COPD Update

James Allen, MD
Medical Director
The Ohio State University Wexner Medical Center East Hospital
Professor of Internal Medicine
Division of Pulmonary and Critical Care Medicine
The Ohio State University Wexner Medical Center

After this lecture, you should be able to:

1. Diagnose and classify COPD
2. Prescribe step-wise treatment for management of stable COPD
3. Identify patients who would benefit by home oxygen
4. Manage COPD exacerbations
5. Develop strategies to reduce re-admissions for COPD
Impact of COPD in U.S.

- 15.5 million people diagnosed
- 715,000 hospital admissions per year
- 120,000 deaths/year
- Annual cost up to $50 billion
  - $30 billion direct
  - $20 billion indirect

Prevalence of COPD In The U.S.
Prevalence of COPD Has Declined as Other Chronic Conditions Have Increased

Percent of adults aged 40 years or older who reported having been diagnosed with chronic conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>2008 and 2009</th>
<th>2014 and 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPD</td>
<td>7.2%</td>
<td>6.4%</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>45.0%</td>
<td>45.3%</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>38.8%</td>
<td>40.2%</td>
</tr>
<tr>
<td>Heart disease</td>
<td>20.6%</td>
<td>21.4%</td>
</tr>
<tr>
<td>Cancer</td>
<td>15.6%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>13.9%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Asthma</td>
<td>8.6%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

JAMA 2019; 322: 602

COPD-related deaths in U.S. adults
Prevalence of COPD by Age, Income, and Insurance

- **Age:**
  - > 65 years: 10.2%
  - 40-64 years: 4.6%

- **Income:**
  - Poor: 13.6%
  - Low: 9.9%
  - Medium: 6.0%
  - High: 3.7%

- **Insurance:**
  - Medicare: 14.0%
  - Other public: 11.1%
  - Commercial: 4.3%
COPD Expenditures Are Increasing

- Percent COPD Patients Using Emergency Department Services:
  - 2008 – 2009: 8.0%
  - 2014 – 2015: 13.2%

- Annual COPD Prescription Drug Costs:
  - 2008 – 2009: $1,197
  - 2014 – 2015: $1,768

Spirometry is essential to diagnosis of COPD
There are two commonly used scales of obstruction severity:

American Thoracic Society (ATS) Global Initiative on Obstructive Lung Disease (GOLD)

<table>
<thead>
<tr>
<th>FEV1 (% predicted)</th>
<th>Obstruction</th>
<th>FEV1 (% predicted)</th>
<th>Obstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 70%</td>
<td>Mild</td>
<td>&gt; 80%</td>
<td>Mild</td>
</tr>
<tr>
<td>60-69%</td>
<td>Moderate</td>
<td>50-79%</td>
<td>Moderate</td>
</tr>
<tr>
<td>50-59%</td>
<td>Moderately Severe</td>
<td>30-49%</td>
<td>Severe</td>
</tr>
<tr>
<td>35-49%</td>
<td>Severe</td>
<td>&lt; 30%</td>
<td>Very Severe</td>
</tr>
<tr>
<td>&lt; 35%</td>
<td>Very Severe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ATS defines obstruction as an FEV1/FVC ratio of less than the 5th percentile of predicted for that patient’s age and this number will vary from patient to patient. The GOLD defines obstruction as anyone with an FEV1/FVC ratio of less than 70% for all patients, regardless of age.

Staging

- **Risk:**
  - Low:
    - 0-1 exacerbations/yr
    - No hospitalizations/yr
  - High
    - ≥ 2 exacerbations/yr
    - ≥ 1 hospitalizations/yr

- **Symptoms:**
  - Less: MRC 0-1
  - More: MRC ≥ 2
mMRC Score

0 – Only breathless with strenuous activity
1 – Short of breath when hurrying on ground level or walking up a slight hill
2 – Walk slower than people of similar age on level ground or have to stop walking at my own pace
3 – Stop for breath after walking 100 yards or a few minutes on level ground
4 – Too breathless to leave the house or breathless when dressing

Can you have emphysema with normal spirometry?

Yes!

- Suspect in at-risk patients with dyspnea and either:
  - Hyperinflation or air-trapping by lung volumes
  - Low diffusing capacity
- Confirmation by high resolution chest CT
- 50% of smokers age > 75 with normal spirometry have evidence of emphysema or air trapping by CT
Alpha-1-Antitrypsin Deficiency

- U.S. prevalence = 1 out of 1,500 to 5,000 people
  - Approximately 100,000 Americans
- World Health Organization recommends all patients with COPD be screened once for alpha-1-antitrypsin deficiency
- Screen with alpha-1-antitrypsin levels
  - Deficiency established with level < 57 mg/dL
  - Do genotyping if level < 100 mg/dL

Where do our treatment guidelines come from?

- **GOLD** (Global initiative for Obstructive Lung Disease)
  - 2020 *Guide to COPD Diagnosis, Management, and Prevention*
- **ACCP/CTS** (American College of Chest Physicians; Canadian Thoracic Society)
  - 2015 *Prevention of Acute Exacerbations of COPD*
- **ATS** (American Thoracic Society)
  - 2020 *Pharmacologic Management of Chronic Obstructive Pulmonary Disease*
ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine

Ipratropium + albuterol is superior to albuterol alone

![Graph showing percent change in FEV1 over hours after dose for Albuterol, Ipratropium, and Albuterol + Ipratropium.](Arch Intern Med. 1999;159(2):156-160)
# Short-Acting Bronchodilators

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Albuterol</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$18</td>
</tr>
<tr>
<td>Proair</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$66</td>
</tr>
<tr>
<td>Proair Respliclick</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$59</td>
</tr>
<tr>
<td>Ventolin</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$60</td>
</tr>
<tr>
<td>Proventil</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$86</td>
</tr>
<tr>
<td>Generic levalbuterol</td>
<td>levalbuterol</td>
<td>Q 6 Hours PRN</td>
<td>$33</td>
</tr>
<tr>
<td>Atrovent</td>
<td>ipratropium</td>
<td>Q 6 Hours PRN</td>
<td>$414</td>
</tr>
<tr>
<td><strong>Combivent Respimat</strong></td>
<td><strong>ipratropium + albuterol</strong></td>
<td>Q 6 Hours PRN</td>
<td><strong>$429</strong></td>
</tr>
<tr>
<td>Generic Albuterol*</td>
<td>albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$21</td>
</tr>
<tr>
<td>Generic ipratropium*</td>
<td>ipratropium</td>
<td>Q 6 Hours PRN</td>
<td>$17</td>
</tr>
<tr>
<td>Duoneb*</td>
<td>ipratropium + albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$32</td>
</tr>
</tbody>
</table>

* Nebulized

Cost per month: GoodRx
ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine

Tiotropium (LAMA) Is Superior To Salmeterol (LABA) in COPD

![Graph showing the probability of COPD exacerbation over time for Tiotropium and Salmeterol. The graph indicates that Tiotropium is superior with a P < 0.001.](image)

Aclidinium is similar to tiotropium

![Graph showing change in FEV1 (L) over time after dose (hours) for Aclidinium, Tiotropium, and Placebo.]

Chest 2012; 141:745-52

Long-Acting Anti-Cholinergics (LAMAs)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spiriva Handihaler</td>
<td>tiotropium</td>
<td>Daily</td>
<td>$457</td>
</tr>
<tr>
<td>Spiriva Respimat</td>
<td>tiotropium</td>
<td>Daily</td>
<td>$440</td>
</tr>
<tr>
<td>Tudorza</td>
<td>aclidinium</td>
<td>Twice Daily</td>
<td>$193</td>
</tr>
<tr>
<td>Incruse</td>
<td>umeclidinium</td>
<td>Daily</td>
<td>$347</td>
</tr>
<tr>
<td>Seebri</td>
<td>glycopyrrolate</td>
<td>Twice Daily</td>
<td>$397</td>
</tr>
<tr>
<td>Lonhala Magnair*</td>
<td>glycopyrrolate</td>
<td>Twice Daily</td>
<td>$1,126</td>
</tr>
<tr>
<td>Yepelri*</td>
<td>revefenacine</td>
<td>Daily</td>
<td>$1,097</td>
</tr>
</tbody>
</table>

* Nebulized formulation

Cost per month: GoodRx
# Long-Acting Beta Agonists (LABAs)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serevent diskus</td>
<td>salmeterol</td>
<td>Twice daily</td>
<td>$402</td>
</tr>
<tr>
<td>Arcapta</td>
<td>indacaterol</td>
<td>Daily</td>
<td>$263</td>
</tr>
<tr>
<td>Striverdi</td>
<td>olodaterol</td>
<td>Twice daily</td>
<td>$218</td>
</tr>
<tr>
<td>Brovana*</td>
<td>arformoterol</td>
<td>Twice Daily</td>
<td>$1,067</td>
</tr>
<tr>
<td>Performomist*</td>
<td>formoterol</td>
<td>Twice Daily</td>
<td>$1,056</td>
</tr>
</tbody>
</table>

*Nebulized formulation

Cost per month: GoodRx
ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine
LAMA/LABA combination is superior to LABA alone or LAMA alone

![Graph showing Trough FEV1 Response (ml) over Test Day]

Eur Resp J 2015; 45:969-79

ATS Guideline on Pharmacologic Management of Chronic Obstructive Pulmonary Disease

1. LABA/LAMA dual therapy preferred over either LAMA alone or LABA alone
2. ICS/LABA/LAMA triple therapy recommended for patients with > 1 exacerbation per year requiring:
   - Antibiotics
   - Steroids
   - Hospitalization
3. ICS can be withdrawn if no exacerbations for 1 year

Am J Respir Crit Care Med Vol 201, Iss 9, pp 1039–1049, May 1, 2020
# LAMA/LABA Combinations

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stiolto</td>
<td>tiotropium + olodaterol</td>
<td>Twice daily</td>
<td>$407</td>
</tr>
<tr>
<td>Anoro</td>
<td>umeclidinium + vilanterol</td>
<td>Twice daily</td>
<td>$425</td>
</tr>
<tr>
<td>Utibron</td>
<td>glycopyrrolate + indacaterol</td>
<td>Twice daily</td>
<td>$371</td>
</tr>
<tr>
<td>Bevespi</td>
<td>glycopyrrolate + formoterol</td>
<td>Twice daily</td>
<td>$387</td>
</tr>
<tr>
<td>Duakli</td>
<td>Acidinium + formoterol</td>
<td>Twice daily</td>
<td>$990</td>
</tr>
</tbody>
</table>

Cost per month: GoodRx
ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine

TORCH study: ICS + LABA are better than either LABA or ICS alone

**FLAME Study**

- 356 hospitals in 43 countries
- Randomized, double-blind study:
  - 1,680 subjects: LABA/LAMA
  - 1,682 subjects: LABA/ICS
- Subjects followed for 1 year
- LABA/LAMA subjects had:
  - Fewer COPD exacerbations
  - Fewer pneumonias


---

**LABA/LAMA is superior to LABA/ICS**

![Graph showing probability of exacerbation over weeks for Salmeterol + fluticasone and Indacaterol + glycopyrronium with P < 0.001](image)

* N Engl J Med 2016;374:2222-2234*
**LABA/ICS Combinations**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advair Diskus</td>
<td>salmeterol + fluticasone</td>
<td>Twice Daily</td>
<td>$396</td>
</tr>
<tr>
<td>Advair HFA</td>
<td>salmeterol + fluticasone</td>
<td>Twice Daily</td>
<td>$396</td>
</tr>
<tr>
<td>Dulera</td>
<td>formoterol + mometasone</td>
<td>Twice Daily</td>
<td>$320</td>
</tr>
<tr>
<td>Symbicort</td>
<td>formoterol + budesonide</td>
<td>Twice Daily</td>
<td>$258</td>
</tr>
<tr>
<td>Breo</td>
<td>vilanterol + fluticasone</td>
<td>Twice Daily</td>
<td>$365</td>
</tr>
<tr>
<td>Airduo</td>
<td>salmeterol + fluticasone</td>
<td>Twice Daily</td>
<td>$280</td>
</tr>
<tr>
<td>Wixela</td>
<td>salmeterol + fluticasone</td>
<td>Twice Daily</td>
<td>$100</td>
</tr>
<tr>
<td>fluticasone/salmeterol</td>
<td>salmeterol + fluticasone</td>
<td>Twice Daily</td>
<td>$49</td>
</tr>
<tr>
<td>budesonide/formoterol</td>
<td>formoterol + budesonide</td>
<td>Twice Daily</td>
<td>$258</td>
</tr>
</tbody>
</table>

Cost per month: GoodRx
And now, a LAMA/LABA/ICS!

IMPACT Trial: Triple therapy inhaler is better than dual therapy inhalers in COPD

ATS Guideline on Pharmacologic Management of Chronic Obstructive Pulmonary Disease

1. LABA/LAMA dual therapy preferred over either LAMA alone or LABA alone

2. ICS/LABA/LAMA triple therapy recommended for patients with > 1 exacerbation per year requiring:
   - Antibiotics
   - Steroids
   - Hospitalization

3. ICS can be withdrawn if no exacerbations for 1 year

LAMA/LABA/ICS Combination

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trelegy</td>
<td>salmeterol + umeclidinium + vilanterol</td>
<td>Once Daily</td>
<td>$573</td>
</tr>
</tbody>
</table>

Cost per month: GoodRx
TORCH study: ICS and LABA are equivalent

Which patients with COPD should have an inhaled corticosteroid?

Excess Number Of Patients With A Hospitalization Per 100 Treated In 1 Year:
ICS + LABA versus LABA Alone

Chest 2017; 152:227-231
Which patients with COPD should have an inhaled corticosteroid?

Excess Number Of Patients With A Hospitalization Per 100 Treated In 1 Year:
ICS + LABA versus LABA Alone

-6 -5 -4 -3 -2 -1 0 1 2 3

All Patients
Eosinophils > 2%
Eosinophils > 4%

- COPD Exacerbations
- Pneumonia

Chest 2017; 152:227-231

ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine
What Does GOLD Say About Inhaled Steroids?

- **Do use:**
  - History of COPD exacerbation hospitalizations
  - >2 exacerbations per year
  - Eosinophil count > 300
  - Concurrent asthma

- **Consider using:**
  - 1 exacerbation per year
  - Eosinophil count 100-300

- **Against use:**
  - History of recurrent pneumonia
  - Eosinophil count < 100
  - History of mycobacterial infection

---

Inhaled Corticosteroids

<table>
<thead>
<tr>
<th>Brand</th>
<th>Component</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asmanex</td>
<td>mometasone</td>
<td>Twice Daily</td>
<td>$230</td>
</tr>
<tr>
<td>Arnuity</td>
<td>fluticasone</td>
<td>Daily</td>
<td>$183</td>
</tr>
<tr>
<td>Pulmicort flexhaler</td>
<td>budesonide</td>
<td>Twice Daily</td>
<td>$240</td>
</tr>
<tr>
<td>Aerospan</td>
<td>flunisolide</td>
<td>Twice Daily</td>
<td>$209</td>
</tr>
<tr>
<td>Flovent HFA</td>
<td>fluticasone</td>
<td>Twice Daily</td>
<td>$256</td>
</tr>
<tr>
<td>Flovent Diskus</td>
<td>fluticasone</td>
<td>Twice Daily</td>
<td>$193</td>
</tr>
<tr>
<td>Qvar</td>
<td>beclomethasone</td>
<td>Twice Daily</td>
<td>$223</td>
</tr>
<tr>
<td>Alvesco</td>
<td>ciclesonide</td>
<td>Twice Daily</td>
<td>$132</td>
</tr>
<tr>
<td>Armonair</td>
<td>fluticasone</td>
<td>Twice Daily</td>
<td>$175</td>
</tr>
<tr>
<td>Budesonide (generic)*</td>
<td>budesonide</td>
<td>Twice Daily</td>
<td>$34</td>
</tr>
</tbody>
</table>

*Nebulized formulation
Cost per month: GoodRx
ACCP/CTS Guideline To Prevent COPD Exacerbations:

- Short-acting combination anti-cholinergic plus short acting beta agonist = initial PRN rescue inhaler
- LAMA = first line maintenance therapy
- LAMA/LABA = second line maintenance therapy
- LAMA/LABA/ICS = third line maintenance therapy
- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - N-acetylcysteine
  - Daily azithromycin
  - Roflumilast
N-acetylcysteine prevents COPD exacerbations

Azithromycin prevents COPD exacerbations
Roflumilast prevents COPD exacerbations in patients with frequent exacerbations

![Bar chart showing the rate of exacerbations with Roflumilast and Placebo.](image)

Am J Resp Crit Care Med 2016; 194:559-67

Roflumilast improves FEV1

![Line chart showing the improvement in FEV1 with Roflumilast and Placebo.](image)

Lancet 2015; 385: 857-66
Drugs to prevent COPD exacerbations

- N-acetylcysteine
  - Over the counter
  - 600 mg twice daily
  - No monitoring required
- Azithromycin
  - 250 mg daily
  - Check baseline EKG (QTc)
  - Advise patients about hearing loss
  - Not effective in active smokers
- Roflumilast
  - 500 mg daily
  - Check LFTs
  - Monitor weight monthly

Frequent Exacerbation Medications

<table>
<thead>
<tr>
<th>Brand</th>
<th>Frequency</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-Acetylcysteine</td>
<td>Twice Daily</td>
<td>$14</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>Daily</td>
<td>$14</td>
</tr>
<tr>
<td>Roflumilast (Daliresp)</td>
<td>Daily</td>
<td>$386</td>
</tr>
</tbody>
</table>

Cost per month: GoodRx
### Step-Wise Approach To COPD:

<table>
<thead>
<tr>
<th>Step</th>
<th>Maintenance Drug</th>
<th>PRN Drug</th>
<th>Total Cost*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Combivent</td>
<td>$429</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Albuterol</td>
<td>$18</td>
</tr>
<tr>
<td>2</td>
<td>LAMA</td>
<td>Albuterol</td>
<td>$211</td>
</tr>
<tr>
<td>3</td>
<td>LAMA + LABA</td>
<td>Albuterol</td>
<td>$389</td>
</tr>
<tr>
<td>4</td>
<td>LAMA + LABA + N-acetylcysteine</td>
<td>Albuterol</td>
<td>$403</td>
</tr>
<tr>
<td></td>
<td>LAMA + LABA + azithromycin</td>
<td>Albuterol</td>
<td>$403</td>
</tr>
<tr>
<td></td>
<td>LAMA + LABA + roflumilast</td>
<td>Albuterol</td>
<td>$775</td>
</tr>
<tr>
<td>5</td>
<td>LAMA + LABA + ICS</td>
<td>Albuterol</td>
<td>$438</td>
</tr>
</tbody>
</table>

*LAMA: Long-acting muscarinic antagonist (long-acting anti-cholinergic)*  
LABA: Long-acting beta agonist  
ICS: Inhaled corticosteroid

*Cost is monthly cost for least expensive brand alternatives*
Don’t forget inhaler technique training!

- CPT code 94664
- Medicare reimbursement:
  - 0.49 RVUs
  - $18

IL-5 antibody reduces severe exacerbations in eosinophilic COPD

<table>
<thead>
<tr>
<th>Weeks</th>
<th>0</th>
<th>12</th>
<th>24</th>
<th>36</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placebo</td>
<td>0</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Mepolizumab</td>
<td>0</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
</tr>
</tbody>
</table>

P = 0.04

Mepolizumab: 1.40/year
Placebo: 1.73/year

Home non-invasive nocturnal ventilation reduces hospital readmission rates

- Baseline PCO₂ > 53
- Excluded patients with BMI > 35 or known sleep apnea
- 116 patients: oxygen alone versus oxygen plus ventilation
- Typical setting: IPAP 24, EPAP 4, backup rate 14

**Mean time to readmission:**
- 4.3 months NIV group
- 1.4 months control group

JAMA 2017; 317:2177-86

---

LOTT: Long-Term Oxygen Treatment Trial

- 738 patients
- 42 medical centers
- Resting sat 89-93%
- 6 MWT sat > 80%
- Randomized to oxygen 2 L versus room air

[Image of journal cover: A Randomized Trial of Long-Term Oxygen for COPD with Moderate Desaturation]
Probability of Death

![Graph showing the cumulative probability of death over months for no oxygen and supplemental oxygen. The graph indicates that there is no statistically significant difference (P = NS) between the two groups.]


Probability of Death or Requirement for Long-Term Oxygen

![Graph showing the cumulative probability of death or requirement for long-term oxygen over years for placebo and nocturnal oxygen. The graph indicates that there is no statistically significant difference (P = NS) between the two groups.]

Conservative oxygen therapy is associated with better survival

![Graph showing cumulative survival (%)](image)

The Lancet. 391; April 2018: 1693-1705

So, who should get home oxygen in 2020?

- Resting oxygen saturation ≤ 88%
- Exertional oxygen saturation < 80%
- Patients who *may* benefit by oxygen with higher saturations:
  - Signs of pulmonary hypertension
  - Dyspnea or fatigue improved with oxygen
  - Nocturnal oxygen saturation < 88% for more than 5 minutes total
- For COPD exacerbations: titrate oxygen to 88-92% *and not higher*
Home Oxygen Options

- Concentrators
  - Standard (5 L continuous flow)
  - High-Flow (10 L continuous flow)
  - Portable (4-6 L pulse flow)
- Compressed oxygen gas
  - E tank (4.4 hours at 2 L continuous flow)
  - D tank (2.5 hours at 2 L continuous flow)
- Liquid oxygen
  - Reservoir (4-6 weeks)
  - Portable tank (8 hours at 2 L pulse low)
**Cost of Oxygen**

- Yearly oxygen rental cost: $2,400
- Purchase options*:
  - Portable concentrator: $2,500
  - Home concentrator: $500
- Yearly electricity cost: $325

*Medicare will pay for oxygen rental costs but not purchase costs

---

**Are Beta Blockers Safe in COPD?**

- Beta-blockers are associated with *lower* COPD exacerbations when beta-blockers are indicated for cardiovascular conditions
  - Thorax 2016; 71:8014
- Beta-blockers do not prevent COPD exacerbations when there is no cardiovascular indications
What about treating exacerbations?

- Short-acting bronchodilators (eg, albuterol and/or ipratropium)
- Initiate maintenance inhaler
- Steroids for 5-7 days (eg, prednisone 40 mg/day)
- Antibiotics for 5-7 days if increased sputum volume/purulence
  - Azithromycin
  - Doxycycline
  - Ampicillin-clavulanate
- Oxygen to keep SaO2 88-92% (but not higher!)
- Non-invasive ventilation when respiratory failure results

Other interventions in very severe COPD:

- Lung volume reduction surgery
  - Upper lobe dominant emphysema
- Bullectomy
  - Large bullae
- Endobronchial valves
  - Localized emphysema without collateral ventilation
- Lung transplant
  - Patients not meeting criteria for other interventions
Treatments to avoid in COPD:

- Inhaled corticosteroid monotherapy
- Long-term oral steroids
- Oral bronchodilators
- Theophylline
- Anti-tussives
Life expectancy for smokers and non-smokers

The average smoker loses 14 minutes of life for every cigarette smoked
Cigarette smoking causes 480,317 U.S. deaths per year*

- Lung cancer: 57,117
- Other cancers: 135,033
- Cardiovascular disease: 100,600
- COPD: 36,000
- Other: 192,951

*18.5% of U.S. deaths are attributable to cigarette smoking

Data source: CDC 2020

---

Prevalence of Adult Smokers In The U.S.

In 2018: Male adult smokers = 15.6%; Female adult smokers = 12.0%

Data: Centers for Disease Control 2020
Who Smokes In The United States?

Centers for Disease Control 2020

Who Smokes In The United States?

Prevalence By Annual Household Income

Centers for Disease Control 2020
Who Smokes In The United States?

Prevalence Of Smoking By Race

[Bar chart showing the prevalence of smoking by race: Native American (25%), White (15%), Black (10%), Hispanic (5%), Asian American (0%)]

Centers for Disease Control 2020

Who Smokes In The United States?

[Map showing smoking prevalence by state, with Ohio highlighted at 21.1%]

About This Map
- 8.9% - <12.4%
- 12.4% - <15.9%
- 15.9% - <19.4%
- 19.4% - <22.9%
- 22.9% - 26.4%

2017 Data

Ohio = 21.1%

Source: CDC 2020
Pulmonary Rehabilitation

- 8 week program
- 3 days per week
- 2 hours per session
- Focus on:
  - Education
  - Aerobic conditioning
  - Strength training
  - Quality of life

Effect of Pulmonary Rehabilitation on Survival

![Graph showing mortality over time after pulmonary rehabilitation initiation. The graph indicates a significant decrease in mortality after 90 days with P < 0.001.](image-url)

JAMA. 2020;323(18):1813-1823
Effects of Pulmonary Rehabilitation on Hospital Readmission for COPD

25% reduction in hospital readmission

Respiratory Research 2005, 6:54

Medicare 2020 readmission penalty

- 2,583 hospitals penalized (83%)
- $563 million in penalties
- Average penalty = 0.57% ($217,963)
- 2,142 hospitals exempt: veteran’s, children’s, psychiatric, critical access hospitals
Why Do COPD Patients Get Readmitted?

- Analysis of 27 million Medicare admissions from 2006-2010
  - 3.5% were for COPD
- 20.2% readmission in 30 days
  - Dual coverage (Medicare + Medicaid) most likely to be readmitted
  - 50% of readmissions occur in the first 2 weeks
- Only 28% of readmissions due to COPD
- 50% due to non-respiratory conditions
  - CHF
  - Sepsis
  - Arrhythmias
  - Fluids/electrolytes
  - Intestinal infection

Shah T. Chest 2015; 147:1219

So what can we do to prevent readmissions?

1. Guideline-directed ER and hospital management
2. Utilize transition clinics
3. Smoking cessation
4. Inhaler education
5. Exacerbation action plans
6. Provider visit within 1 week
7. Post-discharge phone call at 48 hours
8. Pulmonary rehabilitation
9. Community home care services