Allied Health Professions

# Oxygen Therapy for Acute Adult Inpatients

## Allied Health Learning Module
## Category 1 and 2

Alberta Health Services
Allied Health Professions

# Table of contents

This document has been reviewed and revised in 2024 by HPSP and subject matter experts to align with updates in clinical practice and documentation norms.

This document has been reviewed and revised in 2019 by HPSP, to reflect the changes in the Oxygen Management Guideline – Allied Health Adult Acute Care Inpatients.

This document has been reviewed and revised in 2015 by an Allied Health provincial multi-disciplinary group to reflect the needs of all areas of the province. It is intended for the use of adult acute care Allied Health Staff across AHS and is based on previous educational material produced in the Calgary Zone.

The original document was developed in 2006 by a group of Calgary Health Region staff including Physical Therapists, Management and Program Facilitators. In 2013 it was reviewed and revised by the Allied Health Educators of the Calgary Zone, AHS.

# Introduction

In compliance with the Oxygen Management – Allied Health Adult Acute Care Inpatients Guideline, this module is designed to provide Allied Health (excluding respiratory therapists) with the necessary knowledge and skills to provide and support safe delivery of oxygen therapy.

Oxygen is an odorless, colourless, tasteless gas constituting one fifth of the earth's atmosphere and is essential to the life of living organisms. Oxygen is also a medical intervention in the prevention and treatment of hypoxia.

Oxygen therapy is an area of patient care where recognition of its need and efficient administration can significantly impact a patient's well-being. Caring safely for patients receiving oxygen therapy is a vital part of Allied Health Practice.

A patient who does not require supplemental oxygen therapy will receive 21% oxygen from the air. This amount of oxygen is adequate as long as the airway is clear, the lungs can exchange gases properly, and there are enough oxygen-carrying components in the blood. The cardiovascular system must be intact and able to circulate blood to all body tissues. If any of these systems fail, higher concentrations of oxygen must be delivered to the patient's lungs. This makes it more likely that adequate levels of oxygen will reach all vital body tissues necessary to sustain life.

Oxygen therapy should be provided continuously unless the need has been shown to be associated only with specific situations (e.g. exercise and sleep). Care should be taken to avoid interruption of oxygen therapy in situations including ambulation or transport for procedures.

**OXYGEN THERAPY IS A MEDICAL INTERVENTION**

Ensure the correct patient, correct flow rate, correct device, and correct connection to an oxygen source. If using a portable system, check sufficient oxygen reserve is available. Without oxygen we cannot live. Without supplemental oxygen therapy, many patients cannot survive.

# Purpose of the Educational Program

This learning module will familiarize the learner with the information necessary to work safely with patients who are receiving oxygen therapy. Participants must successfully complete the theory component of this module by achieving 90% on the qualification quiz. The quiz is open book format. The practical component of oxygen training includes demonstration of the correct application of oxygen therapy.

This module is intended to promote patient safety by enhancing the knowledge and skills of Allied Health staff who care for adult patients receiving oxygen therapy. Discussion and consultation with nursing and respiratory therapy is recommended whenever necessary. This module is not an educational package to ensure competency of health professionals to treat cardiopulmonary patients with chest physiotherapy techniques, or to complete full chest assessments.

The educational program for oxygen therapy has been standardized. It is comprised of four components:

- Oxygen Therapy Learning Module
- Review of Oxygen Management – Allied Health Adult Acute Care Inpatients Guideline
- Qualification quiz
- Practical component

Demonstration and maintenance of competency is done annually by reading the module and completing the quiz. As part of orientation, all staff on initial training are required to do a practical component under the guidance of a local educator or designate. The practical component may be required yearly at the discretion of Allied Health management.

# Who Should Complete This Module

This module is mandatory for the following staff, working in acute care adult inpatient settings.

### Category 1 Staff

- Occupational Therapists
- Physical Therapists
- Speech-Language Pathologists

### Category 2 Staff

- Therapy Assistants

Students of category 1 staff (OT, PT, SLP) and students of category 2 staff (Therapy Assistants) are able to provide oxygen therapy, as set out in the guideline, under the supervision (direct, indirect, or remote) of category 1 staff who have demonstrated oxygen therapy competency. The category 1 supervisor is responsible for determining the competence of the student, with respect to knowledge and skill in providing oxygen therapy and for providing the appropriate amount and type of supervision.[11]

# Learning Objectives

On completion of the learning module, the learner will be able to:

1. Differentiate between ventilation, internal respiration, and external respiration.
2. Identify the major muscles of respiration.
3. Identify factors affecting external and internal respiration.
4. Define hypoxemia and hypoxia.
5. Identify the conditions and indications for oxygen therapy.
6. Identify the dangers, problems and contraindications for oxygen.
7. Identify the normal response to physical activity.
8. Identify the communication components needed for safe assignment of patients with oxygen to a category 2 staff member.
9. Identify the components required for physical assessment/monitoring of patients.
10. Identify the normal adult ranges for vital signs.
11. Identify the signs of respiratory instability/distress and when to obtain assistance.
12. Determine the level of risk for a patient receiving oxygen and differentiate between low, moderate, and high risk.
13. Identify the key elements for oxygen therapy documentation.
14. Identify the different oxygen tanks.
15. Identify the reserve volume in an oxygen tank and safe duration time for use.
16. Understand how to safely fill a liquid oxygen tank.
17. Identify injury prevention measures when working with oxygen.
18. Differentiate between low flow and high flow oxygen delivery systems.
19. Identify different oxygen delivery devices.
20. Define pulse oximetry.
21. Identify the indications for pulse oximetry.
22. Understand the limitations of pulse oximetry.
23. Identify when to access medical assistance.
24. Differentiate between initiating a Code Blue and calling for medical assistance.
25. Understand the importance of the Goals of Care.

# Learning Resources

Resources that will assist the learner in oxygen safety:

**Clinical Leaders and Clinical Educators**

**Policy**

- Use of Portable Oxygen during Transfers – HCS-205

**Guideline**

- Oxygen Management - Allied Health Adult Acute Care Inpatients Guideline
- AHS Emergency Procedures - Code Blue Policy

**Resources**

- Allied Health Provincial Oxygen Learning | Insite (albertahealthservices.ca)
- Prudent Use of Oxygen Therapy | Insite (albertahealthservices.ca)
- Oxygen Therapy - Lippincott Procedures
- Oxygen Titration Quick Reference Tool (albertahealthservices.ca)
- Oxygen Delivery (AGMP Poster) (albertahealthservices.ca)
- Oxygen Therapy in the Hospital (patient handout)
- Oxygen Therapy Resource (albertahealthservices.ca)

**Books:**

Chung,F., Reid,W.D., (2004). Cardiopulmonary Physical Therapy. SLACK Incorporated New Jersey

DeTurk,W.E., Cahalin,L.P., (2004). Cardiovascular and Pulmonary Physical Therapy - An Evidence-Based Approach. McGraw-Hill Companies Inc. USA

Frownfelter, D.L.,Dean, E., (2006). Cardiovascular and Pulmonary Physical Therapy. Mosby Inc.

Kisner,C., Colby,L.A., (1990). Therapeutic Exercise Foundations and Techniques. Davis and Co. Philadelphia PA

# Definitions and Abbreviations

For the purposes of this learning module:

**Absorption Atelectasis** - About 80% of the gas in the alveoli is nitrogen. If high concentrations of oxygen are provided, the nitrogen is displaced. When the oxygen diffuses across the alveolar-capillary membrane into the bloodstream, the nitrogen is no longer present to distend the alveoli, which contributes to their collapse and atelectasis.

**Acute care adult inpatient settings** - include rural and community hospitals, regional hospitals, metropolitan hospitals, and tertiary hospitals.

**Adult** - 18 years or older.

**Artificial Airway** - e.g. tracheostomy tube, endotracheal tube, or nasotracheal tube.

**Category 1 Staff** - professionals who work with adult inpatients requiring oxygen therapy. The following health care professionals are included in this category: Physiotherapists, Occupational Therapists, and Speech-Language Pathologists.[11]

**Category 2 Staff** - health care providers who work with adult inpatients requiring oxygen therapy. The following health care providers are included in this category: Therapy Assistants.[11]

**Chronic Obstructive Pulmonary Disease (COPD)** - is a lung condition characterized by the blockage of airflow in the lungs and associated structures that makes breathing difficult. The disease is progressive and often worsens over time, resulting in breathlessness, fatigue, and a decreased ability to perform activities of daily living. Emphysema and bronchitis are conditions that are considered to be COPD.

**$FiO_2$** - fraction of inspired oxygen.

**Hypoxemia** - a decreased oxygen tension ($Pa0_2$) in the blood below the normal range.

**Hypoxia** - an inadequate supply of oxygen to the tissue or cell.

**Initiate** - place patients/clients on supplemental oxygen, who previously were not on supplemental oxygen.

**LPM** - liters per minute

**Most Responsible Health Practitioner** - means the health practitioner who has responsibility and accountability for the specific treatment/procedure(s) provided to a patient and who is authorized by Alberta Health Services to perform the duties required to fulfill the delivery of such a treatment/procedure(s), within the scope of his/her practice.[11]

**Oxygen Therapy Risk Assessment** - clinical determination of the patient's/client's inability to tolerate interruption of therapeutic oxygen administration.

**$PaCO_2$** - partial pressure of carbon dioxide in arterial circulation.

**Pulse Oximetry** - is the measurement of the oxygen saturation of hemoglobin in arterial blood, with 100% as the maximum reading possible. It is a measure of the average amount of oxygen bound to each hemoglobin molecule.

**Respiratory Acidosis** - a decrease in pH in the blood due to an increase in partial pressure of carbon dioxide in the arterial blood ($PaCo_2$).

**Significant Change** - a variation in values outside of a predefined range, set by an appropriate regulated health professional (e.g., physician, nurse practitioner, registered nurse, respiratory therapist, or category 1 staff). The predefined range will be individual for each patient.

**$SaO_2$** - arterial oxygen saturation of hemoglobin.

**$SpO_2$** - the measurement of functional saturation of oxyhemoglobin. This measurement is obtained non-invasively (i.e. via pulse oximeter).

**Student** - an individual enrolled in an entry-level health care discipline/education program, leading to initial entry-to-practice as a regulated or non-regulated health care provider.[11]

**Titration** - the process of gradually adjusting the dose of oxygen until the desired effect is achieved.

**Valid Oxygen Order** - an order issued by a health professional authorized to provide medication orders within AHS.

# Instruction for Completion

1. **Please do not write in this module**. Record your answers to the self-test on a separate piece of paper.
2. Review the oxygen therapy learning objectives identified on page 6. Note: if this is a re-certification, you can skip to #4 and only review the learning objectives if answers are incorrect.
3. Review each section of the learning module and consult additional cited resources as needed.
4. Complete the self-tests at the end of each section of the module. Compare answers with the information provided in the module. Refer to Appendix A for the answer key. Review sections of the module as needed for clarification.
5. Complete the post quiz “Oxygen Therapy Quiz for Allied Health Category 1 and 2” through MyLearning Link. Print and submit a copy of the completed course page to your clinical educator or designate.

   **Note:** The quiz is open book. The pass mark is 90% (30/33 correct answers). Errors will cue you to review the pertinent information and make corrections.

6. New staff are also required to complete the practical component and the performance checklist (page 69 & 70). Submit the checklist to your clinical educator or designate once completed.

# Section One:
# Respiratory Physiology and Anatomy

## Learning Objectives

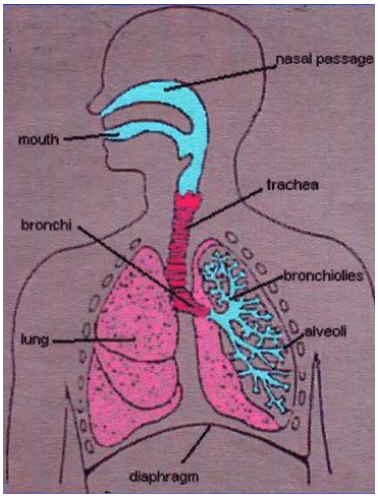
Upon completion of this section, the learner will be able to:

1. Differentiate between ventilation, internal respiration and external respiration.
2. Identify the major muscles of respiration.
3. Identify factors affecting external and internal respiration.

## Respiratory Physiology

Respiration is the exchange of gases between the atmosphere, the blood, and the cells. These are the three processes involved in this exchange:

1. Ventilation – breathing in and out.
2. External Respiration – how the lungs exchange oxygen ($O_2$) and eliminate carbon dioxide ($CO_2$).
3. Internal Respiration – how the cells exchange oxygen and carbon dioxide.




### A. Ventilation – Air in / Air out

This is the movement of air in and out of the body during inspiration and expiration. During inspiration air is drawn in through the nose, mouth, and throat, through the larynx and down the trachea. The trachea then branches into right and left primary bronchus, followed by secondary bronchi that enter both the right and left lobes of the lungs. The bronchi continue to divide, becoming smaller and smaller, very much resembling the branches of a tree, ending at the smallest air passage called the terminal bronchiole. It is here, at the terminal bronchiole, that the tiny air sacs called alveoli are located and where the exchange of gases takes place.

### B. External Respiration – O2 in and CO2 out

This is the exchange of $O_2$ from the alveoli in the lungs, for $CO_2$ from the blood capillaries which surround the alveoli. The thin membranes and the differences in gas pressures on each side of these membranes cause $O_2$ to enter the bloodstream from the alveoli, and $CO_2$ to enter the alveoli from the bloodstream. $CO_2$ is removed from the alveoli when the person exhales.

Efficiency of external respiration depends on several factors. Some of these are:

- Total surface area available for $O_2$ – $CO_2$ exchange: any disease or injury which decreases or obstructs the gas exchange surface area of the lung, decreases the efficiency of external respiration. An example of this would be COPD.

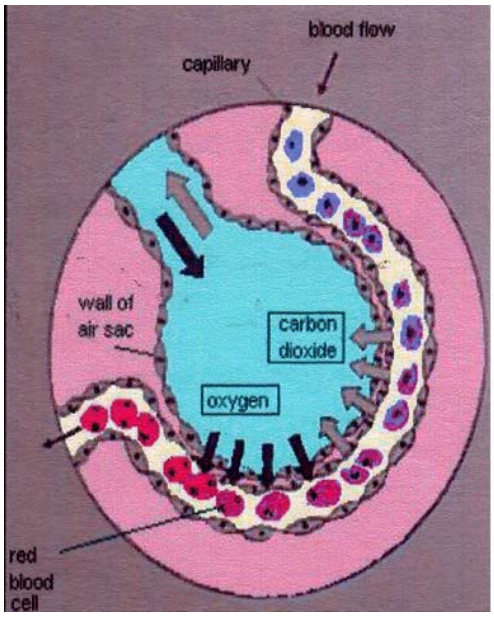
- Minute volume of respiration: minute volume is the total volume of air taken in during a minute of breathing. Slow respiratory rates and/or shallow respirations decrease the minute volume, thereby reducing the efficiency of external respiration. For example, sedative drugs can result in a slower respiratory rate, or respirations may be shallow due to pain from abdominal surgery.

### C. Internal Respiration

This is the exchange of $O_2$ and $CO_2$ between the blood and the cells. Once oxygen diffuses from the alveoli into the capillaries, it binds with the hemoglobin in red blood cells. The oxygenated blood is transported to the left side of the heart via the pulmonary veins, and then pumped throughout the body via the arterial system to the cells. It is in the capillaries that $O_2$ is released from the blood to supply the cells, and $CO_2$ is picked up for elimination.

Factors affecting internal respirations:

- Amount of $O_2$ in the blood
- Medical conditions e.g. anemia
- Loss of blood e.g. trauma
- Impairment of circulation
- Presence of drugs or chemicals that impair cellular $O_2$ exchange




(Reference 6)

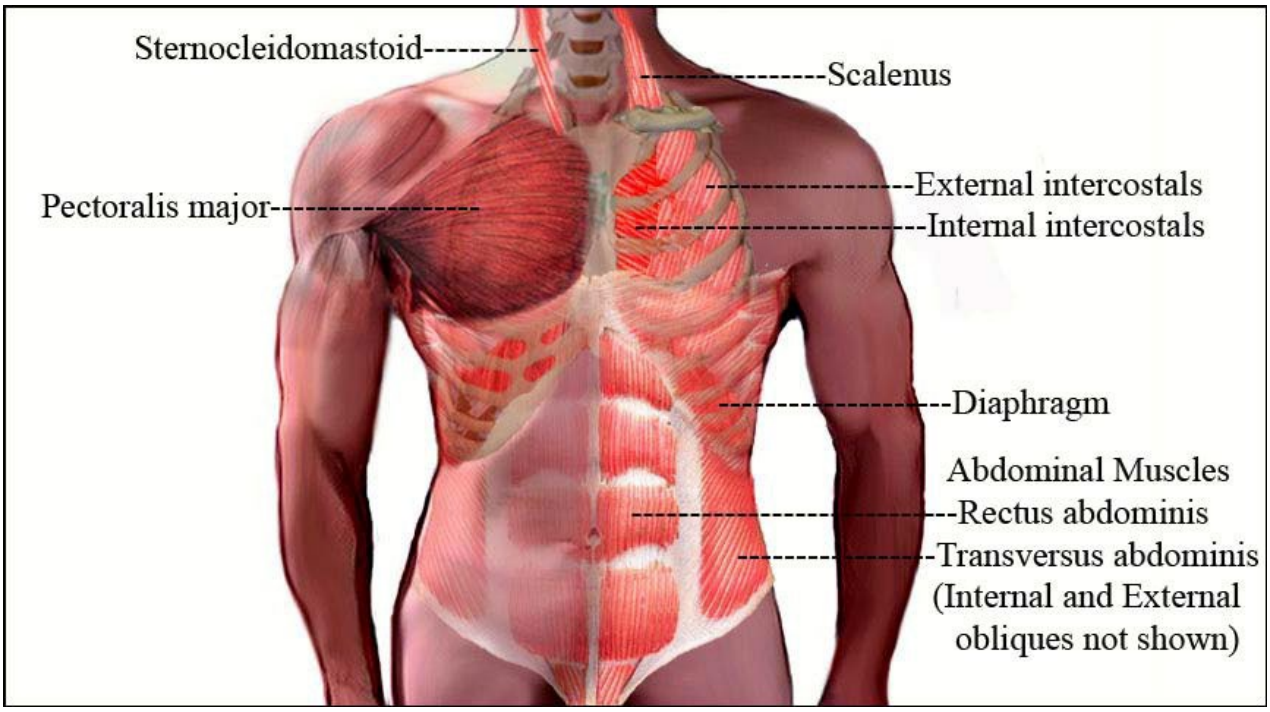
## Respiratory Anatomy

The thorax (chest wall) protects the main organs of respiration and circulation, and the liver and stomach. The posterior thorax is formed by the 12 thoracic vertebrae and the posterior surface of the 12 rib pairs. The anterior thorax is formed by the sternum and the costo-chondral cartilage. The lateral thorax is formed by the ribs.[16] The thorax provides the bony sites of attachment for the muscles of ventilation which mechanically enlarge the thorax for inspiration (breathing in) or compress the thorax for expiration (breathing out).

The diaphragm is the principal muscle of respiration and separates the thoracic and abdominal cavities. During inspiration, the diaphragm contracts to force the abdominal contents away from the thorax (abdomen moves out) and creates more space for the lungs to expand. The intercostals also contract during inspiration, moving the ribs upward and outward. Expiration is achieved through the elastic recoil of the thorax and abdominal wall. During forced deep breathing or labored breathing, many accessory muscles may also contract.

Inspiratory accessory muscles include the scalenes, sternocleidomastoids, upper trapezius, pectoralis major, and erector spinae muscles. Expiratory accessory muscles include the rectus abdominis, transverse abdominis, internal obliques, external obliques and pectoralis major muscles.

Respiratory Muscles (Anterior View)




(Reference 5)

Posterior view not shown – the trapezius muscles form a diamond shaped sheet extending from the head down the back and out to both shoulders. The erector spinae is a large muscle extending from the sacrum to the skull.

For further information on the respiratory muscles please refer to DeTurk Cardiovascular and Pulmonary Physical Therapy – an Evidence Based Approach.[13]

**Self-Test Section One**

1. Respiration is the exchange of gases between the _____, the _____ and the cells.
   A. Atmosphere, Blood
   B. Air, Skin
   C. Atmosphere, Skin
   D. None of the above

2. The principal muscle(s) for respiration is the:
   A. Sternocleidomastoid
   B. Pectoralis major
   C. Diaphragm
   D. Abdominal muscles

3. Normal expiration is achieved through:
   A. Contraction of the pectoralis major
   B. Elastic recoil of the thorax and abdominal wall
   C. Contraction of the sternocleidomastoid
   D. Relaxation of the pectoralis major

# Section Two: Role of Oxygen Therapy in the Acute Care Setting

## Learning Objectives

Upon completion of this section, the learner will be able to:

4. Define hypoxemia and hypoxia
5. Identify the conditions and indications for oxygen therapy.
6. Identify the dangers, problems, and contraindications for oxygen

## Role of Oxygen Therapy in the Acute Care Setting

**Hypoxemia**

Hypoxemia is an inadequate supply of oxygen in the arterial blood. In the acute care setting, the pulse oximeter is used to estimate oxyhemoglobin saturation ($SpO_2$). The most common $SpO_2$ range is 92%-96% but may vary depending on the patient, and the nature of the condition being treated.[12] For example, known $CO_2$ retainers may have an acceptable $SpO_2$ range of 88%-92%; therefore, always refer to individual patient-specific oxygen orders.

Examples of medical conditions that may cause acute hypoxemia:

| | |
|---|---|
| • Asthma<br>• COPD exacerbation<br>• Heart failure<br>• Pleural effusions<br>• Pneumonia | • Pneumothorax<br>• Pulmonary edema<br>• Pulmonary emboli |

Hypoxemia is important as it can lead to Hypoxia.

**Hypoxia**

Hypoxia is an inadequate supply of oxygen to the tissue or cells. Cellular hypoxia occurs when oxygen transport fails to meet the tissue demand for oxygen. This may be due to a problem with the lungs (e.g. airway obstruction, including secretions, foreign objects, or tumors,) hypoventilation due to disease, injury, drugs, or blood flow due to the circulatory system.

Hypoxia secondary to problems with the blood (anemia) or the circulatory system (e.g. decreased cardiac output) responds poorly to oxygen therapy.

**Indications for Oxygen in the Acute Care Setting**

- To treat hypoxemia
- Post-operatively, oxygen may be ordered for a specific time frame and/or flow rate

**Contraindications to Oxygen Therapy**

When indications are present, there are no contraindications to oxygen therapy.

**Prevention of acute hypoxia should be your first priority.**

DO NOT deprive the hypoxic patient of oxygen while awaiting further medical intervention.

**Dangers, Problems, and Complications for Oxygen Therapy**

Oxygen administration can result in detrimental effects in some cases. These include:

- Increased risk of fire
- Specific complications related to $FiO_2$ greater than 50%
    - Absorption atelectasis
    - Oxygen toxicity
    - Depression of ciliary or leukocytic function
- Development of pressure injuries on the patient's head, face, or around the nose
- Oxygen-exacerbated bleomycin pulmonary toxicity

**The goal of oxygen therapy is:**

To achieve an optimal arterial oxygen tension by giving the lowest possible most effective dose of oxygen, while avoiding its potentially toxic effects. For most patients, $SpO_2$ 92% to 96% will achieve this goal.

For patients **known to retain $CO_2$**, a target $SpO_2$ of 88% to 92% may be ordered to prevent further increases in $PaCO_2$.

In circumstances where there is not an oxygen order in place, category 1 health care professionals may initiate oxygen based on their assessment of the patient's condition. **Consultation and an oxygen order for further oxygen therapy shall be obtained as soon as possible.**

**Self-Test Section Two**

1. What is the most common oxygen saturation range ordered for **adult patients**?
   A. 88% - 92%
   B. 90% - 92%
   C. 92% - 96%
   D. 96% - 100%

2. What is the most appropriate oxygen saturation range for **known $CO_2$ retainers**?
   A. 88% - 92%
   B. 90% - 92%
   C. 92% - 96%
   D. 96% - 100%

3. _____ is an inadequate supply of oxygen in the arterial blood.
   A. Hypoxemia
   B. Hypoxia

4. When indications are present, there are no contraindications to oxygen therapy.
   A. True
   B. False

5. Which of the following is **NOT** a complication, problem or danger to consider with oxygen therapy?
   A. Oxygen toxicity
   B. Absorption atelectasis
   C. Decreased risk of fire
   D. Pressure injuries

# Section Three: Activity and Oxygen

## Learning Objectives

Upon completion of this section, the learner will be able to:

7. Identify the normal response to physical activity
8. Identify the communication components needed for safe assignment of patients with oxygen to a category 2 staff member

## Activity and Oxygen

Endurance is the ability to work for a prolonged period of time and resist fatigue. Endurance is dependent on an individual's oxygen transport system which works to supply all muscles with the oxygen required to perform tasks. Many factors influence the oxygen transport system. For this module, the following will be considered:

| System | Function | Normal response to exercise |
|---|---|---|
| Heart | Pumps the blood | Increased heart rate and force of heartbeat |
| Lungs | Transfers the $O_2$ to the blood | Increased respiratory rate and deep breathing |
| Vascular | Transports the oxygen | Increased blood pressure |
| Muscles | Utilize the oxygen | Increased use of oxygen delivered |

An acute care patient may have pathology or be taking medications that will affect their response to exercise. Additionally, the patient may be deconditioned.

Systems affected may include:

**Heart:** the use of heart rate-limiting drugs, decreased blood circulation, or heart disease.

**Lungs:** limited oxygenation in lungs secondary to conditions like pneumonia, COPD, pleural effusions, pulmonary fibrosis, etc.

**Muscle:** decreased available muscle mass makes the body work harder to do the same task.

The deconditioned body responds quickly to exercise to improve heart, lung and muscle function. To start out, a deconditioned patient may be medicated with supplemental oxygen to decrease the stress on the whole body – especially the heart.

## General Considerations[16]

**At no time should a patient be exercising using less oxygen than is used at rest.**

- A patient should be asked why they need to stop exercising. It may be due to muscle cramping caused by increased oxygen demands of the muscles, versus shortness of breath. Although cardiopulmonary factors are considered the most important, skeletal muscle dysfunction has been increasingly recognized as a key factor that contributes to exercise intolerance. The perception of increased leg effort or discomfort is the main symptom that limits exercise in 40-45% of patients with COPD.
- Large bodies will expend more energy (may need more rest or oxygen) than small bodies.[21]
- Recovery after vigorous exercise may take 5-10 minutes or more to return to baseline vitals.

**Oxygen titration and weaning.**

- Titration of oxygen (the process of gradually adjusting the dose until the desired effect is achieved) occurs when the oxygen order provides a range (e.g., 92%-96%) or other instructions for discontinuation. All changes in oxygen flow rate must be documented. The patient must be reassessed 5-15 minutes after the change in $FiO_2$ (fraction of inspired oxygen) or change in flow rate. The new assessment finding(s) must be documented on the chart.
- The Oxygen Titration Quick Reference Tool is designed to support oxygen orders that specify a target range.
- Category 2 staff (Therapy Assistants), who have demonstrated competency, may adjust oxygen and switch between oxygen supply sources for low-risk patients (refer to section 5 for risk levels) under the supervision of a category 1 staff (OT, PT, SLP), who have demonstrated oxygen therapy competency. $O_2$ flow rate and $FiO_2$ may be increased during activity, within the guidelines set by the category 1 staff. These guidelines are patient-specific and need to be documented and communicated to the therapy assistant (TA).[11] The therapist must assess the patient and communicate all the information to the TA before the TA sees the patient.

**Exercise will affect one or more systems.**

- Therapists should set restrictions on areas of compromise for the patients.
- When in doubt, ask.

## Monitoring a deconditioned patient during exertion

| Vital Sign | Findings | What it means | Category 2 (Therapy Assistant) Action to Perform | Category 1 (Therapist) Action to Perform |
|---|---|---|---|---|
| **Heart Rate (HR)**<br><br>Normal Range<br>60 to 100<br>beats per minute<br><br>Measured by<br>cardiac monitor<br>manual pulse check<br>Pulse oximeter<br>(correlated with<br>manual pulse check) | Increased | Normal to a set maximum identified by the therapist | If maximum HR reached, rest patient and monitor HR for 3 minutes. If still at or near maximum, call any category 1 staff or RN | Regulated rehabilitation professionals will use their clinical judgement and assessment skills.<br><br>May require the following interventions:<br>- Stop treatment, let patient rest, and observe vital signs. Once stable, document event<br>- Change position<br>- Change oxygen level and/or delivery system<br>- Contact Nursing and/or Respiratory Therapist<br>- Contact doctor<br><br>Activate the emergency response system at your site – see Sect. 9 |
| | Decreased | Be concerned if lower than set minimum | Call any category 1 staff or RN | |
| | No change | May be on rate control drugs, rate control pacemaker or cardiac transplant patient | Monitor $SpO_2$ and RR closely | |
| **Oxygen Saturation (SpO2)**<br><br>Normal Range<br>95 to 100%<br><br>Measured by<br>pulse oximeter | Increased | Normal after exercise | | |
| | Decreased | Normal within the range specified by therapist | Below the specified range, rest the patient, do breathing exercises, and if required increase oxygen within specified parameters. If saturation does not return to specified range, then call any category 1 staff or RN/RT to assess. | |
| **Respiratory Rate (RR)**<br><br>Normal Range<br>12 to 16<br>breaths per minute<br><br>Measured by<br>manual count | Increased | Normal with exercise to set maximum identified by the category 1 staff | Above set maximum stop activity, encourage slow deep breaths and check $SpO_2$. If too fast or distressed, call any category 1 staff or RN/RT to assess. | |
| | Decreased | Normal if taking deeper breaths | | |

Example: Mr. X

- Must keep his oxygen saturation between 92% and 96%.
- The $O_2$ may be increased from 3 to a maximum of 5 liters per minute during activity
- $O_2$ flow rate should be returned to baseline within 5 minutes after exercise, as long as $SpO_2$ is maintained within established parameters.
- $SpO_2$ should be rechecked at least 10 minutes later.
- $O_2$ saturations must be taken prior to activity, during the activity, immediately post-activity and/or after any change in oxygen delivery. Observe patient for changes to breathing pattern and rate.

All category 1 and 2 staff are expected to check the chart prior to treating the patient. For category 2 staff, if the flow rate of FiO2 (fraction of inspired oxygen) is outside the parameters provided by the category 1 staff, they need to clarify flow rate or FiO2 with the category 1 staff.

## Expectations of the Category 1 Staff Assigning Patients with Oxygen to a Therapy Assistant

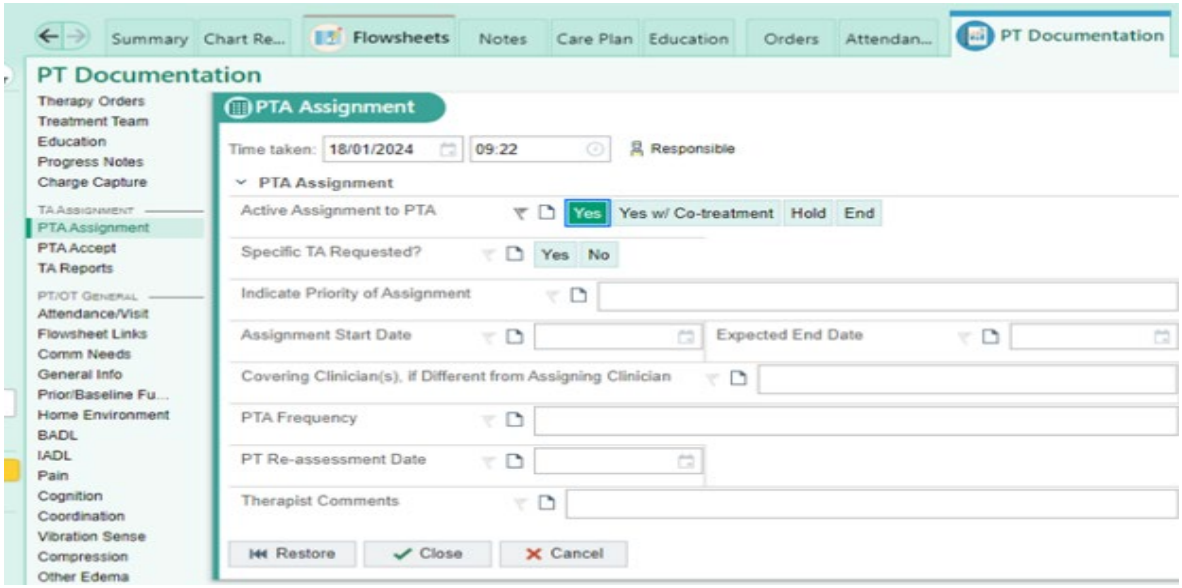
1. **Determine the patient's level of risk** according to the definitions on page 29 of this module.
2. **Determine the activities, location of activity, and parameters for treatment**. Please note:
    - Category 1 clinicians may assign therapeutic tasks to Therapy Assistants (Category 2) for those patients in the low-risk categories to Therapy Assistants (Category 2).
    - Category 1 clinicians may assign therapeutic tasks to therapy assistants (category 2) for medically stable, high and moderate risk patients. In this case, Therapy Assistants may not switch between oxygen supply sources during their treatment and must remain on the patient care unit.
    - There may be circumstances when Therapy Assistants who work in Pulmonary units, Thoracic units or with patients on other patient care units who have oxygen requirements consistent with their chronic high baseline oxygen needs, and who have received specialized training with oxygen sources may, transport patients or work with them away from the patient care unit for stable moderate risk patients. The category 2 staff member must receive direction from the Category 1 staff assessing the patient. That direction will be based on discussion by the Category 1 staff and with approval from the physician or nurse practitioner. Category 1 staff will document the outcome of approval from the physician or nurse practitioner. Category 1 staff will document the outcome of the discussion with the attending physician or nurse practitioner.[11]
    - Therapy Assistants are unable to independently treat patients in the moderate and high-risk category off the patient care unit. They are able, under direct supervision of a category 1 staff, to provide a second set of hands. There may be circumstances when Therapy Assistants who work in Pulmonary units, Thoracic units or with patients on other patient care units who have oxygen requirements consistent with their chronic high baseline oxygen needs, and who have received specialized training may switch oxygen sources, transport patients or work with them away from the patient care unit for stable moderate risk patients. The category 2 staff member must receive direction from the Category 1 staff assessing the patient. That direction will be based on discussion by the Category 1 staff and with approval from the physician or nurse practitioner Category 1 staff will document the outcome of the discussion with the attending physician or nurse practitioner.[11]
    - Provincial and local policies and procedures exist that guide the transportation of patients with respiratory instability or on high flow oxygen away from the care unit. All staff working with these patients must be aware of these policies.
3. **Communicate relevant information to the category 2 staff.**

    This would include the following:

    - $O_2$ LPM or $FiO_2$
    - Level of risk as defined in Guideline HCS-111-01 N.B. Use of Portable Oxygen During Patient Transfers Policy HCS-205 uses only High and Low risk

- $SpO_2$ target range
- Heart rate target range
- Respiratory rate target range
- If flow rate of $O_2$ can be adjusted up or down to maintain specified $SpO_2$
- Max $O_2$ flow rate a patient can be raised to, before the category 1 staff or RN/RT must be called
- Indicate if the $O_2$ is not to be changed
- Frequency of treatment
- Treatment goals (these should be specific and time limited)
- Treatment activity (this needs to be specific, with identified ways to progress)

4. **Perform Clinical Documentation according to discipline standards.**
5. **Document TA Assignment (if applicable)**
    - Use Navigator to, at a minimum, document TA Assignment has been made.
    - Create a progress note with details of TA Assignment relating to Oxygen Management.
    - Tag this progress note as a Treatment Change.



**Self-Test Section Three**

1. The normal response of the heart rate to exercise is:
   A. No change
   B. Decreased
   C. Increases

2. During exercise your patient's heart rate increases to maximum (as set by the therapist). What would you do?
   A. Call immediately for medical intervention
   B. Continue exercise at the same level
   C. Rest the patient for 3 minutes while monitoring heart rate

3. During exercise your patient's respiratory rate increases above the maximum (as set by the therapist). What would you do?
   A. Explain to the patient that increased respiratory rate is a normal response to exercise, while encouraging the patient to continue the exercise program at the same intensity.
   B. Rest the patient, check $SpO_2$ and encourage slow deep breaths.
   C. Encourage patient to continue the exercise program at the same intensity and document the results in the medical chart.

4. What action would you take if during exercise your patients $SpO_2$ decreases below the range set by the physician or nurse practitioner?
   A. Encourage deep breathing while maintaining the current exercise program
   B. Rest the patient. Encourage deep breaths and increase oxygen flow rate if required, up to prescribed maximum.
   C. Change to a less intense exercise and monitor

5. What should the Therapy Assistant do, when they are assigned a client on oxygen and have not been given all the information needed?
   A. Treat the patient and contact the therapist afterwards.
   B. Provide no service and contact the therapist for clarification.

# Section Four: Physical Assessment, Monitoring and Signs of Respiratory Distress

## Learning Objectives

Upon completion of this section, the learner will be able to:

9. Identify the components required for physical assessment/monitoring of patients
10. Identify the normal adult ranges for vital signs
11. Identify the signs of respiratory instability/distress and when to obtain assistant

## Physical assessment and monitoring

All staff need to be able to monitor patients and immediately identify values outside the norm (as defined for the patient), trends in values, and signs of respiratory distress. Measurement and observation of these parameters is to be completed **pre and post** rehabilitation intervention, on all patients receiving oxygen.

- **Respiratory Rate (RR):** Is usually assessed by observing the movement of the chest wall and /or the abdomen. It is very important that the patient is unaware that this measure is being taken and that the health professional does not place their hand on the patient's chest wall or abdomen to take it. If the patient becomes aware, they may alter their RR and an inaccurate measurement will occur. The respiratory rate should increase during exercise.
- **Respiratory Pattern:**
  - Normal Breathing – Upper chest (thoracic) or abdominal (diaphragmatic) pattern.
    - Upper chest – the thorax elevates and expands during inspiration and the abdomen remains relatively motionless.
    - Abdominal – during inspiration the abdomen expands, and the thorax remains relatively motionless.
  - Abnormal Breathing
    - Excessive accessory muscle use - excessive upper chest motion with increased use of the sternocleidomastoid, scalene and other accessory muscles of inspiration.
    - Paradoxical breathing pattern – is the reverse pattern of normal breathing.

- **Oxygen flow rate or Fraction of inspired Oxygen ($FiO_2$):** refer to the section in manual on oxygen equipment.
- **Oxygen delivery device:** refer to the section in manual on oxygen delivery devices.
- **Connection of oxygen delivery device to oxygen source**: refer to the section in the manual on oxygen equipment.
- **Saturation of oxygen by pulse oximetry ($SpO_2$):** refer to the section in the manual on pulse oximetry.
- **Pulse:** In most cases the radial pulse is used. Two or three fingers (not your thumb) are placed just lateral to the flexor tendons on the radial side of the wrist. Gentle pressure is applied and released until the pulse is palpated and counted for 15 seconds. The value is then multiplied by 4 to determine the beats per minute. If the pulse is irregular, count the pulse for the full minute.
- **Blood Pressure (BP):** is not done routinely on all patients.

| Vital Sign | Normal Adult Ranges |
|---|---|
| Respiratory Rate (RR) | 12 to 16 breaths per minute |
| Heart Rate (HR) | 60 to 100 beats per minute |
| Oxygen Saturation ($SpO_2$) | 95 to 100% |
| Blood Pressure (BP) | Approximately 120 systolic; approximately 80 diastolic [23] |

(Reference 5)

## Signs of Respiratory Instability/Distress

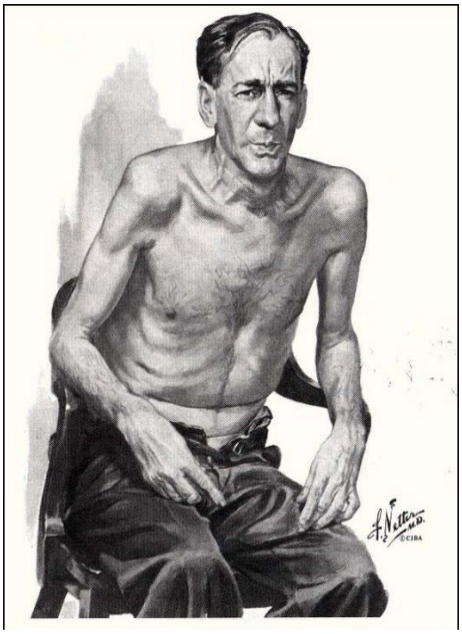
Respiratory instability or distress occurs when the respiratory system cannot eliminate enough carbon dioxide to prevent respiratory acidosis and/or pick up enough oxygen, resulting in hypoxemia.

There are many causes of respiratory instability/distress. Some examples are lung disorders (e.g., COPD or asthma), mechanical disorders (e.g., spinal cord injury or chest trauma), and depression or overstimulation of the respiratory center, caused by drugs, CVA, metabolic issues or head injury.

During rehabilitation treatment there may be an increased demand for oxygen. If this is not readily available, it may lead to respiratory instability/distress.

The signs of respiratory instability/distress include:

- Oxygen Saturation
  - consistently less than the prescribed acceptable range indicated in an order from the most responsible health practitioner or
  - less than 90%, if no range has been identified, on supplementary oxygen.[11]
- Respiratory Rate
  - less than eight or greater than thirty[11]
  - a significant change from baseline respiratory rate as per clinical judgment.[11]
- Colour Changes – A bluish colour seen around the mouth, on the inside of the lips, or on the fingernails, may occur when a person is not getting as much oxygen as needed. The colour of the skin may also appear pale or gray.[25]
- Evidence of excessive use of accessory muscles of respiration, evidence of forced exhalation or increased work of breathing.[11]
- Grunting – A grunting sound can be heard each time the person exhales. This grunting is the body's way to try to keep air in the lungs so they will stay open.[25]
- Nasal Flaring – The nostrils spreading open while breathing may indicate that the person has to work harder to breathe.[25]
- Accessory Muscle Use - Inspiratory accessory muscles include the scalenes, sternocleidomastoids, upper trapezius, pectoralis major, and erector spinae muscles. Expiratory accessory muscles include the rectus abdominis, transverse abdominis, internal obliques, external obliques and pectoralis major muscles. – See illustration.
- Paradoxical Breathing Pattern - the reverse pattern of normal breathing.
- Retractions (Indrawing) – The chest appears to sink in just below the neck and/or under the breastbone with each breath in an attempt to bring more air into the lungs.[25]
- Excessive secretions requiring suction.[11]
- Sweating – There may be increased sweat on the head, but the skin does not feel warm to touch. More often the skin may feel cold and clammy. This may happen when the breathing rate is very fast.[25]
- Wheezing – A tight whistling or musical sound heard with each breath. This may indicate that the air passages may be smaller, making it more difficult to breathe.[2]



*A patient with a diagnosis of COPD. Note the generalized muscle wasting, shortness of breath with pursed lip breathing and use of accessory muscles with a forward-leaning posture.[13]*

## Risk for an Unstable Airway:

A known unstable airway can cause respiratory instability. All of the following can place a patient at greater risk for an unstable airway:

- retropharyngeal abscess,
- laryngospasm,
- smoke inhalation & facial burns from a thermal or chemical injury,
- neck masses,
- epiglottitis,
- inflammation by whatever cause,
- foreign body,
- laryngitis,
- asthma and COPD exacerbations,
- tracheostomy,
- laryngectomy or tracheal stent,
- chest injuries,
- fractured ribs causing hemo & pneumo thoracies.

A patient who is showing signs of respiratory instability/distress is considered to be breathing inadequately and should be treated accordingly. Treatment consists of providing adequate oxygenation and reversing the respiratory instability. If a category 2 staff encounters a patient experiencing one or more of these symptoms, they should immediately stop any activity and notify the nurse, or **any** category 1 staff. The category 1 staff or RN should do an assessment of the situation and treat accordingly. If needed, they should immediately page Respiratory Therapy or **activate the emergency response system at your site – see Section 9.**

Under no circumstances should a patient in respiratory distress, who has not been assessed by a category 1 staff or RN, be sent back to the patient care unit.

**Self-Test Section Four**

1. Match the vital signs with the correct normal adult range:

| | |
|---|---|
| 1. $SpO_2$ | A. 12 to 16 |
| 2. BP | B. 95 to 100 |
| 3. RR | C. 60 to 100 |
| 4. HR | D. Approximately 120 systolic / Approximately 80 diastolic |

2. Which of the following are signs of respiratory distress?

   A. $SpO_2$ consistently less than prescribed range Yes No
   B. Respiratory rate outside the patient's prescribed range Yes No
   C. $SpO_2$ greater than 98% Yes No
   D. Patient struggling to clear secretions (i.e. choking) Yes No
   E. Excessive use of accessory muscles Yes No

# Section Five: Determination of Level of Risk and Documentation

## Learning Objectives

Upon completion of this section, the learner will be able to:

12. Determine the level of risk for a patient receiving oxygen and differentiate between low, moderate, and high risk.
13. Identify the key elements for oxygen therapy documentation.

## Determination of the Level of Risk

The oxygen therapy risk assessment is the clinical determination of the patient's/client's inability to tolerate interruption of therapeutic oxygen administration. It is important that:

- Category 1 staff can determine the level of risk and communicate this to the category 2 staff
- Category 2 staff can differentiate between low, moderate, and high risk

### High Risk

- Patient/client requires **eight liters per minute (8 Lpm) or greater** of oxygen (a lower oxygen requirement may be determined by the site or most responsible health practitioner); or
- Patient/client requires **greater than 50 per cent** concentration of oxygen or
- Patient/client exhibits one or more symptoms of respiratory instability (see page 26), or
- Patient/client requires transition from a heated high flow oxygen therapy system (the integration of heated humidification and a precise blend of air and oxygen delivered via an innovative nasal cannula or tracheostomy interface) for transport away from the unit.

### Moderate Risk: (As per Oxygen Management Guideline HCS-111-01)

- Patient/client requires **six (6) to less than eight (8) liters** of oxygen per minute
- Patient/client requires between **40 and 50 per cent** concentration of oxygen
- Patient/client is receiving oxygen via an **artificial airway** (less than **7 days** post-operatively after artificial airway insertion).[11]

Low Risk:

- Patient/client receiving supplementary oxygen who do not meet the criteria for high or moderate risk.

Other policies and procedures exist that guide the transportation of patients with respiratory instability or on high flow oxygen away from the care unit. All staff working with these patients must be aware of these policies.

After demonstrating competency, category 2 staff may adjust oxygen or switch between oxygen supply sources for low-risk patients under the supervision of a category 1 staff member, who has demonstrated competency in oxygen therapy.

Category 2 staff **must not** adjust or switch between oxygen supply sources for **moderate and high-risk** patients. Category 2 staff may work with **moderate and high-risk** patients on the patient care unit, providing they don't adjust oxygen or switch between oxygen supply sources during their treatment, and the category 1 staff has deemed the patient medically stable.[11]

Category 2 staff are **unable** to independently treat patients in the **moderate and high-risk category off the patient care unit**. They are able, under direct supervision of a category 1 staff, to provide a second set of hands.

There may be circumstances for Therapy Assistants who work in **Pulmonary units, Thoracic units or** with patients on other patient care units who have oxygen requirements consistent with their **chronic high baseline oxygen needs** and who received specialized training may:

- Switch oxygen sources for stable high risk patients
- Switch oxygen sources, transport patients or work with them away from the patient care unit for stable moderate risk patients

In both of these cases above, the category 2 staff member must receive direction from the category 1 staff assessing the patient. This direction will be based on discussion by the category 1 staff and with approval from the physician or nurse practitioner. Category 1 staff will document the outcome of the discussion with the attending physician or nurse practitioner.[11]

## Documentation for Patients/Clients Receiving Oxygen Therapy

Assessment and documentation of oxygen administration will include oxygen flow rate or $FiO_2$, the oxygen delivery device, and the connection of oxygen delivery device to oxygen source.

Initiation and all changes to the FiO2 or flow rate shall be documented by all disciplines.

The $SpO_2$ (where monitors are available), vital signs and respiratory assessment (including respiratory rate, and abnormal patterns of respirations) are obtained and documented on the progress record as follows, for all patients:

- Before and 5-15 minutes after an $FiO_2$ change or change in $O_2$ flow rate
- When the patient's condition changes
- Prior to and post transport of patients, away from the patient care area, for diagnostic or therapeutic procedures
- After connection/reconnection to a portable oxygen delivery system
- Before and after any intervention that may have an impact on oxygenation

Allied Health documentation must occur at least once per rehabilitation visit. This applies whether the patient is treated in the rehabilitation department or the patient care unit. Documentation must include all necessary content as outlined in the Oxygen Management - Allied Health Adult Acute Care Inpatients Guideline, the AHS charting guidelines and Connect Care standards.

Timing of the documentation process is best approached from the perspective of two scenarios –

- The patient's condition is as expected, and no changes need to be made
- The patient's response is not as anticipated

Where the patient's condition and response to treatment are within the expected parameters, documentation is completed as soon as possible and no later than the end of the shift. The actual time of treatment should be recorded within the note.

Where the patient's condition and response to treatment are outside of the expected parameters, documentation should occur as soon as possible - ideally immediately. Also, other healthcare providers must be informed as required.

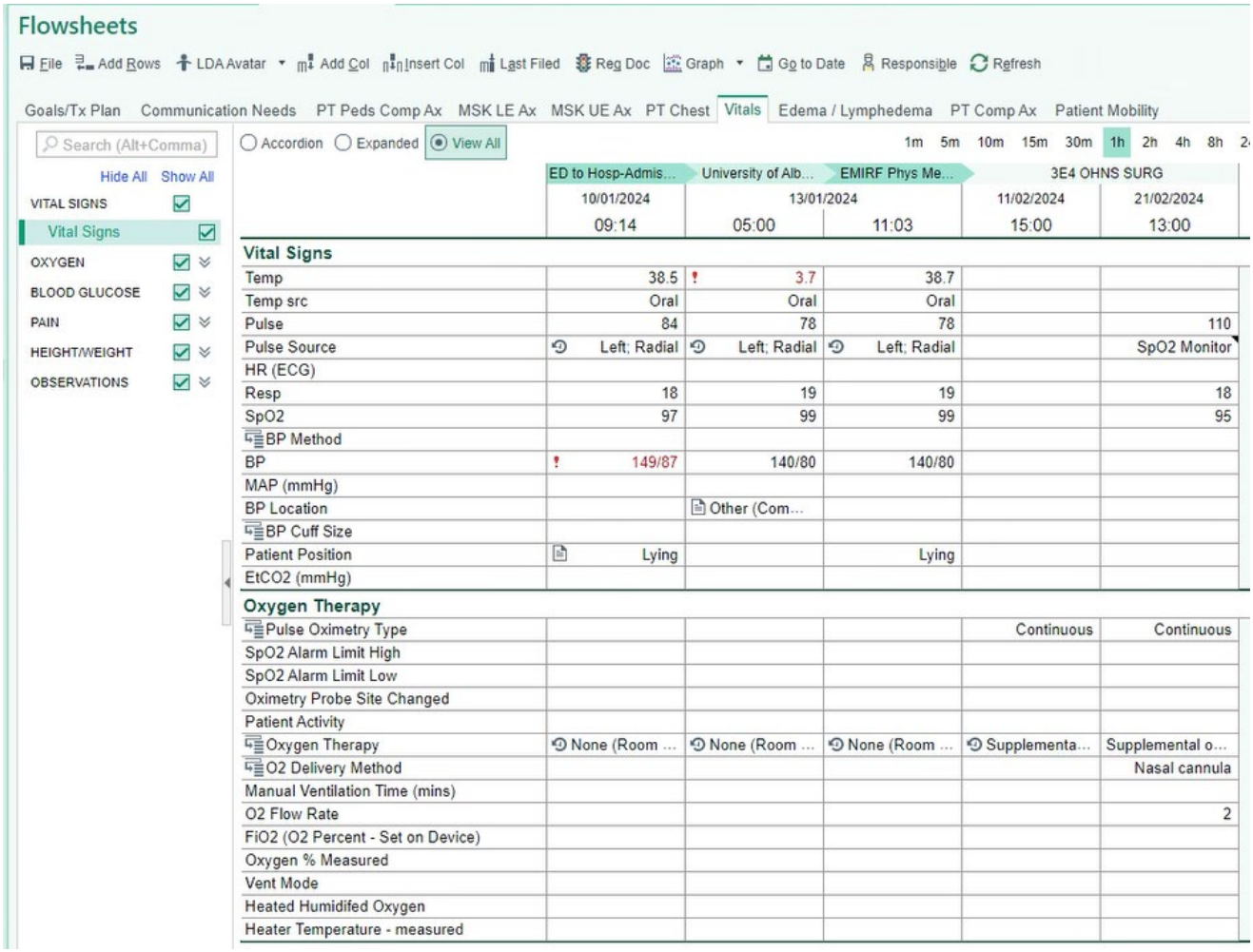
Depending on the zone, program and facility, documentation may occur on a flow sheet or a multi-disciplinary progress note. Documentation may be in the electronic medical record (Connect Care) or paper as per downtime procedures.

# Examples of Connect Care Documentation

Vital signs documented in notes only are not readily available to the interprofessional team. Therapists are encouraged to document these values on the vital signs flowsheet.

Once vital signs are entered, clinicians should immediately document in the progress note. Delays may result in vital signs documented by others being incorporated into their progress note.

## Vitals Signs Flowsheet



Flowsheets

File | Add Rows | LDA Avatar | Add Col | Insert Col | Last Filed | Reg Doc | Graph | Go to Date | Responsible | Refresh

Goals/Tx Plan | Communication Needs | PT Peds Comp Ax | MSK LE Ax | MSK UE Ax | PT Chest | Vitals | Edema / Lymphedema | PT Comp Ax | Patient Mobility

Search (Alt+Comma) | Accordion | Expanded | View All | 1m 5m 10m 15m 30m 1h 2h 4h 8h

Hide All Show All

VITAL SIGNS
Vital Signs
OXYGEN
BLOOD GLUCOSE
PAIN
HEIGHT/WEIGHT
OBSERVATIONS

| | ED to Hosp-Admis... | University of Alb... | EMIRF Phys Me... | 3E4 OHNS SURG | |
|---|---|---|---|---|---|
| | 10/01/2024 | 13/01/2024 | | 11/02/2024 | 21/02/2024 |
| | 09:14 | 05:00 | 11:03 | 15:00 | 13:00 |
| **Vital Signs** | | | | | |
| Temp | 38.5 | ! 3.7 | 38.7 | | |
| Temp src | Oral | Oral | Oral | | |
| Pulse | 84 | 78 | 78 | | 110 |
| Pulse Source | Left; Radial | Left; Radial | Left; Radial | | SpO2 Monitor |
| HR (ECG) | | | | | |
| Resp | 18 | 19 | 19 | | 18 |
| SpO2 | 97 | 99 | 99 | | 95 |
| BP Method | | | | | |
| BP | ! 149/87 | 140/80 | 140/80 | | |
| MAP (mmHg) | | | | | |
| BP Location | | Other (Com... | | | |
| BP Cuff Size | | | | | |
| Patient Position | Lying | | Lying | | |
| EtCO2 (mmHg) | | | | | |
| **Oxygen Therapy** | | | | | |
| Pulse Oximetry Type | | | | Continuous | Continuous |
| SpO2 Alarm Limit High | | | | | |
| SpO2 Alarm Limit Low | | | | | |
| Oximetry Probe Site Changed | | | | | |
| Patient Activity | | | | | |
| Oxygen Therapy | None (Room ... | None (Room ... | None (Room ... | Supplementa... | Supplemental o... |
| O2 Delivery Method | | | | | Nasal cannula |
| Manual Ventilation Time (mins) | | | | | |
| O2 Flow Rate | | | | | 2 |
| FiO2 (O2 Percent - Set on Device) | | | | | |
| Oxygen % Measured | | | | | |
| Vent Mode | | | | | |
| Heated Humidifed Oxygen | | | | | |
| Heater Temperature - measured | | | | | |

## Progress Note

Grana, Pasha-Pt, PT
Physiotherapist
Rehabilitation - Allied Health

Progress Notes
Signed

Date of Service: 21/02/2024 13:00

**PT Notes**

**S.** Patient arrived in the department for PT Treatment Patient had no complaints of breathlessness.

**O.** Patient was on 2 liters per minute (lpm) oxygen (O2) by nasal prongs on a portable oxygen cylinder,

| | 21/02/2024 13:00 |
|---|---|
| **Vital Signs** | |
| Pulse | 110 |
| Pulse Source | Right;Radial |
| Resp | 18 |
| SpO2 | 95 % |
| **Oxygen Therapy** | |
| Pulse Oximetry Type | Continuous |
| Oxygen Therapy | Supplemental oxygen |
| O2 Delivery Method | Nasal cannula |
| O2 Flow Rate | 2 L/min |

Post treatment: SpO2 on 2 lpm O2 after exercise 95%, HR 110, RR 18 5 minutes post exercise

**A.** Respiratory assessment completed and oxygen cylinder checked for adequate oxygen upon arrival and before transportation back to the patient care unit. Patient ambulated with a 4 wheeled walker 10 meters X 2 repetitions. Patient requires one person standby assist to ambulate. Patient tolerated ambulation well.

**P.** Exercise program reviewed with patient and repetitions increased. Patient stopped ambulating due to leg fatigue. Treatment to continue.

Patient will be seen by Therapy Assistant 5x a week to continue with the above ambulation and exercise program. Patient will be seen by Physiotherapist Monday and Wednesday next week to review and revise exercise and ambulation program.

**Self-Test Section Five**

1. Therapy Assistants may switch between oxygen supply sources for:
   A. Low risk patients
   B. Moderate risk patients
   C. High risk patients
   D. Low and moderate risk patients

2. Match the level of risk – low, moderate and high with the amount of oxygen being received.
   A. 8 liters of oxygen — Low
   B. Less than 6 liters of oxygen — Moderate
   C. Between 40 and 50% concentration of oxygen — High

3. Documentation for patient receiving oxygen therapy will include the following:
   A. Oxygen delivery device (i.e., nasal prongs) — Yes No
   B. Oxygen flow rate of $FiO_2$ — Yes No
   C. Oxygen source — Yes No
   D. $SpO_2$ (if monitor is available) — Yes No
   E. Respiratory rate — Yes No

# Section Six: Oxygen Equipment

## Learning Objectives

Upon completion of this section, the learner will be able to:

14. Identify the different oxygen tanks
15. Identify the reserve volume in an oxygen tank and safe duration time for use
16. Understand how to safely fill a liquid oxygen tank
17. Identify injury prevention measures when working with oxygen

## Oxygen Equipment

### Oxygen Cylinders

Oxygen cylinders (e.g., Grab'nGo) are made from steel or aluminum and hold compressed oxygen at 2000-2200 psi (pounds per square inch). A pressure regulator reduces the 2000-2200 psi cylinder pressure to about 50 psi. The flow meter controls the rate of oxygen delivery to the patient.

The safe residual pressure for an oxygen cylinder while actively being used is 500 psi. An oxygen tank should never be allowed to run dry and should be changed at 500 psi.

The Grab'nGo systems operate ONLY when positioned at the flow rates marked on the flow adjusting knob. The flow rates are marked in liters per minute. Refer to page 45 for flow rates.[22] If the flow rate your patient is on is not available on the Grab'nGo, select the next highest level available. For example, a patient is on wall oxygen at 2.5LPM. The only option on the Grab'nGo is 2 or 3; therefore, choose 3 LPM if no other portable system is available. Remember when they go back on wall oxygen at 2.5LPM they need to be monitored to ensure they can tolerate the decrease in oxygen. See Section 3 for details. For high flow rates, if the correct setting is not available on the oxygen tank, any change in flow rates should be discussed with the respiratory therapist or attending physician and documented.

Some sites have oxygen cylinders that need to have a regulator attached before use. Refer to page 46 for details.

### Liquid Oxygen Units/Tanks

Use of liquid oxygen is not best practice due to cost and risks associated with use. Liquid tanks are measured by weight. To determine the amount of oxygen in a liquid tank, grasp the strap closest to the content indicator, approximately 6 inches above the tank. Lift the unit off the floor. The needle, on the indicator, is spring loaded and will move when the tank is lifted. Repeat 3 times to get an average reading. The needle in the green area indicates the amount of oxygen available. The needle in the red area indicates a new oxygen source is needed.

If you find a liquid oxygen tank not working, remove it from circulation and report it to the patient care unit so it can be sent for maintenance as per site policy.

### Tanks with Low Capacity Alarm Function

If these are available at your site, you must recognize the implications of an activated low capacity alarm and act accordingly (refer to page 47 for an example). Replace the portable oxygen cylinder with a cylinder containing more oxygen or change the oxygen delivery system to a wall outlet if available.

### Portable Oxygen Safety

Improper handling of portable oxygen can create a potentially unsafe work area. Improper handling of a portable oxygen cylinder can convert it into an unguided missile with enormous destructive power. If the oxygen cylinder is punctured, or if a valve breaks off, the results can be lethal. Oxygen cylinders (E-size) should always be transported in a cylinder (tank) holder and never lying on a bed or stretcher. Oxygen cylinders and liquid oxygen canisters are to be secured to prevent tipping and falling. Liquid oxygen tanks must be transported upright. Placing a liquid oxygen tank on its side will lead to leakage of liquid oxygen, which will cause skin burns and corrosion of building materials (such as laminate floors or tiles). Liquid oxygen tanks must never be placed on a patient's lap or beside them on a stretcher. This can result in frostbite to the patient.

Instruct the patient and family in the following safety measures as appropriate: [9]

- Do not use oxygen in the presence of an open flame.
- Do not smoke around oxygen.
- Do not wear synthetic fabrics that can build up static electricity.
- Do not apply oils and petroleum products to the patient's face.
- Do not allow the oxygen tubing to become tangled as this may result in kinks cutting off the oxygen supply.
- For patients entering Acute Care facilities with their own oxygen equipment, assess the environment to ensure liquid oxygen storage is available in a well-ventilated area, away from direct heat or sunlight and properly grounded. If storage racks are not available lay compressed gas oxygen cylinders flat when storing them.

### Points of Emphasis

- Under no circumstances should a patient be sent from or back to a patient care unit with a low/empty portable oxygen source.
- A portable oxygen source should be assessed for the amount of oxygen, before and after treatment, to ensure adequate supply. A patient must always be provided with enough oxygen to last for the treatment time, porter wait time, transportation time, and any delays after returning to the unit, before being returned to the wall supply.
- If there is an inadequate supply, replace with a full tank.
- Always test that the system is intact, and you can feel flow coming out of the nozzle when turning the oxygen tank on.
- Prior to reattaching to the wall outlet, ensure the proper oxygen flow rate.
- Always ensure the correct flow rate is set on the portable oxygen source. If your patient is on 2.5 LPM and the tank gauge has settings for 2 LPM or 3 LPM, you would place them on 3 LPM for the duration of using the tank. Remember when they go back onto wall oxygen at 2.5 LPM they need to be monitored to ensure they can tolerate the decrease in oxygen. See Section 3 for details.
- An additional source of oxygen should be available for all high-risk patients.

If a patient arrives in the department or is found on the unit connected to an empty tank, complete a Patient Safety Learning Report through the Reporting and learning System (RLS) after ensuring the patient has a new oxygen tank.

To determine oxygen duration using the Grab'nGo oxygen tank, refer to the chart on the next page. For example:

- If the needle is at 1800 psi, and your patient is on 3 liters per minute flow, the tank will last approximately 136 minutes.
- If the needle is at 800 psi, and your patient is on 3 liters per minute flow, the tank will last only 31 minutes.

# New All-In-One Portable Oxygen Cylinder

## Praxair Vantage Grab'nGo

**Never** search for a cylinder regulator again!

**Never** worry about removing or attaching a cylinder regulator again!

**No cylinder wrench?**
No problem, you won't need one!

Available flow rates of **0.5 to 25 LPM**. Other flow rates available with respiratory or physician consult.



**NEVER** attach an oxygen connector (Christmas tree) to the Auxiliary Port!

### How to Use the Grab'nGo Portable Oxygen Cylinder:

- Ensure adequate amount of oxygen **(check pressure gauge)**
- Attach $O_2$ tubing to outlet port
- Turn flow-adjusting knob to desired flow setting
- Verify flow at the patient's end of the tubing before applying on patient
- When patient is returned to wall oxygen, ensure flow-adjusting knob is turned to the **"OFF"** position

### Flow Rates Available on the Grab'nGo (Litres Per Minute)

| 0.5 | 1.0 | 1.5 | 2.0 | 3.0 | 4.0 | 6.0 | 8.0 | 15 | 25 |
|---|---|---|---|---|---|---|---|---|---|

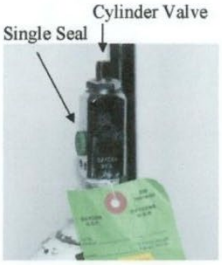
### E-Size Oxygen Cylinder Duration Chart (in Minutes)

| | Cylinder Pressure (PSI) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Flow (LPM) | 2200 | 2000 | 1800 | 1600 | 1400 | 1200 | 1000 | 800 | 600 | 500 |
| 0.5 | 1066 | 941 | 815 | 690 | 565 | 439 | 314 | 188 | 63 | 0 |
| 1 | 533 | 470 | 408 | 345 | 282 | 220 | 157 | 94 | 31 | 0 |
| 1.5 | 355 | 314 | 272 | 230 | 188 | 146 | 105 | 63 | 21 | 0 |
| 2 | 267 | 235 | 204 | 172 | 141 | 110 | 78 | 47 | 16 | 0 |
| 3 | 178 | 157 | 136 | 115 | 94 | 73 | 52 | 31 | 10 | 0 |
| 4 | 133 | 118 | 102 | 86 | 71 | 55 | 39 | 24 | 8 | 0 |
| 6 | 89 | 78 | 68 | 57 | 47 | 37 | 26 | 16 | 5 | 0 |
| 8 | 67 | 59 | 51 | 43 | 35 | 27 | 20 | 12 | 4 | 0 |
| 15 | 36 | 31 | 27 | 23 | 19 | 15 | 10 | 6 | 2 | 0 |
| 25 | 21 | 19 | 16 | 14 | 11 | 9 | 6 | 4 | 1 | 0 |

When you first use the Grab'nGo, tear off the lower section of the label to indicate the cylinder is now in use. Once the tank reaches 500 psi, tear off the IN USE section of the label to indicate that the tank is now empty.

## How to attach a regulator to an oxygen cylinder

- Identify the oxygen cylinder.
- Check that the label says "USP MEDICAL OXYGEN".
- If the cylinder has not been used before it will have a green tab covering a seal around the outlet.
- Remove the tab by pulling it sharply forward and one green seal should remain around the outlet.




- Place the wrench on the cylinder valve and turn it counter-clockwise just enough (usually less than 45 degrees) to allow gas to escape for less than 1 second and then close the valve before attaching the regulator. This is done to expel foreign material from the outlet port of the valve.
- If the cylinder is already in use, only **one** green seal should be present. Remove any other seals including any seals attached to the regulator.
- The regulator has two pins on it.
- The cylinder post has two matching holes.
- Place the regulator over the stem of the cylinder and line up the pins with the holes.
- Hand tighten the handle of the regulator as much as you can to get a good seal, but don't use a wrench.

To turn cylinder on

- Place the wrench on the cylinder valve and turn it counter-clockwise until it is fully open, then back it off ¼ turn.
- Observe the cylinder pressure gauge. A full cylinder will read about 2200 psi.
- Check the cylinder duration chart to ensure that there is enough oxygen to last as long as you require (see below).

Duration chart for compressed gas portable oxygen cylinders
*calculation assumes that cylinder is empty 500 psi*

| Set Flow | 2200psi (full) | 1600psi (3/4 full) | 1100 psi (1/2 full) |
|---|---|---|---|
| 2 LPM | 4 hours | 2 hours 30 min. | 1 hour 25 min |
| 3 LPM | 2 hours 50 min | 1 hour 45 min. | 56 min. |
| 4 LPM | 2 hours | 1 hour 15 min. | 42 min. |
| 5 LPM | 1 hour 30 min. | 1 hour | 34 min. |
| 6 LPM | 1 hour 20 min. | 51 min. | 28 min. |
| 7 LPM | 1 hour 10 min. | 44 min. | 24 min. |
| 8 LPM | 1 hour | 39 min. | 21 min. |
| 9 LPM | 53 min. | 34 min. | 19 min. |
| 10 LPM | 48 min | 31 min. | 17 min. |
| 11 LPM | 43 min. | 28 min. | 15min. |
| 12 LPM | 40 min. | 26 min. | 14 min. |
| 13 LPM | 37 min. | 24 min. | 13 min. |
| 14 LPM | 34 min. | 22 min. | 12 min. |
| 15 LPM | 32 min. | 21 min. | 11 min. |

- Turn the handle to obtain the desired flow rate.

To turn cylinder off

- Place wrench on cylinder valve and turn clockwise until off.
- When the needle in the pressure gauge is at zero, ball in flow litre gauge will fall to zero. Turn flow litre control knob to off.
- Tear off the lower section of the label to indicate that the cylinder is "IN USE".


- A cylinder should be changed when the pressure gauge reaches 500 psi and enters the 'red zone'. To indicate the cylinder is "EMPTY", tear off the remaining section of the label.

**Cylinders should be stored upright, secured in a stand or lying horizontally (DO NOT store under the Total Care beds).**

Reference: Airgas Product and Service Information Manual.
FDA and NIOSH Public Health Notification: Oxygen regulator Fires Resulting from incorrect use of CGA 870 Seals April 24 2006.

# EZ-OX Plus™

## OXYGEN USP

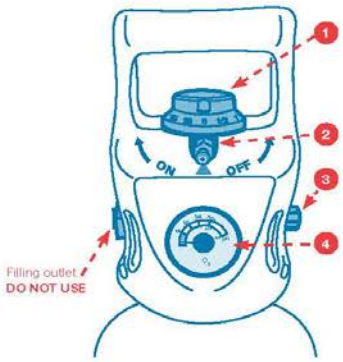
### Valve instructions

**Before use check:**
- The pressure gauge to 4 confirm contents

**Connect according to use**
- Connect the tube to the nipple outlet 2
- Or connect the appropriate equipment to the 50 psi DISS connection 3

**Using the cylinder**
- Adjust the dial 1 to the required flow rate if the nipple outlet 2 is used
- Ensure there is a flow

**After each use**
- Turn the cylinder off by setting the flow rate to 0 litre/min (dial 1)
- Remove the tubing 2 or the equipment 3 if necessary




**WARNING : If the dial is set between two flow rate values, the flow will stop 2**
**WARNING : Operate regulator in temperature range of -18 °C to +49 °C**

### Handling

- Keep cylinder, regulator, all equipment, and connections free of oil, grease, or other combustible materials at all times.
- Use only accessories (ie nasal cannula, masks, hoses etc) which are intended for and cleaned for oxygen services.
- DO NOT smoke in the area where oxygen is in use. Oxygen enriched environments may ignite causing personal injury or property damage.
- Never store system near heat or open flame, or in extreme cold conditions.
- Inherently, portable oxygen systems are subject to more abuse than stationary units. Care must be taken to minimize the abuse a portable oxygen system endures to ensure the accuracy and longevity of your system. One should avoid jarring or dropping systems as this may cause damage to the unit. If a system is jarred, dropped or knocked over, it should be checked to ensure connections are secure, components are not damaged, and that the proper flow rates are maintained.
- Always turn oxygen systems on slowly and ensure system is secured.
- Do not attempt to disassemble or repair the regulator or cylinder. In the event of leakage return the regulator and cylinder to your supplier.
- Do not move the regulator or cylinder during MRI scanning.
- Do not expose the regulator to corrosive substances (e.g ammonia).
- Use in MRI static field setting of less than or equal to 3 Tesla.

### Storage & Maintenance

- DO NOT attempt to service or remove regulator from the cylinder. Improper servicing of product may create conditions for the regulator or cylinder to propel with great force.
- Systems should be stored where they will not fall over or be subjected to damage from objects falling on or against them.
- Systems should be stored in a sheltered location to protect them from the elements and excessive moisture.
- Never store system near heat or open flame, or in extreme cold conditions.
- When the flow knob is set to 0, if any hissing sound can be heard indicating a leak, remove the cylinder from service, place it in a well ventilated area, and tag and return it for repair.
- If cover or knob is damaged, any leakage noticed, if knob does not turn or grinds — return cylinder.
- Oxygen system will be tested at a minimum every 5 years by VitalAire (inspection date will be applied after testing).

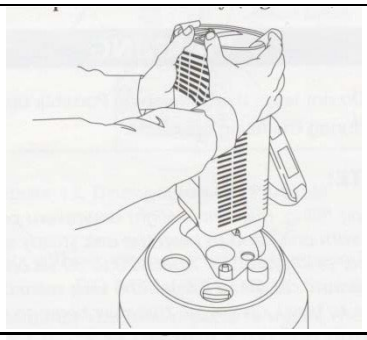
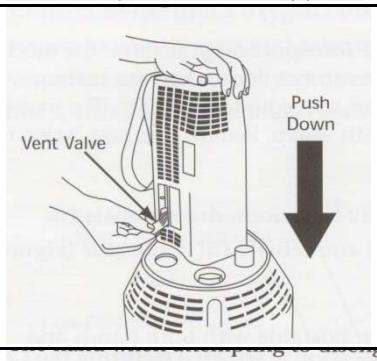
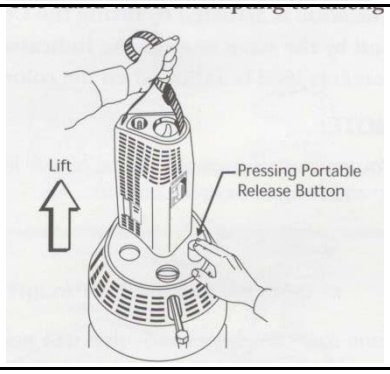
VitalAire AIR LIQUIDE Medical

Distributed by:
Air Liquide Medical,
a division of VitalAire Canada Inc.
6990 Creditview Road Unit 6,
Mississauga, ON L5N 8R9

# A Guide to Portable Liquid Oxygen Units

## Filling the portable unit

*In acute care settings, best practice requires the use of thermal gloves and eye protection while filling portable liquid oxygen units.

| | |
|---|---|
| 1. Clean and dry the fill connectors on both the stationary and portable units to prevent freezing. Hold the portable unit with both hands and position the contoured case over the matching recessed area on top of the stationary reservoir. Ensure that the fill connectors are properly engaged. Place one hand on top of the portable, directly over the fill connector and press straight down. The portable will lower a further 10 mm into place. |  |
| 2. While still holding the portable down in the fill position, open the side vent valve. A loud hissing sound will occur. This will continue until the valve is closed. Filling the portable completely should not take longer than two minutes. An irregular hissing sound will occur when the unit is full. You may also note that there is a white cloud of liquid oxygen around the reservoir. Close the valve when this occurs as the unit is full. |  |
| 3. Disengage the portable from the stationary reservoir by holding the carrying strap above the unit and depressing the release button. Place portable unit upright on the floor. There will be some 'steam' at the bottom of the portable unit – this is normal. To weigh contents: with one hand, grasp the strap closest to the contents indicator, about six inches from portable. The needle will move into the green area on the content indicator. Repeat 3 times for an average reading. |  |

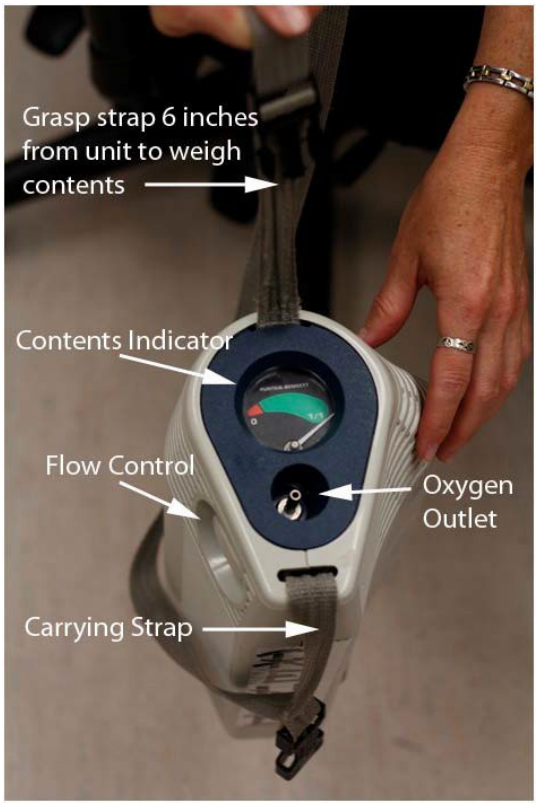
- It is very important to connect the portable liquid unit all the way down onto the reservoir and hold it there while filling.
- If the portable sounds like it's filling, but the hissing sound slowly fades within a minute, you have not held the portable down all the way. Reconnect the portable and try again.
- If the portable makes a hissing sound and seems like it is leaking after its been filled, this is normal. The pressure relief valve is releasing pressure from excess filling.
- If the portable is leaking, it will vent immediately.

- The portable unit may make a 'honk' sound if knocked over or picked up suddenly. If the 'honking' continues after being placed upright, it should be considered faulty and should not be used. If the unit is found lying down and is not 'honking', it should be sent for maintenance according to site process.

| Troubleshooting the portable oxygen system | | |
|---|---|---|
| **Problem** | **Cause** | **Solution** |
| Portable unit not filling | Unit has become disengaged from the reservoir | 1. Push portable down to secure it onto the reservoir.<br>2. Make sure the vent valve lever is open. |
| Unit has been filled but no oxygen is coming out | Unit is frozen due to excessive filling | 1. Allow the unit to sit at room temperature until it thaws.<br>2. If the problem persists once the unit is thawed, it is considered faulty and should not be used. |
| Portable unit cannot disengage from the reservoir after filling procedure | Unit is frozen onto valve. This can happen after filling numerous portables in a row. Allow 15 minutes between filling portables. | 1. Make sure the vent valve is in the closed position and let sit for 15-20 minutes to thaw.<br>2. Do not attempt to pull off or you will break the lip seal on the portable. |
| Filling valve on the reservoir is frosted or very wet | Reservoir has just been filled or more than 1 portable has been filled | 1. Wipe excessive moisture with a lint free cloth.<br>2. Use as required once the fill valve is dry. |

### Safety

- Keep the unit away from electrical equipment or sources of heat
- Keep flammable materials away from unit
- Always turn unit off when not in use
- Liquid oxygen is extremely cold -300F (-184 C). Liquid oxygen, or parts of the equipment that have been in contact with liquid oxygen, can cause frostbite.
- If the unit is turned over, oxygen will escape
- Liquid oxygen units should be transported in such a manner that they do not come into direct contact with the patient and must be in an upright position, at all times, to prevent leakage




| Approximate use time of a FULL portable liquid oxygen tank | |
|---|---|
| **Flow control knob setting** | **Approx. use time** |
| 1 | 15.5 hours |
| 1.5 | 11 hours |
| 2 | 8 hours |
| 2.5 | 6.5 hours |
| 3 | 5.5 hours |
| 3.5 | 5 hours |
| 4 | 4 hours |
| 5 | 3 hours |
| 6 | 2.5hours |
| 8 | 2 hours |
| 10 | 1 hour |
| 15 | 0.5 hours |

(References: 4, 7)

The approximate use time will vary depending on the size of your liquid oxygen tank. Please refer to the chart at your site for approximate use times.

To determine oxygen duration using the liquid oxygen tank, refer to the chart above.

For example:

- If the needle is at the far right of the green area, the tank is full.
- If your patient is on a flow rate of 2 liters per minutes, a full tank will last approximately 8 hours.
- If the needle is in the middle of the green area and your patient is on a flow rate of 2 liters per minutes, the tank will last approximately 4 hours.

## Self-Test Section Six

1. An oxygen cylinder should be changed when the gauge reads?
   A. 800 psi
   B. 500 psi
   C. 1000 psi
   D. 100 psi

2. Why should oxygen cylinders be handled with care?

| | | | |
|---|---|---|---|
| A. | Costly to repair | Yes | No |
| B. | Injury to patient/staff may occur | Yes | No |
| C. | Can become an unguided missile with enormous destructive power | Yes | No |

3. If a portable liquid oxygen tank is set at 2 LPM, what is the approximate use time for a full tank?
   A. 8 hrs
   B. 6.5 hrs
   C. 5.5 hrs
   D. 2 hrs

4. Your patient arrives in the treatment area on 4 LPM and the liquid portable tank is half full. Is there sufficient oxygen supply for the patient to receive 30 minutes treatment and 15 minutes travel time?
   A. Yes
   B. No

5. The oxygen tank has a choice of 2 or 3 liters per minutes flow rate, your patient is on 2.5 LPM via nasal prongs, what would you set the oxygen flow rate to?
   A. 2 liters per minute
   B. 3 liters per minute
   C. 4 liters per minute

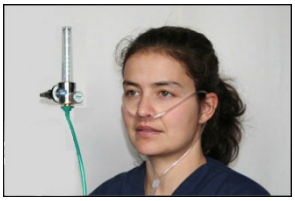
# Section Seven: Oxygen Delivery Devices

## Learning Objectives

Upon completion of this section, the learner will be able to:

18. Differentiate between low flow and high flow oxygen delivery systems
19. Identify different oxygen delivery devices

## Oxygen Delivery Devices

| Low Flow or Variable Oxygen Concentration Devices | | |
|---|---|---|
| These devices provide variable oxygen concentration (fraction of inspired oxygen = FiO2). Concentration cannot be guaranteed. It is influenced by the patient's rate and depth of breathing. | | |
| | **Flow rate** | **Point of interest** |
| **Nasal prongs/cannula**  | 1-6 LPM | Ensure nostrils are not blocked. (Effectiveness is decreased with deformity, secretions, silastic or NG tubes). Tubing colour is clear. Flow is adjusted to meet a target $SpO_2$. |
| **High flow nasal prongs/cannula**  | Typically 7-15 LPM | Used for patients who require higher flows to adequately oxygenate but cannot tolerate face mask for long periods. Tubing colour is usually green. May be used at lower flow rates in emergency, when regular nasal prongs are not available. |
| **Simple oxygen mask**  | 5-10 LPM<br>Never less than 5 LPM to prevent re-breathing $CO_2$ | Not recommended for long term use or when changing levels of oxygen. |

| Low Flow or Variable Oxygen Concentration Devices | | |
|---|---|---|
| | | |
| | **Flow rate** | **Point of interest** |
| **High Concentration Oxygen Mask with Reservoir**<br>  | Generally 10 LPM<br><br>Flow rate is set to ensure the reservoir bag remains at least 2/3rd inflated during inspiration. | The reservoir bag provides for extra oxygen when the patient breathes faster or deeper.<br>Ensure the reservoir bag remains partially inflated during inspiration. |

| Interfaces used with High Flow Devices | | |
|---|---|---|
| **Aerosol mask with or without tusks** | **Tracheostomy mask or collar** | **Face tent** |
|  |  <br><br>Can be used with a venturi device for short term application (i.e., patient transport). Other than for the purpose of transport, must be used with a cold nebulizer or high flow nebulizer. |  <br><br>Used for patients who find a mask claustrophobic, have burns to the face or have facial/nasal surgery.Use with a cold nebulizer. |

| High Flow or Fixed Oxygen Concentration Devices | | | |
|---|---|---|---|
| These devices meet all of the inspiratory demands of the patient and therefore, provide fixed oxygen concentrations. Concentration is precise and constant, regardless of the patient's breathing pattern. | | | |
| | **Oxygen concentration** | **Flow rate** | **Point of interest** |
| Venturi device  | Available in 24% (blue)<br>28% (yellow)<br>31% (white)<br>35% (green)<br>40% (pink)<br>50% (orange) | = 2 LPM<br>= 4 LPM<br>= 6 LPM<br>= 8 LPM<br>= 8 LPM<br>= 12 LPM | The minimum flow rate for a particular oxygen concentration is stamped on the bottom of each venturi adapter. |
| Cold nebulizer  | 28%, 30%, 35%, 40%, 50%, 70%, or 100%<br><br>The dial on the neck of the nebulizer gives the $O_2$ concentration. | 10-15 LPM | The nebulizer unit attaches directly to the oxygen flow meter. Adjust the oxygen flow meter so that mist is visible exiting the mask during inspiration.<br>Adjust the venturi opening on top of the nebulizer by turning the collar to the desired oxygen concentration.<br>At settings above 50%, the flow delivered by the device will be diluted by the patient's inspiratory efforts lowering the effective $FiO_2$.<br>**Do not use for transport.** |
| High flow oxygen with heated humidity via nasal prongs or trach interface   | 30% - 100% | 10-60 LPM | Special education and training is required for this device. Patients who may benefit include those with: high oxygen requirements, high inspiratory flow demands, retained secretions, poor compliance with high flow oxygen delivery via an aerosol mask, hypothermic core body temperature.<br>**Do not use for transport.**<br>This device may be referred to as "Optiflow". |

(References 8, 9, 10, 15)

**There may be other oxygen delivery devices used at your site. Please contact Nursing or Respiratory Therapy for further details on a specific device.**

**Self-Test Section Seven**

1. Regular Nasal prongs are used for flow rate up to _____ LPM for adults.
   A. 6
   B. 8
   C. 4
   D. 3

2. Match the oxygen delivery device to the most appropriate statement/photo.

| Answer (A, B, or C) | Device | Statement/Photo |
|---|---|---|
| | High Concentration Oxygen Mask with Reservoir | A. Should not exceed 6 LPM |
| | Regular Nasal Prongs | B.  |
| | High Flow Nasal Prongs | C. Used for patients that require higher flows to adequately oxygenate, but cannot tolerate a face mask for long periods of time. |

# Section Eight: Pulse Oximetry

## Learning Objectives

Upon completion of this section, the learner will be able to:

20. Define pulse oximetry
21. Identify the indications for pulse oximetry
22. Understand the limitations of pulse oximetry

## Pulse Oximetry

**Pulse oximetry** is a measure of how well oxygenated the hemoglobin in arterial blood is. It is used in conjunction with other assessment tools (see section 4) to help assess a person's ability to tolerate physical activity such as exercising, feeding, chewing and swallowing.

A **pulse oximeter** measures a person's pulse (in beats per minute) and estimates the arterial oxygen saturation of hemoglobin (in percent) through a sensor typically clipped to a finger but is also effective on the toe; different sensors are available for the earlobe or bridge of the nose.

The sensing device detects changes in oxygen saturation level by monitoring light signals generated by the oximeter and reflected by the blood through the tissue at the probe site. As the oxygen saturation changes, so does the amount of light absorbed.

**A pulse oximetry reading, in and of itself, is not a reliable indicator of oxygenation status** and must be done in conjunction with clinical assessment. This includes, but is not limited to, appearance, respiratory rate, depth of ventilation, peripheral circulation, and blood pressure. See Section 4: Physical Assessment and Signs of Respiratory Distress.

What does a pulse oximeter measure:

- The oxygen saturation of hemoglobin in arterial blood, with 100% as the maximum reading possible. It is a measure of the average amount of oxygen bound to each hemoglobin molecule.
- Pulse rate is measured in beats per minute, averaged over 20 seconds.

A pulse oximeter gives no information about the following:

- The amount of hemoglobin in the blood.
- The amount of oxygen dissolved in the blood.
- The cardiac output or blood pressure.

A pulse oximeter also gives no indication of a patient's ventilation, only of their oxygenation. It can give a false sense of security, if supplemental oxygen is being given. In addition, there may be a delay between the occurrence of a potentially hypoxic event, and a pulse oximeter detecting low oxygen saturation. Pulse oximeters rely on adequate perfusion to function effectively.

Pulse oximetry readings correlate closely with the oxygen saturations obtained by arterial blood gases, when the $SpO_2$ (saturation of oxyhemoglobin) level is above 70%. **Oxygen saturation values below 70%, obtained by pulse oximetry, are unreliable.**

**Advantages of measuring blood oxygen saturation by pulse oximetry:**

- Non-invasive
- Inexpensive
- Easy to tolerate
- Allows continuous measurement

**Indications**

- To obtain baseline data and data trends, during intervention and post intervention
- To detect a patient at possible risk of hypoxemia
- Symptoms of respiratory distress
- Monitoring and adjusting $O_2$ therapy
- During invasive procedures
- Following anesthesia
- During exercise

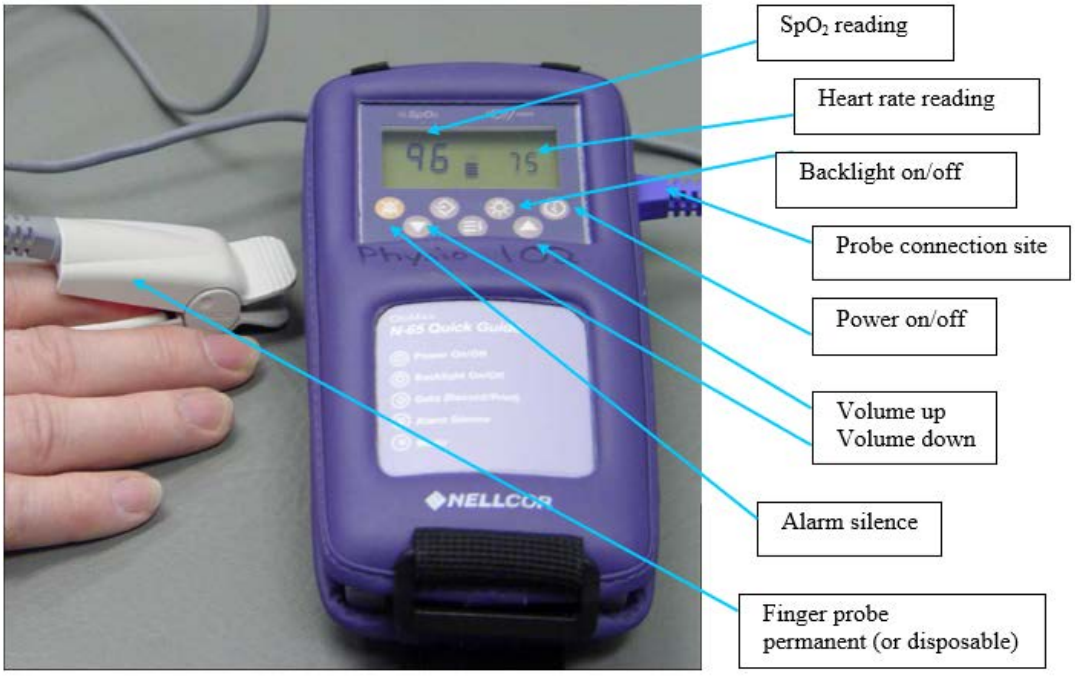
**Limitations**

- Pulse oximeters vary in accuracy, especially at saturations < 70%.
- Poor perfusion to the extremities makes it difficult for the sensor to lock onto a pulsatile artery.
- Ambient light may enter the space between the sensor and the finger, affecting the optics of the oximeter and give a false low reading.
- Skin pigmentation (dark skin) may cause an over estimation of oxygen saturation, at saturations below 80%.
- Acrylic nails and nail polish lower the saturation reading.
- Movement that occurs with tremor, shivering or patient transport, may mimic vascular pulsations and result in an inaccurate reading.
- Cold hands or feet may cause a poor signal and lead to an inaccurate reading.
- False high readings are obtained from smokers and anyone who is exposed to carbon monoxide. A falsely high reading may be produced up to 4 hours after smoking a cigarette.[19]

**Clinical Points of Interest**

- Therapists should be aware of the trends in changes of the $SpO_2$ reading and be able to identify and record factors that cause increases and decreases in the individual patient's $SpO_2$.
- Post treatment it should be noted whether improvements in $SpO_2$ are maintained.
- The target $SpO_2$ for individual patients may be different and may depend on the patient's pathology. The medical chart should be checked for a specified $SpO_2$ goal or range.
- Is the pulse oximeter reading correct? The reading can be correlated with other measures as follows: palpation of radial pulse, heart rate reading on the monitor, signal quality indicator on the monitor (shown as 1, 2, or 3 bars with increasing quality).
- The finger probe and device should be cleaned according to AHS Infection Prevention and Control and Manufacturers recommendations.
- If the patient has a BP cuff on their arm, ensure the pulse oximeter is placed on the arm without the BP Cuff.

## The Pulse Oximeter




Instructions for operating the functions are usually located on the front or back of the oximeter. For your site follow the manufacturer's user manual.

(References: 1,9, 14, 17, 18, 19)

## Clinical Implications – Review

- A clinician can obtain a baseline pulse rate and oxygen saturation level and then compare them when the person is engaged in physical activity (such as exercise, feeding, chewing, and swallowing).
- Generally, readings between 95 and 100% are considered normal, however the target $SpO_2$ for individual patients may be different and may depend on the patient's pathology. The medical chart should be checked for a specified $SpO_2$ goal or range.
- A downward trend from the baseline may be a sign of fatigue, increased work of breathing, or aspiration. During feeding and swallowing, a drop in $SpO_2$ may suggest possible aspiration.[24] NB: There is inconsistent evidence that pulse oximetry can reliably determine the occurrence of aspiration events during feeding and swallowing. Clinical decisions should not be based solely on information obtained from this procedure.
- Levels below the target $SpO_2$, or 90% if no range has been identified and on supplementary oxygen-may be life threatening.
- Ensure the pulse oximeter is reading correctly.

**Self-Test Section Eight**

1. What does pulse oximetry estimate?
   A. Arterial oxygenation saturation of hemoglobin Yes No
   B. Amount of hemoglobin Yes No
   C. Pulse rate Yes No
   D. Blood pressure Yes No

2. Below what percentage, is the pulse oximetry reading unreliable?
   A. 88%
   B. 80%
   C. 85%
   D. 70%

3. You would know the pulse oximeter was reading correctly when?
   A. Correlates with respiratory rate
   B. Patient is able to talk normally
   C. Correlates with pulse

# Section Nine:
# Allied Health / Rehabilitation Services Acute Care Sites Emergency Response

## Learning Objectives

Upon completion of this section, the learner will be able to:

23. Identify when to access medical assistance
24. Differentiate between initiating a Code Blue and calling for medical assistance
25. Understand the importance of the Goals of Care

**Calling for Medical Assistance** is required for any of the following:

- Any patient you are seriously worried about
- Respiratory rate less than 8 or greater than 30
- Signs of respiratory instability (see section 4)
- Acute Change in $O_2$ Sats less than 90 despite $O_2$ greater than 5LPM
- Heart rate less than 40 or greater than 140
- BP systolic less than 90 or greater than 200 or acute drop in systolic blood pressure
- Sudden decrease in level of consciousness or Glasgow Coma Scale drops greater than 2 points
- Seizures

## Indications for calling a Code Blue

- Any person experiencing acute physiological compromise, airway threat, respiratory and/or cardiac arrest.

**Please refer to your site-specific guidelines to learn your code blue policy and how to activate the emergency response system in your facility.**

In cases of acute respiratory distress, category 1 and 2 staff may initiate oxygen therapy (i.e., place the patient on supplementary oxygen), or increase flow rate, while awaiting further medical direction unless the oxygen order specifically prohibits initiating oxygen or increasing flow rate.

Staff working with patients away from the patient care unit must be aware of the patient's goals of care designation at all times.

## Goals of Care documentation

Patients who have discussed and decided upon a Goals of Care designation will have the goals of care documented in the electronic and or paper chart. While on hospital property, the goals of care designation in the chart is the "source of truth". When a patient is away from the patient care unit, and in an area to which the code team does not respond, during a medical emergency, EMS will need evidence of the patient's Goals of Care designation to treat appropriately. The green sleeve (where available) is the universally identified container for Goals of Care documentation in the community and becomes the source of truth for Goals of Care designation. EMS will look for this green sleeve when responding to a medical emergency.

**Self-Test Section Nine**

1. You would call a Code Blue when:
   A. No pulse Yes No
   B. Respiratory rate 16 Yes No
   C. No breathing Yes No

# Appendix A – Self Test Answer Key

**Section 1**

1. A
2. C
3. B

**Section 2**

1. C
2. A
3. A
4. A
5. C

**Section 3**

1. C
2. C
3. B
4. B
5. B

**Section 4**

1. 1 - B, 2 - D, 3 - A, 4 – C
2. A - Yes, B - Yes, C - No, D - Yes, E – Yes

**Section 5**

1. A
2. Low - B, Moderate - C, High – A
3. A - Yes, B - Yes, C - Yes, D - Yes, E - Yes

**Section 6**

1. B
2. A - Yes, B - Yes, C - Yes
3. A
4. A
5. B

**Section 7**

1. A
2. 1 - B, 2 - A, 3 - C

**Section 8**

1. A – Yes, B – No, C – Yes, D – No
2. D
3. C

**Section 9**

1. A – Yes, B – No, C – Yes

# Appendix B – Quiz

1. COPD patients may have an acceptable oxygen saturation of 88%
   A. True
   B. False

2. Every patient needs to have $SpO_2$ greater than 92%
   A. True
   B. False

3. What action would you take if during exercise your patient's heart rate increases to maximum (as set by the therapist)?
   A. Continue exercise at the same level
   B. Rest the patient for 3 minutes, while monitoring heart rate
   C. Call immediately for medical intervention

4. During exercise your patient's $SpO_2$ decreases below the range set by the physician or nurse practitioner. What would you do?
   A. Rest the patient, encourage deep breaths and increase the flowrate if required, up to prescribed maximum
   B. Encourage deep breathing while maintaining the current exercise program
   C. Change to a less intense exercise and monitor

5. During exercise your patient's respiratory rate increases above the maximum (as set by the therapist). What would you do?
   A. Rest the patient, check $SpO_2$ and encourage slow deep breaths
   B. Explain to the patient that increased respiratory rate is a normal response to exercise, while encouraging the patient to continue the exercise program at the same intensity
   C. Encourage patient to continue the exercise program at the same intensity and document the results in the medical chart

6. Match the vital signs with the correct normal adult range.

| | |
|---|---|
| 1. $SpO_2$ % | A. 12 to 16 |
| 2. BP | B. 60 to 100 |
| 3. Respiratory Rate per minute | C. 95 to 100 |
| 4. Heart Rate per minute | D. approximately 120 systolic / 80 diastolic |

7. Therapy Assistant may switch between oxygen supply sources for:
   A. High risk patients
   B. Moderate risk patients
   C. Low and moderate risk patients
   D. Low risk patients

8. Match the level of risk – low, moderate and high - with the amount of oxygen being received.
   A. Less than 6 liters of oxygen — Moderate
   B. 8 liters of oxygen — Low
   C. Between 40 and 50% concentration of oxygen — High

9. Documentation for patients receiving oxygen therapy will include the following:
   A. Oxygen delivery device (e.g., nasal prongs) — Yes No
   B. Oxygen flow rate or FiO2 — Yes No
   C. $SpO_2$ if monitor is available — Yes No

10. What should the Therapy Assistant do, when they are assigned a patient on oxygen and have not been given all the information needed?
    A. Treat the patient and contact the therapist afterwards.
    B. Contact the therapist as soon as possible for clarification and provide no service until further information is received.

11. Signs of respiratory instability that require immediate attention include the following:
    A. $SpO_2$ consistently less than prescribed range Yes No
    B. $SpO_2$ greater than 98% Yes No
    C. Respiratory rate less than prescribed range Yes No
    D. Patient struggling to clear secretions (i.e., choking) Yes No
    E. Excessive use of accessory muscles Yes No

12. Why should oxygen cylinders be handled with care?
    A. Costly to repair Yes No
    B. Injury to patient/staff may occur Yes No
    C. If damaged can become an unguided missile with enormous destructive power Yes No

13. If a portable liquid oxygen tank is set at 3 LPM, what is the approximate use time for a full tank?
    A. 8 hrs
    B. 6.5 hrs
    C. 5.5 hrs
    D. 2 hrs

| Approximate use time of a FULL portable liquid oxygen tank | |
|---|---|
| **Flow control knob setting** | **Approx. use time** |
| 1 | 15.5 hours |
| 1.5 | 11 hours |
| 2 | 8 hours |
| 2.5 | 6.5 hours |
| 3 | 5.5 hours |
| 3.5 | 5 hours |
| 4 | 4 hours |
| 5 | 3 hours |
| 6 | 2.5hours |
| 8 | 2 hours |
| 10 | 1 hour |
| 15 | 0.5 hours |

14. Your patient arrives in the treatment area on 5 LPM and the liquid portable tank is half full. Is there sufficient oxygen supply for the patient to receive 30 minutes treatment and 15 minutes travel time?
    A. Yes
    B. No

15. The oxygen tank has a choice of 2 or 3 liters flow rate. Your patient in on 2.5 LPM via nasal prongs. What would you set the oxygen flow rate to?
    A. 2 liters per minute
    B. 3 liters per minute
    C. 4 liters per minute

16. Match the oxygen delivery device to the most appropriate statement/photo.

| Answer (A, B, or C) | Device | Statement/Photo |
|---|---|---|
| | Regular Nasal Prongs | A. Used for clients that require higher flows to adequately oxygenate, but cannot tolerate a face mask for long periods of time. |
| | High Concentration Oxygen Mask with Reservoir | B.  |
| | High Flow Nasal Prongs | C. Should not exceed 6 LPM |

17. You would know the pulse oximeter was reading correctly when?
    A. Correlates with the pulse
    B. Patient is able to talk normally
    C. Correlates with the respiratory rate

# Appendix C – Practical Component (New Staff)

Demonstrate competency in the following activities:

1. Filling the liquid portable oxygen system – if available
2. Moving the $O_2$ delivery system from wall to portable system and back to wall outlet, while providing the correct level of oxygen for liquid oxygen and portable oxygen cylinder.
3. Evaluation of $O_2$ reserve in the liquid oxygen and portable oxygen cylinder
4. Measurement of respiratory rate.
5. Correct use of pulse oximeter, including correlating the pulse oximeter reading with the heart rate.

## Appendix D – Performance Checklist (New staff)

Alberta Health Services

**Oxygen Therapy**
Performance Checklist

**Name:** _____ **Unit/Dept:** Allied Health /Rehabilitation

| Criteria | Completed |
|---|---|
| 1. Complete post test. | |
| 2. Fill the portable liquid oxygen system - if available. | |
| 3. Move the $O_2$ delivery system from wall to portable system and back to wall outlet. Provide the correct level of oxygen for each device. | |
| 4. Evaluate $O_2$ reserve in the liquid oxygen and portable oxygen cylinder. | |
| 5. Measure respiratory rate. | |
| 6. Measure saturation of oxyhemoglobin via a pulse oximeter and correlate the reading with the heart rate. | |

**Date:** _____ **Signature of Trainer:** _____

# Appendix E – Specialized Training for Therapy Assistants (TA) who work in Pulmonary and/or Thoracic units, or with patients who have chronic high baseline oxygen needs

**Specialized Training Therapy Assistant**
Annual Performance Checklist

**TA Name:** _____ **Unit/Dept:** _____

| Criteria | Initial by TA and Therapist plus Date |
|---|---|
| 1. Correctly identify $FiO_2$ and Flow Rate for patients on Cold Nebulizer and Heated High Flow $O_2$ Delivery Systems. | |
| 2. Move to and from Wall High Flow Nasal Cannulae to Portable $O_2$ tank. | |
| 3. Move to and from Wall Cold Nebulizer $O_2$ Delivery System to Portable $O_2$ tank with Venturi Adapter or High Flow Nasal Cannulae. | |
| 4. Move to and from Heated High Flow $O_2$ Delivery System to Portable $O_2$ tank with Venturi Adapter or High Flow Nasal Cannulae. | |
| 5. Correctly monitor respiratory status when $O_2$ Flow Rate has been adjusted when on Portable $O_2$ tank and when returned to Wall $O_2$ Delivery System. | |
| 6. Demonstrate knowledge of appropriate action required for acute respiratory distress in patient on Portable $O_2$ tank on High Flow Nasal Cannulae. | |
| 7. Demonstrate knowledge of appropriate action required for acute respiratory distress in patient using a Venturi Adapter with Face Mask or Trach Cradle. | |

Enter N/A if not applicable to your setting

**Signature of Category 1 staff member:** _____

# Appendix F – Responsibilities of Category 1 staff member when Patient assigned to Therapy Assistants (TA) with Specialized Training

Alberta Health Services

**Category 1 Staff Member Responsibilities**
Checklist

**Name:** _____ **Unit/Dept:** _____

| Responsibilities | Initial and Date Completed |
|---|---|
| 1. Discuss and obtain approval from Attending Physician or Nurse Practitioner for patient participation with TA program. | |
| 2. Document discussion with Attending Physician or Nurse Practitioner in Chart.<br>[The following parameters have been set for the above name patient in discussion with PT (name) and Physician (name) and are deemed appropriate for this patient as of (date). Any changes in patient status should be communicated to a Category 1 staff member prior to treatment.] | |
| 3. Provide clear detailed parameters and guidelines on TA Assignment Form.<br>Indicate patient is high or moderate risk.<br>Indicate baseline device, $FiO_2$ and $O_2$ Flow Rate.<br>Indicate treatment device, $FiO_2$ and $O_2$ Flow Rate. | |
| 4. Aware of Use of Portable Oxygen During Patient Transfers Policy HCS-205 | |

**Signature of category 1 staff member: _____**

# Appendix G – References

**References**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