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Review

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A critical review of Oxygen equipment for long-term Oxygen Therapy with the aid of renewable energy sources and comparison for use in low-resource settings

Sandeep Nalavade,[1,*] Sameer Bhosale,[1] Raviraj Gurav,[2] Pradip Tamkhade,[3] Pritee Purohit,[2] Amit Desale[3]

[1]P.E.S. Modern College of Engineering, Pune, Maharashtra, India. [2]Army Institute of Technology, Pune, Maharashtra, India. [3]Marathwada Mitra Mandals College of Engineering, Pune, Maharashtra, India.

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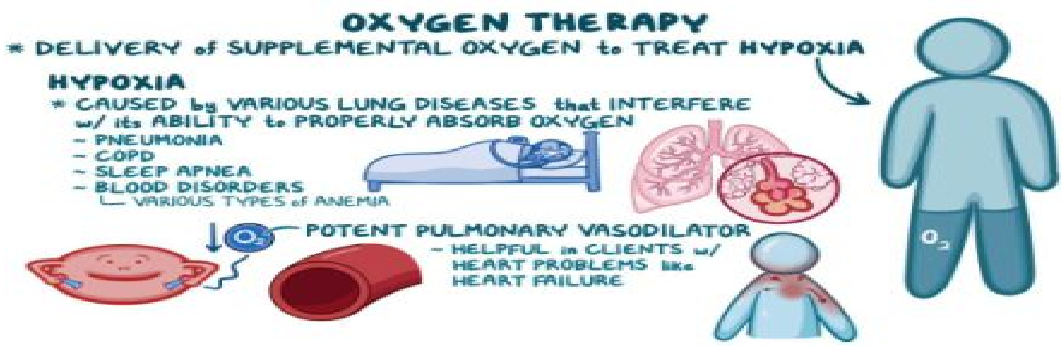
ABSTRACT



Chronic Obstructive Pulmonary Disease (COPD) is a primary cause of death in global, particularly in low-resource settings with insufficient medical facilities arising because of high costs of medical apparatus, diagnosis and treatment. The Long Term Oxygen Therapy (LTOT) is used to treat COPD patients as it has been shown to improve patient survival and better life expectancy; however, it is also an expensive treatment, making it difficult to use in poor-resource settings. This review discusses various LTOT devices and evaluates their suitable applicability in resource poor settings. The devices are compared based on their cost (both capital and operational) and performance. The article also discusses the observation of oxygen supply during treatment and the use of delivery systems.

Keywords: Chronic Obstructive Pulmonary Disease (COPD), Long-Term Oxygen Therapy (LTOT), Oxygen Concentrator (OC), Liquid Oxygen, Portable Oxygen Concentrator (POC).

INTRODUCTION

The human respiratory system is critical to the body's functions as it is responsible for supply of required sufficient amount of oxygen to maintain arterial blood oxygen levels and oxygen levels in body tissues.[1] Majority of energy associated biochemical reactions in the body rely on an adequate supply of oxygen.[2] Patients with Chronic Obstructive Pulmonary Disease (COPD) are prescribed Long-Term Oxygen Therapy because their respiratory system is unable to provide adequate oxygen levels on its own. This review focuses on various types of devices for Long-Term Oxygen Therapy (LTOT) and appropriate methods for LTOT in Low Resource Settings.

*Corresponding Author: Nalavade Sandeep, PES Modern College of Engineering, Pune, India
Tel: +91-9822395953; Email: spnwce@gmail.com

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LONG-TERM OXYGEN THERAPY (LTOT)

Chronic respiratory diseases fall into four major categories of noncommunicable diseases (NCDs). As per World Health Organization (WHO), NCDs caused approximately 41 million deaths, or 71% of the total 57 million deaths in 2016. Chronic respiratory diseases, which are classified as NCDs, caused approximately 3.8 million deaths, accounting for 9%.[3] COPD is classified as a chronic respiratory disease, and the all-encompassing action for Obstructive Lung Disease (GOLD) has indicated that it is treatable and preventable.[4,5] COPD affects approximately 210 million people globally. COPD was the fourth primary cause of death broadly in 2004 (5.1%), and it is expected to rise to 8.6% by 2030.[6]

In the late 1970s, the British Medical Research Council, the Nocturnal Oxygen Therapy Trial (NOTT) showed that using Long-Term Oxygen Therapy (LTOT) for larger than 15 hours per day improves the survival rate of COPD patients with resting hypoxaemia. Thus, LTOT has been demonstrated to be a therapeutic modality for the treatment of COPD.[4] Pavlov et al. also stated that COPD is a leading cause of death globally and forecasted that mortality rates would continue to rise in the future. LTOT has been shown to reduce overall mortality rates. This treatment also improves the emotional and cognitive functions of COPD patients.[5]

Prescription for LTOT

When a patient suffers from hypoxaemia and COPD, long-term oxygen therapy is recommended. It is generally recommended that COPD sufferers use LTOT for longer than 15 hours in a day. Improvement can be expected if LTOT is followed strictly or as prescribed, and it should always be used with a written order from a licensed physician. Patients with hypoxaemia and COPD are prescribed LTOT if their PaO_2 is less than 55 mm Hg, or if their PaO_2 is between 55 and 60 mm Hg. The treatment must be properly monitored on a daily basis during the LTOT period.[7–9] M.J. Kampelmacher and colleagues stated that the European Respiratory Society and the American Thoracic Society have recommended that LTOT be prescribed for patients with hypoxaemia and COPD. Also, it is recommended that oxygen therapy be prescribed for 15 hours per day.[10]

Type of Devices for LTOT

Long-Term Oxygen Therapy (LTOT) at home is typically carried out using this sources: liquid oxygen, pressurized gas cylinders, and oxygen concentrators.[8]

Figure 1. (a)Oxygen cylinders, (b)Oxygen Concentrator, (c) Liquid Oxygen system. Sources of Oxygen at home for LTOT.[8]

Liquid Oxygen

The liquid oxygen is used for home oxygen therapy since 1965, with the development of the first home-based liquid oxygen system. The liquid oxygen system was divided into two parts: a large stationary subsystem for use at home and a refillable liquid oxygen portable subsystem for use outside the home. Figure 1c depicts a liquid oxygen system. This system supplies 100% oxygen and is kept in cryogenic tanks at -183°C.[11,12] The analysis by J. Schaanning and team, 117 patients were specifiedthis treatment, with the mean flow rate being 1.9 litre /min and 20.5 hrs/ day, which satisfies the conditions for LTOT.[13]

Advantages of Liquid Oxygen

Portable liquid oxygen equipment has the advantage of being lightweight, with models weighing as little as 2.5 kg. Another obvious advantage is that it can be used for up to 15 to 20 hours with oxygen-saving devices.[13] Because of its light weight, it is better suited for portable applications and can be used by a wide range of people, regardless of age or strength. Patients can go outside when using a liquid oxygen system, and filling and using the system is simple. In literature survey it is found that sufferers or patients prefer liquid oxygen more than gaseous oxygen, making it more effective oxygen therapy. Neri et al. studied and confirmed that portable liquid oxygen reduces breathlessness and is beneficial to hypoxaemia patients or sufferers .[14]

Disadvantages of Liquid Oxygen

Liquid oxygen therapy is more expensive than the other forms of oxygen therapy discussed in this article. According to a Swedish study, liquid oxygen therapy is four times more expensive than oxygen therapy using a gas cylinder and oxygen concentrator.[15] Additional precautions must be taken for liquid oxygen therapy. Because liquid oxygen therapy has a minimum purity of 99.5%, it should be used with caution in neonates, who require a concentration of less than 40%, and in elderly patients with chronic bronchitis, where the inspired oxygen should be 30% concentrated. Before administering liquid oxygen to the patient, it is vaporized, compressed, and heated to ambient temperature.[16]

Compressed Gas Cylinder

Oxygen and other gases used in medical applications are kept in metal containers known as gas cylinders. These cylinders are primarily made of steel alloys or aluminum, and the tops contain a variety of valves such as a pin index valve, hand wheel valve, integral valve, and bull nose valve to control flow. Oxygen cylinders come in a variety of sizes and capacities, as shown in Table 1. Thus, the patient can select the cylinder based on their needs and application at home or outside.[17] Cylinders can be used for portable applications using trolleys, backpacks, and other equipment, but they are generally less preferred because they have a lower capacity than liquid oxygen and portable oxygen concentrators. The main advantage of compressed cylinders is that they can be used as an emergency oxygen source when oxygen concentrators are unavailable due to power outages, which is common in low-resource settings. To avoid potential hazards, frequent filling, maintenance, and additional precautions must be taken.[12] Figure 1(a) represents the gas cylinders.

Table1. Size and specification of often used oxygen cylinders.[17]

Size	Volume (L)	Pressure (psi)	Tare Wt. (kg)	Valve type
B	200	1900	2.27	Pin index
D	400	1900	3.4	Pin index
E	660	1900	5.4	Pin index
F	1360	1900	14.5	Bull Nose
G	3400	1900	34.5	Bull Nose
H	6900	2200	53.2	Bull Nose
M	3450	2200	29.0	Bull Nose

Oxygen Concentrator

The surrounding air is drawn by oxygen concentrator (OC) and directs the oxygen to therapeutic levels by moving it through different filters or zeolite sieve beds. These oxygen concentrators require minimal maintenance and can operate maximum 5 years when attached to a power source.[18] They are available in 3, 5, 8, and 10 l/min units, producing up to 95.5% concentrated oxygen. For LTOT in low-resource settings, oxygen concentrators are the most cost-effective solutions.[18] Figure 1(b) shows an oxygen concentrator.

USE OF OXYGEN CONCENTRATORS IN LOW-RESOURCE SETTINGS

Many studies and research have shown that, while concentrators produce concentrated oxygen immediately, they are as efficient as other sources of oxygen and are prescribed to many patients with respiratory failure. A test was carried out in which 14 concentrators were given to patients over a 12-month period, with regular maintenance and questionnaires. It concluded that the test was successful due to the device's good mechanical performance. The study also stated that oxygen concentrators have a much lower running cost than compressed gas cylinders and liquid oxygen.[19] According to Jackson, an oxygen concentrator is equivalent to 21 cylinders over the course of a month on a 2 liter per minute supply. The study provides a relationship between cost and oxygen treatment for the number of hours per day, for treatment with cylinders and oxygen concentrators, as shown in Figure 2, concluding that treatment with oxygen concentrators is always less expensive than treatment with cylinders when used for more than 14 hours per day.[20]

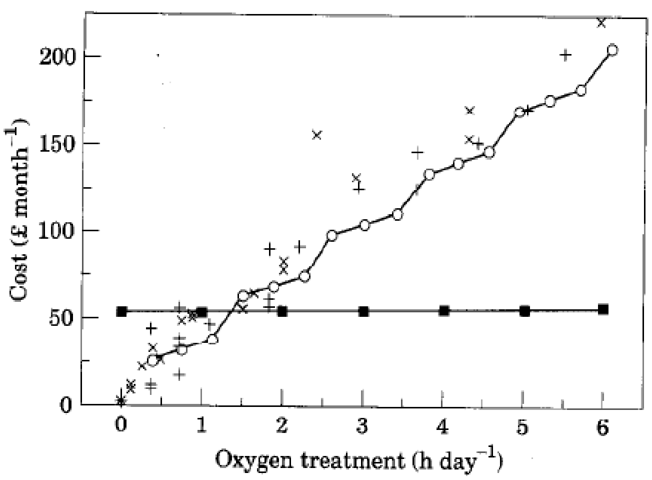

Figure 2. The cost of concentrator Vs theoretical and actual costs of oxygen required for treatment

An oxygen concentrator is difficult to use in low-resource settings because it requires a continuous power supply to function, whereas many developing countries have intermittent power supplies. Thus, Bradley and his team identified and developed an oxygen system that operates on a battery and can be charged by an intermittent electric supply. Oxygen Concentrators are still preferred because, in developing countries, there are a lack of roads and transportation systems, intermittent electricity, and fewer funds for health, making it difficult to provide a continuous supply of cylinders, which requires regular refilling, making treatment too expensive.[21] Wilson et al. also reported that oxygen concentrators are more appropriate in developing countries where compressed gases are scarce, and that they save money by eliminating the need for cylinder hiring and transportation.[22] A study conducted in Solukhumbu District, Nepal at an elevation of 3900 meters, also demonstrated that oxygen concentrators are dependable and effective in high-altitude remote areas. They provide less expensive oxygen therapy than cylinders because refilling facilities for cylinders are not available in such remote areas, saving money on frequent transportation costs.[23] Table 2 compares oxygen cylinders, concentrators, and central oxygen, also known as a pipeline system. It can be seen that, while oxygen concentrators have a higher capital cost than cylinders, their operational costs are significantly lower, resulting in overall cost savings and making them useful in low-resource settings for LTOT.

PORTABLE OXYGEN CONCENTRATORS AND ITS EFFICACY

Although oxygen concentrators are the most cost-effective option for LTOT, they limit patients outdoor activities. As a result, a patient who needed to travel or participate in outdoor activities was forced to use the liquid oxygen portable unit, which cost more money. However, this problem has been solved thanks to the invention of the Portable Oxygen Concentrator (POC). Nasilowski et al. conducted a 6-minute walk test and found that POC did not differ from portable liquid oxygen units.[24] POCs weigh as little as five pounds. POCs operate on both AC and DC power sources, including rechargeable batteries and vehicle DC outlets. Thus, it is ideal for outdoor use. POCs deliver oxygen in either Continuous Flow (CF) or Intermittent Flow (IF). Combined CF and IF devices are also available. CF POCs are similar to stationary OCs (flow is measured in l/min), whereas If POCs provide flow in mL/breath (FBV) or mL/minute (FMV).[25] POC is a type of oxygen concentrator that, like stationary concentrators, has a high capital cost but a low operational cost, making it useful in low-resource settings. Every POC available in the market has different specifications and produces different results depending on the user's working environment. As a result, a suitable point of care (POC) should be chosen for the patient based on the conditions and activities for which it willbe used. Chatburn and Williams' test demonstrates this.[26] Patients with COPD and severe hypoxemia require oxygen delivery devices that allow for mobility as needed. However, certain devices may limit individuals' ability to engage in physical activity as desired. Individuals with COPD may have a lower perceived quality of life because of their limited mobility. This study aimed to understand the limitations that COPD patients face when using long-term oxygen therapy (LTOT) devices.[27]

COMPARISON IN LTOT CATEGORIES

Table 2 compares the available types of Long-Term Oxygen Therapies (Central Oxygen Pipeline System, Oxygen Cylinders, and Oxygen Concentrators) in terms of power supply, transportation, exhaustible supply, initial and operational costs, user care, and maintenance requirements.[18]

MONITORING OF OXYGEN SATURATION

Patients with hypoxaemia and COPD have low oxygen saturation in their blood and are therefore prescribed oxygen therapy. However, it is critical to monitor blood oxygen saturation on a regular basis in conjunction with LTOT to determine whether the therapy is meeting the oxygen requirement or if the prescribed values need to be adjusted. As a result, frequent monitoring of oxygen saturation is required in patients with LTOT; additionally, it should be inexpensive and accessible in low-resource settings. A pulse oximeter can be prefered to count saturation level of oxygen in hemoglobin in arterial blood as well as pulse rate, and it provides instant results via a digital screen and audible beep. It is a low-cost, accurate, and easy-to-read device.[28,29]

DELIVERY SYSTEMS

There are several oxygen delivery systems available, and you should choose one based on the flow rate. Oxygen delivery systems are classified as low or high flow (which includes venturi masks). Table 3 displays these delivery systems, as well as the flow rate and approximate fraction of inspired oxygen (FiO2) provided by these devices, to assist in making an appropriate selection.[30] The focus for developing countries is always on providing low-cost, dependable infrastructure. Thus, the World Health Organization (WHO) recommends nasal prongs and nasopharyngeal catheters for low flow rates.[31]

OXYGEN SUPPLY IN POOR RESOURCE SETTINGS

Prosper Edouma Fils et al. developed a novel, cost-effective on-site system for providing medical oxygen using renewable energy sources.[32] They created a system consisting of photovoltaic farm, a alkaline main electrolyzer, auxiliary electrolyzer, and fuel cell used for power. This system supplies 20 m^3 of medical oxygen per day while also generating 600.5 kWh of electrical energy per day.

As evidenced by the COVID-19 crisis, medical oxygen is aprimary health product.[33] The motive of this investigation is to determine when a non-conventional Energy Sources based water electrolysis system for preparation of oxygen in hospitals can compete economically with the current medical gas market. The suggested plant can provide oxygen while also storing energy in the hydrogen form, which represents a novel approach to RES applications.

The consumption of energy and production patterns in a rural and urban areas are influenced because of COVID- 19.[34] It results to rise in demand of energy. It is found that there was shortage of power in month of summer and it is ovserved by maximum health care units. As a result, incorporating non-conventional energies into hospitals is a challenging process for reliably meeting requirement of electricity while emitting less CO_2. In this analysis, the hybrid renewable energy system (HRES) with hydrogen energy storage is simulated to fulfill the energy requirements of every sections and wards in a hospital that diagnosed and treated COVID-19 patients. The oxygen produced by the hydrogen storage system is collected and kept in medical tablets to meet the requiremet of oxygen to the patients. According to the findings, COVID-19 uses 29.64% of the energy consumed annually.

Ali Al-Karaghouli et al. studied the electricity requirement in rural regions of southern Iraq. Authorsuggested a photovoltaic (PV) solar system whih provides the energy to a clinic in this region. The National Renewable Energy Laboratory (NREL) optimization computer model is prefered to calculatewhole system size and also life cycle cost.[35]

The Kyoto agreement, which expresses appreciable concern about change in global climate, states that greenhouse gas emissions, particularly CO_2 from the use of fossil fuels, must be decreased. As per this agreement, emissions must be reduced by available plants. Additionally, there is a considerable attention on implementing effective systems to minimize energy losses. In the group of high efficiency technologies, the fuel cells come into view to be the most encouraging due to their great efficiency and minimal impact on environment. The innovations in fuel systems is first analysed and then simulation of operation of a hybrid fuel cell plant for typical hospital have been carried out in the study reported by G. Bizzarri et.al.[36] The study mainly analysed the energy requirements for hospital using this system.[36]

Similarly, S. Koumi Ngoh et.al. designed and simulated a solar-powered system for ideal provision of green electricity and medical oxygen to hospitals in rural areas that are disconnected from the power grid.[37]

Oxygen supplies are limited in rural developing-country hospitals, making it difficult to detect hypoxaemia. The pulse oximeters and oxygen concentrators may help to act on disease; but, the practical usefulness of such technology requires careful consideration in developing countries.[38]

The potential of crucial non-conventional energy sources (solar and wind) in chosen locations across Nigeria's 6 geo-political regions, has been determined by long-term daily meteorological data.[39] Furthermore, the technoeconomic viability of using diesel/wind/ hybrid photovoltaics with battery storage systems to fulfill the load of a specific village/rural healthcare facility at the chosen areas was evaluated. The system's optimal dimensions are described for each location. This hybrid Optimization Model for Electric Renewable software has been used in the study by L. Olatomiwa et.al.[39]

The Pneumonia is the primary cause of child mortality worldwide. The oxygen (O_2) therapy is required for children having severe pneumonia and hypoxaemia, which is available in very few countries. The Solar powered operated oxygen (SPO_2) is a new technology for discharging therapeutic oxygen in resource constrained settings.[40]

A model is described by D. Peel et.al. to compare the cost optimization of various oxygen technology design systems particularly for health care facilities with irregular power. The comparison is made for facility available to store energy in battery and supply of oxygen. The model with conceptual designs for oxygen storage systems accounts for daily grid power hours, demand of oxygen yearly, cost of systems and lifespan, as well as electricity and maintenance costs.[41]

For various medical oxygen systems, specifications are described and comparison has been reported using a variety of criteria related to poor resource environments. The criterias like available resources, practicability, Technical complications, durability and applicability are considered for comparison. Out of the four design systems, two systems are designed to use available power to produce and store oxygen and other two systems depends upon battery back up at the time of power outage. As per cost optimization model solar system is economical when electrical energy availabilty is less. Again, solar energy effeciency and intensity depends on the location. The grid charged system is excellent when electrical energy supply is more than 10 hours per day and need not to pay more on solar panel and their installation to get solar energy as a power back up. The findings of this study have significance for future research into the modeling, design, and making prototype of alternative oxygen supply facilities for areas with less grid power and little technological and financial resources. It concludes that solar and grid charge system are economical as compare to Ultrox system which is still good for big hospitals with high pateint loads.[42]

The Pneumonia is the primary reason of child mortality worldwide. The oxygen therapy increases survival rates in children with pneumonia. But more deaths occur due to its limited availabilty in many resource-constrained settings. Solar-powered oxygen delivery could be a long-term solution for improving oxygen delivery in remote areas with limited access to compressed oxygen cylinders and reliable electricity. The survey completed in year 2012 shows that only 44 percent health centers or clinics in 12 African countries were getting oxygen on regular basis. The survey completed in year 2008 in Malawi shows that oxygen was not available in 4 out 5 district hospitals. So improvement in oxygen delivery system with proper system and enough capacity is required to save the life.[43]

The use of oxygen concentrators is regular, but their ability to provide uninterrupted oxygen is limited because of the power grid reliability. The continuos supply of oxygen cylinders is common, but they can pose additional logistical challenges. The investigation is carried here about use of a innovative low pressure oxygen storage system to intake maximum oxygen from a concentrator and deliver it to patients or sufferers during an outage. During the trial, 1284 power outages with an average period of 3.1 minutes were observed. Over the course of the study, the low-pressure system delivered oxygen for 56 percent of the 4,295 power outage minutes and covered more than 99 percent of power outage event.[44] Widespread availability of medical oxygen can reduce pneumonia mortality worldwide. Though Oxygen concentrators can be proposed as a solution, but limitations with susceptibility to power fluctuations and failure during outages leads to think another novel and innovative system to survival of the pateints. The oxygen concentrator is a best device and good option for treating children with disease Pneumonia in countries with poor and average economy. But because of irregular power supply can break the oxygen supply and voltage fluctuation leads to damage or shorten of these devices. In the low resource environments, the low pressure oxygen storage system overcomes these limitations. This system was strong, long lasting at least for 2 years without failure. In spite of power outages, the system regularly supplied oxygen, almost equal to treating single child, for 30 days in specific power conditions in Sub-Saharan Africa without need of electric energy or any repair work from skilled operator. Also there was no wear of all these devices.[45]

A solar energy operated oxygen delivery device was planned, modeled, developed and used for children having hypoxemic illness. The solar energy and air is freely available and this system can be located or installed easily in remote location where electrical energy provision is difficult or provision with less quantity. The study prepared a solar powered oxygen delivery (SPO_2) system for hospitals where minimum resources are available to diagnose, treat patients sufering with Pneumonia. The target of new system is to produce oxygen continuously with high relaibility and with 85% purity at volume flow rate 5 litre per minute which is sufficient for 2 children at a time using solar as only source to produce power for new system. The parts like solar panels, battery banks and oxygen concentrator are used here to prepare complete device. This concludes this new system is desirable and reliable to hospitals where minimum resources are available.[46]

Critical pneumonia caused by hypoxemia necessitates oxygen therapy; however, the oxygen supply remains dependable on available resources in poor and average income countries. The Solar energy powered oxygen delivery system is well proven, safe and effective technology for delivery of medical oxygen.[47]

The COVID-19 pandemic[48–53] put enormous strain on the African countries hospitals and health clinic, specifically in rural areas. The inundation of Covid-19 patients caused severe energy shortages in rural healthcare facilities, putting a strain on their running capacities. All the facilities typically use diesel engines power source, and this procces limited governments' ability to address the energy crisis. Maximum people worldwide tries to live in urban areas because of basic amenities like schools, hospitals and water availability. All these amenities are available in urban area because of sufficient electrical energy provision. And due to this there is progress in living standards and social-economical life style. But some countries in Africa are having less hospitals, health clinics and they are poor in social-economical development due to insufficient energy availability. Due to energy problem, Nigeria and some African countries suffered with subsequent waves of pandemic. So instead of using single source of energy hybrid source is better option to avoid high initial cost and irregular supply of power. In a study, A.O. Yakub et.al. modeled, simulated and analysed various configurations such as PV- Diesel and wind-diesel of hybrid energy systems. They finally conclude that PV-Disel device is best option considering initial cost, maintainance and operating cost.[54]

The majority of Africans living in rural areas do not have clean and well founded electricity. This has denied rural residents entry to advanced healthcare services. In a report by T.R. Ayodele et.al., the wind energy and solar energy with hydrogen storage system is studied to fulfill the demand of power in hospitals available in rural areas.[55] The UN development always tries and promots to see everyone healthy, because health care is not a luxury thing but it is fundamental right of every person and they deserves good health care facilities.[55] It has been determined that the proposed non conventional energy microgrid attached with hydrogen storage system is a feasible option for the rural community health clinics. The lack of modern electricity supply has hampered the proper operation of rural healthcare centers, contributing to the country's high maternal and child mortality rates. Examination of stand-alone hybrid renewable energy systems for basic healthcare services in rural areas has been reported where grid energy supply is unavailable or erratic and unreliable.[56] The study makes use of hybrid optimisation software (HOMER) to optimize the technical and economic design and sizing of hybrid electrical power system components such as wind, PV, battery, and inverter.

MEDICAL OXYGEN SUPPLY POST COVID-19

Recently, medical product supply chain operations were tested due to the extreme uncertainties caused by the COVID-19 pandemic.[57] For example, medical oxygen distribution to hospitals necessitates complex decision making due to volatility, which affects both industrial gas manufacturers and healthcare managers. A two-stage stochastic programming (TSSP) formulation is proposed, with inventory decisions serving as the here-and-now variables.[58]

During the COVID-19 pandemic, power supply was critical for keeping hospitals and critical medical equipment operational, as evidenced by increased electricity consumption and new consumption patterns.[59] This work provides policymakers, academics, and researchers with valuable insights into the importance of updating hospital power supply standards, as well as demonstrating the need to electrify remote hospitals.

The increased frequency of natural disasters in recent years, combined with the emergence of COVID-19 and the strain it has put on healthcare services, has necessitated the need to ensure power supply to critical infrastructures. The studies suggests to improve a hospital's energy resilience by installing a microgrid that includes a photovoltaic system and a diesel generator in the energy resilience scenario.[60]

Table 2. Comparison of various oxygen sources.[18]

System	Central oxygen (pipe line system)	Oxygen cylinders	Oxygen concentrators
Power source requirement	No	No	Yes, regularly (100 to 600 W, as per model)
Transport required	Related with oxygen cylinders	Continuously - heavier and high cost to transport	at the time of installation only
Initial costs	significant	Moderate	Moderate
Operational costs	Small to moderate	High	Small
User care	Minimum	Minimum- regular checking leads to reduce fire hazard	Moderate- Proper cleaning of Filters and device exterior reduces fire hazard
Maintenance	Moderate- Checking for pressure leaks using manometers Maintenance/repair of oxygen pipes to avoid leaks and wastage of oxygen Significant: if supply system is on site.	Moderate: checking for pressure leaks with gage	Moderate: checking for low oxygen delivery with analyzer

Table 3. Oxygen flow rate and approximate FiO2 by oxygen delivery systems.[29]

Oxygen delivery Devices	Flow-rate (lpm)	Approximate FiO2
Nasal cannula	1 to 6	0.24 to 0.44
Simple face mask	5 to 8	0.4 to 0.6
Partial rebreathing mask	6 to 10	0.6 to 0.8
Non rebreathing mask	10 to 15	0.9 to 1
Venturi mask	2 to 15	0.24 to 0.6

CONCLUSION

Long-Term Oxygen Therapy (LTOT) is been as effective and efficient solution for the treatment of hypoxaemia and Chronic Obstructive Pulmonary Diseases (COPD). We studied various types of technologies involved in LTOT and also compared them on basis of various factors and conclude that oxygen concentrators are well suitable devices for use in low resource settings. Considering the available variety and need for selecting the most suitable treatment, the choosing and performing should be done as per the prescription of the respiratory physician. Because of irregular power supply can break the oxygen supply and voltage fluctuation leads to damage or shorten of these devices In the low resource environments, the low pressure oxygen storage system overcomes these limitations. Appropriate selection of the oxygen system and oxygen delivery system is to be done depending on the medical condition of the patient. The physician must have knowledge about the devices and their types including the monitoring and should select the device as per the preference of the patient. With developing technology, new devices are getting available in the market, the health and government agencies should focus on the availability of these devices to the patients in low resource settings. Also, the manufacturers must focus on the development of devices with less capital cost and less maintenance and operational cost.

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CONFLICT OF INTEREST

Authors declare that there is no conflict of interest (academic or financial) for publication of this review work.

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