Oxygen Care for Adult and Pediatric Patients Session 5: Device Management (Africa)

Question and Answer - June 24th 2020

For an oxygen concentrator, why is it not possible to have 100% FiO2?

The technology that oxygen concentrators use - they use room air and remove nitrogen, so the highest FiO2, or fraction of inspired oxygen is really low to mid 90s. Specifically, the Pressure Swing Adsorption (PSA) technology used in a concentrator is the limiting factor. The zeolite material does not adsorb 100% of the nitrogen; it means that you will not get 100% Oxygen coming out. The higher the flow, you may get a lower concentration.

Note that sometimes there’s an idea that we need 100% pure oxygen - but it’s not always necessary for the clinical purpose. As oxygen is administered through nasal cannula/prongs or simple masks, for example, ambient air is also being inspired to the patient’s lungs. Not essential in these scenarios to have 100% oxygen - by the time it's inspired it won't be 100% anyways. So the standard of up to 96%, or even between 90-96% with these non-invasive delivery devices should be sufficient for your patient’s needs. Note that for more invasive devices - e.g. CPAPs and intubation - the difference in FiO2 being inspired is more important and we would aim to provide 100% FiO2 in certain circumstances.

Can we use oxygen concentrators in ICUs? Or are they meant for use in non-ICU settings only?

Yes! - you can use an oxygen concentrator in the ICU. This is done frequently.

If you have more than 1 patient that needs oxygen, but just one concentrator - how do you manage that situation? What is the safety of flow-meter splits?

Flow-meter splits are perfectly safe for use in clinical environments - it's something that the WHO recommends as part of an accessory package to oxygen concentrators. From an engineering standpoint, there is not much risk. The only concern is thinking about how long you are running the device, and ensuring that the purity of oxygen you are providing during that time frame is fairly consistent. Example: If you think you are administering 90% oxygen, but there is a problem and you are really delivering 60% oxygen - the consequence is multiplied by the number of patients to whom you were splitting oxygen.

Therefore, before splitting oxygen have your technical teams calibrate and use an oxygen analyzer to confirm that the device is putting out the purity of oxygen that you think it is. Purity level goes down when split across patients, so need to keep in mind concentration of oxygen will drop. See a resource on how to design a flow-meter split on the Learning Resource Centre.

Can oxygen concentrators be used continuously for more than 24 hours? How does ambient temperature affect this?
Yes. Concentrators can run continuously as long as it does not overheat. A concentrator is equipped with temperature sensors. So, if the system heats up it can stop working. But if the concentrator is in a well-ventilated and clean environment it should be able to run for more than 24 hours.

What are your thoughts about using the larger (e.g. 30 LPM) oxygen concentrators to provide oxygen to small clinics?

Great thought about using larger oxygen concentrators (30LPM) in a small clinic. This type of oxygen concentrator is invaluable to rural health facilities, and smaller clinics. However, the complexity increases as it relates to power, maintenance, supply chain (repair and preventive maintenance parts), and training associated with proper use and care of these devices. I think the device is extremely useful, but I’ve also seen too many of these larger oxygen concentrators sitting idle in rural health facilities. These concentrators are also less portable, but some have wheels which makes them easier to move.

What happens if your regulator gauge increases to higher than 2250 PSI?

That is something to be considered at the filling station (oxygen plant) during filling the cylinder; it should not be pressurized above 2250 PSI. Also - full cylinders should not be stored in hot environments / direct sun on hot days. The cylinder may be seen to increase to pressure due to heat.

How can you know/check for leaks?

Many leaks can be heard since the system is under high pressure.

Can you comment on the average lifespan for a concentrator, given there has been a sufficient maintenance schedule? For health centers planning and budgeting for equipment replacement and purchase this would be helpful especially as hospitals prepare during COVID-19.

Oxygen concentrators can last up to 7-10 years with proper care, use, and maintenance. The Zeolite/Sieve tanks mentioned is one of the key components that affect long term use. Most hospitals throw out oxygen concentrators that have reduced oxygen purity. With some technical training, biomed teams can safely, and properly replace the zeolite in the sieve tanks and improve the purity of the output oxygen.

In case you are out of medical oxygen can you use industrial oxygen in order to save patient's life?

No. Medical oxygen is purified. Industrial oxygen does not have the same purity so may cause lung damage.

At what consumption level of cylinders do you say it is better to have an oxygen plant as a more cost-effective alternative?

There is an oxygen consumption calculator on the LRC. You can use this to calculate the oxygen needs for your facility. That will help you decide your needs.
What processes are involved in supply chain management? How much do they cost?
How do you manage essential drugs and equipment in low resource countries? Can you help us understand the key suppliers of oxygen therapy devices?

The answer is that it depends on your institution or facility. Each has its own methods of identifying suppliers of medication and equipment, and personnel in charge of taking care of equipment, ordering equipment, finding the best price, etc. The African Union has just instituted a great resource of African made products, called the African Medical Supply Platform: [https://amsp.africa/](https://amsp.africa/). Please check out the Learning Resource Centre for additional resources - e.g. WHO technical specifications for oxygen concentrators, and oxygen therapy devices, and more. There’s also an oxygen supply and demand calculator - you can type in the source of oxygen, and estimate the amount of oxygen your facility is using. This can help you make decisions on what best supply is most appropriate for your facility, make cost-effective decisions. There is also a nice article on selecting supply options to help you understand what makes most sense for your facility and patients. Many facilities also have equipment committees - a group of individuals at the facility that might need to be on task to calculate needs of facilities and accordingly reach out to the most appropriate suppliers.

**Questions we did not get to:**

1. **What is the difference between 8 lit/ min and 10 lit/min Oxygen Concentrator in terms of (i) management of patient (ii) accessories required such as tubing, nasal cannula, mask (non-rebreather mask)?**
   The oxygen delivery devices such as nasal prongs or masks can be the same. The flow, in liters per minute, depends on the patients’ needs. For a more in depth discussion regarding oxygen delivery devices and oxygen flows used for each device, please see Sessions 1 - 5 on the Learning Resource Center and previous webinar recordings.

2. **How serious a problem are dirty/moldy humidifier bottles?**
   **ANSWER:** Very serious - can cause sickness, should never be allowed

3. **Do people give up using humidifiers because they Don't have access to distilled water and fear infecting patients?**
   **ANSWER:** If distilled water is not available Use clean water, changed daily. Water can be sterilized and distilled by boiling but this must be done without contamination.

4. **Can you provide an overview of the differences/considerations around using industrial oxygen vs. medical oxygen**
   **ANSWER:** Medical oxygen is produced to avoid introducing any contamination. It is pure and will not cause lung damage. Industrial oxygen may have contaminants that lead to lung damage and worse problems for patients.
5. We have some oxygen concentrators, some cylinders and oxygen generator plant on pipe line -- how to make an efficient plan for oxygen for the COVID 19 child and adult patient? How much oxygen is enough for a covid19 Patient with the least risk of hyperoxia?
   ANSWER: These are great questions that were discussed more thoroughly in Sessions 1-4!

6. Is there any risk to keep the cylinder open all the time and the regulator closed?
   ANSWER: Possible leakage and loss of oxygen if the regulator has leaks.