COPD Update

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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:

- COPD: 12.2%
- High cholesterol: 46.6%
- High blood pressure: 61.4%
- Heart disease: 23.6%
- Cancer: 15.2%
- Diabetes: 13.3%
- Asthma: 5.4%

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

There are two commonly used scales of obstruction severity:

<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>&lt; 35%</td>
<td>Very Severe</td>
<td>&lt; 30%</td>
<td>Very Severe</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

Spirometry is essential to diagnosis of COPD
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

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 Respilink</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>$66</td>
</tr>
<tr>
<td>Generic levilbuterol</td>
<td>levilbuterol</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>Combivent Respimat</td>
<td>ipratropium + albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$429</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>Duoden*</td>
<td>ipratropium + albuterol</td>
<td>Q 6 Hours PRN</td>
<td>$32</td>
</tr>
</tbody>
</table>

*I Nebulized  Cost per month: GoodRx

Ipratropium + albuterol is superior to albuterol alone

Arch Intern Med. 1999;159(2):156-160

Albuterol + Ipratropium

Albuterol Only

Percent Change in FEV1

Hours After Dose
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  - Rofumilast
  - N-acetylcysteine

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

Inhaled steroid alone not recommended

For patients with exacerbations:

- Daily azithromycin
- Rofumilast
- N-acetylcysteine

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>Yupelri*</td>
<td>revefenacin</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>Bronavast</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

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- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine
LAMA/LABA combination is superior to LABA alone or LAMA alone

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 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>Ulibron</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>Duaklir</td>
<td>aclidinium + formoterol</td>
<td>Twice daily</td>
<td>$990</td>
</tr>
</tbody>
</table>

Cost per month: GoodRx
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  - 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

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>Dutera</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>Symbicort</td>
<td>salmeterol + budesonide</td>
<td>Twice Daily</td>
<td>$100</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:
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   • Hospitalization
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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:

<table>
<thead>
<tr>
<th>ICS = LABA versus LABA Alone</th>
<th>All Patients</th>
<th>Eosinophils &gt; 2%</th>
<th>Eosinophils &gt; 4%</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td>-5</td>
<td>-4</td>
<td>-3</td>
</tr>
<tr>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>Excess COPD Exacerbations</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>Pneumonia</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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- Inhaled steroid alone not recommended
- For patients with exacerbations:
  - Daily azithromycin
  - Roflumilast
  - N-acetylcysteine

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>Amnity</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:

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  - Daily azithromycin
  - Roflumilast

N-acetylcysteine prevents COPD exacerbations


Azithromycin prevents COPD exacerbations

Roflumilast prevents COPD exacerbations in patients with frequent exacerbations

<table>
<thead>
<tr>
<th>Rate of Exacerbations</th>
<th>Roflumilast</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Three</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>&gt; Three</td>
<td>2.5</td>
<td>3</td>
</tr>
</tbody>
</table>

P = 0.03

Roflumilast improves FEV1

\[
\begin{align*}
\text{FEV1 (L)} & \quad \text{Weeks} \\
\hline
0 & 1.04 \\
4 & 1.12 \\
12 & 1.16 \\
20 & 1.12 \\
28 & 1.12 \\
40 & 1.12 \\
52 & 1.12 \\
\end{align*}
\]

P < 0.0001

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 (Dairesp)</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>Combivent</td>
<td>Albuterol</td>
<td>$429</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**

![Graph showing cumulative number of exacerbations](image)

Mepolizumab:
- 1.40/year
- Placebo:
- 1.73/year

*N Engl J Med 2017; 377:1613-1629*
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


Probability of Death


Probability of Death or Requirement for Long-Term Oxygen

Conservative oxygen therapy is associated with better survival

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 deaths per year
- Other cancers: 100,600 deaths per year
- Cardiovascular disease: 192,951 deaths per year
- COPD: 36,000 deaths per year
- Other: 135,033 deaths per year

*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

Prevalence By Annual Household Income

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

Prevalence Of Smoking By Race

- Native American
- White
- Black
- Hispanic
- Asian American

Centers for Disease Control 2020

Who Smokes In The United States?

Source: CDC 2020

Effect of Pulmonary Rehabilitation on Survival

JAMA. 2020;323(18):1813-1823

Pulmonary Rehabilitation

- 8 week program
- 3 days per week
- 2 hours per session

Focus on:
- Education
- Aerobic conditioning
- Strength training
- Quality of life

Ohio = 21.1%

About This Map
- 0.5% - 12.5%
- 12.5% - 15.5%
- 15.5% - 17.5%
- 17.5% - 20.5%
- 20.5% - 25.5%
- 25.5% - 29.5%
- 29.5% - 32.5%
- 32.5% - 35.5%
- 35.5% - 40.5%
- 40.5% - 45.5%
- 45.5% - 50.5%
- 50.5% - 55.5%
- 55.5% - 60.5%
- 60.5% - 65.5%
- 65.5% - 70.5%
- 70.5% - 75.5%
- 75.5% - 80.5%
- 80.5% - 85.5%
- 85.5% - 90.5%
- 90.5% - 95.5%
- 95.5% - 100.5%

2017 Data

Days from initiation of pulmonary rehabilitation
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