous areas. Cost of providing lightweight portable oxygen traditionally has not been adequately reimbursed [8]. Advances in portable concentrator and liquid-oxygen technology are making lightweight portable Oxygen systems more practical and

less expensive. Patients and physicians alike face a significant challenge when it comes to portable oxygen therapy [9]. We have demonstrated that the amount of bolus may play an essential role in influencing the efficacy of a POC and health practitioners must take into consideration the present and future oxygen demands of patients at all levels of activity when selecting their own POCs.

81,559 patients were treated with home respiratory therapy on 31 December 2017[10]. The average age was 73,8911,67. Most patients used portable concentrations of oxygen. There were just a few research and the results were not promise [11].

For high Fio<sub>2</sub> supply with a turbine fan, OC's offer an alternative to the oxygen cylinders. In the trial, we discovered that the focuser did not recognize an inspiring effort of the patient or provide the preset oxygen flow at any of the settings tested. We indicated that during NIV therapy, the patient should not utilise the portable oxygen concentrator. The subjects covered are inadequate physical and technological aspects of mobile oxygen cylinder and oxygen-dependent concentrator [12].

Persons at risk of poor outcomes with COPD and severe hypoxemia. Mobility reduction related. We discovered that there had been decreased mobility related with certain perceived LTOT device constraints, leading to feelings of diminished autonomy Current research is mostly on the viability of miniaturising the oxygen concentrative system based on adsorption. Chronical Pulmonary Obstructive Disease (COPD) limits the lungs' ability to breathe atmospheric air to oxygenate blood. It is vital that pure oxygen or enriched air are constantly supplied [13].

This paper gives an overview of different kinds and adsorption technique of commercially available MOCs. For air separation technology, key breakthroughs and key principles have been outlined as applicable in systems of small and big size. A portable concentrator has been introduced using the pulse flow oxygen conservation methodology. The intensification of processes using tiny

adsorbent particles and rapid cycles and other major air separation improvements for large and smaller systems have been examined. The efficacy of a portable NIV to enhance the oxygen parameters and the distance travelled during the six-minute walking test [14] has been assessed in ILD-diagnosed individuals in need of oxygen therapy.

In IL patients we carried out a future observational research. In two separate settings, we carried out this test: employing a portable concentrative oxygen with the patient's usual flow during their day-to-day live operations and add a supplementary NIV. The popularity of portable oxygen concentrators is growing. The success of a single device depends on the reliance on an effective pulsed supply of oxygen. The preference for the ambulatory oxygen systems (POC and scooter) in patients with COPD and ILDs was evaluated by Mauro Maniscalco, Michele Martucci [15].

As a result of reduced barometric pressure, air passage shall cause a reduction in the partial pressure of oxygen (O<sub>2</sub>). This hypobaric hypoxia might be harmful to airborne passengers. A need to equip 5,000 to 10,000 mass injuries with more oxygen to prepare the pandemic has been reported by the American Association for Respiratory Care. The mobile oxygen concentrators that are less costly than oxygen cylinders can provide in-flight oxygen therapy. In the instance of a single, semi-continuous PSA test device consisting of miniadsorber the adsorbent was regenerated by heating to the C.O.V.C. (0.4 cm diameter 10.8 cm length) This study shows that oxygen concentrators, which supply oxygen with a purity of <90 per cent, should be explored and developed for mass-victim usage, with an improved portable oxygen [16]. Fans. Three breathing patterns of a COPD patient at rest, while exercising and sleep were recreated by a test lung. Oxygen flow via the trachea was determined by multiplying the flow of the inspiration by measured levels of oxygen. The oxygen pulse volumes, time and time delays were measured in each setup and each POC using an O<sub>2</sub> Conserver Testing System.[17].

The seminar addressed the issues necessary for the long-term treatment of oxygen (LTOT) Kampelmacher analyzed current LTOT and portable oxygen concentrator function indications. In 2015, hypoxemia is prevalent with horse field anesthetist Paige Coutu, Nigel Caulkett et al. [18]. It is questionable that, according to a research by Wanka and Wanka, POCs are generating enough oxidation in cruise aircraft even if they conform with aviation regulations. Dr Little presented a health economic analysis, which showed the cost advantages of a health care oxygen reform in Scotland. The conference closed with a health economic research. The investigation was conducted on a height of 1300 m. Importance has been fixed at  $p < 0.05$ . Bodil Ivarsson et al. in 2020, Sebastian Möller, The aim of this study was to clarify the experiences of patients using a portable oxygen unit with long-term oxygen treatment (LTOT)[19].

An alternative to the application of oxygen cylinders for hypoxemia therapy in field anesthetist were examined in 2012 by Portable battery-driven oxygen concentrators [20]. A reduced oxygen saturation of 20% of patients with the use of a DODS device was clinically significant. The investigation comprised 16 uncontrolled brown bears (*Ursus arctos*), 18 uncontrolled Bighorn sheep (*Ovis canadensis*) and a number of rhinestones. The major purpose of the study was to examine whether the oxygen levels titrated using the 6-MWT for COPD patients are enough to fulfil the demands of patients in their everyday lives [21]. Studied in 2016 During long-term space missions, an on-board oxygen concentrator is necessary to provide medical oxygen [22].

Commercial medical oxygen generators are big and extremely power-intensive based on Pressure Swing Adsorption (PSA). A compact lightweight, portable oxygen Generator based on a vacuum adsorption being developed by TDA Research, Inc. The aim of this study was to evaluate the effects on the perceived mobility and QOL of oxygen-dependent persons with COPD of their reported LTOT satisfaction. The study showed a strong and beneficial effect on mobility satisfaction with a mobile

LTOT device. Although LTOT is efficient, its adherence to treatment is limited, despite its effectiveness [23].

Additional studies should be carried out sooner rather than later to verify the effectiveness of newly discovered strategies to improve patients' results, the authors advise. The authors propose new medicines and tactics that potentially show considerable advantages [24].

A number of devices for Home Oxygen Therapy (HOT) Guidelines are available to provide and monitor no indications on how to choose the delivery device. Some self-stocked delivery-free gadgets might improve the user independence with environmental benefits and, maybe, lower costs. Globally, pulse oximetry has become widespread and certain models provide long-term monitoring. Certain portable closed-loop systems could automatically alter the oxygen flow. This might assist to enhance compliance with adequate titration of oxygen, which is commonly overlooked since it is difficult to execute and takes time [25].

In impoverished nations, hypoxemia is a widespread disease that causes child fatalities. The lowest and most constant supply of oxygen in medical institutions is provided by the oxygen concentrators. The oil-free air compressor within the compressor is crucial since it is the most energy using element. The energy efficiency of these items is increased by 28/38 per cent compared to the standard reciprocating piston-type compressor. However, many other works such as cost, dependability and technology in the manufacture of this new technology were left [26].

The exercise desaturation showed in room air in 30 participants suffering from COPD and interstitial lung disease. All devices have been allocated randomly for 1 week to each participant and changed by the next week. All the subjects answered a questionnaire at the end of the trial process assessing various features of oxygen therapeutic instruments. A portable prototype of oxygen concentration converter (PVSA) was introduced in order to simplify oxygen generation processes by adopting a deep evacuation phase in place of desorption by purge [27]. This study

includes experimental pulse volume, width and time delay measurements of the POC under three distinct conditions and two rest and activity related breathing rates.[28]

These performance experimental data are inputs for a physiologic oxygen uptake model that considers the true and dynamic nature of the gas exchange to show how device-specific parameters and patient-specific factors might impact the oxygenation of patients . This form of physiological study, which examines the genuine effect of blood transfer of oxygen, might be informative for the application of treatments and creation of novel devices rather than administration to the nose (or mouth). In this investigation the SeQual Eclipse II POC was evaluated in the laboratory in conjunction with Impact 754 and the Pulmonetics LTV-1200 fans. We assessed the inspired oxygen fraction (FIO<sub>2</sub>) for many minutes. The aim of this study was to assess the low oxygen rates for hypoxemia in sedated white-tailed deer by continuous or pulsed intranasal administration. The results (*Odocoileus virginianus*). In 2014 a study indicated that the smallest effective oxygen rate during anesthetic for the treatment of hypoxemia is favorable since the lifetime of the oxygen cylinder is prolonged [29].

The usage of transportable oxygen concentrators in high elevations has yet to be reported. In this scenario, oxygen treatment has as its principal purpose improving tissue oxygenations and remedying the severe hypoxemia normally present in these patients in the advanced phases of the illness. An oxygen concentrator is created employing a pressure swing adsorption process , aimed at an 80 percent cut in the energy requirement of commercial systems. In emergencies such as medical backups for manned space flights and rural villages in impoverished nations, this design may be more sustainable [30]. This design is possible. Without boosting oxygen in the ship, this device might supply medical oxygen in an emergency ship. Flight surgeons desire this capacity, but currently no device fits the requirements for power, size and rates of delivery [31].

## II. PROBLEM IDENTIFICATION

Covid 19 has a direct effect on the lungs and destroys the alveolis (little air sacs). Over the past several weeks, the exponential increase of coronaviral infections in India has inundated the health care system. Dozens of hospitals have become short of gas in several Indian cities and cities. According to news reports and sources, 24 patients died on Sunday night in one hospital in Karnataka, Karnataka South, following the hospital's oxygen run. Saturday after an oxygen-packed hospital, 12 other individuals died in New Delhi's capital.

Several hospitals on Sunday evening posted frantic calls on social media for oxygen and merely the nickname of delivery. On Twitter, one child's facility in Delhi alarmed about the lack of oxygen that is said to have put 25 to 30. Experts claim that India produced slightly over seven thousand tons of oxygen per day. Most of them are for industrial usage, but may be diverted for medicinal application. Today, the Indian government has channeled the most industrial oxygen supply in the country to the health care system. With increasing demand, providers have increased capacity to manufacture over 9,000 tons of medical oxygen by mid-May.

## III. COMPARISON OF PORTABLE OXYGEN CONCENTRATORS IN A SIMULATED AIRPLANE ENVIRONMENT

For aircraft patients travelling by lung illness, portable oxygen concentrations (POCs) are particularly desired. The fact that POCs create sufficient oxygen at cruising altitude aboard aircraft is not evident, even when they conform with aviation rules. During air transport, liquid oxygen is forbidden and the conventional oxygen-conserving oxygen steel rollers enable only a relatively limited transit period. Before a POC may be applied for air travel in COPD patients, it is necessary not only to carefully examine weight, but battery life and maximum achievable oxygen production. There are more and more persons with lung disorders, as is the number of persons who wish to travel by air with compromised lung function.

In order to improve safety of their air supply, POCs may elevate our subjects' PaO<sub>2</sub> by at least 1,40 kPa (10

MmHg). The two lightest bins (Freestyle and Invacare XPO2) have to be running at maximum levels to obtain this increase. This reduces the battery life significantly. On the FAA website, you may find POCs certified in the United States by the Federal Aviation Administration (FAA). The frequent usage in Germany is all POCs examined in this study.

On in-flight supplying of oxygen for flights until 14 hours, we evaluated Lufthansa's portable WS120 oxygen demand device (compressed 300bar oxide carbon cylinder). The POC is coupled with a flow analyzer and an artificial pulm system (ASL5000, IngMar Medical Ltd, Pennsylvania, USA) (PF300, imtmedical Corp., Buchs, Switzerland)

All POCs maintained a concentration of oxygen over 94% at the maximum measured altitude (WS120 provided 100% oxygen), although the oxygen bolus given at higher levels was significantly reduced. The Invacare XPO2 could unfortunately not be evaluated, since oxygen supply was not sufficiently steady to assess artificial pulmonary systems. During the investigation using simulated in-air circumstances, the third question was answered. The Pocs have been compared with Lufthansa's system (WS120) to assess oxygenation improvement. The study has been authorised by the local ethics council and all participants have received signed informed permission.

Except to walk to the restroom, patients were not permitted to practise and measures were obtained only after a pause of at least 10 minutes. The measurement data at 2650 m are represented as a mean $\pm$ standard deviation in table 4.1. Based on a technical test failure, na implies not available. In patients with chronic obstructive lung disease, an investigation was done in a Hypobaric chamber examination POC (COPD). AirSep Corp., Buffalo, New York has resulted in decreased oxygen oxygen oxygen odour in compressed oxygen with or without an oxygen-conserving device compared to continuous oxygen flow. In order to assure clinical usefulness, a patient should evaluate his or her personal oxygen needs according to recommendations.

The two lightest balls (Freestyle and Invacare XPO2), which contain less zeolite to absorb ambient Nitrogen, have to be operated at maximum level. This leads to a considerable decrease in the battery life that would require extra battery packs to increase weight on transcontinental trips.

#### IV. OXYGEN DELIVERY VIA NASAL CANNULA ANATOMIC RESERVOIR EFFECT ON LOW-FLOW: CONSTANT FLOW PULSE FLOW AND OXYGEN CONCENTRATOR PORTABLE

The study compares the FIO<sub>2</sub> given by a CF-provided nasal cannula with that of the PF-provided oxygen tank. In the COPD model, CF has dropped more than PF by means of portable concentrators of oxygen. The more oxygen is produced, the greater is the minute volume of Fio<sub>2</sub>. The concentrate setting and CF rate of the devices assessed based on data is unlike the equivalence between portable oxygen.

These data underline the relevance of the titration of the portable concentrator of oxygen to the individual oxygen requirements of each patient, the authors conclude. They argue that the data is consistent with prior human investigations. The authors note that our data is similar to those of previous research. The larger the volume of the pulse, the greater the FIO<sub>2</sub>.

We think our research design is very robust in its capacity to simulate clinical circumstances in the real world. This research also provides an overview of the relative efficacy of CF and PF for COPD treatment. We think that the issue of our study was not covered since the PF devices were traditionally considered useful for the preservation of their oxygen. The objective of this study was to provide an insight into portable oxygen concentration performance rather than to construct a prediction model for patient FIO<sub>1</sub>.

At lower oxygen flows, all four devices improved SpO<sub>2</sub> compared with CF. The only clinically important difference for portable oxygen concentrators was at the highest setting for the Solo2 (decrease of 4%) In conclusion our study

shows that oxygen delivery via a nasal cannula is affected not only by the type of device used, but also by the presence of the end-expiratory flow. The data can contribute to explaining device performance discrepancies reported in human research.

## V. RESULTS AND DISCUSSION

Portable concentrators of oxygen collect air, clean and then disperse air that has altered. Before it enters the concentrator, air is mostly composed of nitrogen and a little oxygen. The system then separates the nitrogen to provide every person the greatest amount of oxygen. A portable oxygen concentration device has certain advantages: easy to use and easy to monitor litre flow and battery life. It's sleeping for a better night.

During sleep, even for persons with healthy lungs, your level of oxygen saturation tends to decrease. You may have transitory nocturnal desaturation, that can interfere in your decent evening sleep, if you have COPD or other chronic lung illness. A highly accessible lightweight battery that you can change in about one or two minutes. No concern about battery exasperation belts, internal batteries unpleasant and connections complicated. Light, small and highly inconspicuous are the newest oxygen concentrators.

Many people who use a POC can work, attend in social gatherings and take part in physical activities. Some POCs are smaller and weigh 6 livres, with a height of just one foot. You will have different demands than the following one if you have chronic bronchitis, emphysema or chronic pulmonary blockage. You might wish to select an oxygen concentration that delivers both pulse flow and continuous flow to determine how best to treat oxygen.

Added oxygen helps to maintain the health of your brain and other essential organs. POCs are not affordable and even the most basic gadget can cost over \$2,300. The industry's choice for the less costly supplementary tanks of oxygen may not cover this high initial cost. Here are some of the POC's greatest options: Single Go Mini Pulse Dose Flow Portable Oxygen Concentrator - this is the handheld option for turning if you need oxygen on the go. Philips

Respironics If you struggle with serious COPD and you have low levels of oxygen in your blood, a POC might help you live healthier, longer lives.

The first high investment in such a gadget is rather pricey, the money you pay might be worth the change for a life of fresh oxygen.

1. Inogen One G3 Portable Pulse Dose Flow Oxygen Concentrator - Compact oxygen concentration for mobile application.
2. SimplyGo Portable Oxygenic Concentrator Philips Respironics.
3. Mobile oxygen concentrator ResMed Activox™.
4. Resmed Activox cell phone loader portable oxygen.

## VI. CONCLUSION

Mobile oxygen concentrators extract oxygen from your environment immediately. No oxygen canisters or tanks need refilling. Consumers' key characteristics and advantages in their purchases include: battery weight, battery life, noise level and packing. An additional driver of the expansion in the world's portable oxygen concentrator market is the rise of elderly populations. However, the main barrier that hampers market expansion during the projected time is the high device cost.

The backpack or easy-to-transport sacks are supplied with both an A/C adapter and a D/C adapter for the usage in every car, boat or motor home. Market growth would be impacted by severe rules and regulations during this analysis period. In 2012, the POC market grew to \$1.9 billion by the year 2019 to \$242.5 million.

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