High-Flow Oxygen Therapy Units

EXECUTIVE SUMMARY

This Product Comparison covers oxygen therapy units that noninvasively provide heated and humidified air, air/oxygen, or helium/oxygen gas mixtures at high flow rates. Only standalone systems are included. Individual components sold separately (e.g., air/oxygen proportioners, standard heated humidifiers) and disposable patient interfaces (e.g., nasal cannulas) are not included in this comparison.

High-flow oxygen therapy systems provide air or a mixture of air and oxygen to patients at flow rates that are much higher (24, 40 or even 60 LPM) than a nasal cannula connected to a standard flowmeter (<15 LPM). These systems use an air/oxygen blender supplied by 50-PSI air and oxygen gas lines or an internal turbine device to generate required flow rates. A specialized flow generator and a heated humidifier are incorporated into the unit to deliver heated, humidified gases to the patient through a disposable nasal cannula. The high flow rate generated from the system flood the patient’s nasal cavity with gases at a set fraction of inspired oxygen (FiO2) level, which increases the amount of oxygen delivered to the patient and reduces the likelihood of rebreathing expired CO2. The high flow rates delivered to the patient may also generate a low level of positive pressure at the patient’s airway. In addition, the heated, humidified gases delivered through the system may help to thin the patient’s secretions.

High-flow oxygen therapy systems are commonly used to treat acute respiratory distress (e.g., bronchiolitis) in spontaneously-breathing neonates and infants and in children and adults (e.g., for chronic obstructive pulmonary disease [COPD]). Recently, high-flow oxygen therapy has been used to treat patients suffering from COVID-19. A specialized HFNC system, designed to deliver a mixture of helium and oxygen to patients with severe upper airway obstruction, is also available. The following device term and product code listed in ECRI’s Universal Medical Device Nomenclature System™ (UMDNS™) is covered:

- High-Flow Oxygen Therapy Units [39-557]

These devices are also called: high-flow nasal cannula (HFNC) systems.

Scope of this Product Comparison

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Purpose

High-flow oxygen therapy systems provide air or a mixture of air and oxygen to patients at flow rates that are much higher (24, 40 or even 60 LPM) than a nasal cannula connected to a standard flowmeter (<15 LPM). These systems use an air/oxygen blender supplied by 50-PSI air and oxygen gas lines or an internal turbine device to generate required flow rates. A specialized flow generator and a heated humidifier are incorporated into the unit to deliver heated, humidified gases to the patient through a disposable nasal cannula. The high flow rate generated from the system flood the patient’s nasal cavity with gases at a set fraction of inspired oxygen (FiO2) level, which increases the amount of oxygen delivered to the patient and reduces the likelihood of rebreathing expired CO2. The high flow rates delivered to the patient may also generate a low level of positive pressure at the patient’s airway. In addition, the heated, humidified gases delivered through the system may help to thin the patient’s secretions.

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Principles of Operation

High-flow oxygen therapy units consist of a flow generator, a heated humidifier, a single-limb heated wire circuit, and a disposable patient interface (typically a large nasal cannula).

The flow generator component may be an air/oxygen blender, a built-in turbine, or an oxygen entrainment system. Most standalone HFNC systems use either a medical gas blender or a turbine to generate required flow. An air/oxygen blender supplied with a 50 PSI air and O2 source can deliver gas to the patient at any required FiO2 from 21% to 100%. The blender’s integrated flowmeter can be set to any required flow rate up to 40 or 60 LPM, depending on the model. Turbine HFNC systems use a blower motor to generate air at required flowrates.

Oxygen is added to the generated airflow using a separate O2 source (i.e., O2 flowmeter, tank, or concentrator) to achieve the required FiO2 level.
The humidifier component adds heat and moisture to the blended medical gas mixture before it is sent to the patient. Either disposable water chambers or cartridges are used to transfer moisture to the dry gas after it enters the humidifier. In some models, the humidifier is also the main component of the system. It contains the electronics needed to control and regulate water flow, gas temperatures, and power to the heated wire circuit to ensure that all gas flowing to the patient is at the proper temperature and humidity. This component also includes all required controls, displays, and alarms needed to provide HFNC therapy safely and effectively.

A disposable heated wire circuit, which connects to the humidifier, controls the temperature of the tubing leading to the patient to prevent excessive condensation (rainout) from accumulating. The patient interface for HFNC therapy is a specialized nasal cannula designed to deliver the heated, humidified gas at the prescribed flowrate and FiO2 to the patient.

Manufacturers offer different types and sizes of cannulas designed specifically for high-flow oxygen therapy. Products have a maximum flow rate for each cannula size that matches the patient’s size and age.

Reported Problems

Noninvasive oxygen therapy devices are generally considered safe if properly used. Potential problems can be similar to other types of respiratory support devices, such as CPAP/BiPAP, and noninvasive ventilators, when in use. For patient safety, it is important to set alarms properly, carefully monitor patients, and ensure that water is not allowed to build up in patient circuits, as this can increase the risk of aspiration and of secondary lung infections.

Purchase Considerations

ECRI Recommendations

Included in the accompanying comparison chart are ECRI’s recommendations for minimum performance requirements for high-flow oxygen therapy units.

Minimum recommended flow range capability of the unit is 2 to 40 LPM for adults and 2 to 20 LPM for infants. FiO2 control range should be 21 to 100%. The temperature should be adjustable within a range of 33 to 40 °C (91 to 104 °F). Other required features include heated circuit capability and water level detection.

Alarms should allow quick assessment and correction of the alarm condition. Audible alarms and visual indicators should activate when temperature, water levels, or oxygen levels move outside of set parameters.

Users should look for units that are easy to operate. The primary controls should be located on one side of the unit, and labels and displays should be clear and visible. The controls should be protected against accidental setting changes.

Other Considerations

High-flow oxygen therapy can be provided by standalone devices designed specifically for this purpose (the models discussed in the report), or by building a system using individual components (i.e., flow generator, humidifier with heated-wire capability, and disposable HFNC patient circuits available from various manufacturers). While a custom-built system can function safely and effectively, standalone HFNC systems offer advantages as all components are designed to work together. This can make equipment setup and operation easier and more intuitive for clinicians. Standalone systems may also offer additional alarm capabilities, electronic medical record (EMR) system connectivity, and better service/support coverage compared to custom built systems. For these reasons, facilities that plan to offer HFNC therapy should seriously consider purchasing systems that are specifically designed for this clinical application.

As these systems are relatively inexpensive compared to mechanical ventilators (and in some cases may reduce or eliminate the need to use a ventilator), they are good investments if clinicians in your facility are proponents of HFNC therapy. For patients, HFNC systems offer a number of advantages: a comfortable, noninvasive interface, the ability to communicate while still receiving therapy, and a greatly reduced potential for nosocomial infection (which is common with invasive respiratory support).

Stage of Development

This type of therapy has been in use for more than 20 years and it continues to gain endorsement for use in patients needing additional respiratory support. Although HFNC therapy has traditionally been used with neonatal patients, its use in adults has increased significantly in recent years. In 2020, HFNC therapy has also been recognized as an effective, noninvasive treatment option for some severely ill COVID-19 patients.

BIBLIOGRAPHY


Fisher & Paykel—AirVO 2 Humidifiers: will not deliver flows of air or O2 to patient when line power is lost [Hazard Report]. Accession no. H0257.
