Oxygen use Recommendations: An Algorithm (clinical decision tree) to use across Practice Settings

Oxygen Task Force:
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Oxygen Use Recommendations

The Task Force would like to thank the APTA Staff and the Cardiovascular and Pulmonary Section for all their support in assisting with the development of these recommendations.

The Task Force has no conflict of interests to declare.

Outline of Presentation

• Process of Establishing these Recommendations
• Overview of Oxygen Use
  --What are the issues facing P.T.?
  --What is the evidence regarding oxygen Use
  --P.T. Legal and Practice Facts
  --How is this information helpful to Physical Therapists?
• Development of an Algorithm
• Field Testing of the Algorithm
• Future Recommendations and Plans
• Questions
Development of Recommendations

• Identified need from clinicians, other stakeholders across the country
• Questions constantly sent to section and to APTA,
• Questions asked to Instructors of Continuing Education across country.

Need identified

• Need to get rid of false information regarding O2 use with COPD or with CO2 retainers
• Quality of care is decreased for patients using oxygen due to lack of knowledge/understanding with titration of oxygen
• Fear of oxygen titration by clinicians due to lack of knowledge/understanding of legal issues with oxygen use

Process

• Task Force established by CV & P Section
• Began with discussion of issues facing clinicians and use of oxygen
• Performed thorough review of literature
• Presented findings at CSM 2011
• Developed a summary document
• Met at APTA in October 2011 to develop formal documents for dissemination
• Developed algorithm: put algorithm through testing
• Developed position statement
• Developed technical summary
• Presentation at CSM 2013 to disseminate information
Evidence Regarding Oxygen Use

Rebecca H. Crouch, PT,DPT,MS,CCS,FAACVPR
Duke University
APTA Combined Sections
January, 2013

Hypoxemia: Short term effects

- Hypoxemia has several physiologic consequences:
  - As PaO2 falls below 55 mm Hg; marked rise in VE (Minute ventilation)
  - Peripheral vascular beds dilate causing compensatory HR rise (tachycardia) and Cardiac Output increases to increase O2 delivery
  - Regional pulmonary vasoconstriction occurs due to alveolar hypoxia
  - Erythropoietin secretion increases: increase in polychthemia (erythrocytosis) and O2 carrying capacity

Kim 2008
Hypoxemia: Long term effects

• Polycythemia
• Pulmonary hypertension
• Right ventricular failure (cor pulmonale)
  – Chronic hypoxemia with cor pulmonale results in poor prognosis: increased mortality (32-100%)
• Cellular changes:
  – Mitochondrial function declines
  – Anaerobic glycolysis occurs
  – Lactate/pyruvate ratio increases

Jones 1987, Boushy 1973

Hypoxemia: Long term Clinical Manifestations

• Impaired judgment at low levels of hypoxemia
• Progressive loss of cognitive and motor functions
• Loss of consciousness
• Other
  – Headache
  – Breathlessness/severe dyspnea
  – Palpitations
  – Angina
  – Restlessness
  – Tremor

Manning 2001, Jones 1987, Criner & Celli 1987

Supplemental Oxygen Advantages

• British Medical Research Council Clinical Trial
  – Improved survival using oxygen 15 hrs/day compared to using no oxygen in patients with PaO2 <55 mm Hg
  – Improved survival did not appear until after 500 days of oxygen use

• The Nocturnal Oxygen Therapy Trial (NOTT)
  – Survival is better in COPD/chronic stable hypoxemic patients who use oxygen 12-15 hrs/day
  – Survival best by using nearly continuous O2
Supplemental Oxygen Advantages

• NOTT: Using nocturnal oxygen therapy (NOT) and continuous oxygen therapy (COT) improved brain function at 6 months

• NOTT: Using COT improved brain function at 1 year

In Summary

• Nocturnal O2 is better than NO oxygen therapy

• Continuous O2 better than nocturnal O2 therapy
  – No studies have shown benefit with mild or moderate hypoxemia
  – No studies have shown benefit when O2 prescribed for exercise-induced O2 desaturation
Physiological Changes Following O2 Administration

• Proposed Mechanisms:
  – Decreased VE (Swinburn 1991 Am Rev Resp Dis)
  – Decrease in dynamic hyperinflation (O’Donnell 2001)
  – Alleviation of hypoxic pulmonary vasoconstriction (Dean 1992)
  – Improvement in hemodynamics (Dec PVR, Inc CO) (Dean 1992)
  – Increase in O2 delivery (Morrison 1992)
  – Improvement in ventilatory muscle function (Bye 1985)
  – Altered ventilatory muscle recruitment (Criner & Celli 1987)
  – Reflexive inhibition of central ventilatory drive (Manning 1995)
  – Decreased perception of dyspnea (Lane 1987)

Clinical Manifestations Following O2 Administration

• Improved breathlessness with exercise in COPD patients

• Improved exercise tolerance in those with mild, moderate or severe hypoxemia

Legal Issues

Ann Fick, PT, DPT, CCS
January 2013
Legal Issues with Oxygen Use

• Oxygen considered a *drug* by Food and Drug Administration (FDA)
• APTA Legislative Department unaware of any state having limitations on PTs in use of or titration of \( \text{O}_2 \)
• Link to check if your state has an official interpretation - http://www.fsbpt.org/licensing/index.asp

Legal Issues with Oxygen Use

• Practitioners should always check the patient’s specific orders
• Oxygen orders should be written based upon:
  – \( \text{SpO}_2 \)
  – Not Liters/minute
• Recommendations:
  – Keep \( \text{SpO}_2 \geq 90 \) (or 88% depending upon diagnosis)
  – 2L/min OR \( \text{SpO}_2 \geq 90\%

Example of State Legislation

• Connecticut legislative changes on the use of \( \text{O}_2 \) in hospitals (Since October 2010)
• Developed to ensure safety of \( \text{O}_2 \) use
• Requires all individuals handling \( \text{O}_2 \) in any way to:
  – Be trained in the use of \( \text{O}_2 \)
  – Provide documentation of training
• Law allows certified staff in hospitals to:
  – Connect or disconnect oxygen
  – Transport a portable oxygen source
  – Connect, disconnect, or adjust a mask or nasal tubes
  – Adjust the flow to carry out a medical order
APTA Position Statement

• Physical therapist patient/client management integrate an understanding of a patient’s/client’s prescription and nonprescription medication regimen with consideration of its impact upon health, impairments, functional limitations, and disabilities

• Administration and storage of medications used for physical therapy interventions is also a component of patient/client management and thus within the scope of physical therapist practice

• Physical therapy interventions that may require the concomitant use of medications include, but are not limited to, agents that:
  – Promote integumentary repair and/or protection
  – Facilitate airway clearance and/or ventilation and respiration
  – Facilitate adequate circulation and/or metabolism
  – Facilitate functional movement

Guide to Physical Therapist Practice
(p. 76 Guide)

• Discusses the use of oxygen in Tests and Measures – Orthotic, Protective and Supportive Devices

• Physical Therapists assess the need for and evaluate the appropriateness of supportive devices such as oxygen

Medicare Criteria for Oxygen Coverage

• Group I:
  – Medicare covers home oxygen therapy if:
    • Arterial blood gas test result ≤55 mm Hg OR
    • Oxygen saturation test result ≤ 88% at rest
  – Coverage also available if:
    • Patient meets required levels during exercise or sleep
    • Physicians must re-certify these beneficiaries after 12 months of therapy
    • Supplier must submit re-certification CMNs with O₂ claims for the 13th month of therapy
Medicare Criteria for Oxygen Coverage

• **Group II:**
  – Coverage available if patient’s:
    • Arterial blood gas test result is between 56 and 59 mm Hg
    • Or O₂ saturation test result equals 89% with evidence of
      – 1) dependent edema suggesting congestive heart failure
      – 2) pulmonary hypertension or cor pulmonale, or
      – 3) erythrocythemia with a hematocrit >56%
    • Physicians must re-certify beneficiaries if their O₂ therapy will continue >three months
    • Suppliers must resubmit recertification CMNs containing new arterial blood gas or O₂ saturation test results with claims for the fourth month of therapy

• **Group III:**
  – Carriers must apply a “rebuttable presumption” of non-coverage for a patient with:
    • Arterial blood gas test result ≥60 mmHg OR
    • O₂ saturation test result ≥ 90%
  – Physicians must submit additional evidence to carrier medical reviewers to justify the medical need for oxygen therapy
  – HCFA expects few claims to be approved
    • (Medicare Coverage Issues Manual Section 60-4)

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### Medicare Criteria for Oxygen Coverage

<table>
<thead>
<tr>
<th>Patient on RA at Rest While Awake</th>
<th>Patient Tested During Exercise</th>
<th>Patient Tested During Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifies for O₂ use if:</td>
<td>Qualifies if resting room air arterial saturation results ≥ 56 mm Hg or arterial O₂ saturation ≥89% HOWEVER during ambulation without O₂.</td>
<td>Qualifies if resting room air arterial saturation results ≥ 56 mm Hg or arterial O₂ saturation ≥89% HOWEVER during sleep without O₂.</td>
</tr>
</tbody>
</table>

- Arterial partial pressure of O₂ (PaO₂) ≤55 mm Hg OR
- Arterial O₂ saturation ≤88%
- Must have documented improvement of hypoxemia during ambulation with O₂

- Arterial partial pressure of O₂ (PaO₂) ≤55 mm Hg OR
- Arterial O₂ saturation ≤88%
- Must have documented improvement of hypoxemia during ambulation with O₂

- Arterial O₂ ≤55 mm Hg OR arterial O₂ saturation ≤ 88% for ≥25 minutes during sleep OR
- ↓ in arterial O₂ of ≥10 mm Hg, or ↓ in arterial saturation ≥5% for ≥5 minutes during sleep associated with s/s attributable to hypoxemia
How is this information helpful to physical therapists?

Amy Pawlik, PT, DPT, CCS
January 23, 2013

PT Role

• Assess need for O2
  – At rest
  – With activity!
• Assist with titration of O2/device
• Ensure safety with activity
• Exercise prescription
• Patient education

Common questions

• When can I titrate O2?
• What about CO2 retainers?
• What devices are available?
• Assessing SpO2
• Documentation
Ask for the order!

- Titrate O2 to keep SpO2> ____%

- Emergency situation
  - Notify physician
  - Order written post-event

CO2 retainers

- Titrate oxygen up during exercise if needed and then return to prior level (or level needed) at rest

Oxygen Delivery Devices

- Nasal cannula
- High Flow nasal cannula
- Simple face mask
- Non-rebreather face mask
- Bi-Pap
- Endotracheal Tube/Ventilator
- Trach Collar
Nasal Cannula

- Thin tubing attached to wall unit with 2 prongs to insert into nostrils for O2 delivery
- Low flow oxygen delivery
- Room air is 21% FiO2, and a nasal cannula can deliver between 24-44% FiO2
- Rule of thumb: FiO2 is increased by 3-4% for each 1 liter per minute of O2 administered
- Most can deliver between .25-6L O2/minute
- If pt needs greater than 6L, need a different device

Simple Face Mask

- Plastic, contoured mask to fit over patient’s mouth and nose
- Used when a nasal cannula cannot provide enough supplemental O2
- Delivers oxygen via nose and mouth
- Holes in the mask allow room air to enter the mask to dilute the oxygen, as well as allow carbon dioxide to escape mask
- Can increase FiO2 to 28-50% on the converter
- Wall connection can deliver 28-100% FiO2
- Can deliver 5-15 L O2/min
- When documenting, state %FiO2 and not number of liters to increase accuracy

Non-Rebreather Face Mask

- One-way valves prevent room air from entering mask, but allow exhaled air to escape mask
- Attached reservoir bag allows for a more concentrated oxygen supply by preventing room air from diluting the O2 supply
- Used when a patient requires at least 10L supplemental O2/min
- Set to deliver an FiO2 of 100%
High Flow Nasal Cannula

- Delivers more concentrated flow of oxygen, up to 100% FiO2 and 60 L/min
- Also provides positive end expiratory pressure (PEEP) to improve gas exchange
- The oxygen is typically humidified to increase comfort
- Can be used as an alternative to face mask to allow patient to eat, drink, and talk
- Oxygen tanks only last ~15 minutes, so ensure you use a full tank if walking the patient
- Frequently seen in patients with pulmonary fibrosis, severe lung disease, or in infants

Bilateral Positive Air Pressure (Bi-PAP)

- A form of respiratory ventilation, used predominantly for patients with sleep apnea
- Has also been found to be beneficial for patients with CHF or lung disorders, specifically those with increased levels of carbon dioxide
- Has 2 pressure settings: one for exhalation and one for inhalation
- Can deliver 40-100% FiO2

Endotracheal Tube (ETT)

- Used when non-invasive forms of supplemental oxygen are unable to be utilized (example - respiratory failure, etc)
- Tube inserted through mouth or nose into trachea to protect airway and attached to a mechanical ventilator
- Humidification is especially important as the oxygen is bypassing the natural humidification route
- Can deliver up to 100% FiO2
Trach Mask/Collar

- Provides supplemental, humidified O2 via a mask placed over the tracheostomy site.
- Significant mixing of room air occurs with this method, which makes humidification of the O2 extremely important.
- Moisture can collect in the mask and should be drained into garbage can before moving the patient, to prevent aspiration.
- Ensure the mask remains over the trach site, as it can easily become dislodged with movement.
- Can provide an FiO2 of 40-100% (same as face mask).

Methods of O2 delivery

- Oxygen concentrator
- Liquid oxygen
- Compressed gas cylinders
- On-demand regulators (pulsed)
- Continuous flow regulators

Pulse Oximetry

- Awareness of “noise”
- 3rd, 4th fingers
- Ear or forehead?
- Fingernail condition
- Probe size/type
- Sensor position
- Low perfusion
Hypoxemia

- Signs/symptoms
  - Impaired judgement
  - Loss of cognitive and motor function
  - Decreased exercise tolerance
  - Headache
  - Breathlessness/dyspnea
  - Palpitations
  - Angina
  - Restlessness, tremors
  - Loss of consciousness

Documentation

- Vital signs
- Signs/symptoms
- O2 delivery system
- O2: rest/activity
- Time: activity/recovery
- Interventions

Bottom line

- Always follow the policies, protocols, and guidelines of the facility in which you practice!
- Baseline vital signs including oxygen saturation must be measured before any activity
- A clinical assessment must be performed by the physical therapist to determine changes in clinical status
- Oxygen saturation measurements should be done continuously or when clinically indicated during physical therapy interventions
- Communication skills and coordination of efforts with other members of the Interdisciplinary team are utilized in order to improve patient outcomes
- At the end of any physical therapy intervention the patient must be placed back on the amount of supplemental oxygen and delivery device prescribed when at rest. In the event the patient is experiencing difficulty and cannot maintain adequate oxygen saturation at the amount of oxygen prescribed for rest, their referring healthcare provider should be contacted immediately.
Development of an Oxygen Delivery/Titration Algorithm

Lawrence P. Cahalin PhD, PT, CCS
Professor
Department of Physical Therapy

APTA Combined Sections Meeting, San Diego, California

Today’s Objectives

• Describe the development of an oxygen delivery/titration algorithm
• Present the oxygen delivery/titration algorithm
• Identify aspects of the algorithm worthy of further consideration and research
• Use a case study to demonstrate the method by which the algorithm may be used

Oxygen Use Meeting – Thursday, October 6, 2011

Final Decision of Group:
• Technical Summary First with general principles followed by specific disorders and link the clinical summary to the document. Why O2 should be used, technical aspects, titration, and clinical methods of what to do when.
• Some discussion was made about acute versus chronic administration of O2 and although the outcomes may be different, the basic physiologic problem is the same – Low levels of oxygenation.
• Develop an algorithm for patients with heart failure and pulmonary hypertension and a basic algorithm for patients in need of supplemental oxygen.
• Think about quality measures for this project.
• Are PTs measuring dyspnea and if not, how do we know the right care is being done.
• Dissemination is very important like a podcast, etc.
Friday, October 7, 2011 Day Two of Oxygen Use Meeting

- Development of an oxygen delivery/titration algorithm.
  - Discussion, Discussion, Discussion, & Discussion
- Drawings of an algorithm by hand
- Development of a computer generated algorithm
- Peer-review of the algorithm
- Modifications to the algorithm
- Testing of the algorithm
Patient Description

- 57 year old male
- Shortness of breath
- Height = 6 ft, 1 inch
- Weight = 190 pounds
- Moderate pulmonary impairment
  - FEV1 (58% of predicted) & FVC (59% of predicted)
- Recent diagnosis of *Idiopathic Pulmonary Fibrosis*
- Resting SpO2 = 94% without supplemental O2
- Referred to PT for examination and treatment

Patient Description

- Physical Therapy Examination
  - Shortness of breath via Modified Borg Dyspnea Scale at rest = 4/10
  - Vital signs
    - HR = 94 bpm
    - BP = 138/92 mmHg
    - RR = 16 breaths/min
    - SpO2 = 95%
  - 6-minute Walk Test
    - Distance of 246 meters with 2 stops and a Modified Borg of 7/10
    - SpO2
      - Minute 2 = 90%
      - Minute 4 = 88%
      - Minute 6 = 84%
**Patient Description**

- **Physical Therapy Examination** – *With 2.0 L O₂*
  - Shortness of breath via Modified Borg Dyspnea Scale at rest = 4/10 and now 3/10
  - Vital signs
    - HR = 94 bpm and now 86 bpm
    - BP = 138/92 mmHg and now 130/86
    - RR = 16 breaths/min and now 14 breaths/min
    - SpO₂ = 95% and now 98%
  - **6-minute Walk Test**
    - Distance of 246 meters with 2 stops and a Modified Borg of 7/10 and now 268 meters with 1 stop and 7/10
    - SpO₂
      - Minute 2 = 90% and now 93%
      - Minute 4 = 88% and now 91%
      - Minute 6 = 84% and now 90%

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**VALIDATION OF OXYGEN ALGORITHM**

APTA Oxygen Task Force
CSM
Susan Butler-McNamara, PT, MS, CCS
January 23, 2013
OXYGEN ALGORITHM

VALIDATION of OXYGEN ALGORITHM

Timeline
- Summer 2012:
- Questionnaire developed
  - Demographics
  - Questions related to use of algorithm
  - Questions related to clinician’s experience with use of oxygen
  - Packets developed, including copies of algorithm
- 15 sites selected across the country
  - Packets distributed by mail to sites October, 2012
  - Return by December 1, 2012

Dear Clinical Site:

Thank you for helping us with field testing this algorithm. We simply
are asking you to use the algorithm and give us feedback. Any feedback
is welcome... whether it is formal feedback or you just email us. We
appreciate your assistance and will recognize you at CSM and in future
publications if you wish.

We ask that you use the algorithm, and look on the back of the card for
(there are thought questions when using this algorithm. Use this on as
many or as few patients. Your goal is that you use this on at least 10
patients if possible). Just let us know what you think! Give us a rough
des on how many patients you used this with.

We just need to get a summary from you by December 1st. PLEASE
COMPLETE THE FORMS AND SEND BACK TO ME BY DEC 1. You may
keep the cards or get more if you wish!! Just let us know.

We thank you for your time and your assistance.
OXYGEN ALGORITHM

VALIDATION of OXYGEN ALGORITHM

1. What is the overall impact of the algorithm on patient care?
   Yes  No

2. What is the overall impact of the algorithm on patient satisfaction?
   Yes  No

3. What is the overall impact of the algorithm on staff satisfaction?
   Yes  No

4. What is the overall impact of the algorithm on the organization's budget?
   Yes  No

5. What is the overall impact of the algorithm on the organization's reputation?
   Yes  No

The following are questions we would like to have you answer whether you use the algorithm.

1. Did you use the algorithm in clinical decision-making?
   Yes  No

2. Did you monitor oxygen saturation at rest?
   Yes  No

3. Did you monitor oxygen saturation during activity?
   Yes  No

4. Did you have to adjust oxygen flow for activity?
   Yes  No

5. Did you monitor oxygen saturation post activity?
   Yes  No

6. Did you note how long it took patient to return to their resting oxygen saturation value and/or how long they had any symptoms?
   Yes  No

7. Did you confirm oxygen saturation value with any other assessment tools?
   A: Taking vital signs, i.e., BP, HR, RR
   B: Observation of patient's color, use of accessory muscles, facial/grunting, posture, etc.
   Yes  No

8. Did you determine accuracy of pulse oximeter?
   Yes  No

9. Did you check patient's pulse manually against value on oximeter?
   Yes  No
VALIDATION of OXYGEN ALGORITHM

OTHER QUESTIONS:

1. Can you, as a physical therapist, adjust level of oxygen with ease?
   Yes ___  No ___
2. Can you inflate mask of oxygen with ease?
   Yes ___  No ___
3. Are you able to adjust flow rate from one setting to another?
   Yes ___  No ___
4. Can you provide therapy at home for patients who have come from a hospital?
   Yes ___  No ___
5. Do you perform therapy on patients who have come from home?
   Yes ___  No ___
6. Have you considered providing oxygen to patients who have come from home?
   Yes ___  No ___
7. Is the algorithm consistent with your hospital’s practice policy?
   Yes ___  No ___
8. Do you know what your state and/or federal policies regarding treatment of oxygen with patients?
   Yes ___  No ___
9. Would additional information be helpful in using the algorithm?
   Yes ___  No ___

VALIDATION of OXYGEN ALGORITHM

Results

Conclusions
Future Recommendations and Plans

• Algorithm cards
• Publication of Position Statement
• Publication of Technical Summary
• Develop a learning module (podcast) to disseminate information and increased knowledge and skills with use of oxygen
• Write a consensus statement