COPD is a chronic and incurable condition that limits airflow via obstruction or chronic inflammation. An individual with COPD may have emphysema, chronic bronchitis, or both. However, similar in their root cause of inflammation, they differ in their cause of inflammation. For example, chronic bronchitis is associated with excess production of mucus due to the inflammation which restricts airflow, whereas emphysema directly damages the functional air sacs and tubes in the lungs. People with COPD may have bronchitis, emphysema, or both. There are several potential effects impairments in the body with COPD including the functions of ventilation, gas exchange, cardiovascular, muscular, symptomatic, or psychological. Ventilatory impairments include increased airway resistance and obstruction, reduced lung or chest wall compliance, increased work of breathing, muscle weakness in ventilator muscles due to hyperinflation or neuromuscular weakness, ventilator inefficiency because of dead space creating an imbalance between tidal volume, muscle fatigue or failure due to weakness, inefficient, functional failure, hypoxemia, and hypercarbia.

COPD is typically seen in people who have smoked for several years. It is a chronic and progressive disease and often times activities of daily living are difficult due to shortness of breath. Therefore working as an exercise physiologist with an individual with COPD you are likely to be in a rehabilitation center doing different breathing techniques, strengthening the diaphragm and surrounding muscles, discussing stress management, and supporting healthful management of co-morbid conditions that may affect the overall condition such as diabetes or congestive heart failure to help the individual as a whole to maintain independence in daily activities and reduce risk factors.

According to the World Health Organization, COPD contributed to 3 million deaths world-wide and ranked as the fourth leading cause of death in 2011. According to the Centers for Disease Control and Prevention, COPD has been diagnosed in approximately fifteen million Americans with several people likely to have the conditions and not yet been diagnosed. The CDC also reports the third leading cause of death in the United States to be attributed to chronic lower respiratory disease, which includes COPD. 5.4% of South Dakota residents have been diagnosed within South Dakota with age-adjusted relevance in 2011. COPD in young healthy individuals is extremely rare. There is a hereditary condition that can occur in a very small percent of people. However, in general, you are more likely to see an older individual who has COPD after several years of smoking.

www.cdc.gov/copd/maps/docs/pdf/SD_COPDFactSheet.pdf
Symptoms and Causes of COPD

Symptoms include a chronic cough, chronic phlegm production, dyspnea or shortness of breath, wheezing when breathing, and feeling unable to breathe deeply. The most common cause of COPD in the U.S. is attributed to tobacco use. Air pollutants including second hand smoke, heating fuels, dusts, gases, and fumes are other contributors that may affect this condition. A lesser percentage of people may also be genetically predispositioned to COPD, but the primary cause is due to cigarette smoking. Therefore, one of the primary goals with management, as well as prevention, is smoking cessation. Otherwise reducing environmental pollutants that may trigger symptoms are important.¹⁴

www.cdc.gov/copd/maps/docs/pdf/SD_COPDFactSheet.pdf

Some individuals with emphysema have chest deformities or an over expanded chest size as their diaphragm is continually in an inspiratory position, rather than allowing for normal inspiratory and exhalation motions. The accessory muscles of the chest are often used more due to the weakened breathing muscles and therefore hypertrophy contributing to the formation of the enlarged chest.³ With chronic bronchitis, shortness of breath as well as reduced partial pressures of arterial oxygen and venous carbon dioxide levels also occur.³ The reduced ventilation and blood flow within the body progress to similar endpoints as emphysema with pulmonary hypertension and right heart failure. However, in later stages of the disease, like the enlarged chest with emphysema, more specific signs of chronic bronchitis and its detrimental effects can often be seen in the extremities with abnormal swelling caused by edema or excess fluid retention.³

Alveoli are small balloon-like sacs within the lung that absorb oxygen. These are damaged in people with COPD, contributing to feelings of being tired, frequent colds, constant coughing or a “smoker’s cough”, mucus production or sputum, chest tightness, wheezing, and shortness of breath. As the disease worsens, these symptoms may also worsen, along with weight loss, edema in the lower extremities, or blue discoloration of the lips or fingernails due to the low oxygenation level. Muscle strength and endurance can also substantially decline when COPD worsens.
With chronic bronchitis, the swollen walls of the airway and constant mucus production are expected. Bronchitis is an inflammation of the lower respiratory tract. In addition to the chronic inflammatory state within the respiratory tract, is the excess of mucus production and how it is a prime opportunity for germs and bacteria to build up and contribute to more frequent colds and flus. As the name preludes- this is a condition of inflamed bronchioles, making it more difficult for oxygen to pass through to the alveoli. Emphysema on the other hand is damaged alveoli, which is where the oxygen is trying to get to in order to perfuse into the capillaries and into the bloodstream to oxygenate the rest of the body.

With emphysema, the alveoli, or small oxygen filled sacs in the lungs, are damaged and are not able to expand and contract properly to allow oxygen in when breathing and carbon dioxide out when exhaling. Then as these sacs are damaged, they lose elasticity and degrade leaving areas in the lung which trap air making it difficult to exhale adequately. Oxygen is not able to perfuse the body and waste products build up in the body more readily.

As the alveoli are damaged, the loss of vasculature occurs. Hypoxemia in the body starts to occur due to the reduction of blood supply. As a result, pulmonary vasoconstriction occurs which then decreases the surface area of the lung that allows gas exchange of oxygen and carbon dioxide. As the pulmonary artery pressure increases, it eventually contributes to structural hypertrophy and pyperlasia of the smooth muscle pulmonary vascular bed with chronic pressure overload. Atherosclerosis of the arteries and fibrosis of the tissue can then be expected prior to the eventual unfortunate progression to right heart failure due to chronic pulmonary hypertension from previously described events. ³
Diagnosis of COPD

Upon presenting to a physician, potential expectations that may occur could include but not be limited to performing a physical exam, including history of smoking, family history, measure the amount of oxygen in the blood via a pulse oximeter or blood testing. Then likely, if COPD is suspected, a spirometry test may also be performed. This device allows the physician to determine how much volume and the rate that a person can inhale and exhale air for the body. X-Rays are not adequate uses to determine COPD diagnosis; however it can be used to rule out other conditions such as pneumonia. In later stages of COPD, the lungs may appear larger on an x-ray due to the chronic inflammation and scarring over the years but is not otherwise seen differently on an x-ray.

Tests can help confirm COPD diagnosis and progression of the disease. In people with emphysema, a higher residual lung volume is likely with difficulty breathing out quickly. Peripheral muscles also have reduced oxidative capacity due to the compromised function of gas exchange and monitoring oxygen levels, symptoms of tolerance, and physical fatigue cues are important during exercise.

Treatment/Management

Primary management methods with COPD include smoking cessation, stress management, exercise, and medication management. Oxygen is another use to ease symptoms in COPD. As physical activity can play a great role in pulmonary conditions and improving quality of life and daily living, the benefits of exercise related to pulmonary rehabilitation programs will be discussed later.

There are several different kinds of medication to help prevent, control, or manage symptoms of COPD These may include bronchodilators, anti-inflammatory, combination medicines, antibiotics, and vaccinations.

Bronchodilators help to relax the muscles around the airways, and allow better air flow, to reduce shortness of breath in people with COPD and other restrictive conditions. There are short-acting and long-acting bronchodilators. Sometimes bronchodilators need to be used for some time before symptom improvement can occur. Short-acting bronchodilators ease symptoms and are often used for people who have intermittent episodes of COPD symptoms. Anti-inflammatory medications help to reduce swelling and inflammation in the surrounding muscles in the airway as well as reduce mucus production that contributes to narrowing the airways. It is recommended to rinse out your mouth after inhaling anti-inflammatory medications to avoid developing thrush, a yeast infection, in the throat.

Inhaled bronchodilators and inhaled corticosteroids are often combination medicines used to reduce COPD symptoms. Antibiotics are used to help treat bacterial or viral infections that can contribute to flare-ups.

Other medications that may be used in COPD management:

Daliresp or roflumilast is a Phosphodiesterase-4 (PDE4) inhibitor, which is typically taken every day to prevent COPD symptoms. Anticholinergics, Beta-2-agonists, or a combination of the two are common
medications for rapid relief. For those who have more chronic symptoms, long-acting bronchodilators such as corticosteroids either as an oral medication or in the form of an inhaler. These can be used preventatively or to help treat flare-ups. Corticosteroids are also often used in people who have asthma. Expectorants are sometimes used to help cough up mucus if it is narrowing the airway because of excess mucus production. Methylxanthines are used in more severe cases of COPD. Metered-dose inhalers (MDIs) and nebulizers are common medications that can often be more mobile with people with COPD.²⁴⁻⁶,¹⁶

Nutrition Therapy

- Weight Management
  - Excess weight increases work load demand for daily activities
  - Underweight: likely due to increased energy expenditure related to compromised breathing in addition to decreased intake often because of chronic shortness of breath; contributes to frailty, loss of muscle mass, decline in ability to perform activities of daily living and increases risks for falls and fractures, and decline in quality of life
- Eat small, more frequent meals to avoid feeling overly full or uncomfortable but to still ensure adequate intake
- Ensure balance and variety of high nutrient-rich foods including fruits, vegetables, lean protein, whole-grains, and low or non fat dairy, as well as adequate fiber and water inclusion
- Limit items high in fat or sodium
  - Saturated and trans-fats contribute to increased cholesterol and associated risk factors, healthful fats can and should still be included in appropriate amounts
  - Sodium can affect blood pressure as well as edema or fluid retention increasing symptoms such as dyspnea
- Let friends and family help with food shopping and preparing to reserve energy use if needed (i.e.: if standing and making meals wears them out than eating will be difficult and likely poor intake will occur)
- Eat in a pleasant, calm, and happy environment to reduce stress and facilitate intake and breathing tolerance

COPD: Exercise Programming Recommendations: (From Durstine’s ACSM’s Exercise Management for Person’s with Chronic Diseases and Disabilities-2003)²
<table>
<thead>
<tr>
<th>Mode</th>
<th>Goal</th>
<th>Intensity/ Frequency/ Duration</th>
<th>Time to Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic</strong></td>
<td>• Increase VO2 peak, lactate threshold, &amp; Ventilatory threshold</td>
<td>• RPE 11-13/20</td>
<td>• 2-3 months</td>
</tr>
<tr>
<td></td>
<td>• Improved breathing patterns (less dyspnea)</td>
<td>• 1-2 sessions, 3-7 days/wk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ADL improvement</td>
<td>• 30 min/session</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Focus on duration over intensity</td>
<td></td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td>• Increase max reps, isokinetic torque/work, and lean body mass</td>
<td>• Low resistance, high reps</td>
<td>• 2-3 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 2-3 days/wk</td>
<td></td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td>• Increase ROM</td>
<td>• 3 sessions/wk</td>
<td></td>
</tr>
<tr>
<td><strong>Neuromuscular &amp; Balance</strong></td>
<td>• Improve gait, balance, and breathing efficiency</td>
<td>• Daily</td>
<td></td>
</tr>
</tbody>
</table>
Chronic Obstructive Pulmonary Disease (COPD)