



University of North Dakota  
UND Scholarly Commons

---

Nutrition & Dietetics Student Publications

Department of Nutrition & Dietetics

---

11-19-2019

## Chronic Obstructive Pulmonary Disease (COPD) and the Nutrition Care Process

Emily Anderson  
[emily.anderson.8@und.edu](mailto:emily.anderson.8@und.edu)

Follow this and additional works at: <https://commons.und.edu/nd-stu>

 Part of the [Dietetics and Clinical Nutrition Commons](#)

---

### Recommended Citation

Anderson, Emily, "Chronic Obstructive Pulmonary Disease (COPD) and the Nutrition Care Process" (2019).  
*Nutrition & Dietetics Student Publications*. 2.  
<https://commons.und.edu/nd-stu/2>

This Paper is brought to you for free and open access by the Department of Nutrition & Dietetics at UND Scholarly Commons. It has been accepted for inclusion in Nutrition & Dietetics Student Publications by an authorized administrator of UND Scholarly Commons. For more information, please contact [zeineb.yousif@library.und.edu](mailto:zeineb.yousif@library.und.edu).

## Chronic Obstructive Pulmonary Disease (COPD) and the Nutrition Care Process

Emily Anderson

University of North Dakota

### Abstract

Chronic Obstructive Pulmonary Disease (COPD) is a progressive disease that limits airflow and breathing in people worldwide. COPD is considered one of the leading causes of death in Americans and the primary factor contributing to diagnosis is smoking (CDC, 2019). Through the progression of this chronic disease, those suffering experience great impacts to their everyday lives. A registered dietitian nutritionist's (RDNs) job is to ensure adequate care through thorough assessment, diagnosis, treatment and evaluation, otherwise known as the Nutrition Care Process (ADIME-NCP). My uncle has been diagnosed with COPD and I have had the opportunity to witness this progression through the last year. It has given me great understanding into the struggles and hardships that come with this disease.

### DEFINITION & PATHOPHYSIOLOGY

Chronic Obstructive Pulmonary Disease (COPD) as mentioned before is a progressive disease that severely limits the airways and breathing. It can include inflammation of the lining of the bronchial tubes otherwise known as bronchitis or destruct the alveoli in the lungs called emphysema, often times patients will experience both disorders. COPD is classified into four groups according to the Global Initiative for Chronic Obstructive Lung Disease also known as GOLD. These classifications include the level, description and spirometry results to assess the severity of the patient's airflow limitations (Nelms, Sucher, Lacey, 2016).

GOLD 1- Mild: FEV1 >80% predicted

GOLD 2- Moderate: 50% < FEV1 < 80% predicted

GOLD 3- Severe: 30% < FEV1 <50% predicted

GOLD 4- Very Severe: FEV1 < 30% predicted

\*FEV1- Forced Expiratory Volume in 1 second\*

COPD is currently incurable and is most often times caused by long-term exposure to irritating gases such as smoking (CDC, 2019). Chronic bronchitis, asthma and emphysema are the primary conditions associated with COPD. With repeated exposure to irritants, pollutants and smoking results in inflammatory responses in the lungs or bronchial tubes. In bronchitis this inflammatory response includes decreased cilia function, increased phagocytosis and decreased immunoglobulin A (IgA). The inflammation causes hyperplasia of mucus-secreting cells resulting in edema of the bronchioles. Due to thickened mucus in the bronchioles bacterial growth is prominent and often times respiratory infections occur. Bronchitis is characterized by decreased airflow rates, dyspnea, hypoxemia and hypercapnia (Nelms, et al., 2016).

Emphysema usually develops later as a complication of bronchitis and can cause actual damage to the lung tissue. Damage to the lung results in loss of surface area and decreases the elasticity of the lung resulting in breathlessness. Decreased expiratory volume or FEV is a result of emphysema, expiration is impaired because air is often times trapped in the lungs. Due to decreased ability to expire, dyspnea and orthopnea occur causing respiratory acidosis or excess CO<sub>2</sub> in the lungs making them too acidic. Extreme fatigue occurs in patients because of the increased use of accessory muscle to expire oxygen (Nelms, et al., 2016).

## ETIOLOGY

One of the most principle classifications for COPD is chronic bronchitis and can be diagnosed with coughing and shortness of breath that last about 3 months or more each year for two or more years in a row. Bronchitis can be found in all ages but is most commonly prevalent in those over the age of 45, with females being twice as likely to develop bronchitis. Emphysema usually develops over years as a result of chronic bronchitis, the two chronic illnesses together are collectively known as COPD. Common signs and symptoms to notice in COPD are shortness of breath, wheezing, chest tightness,

excess mucus in lungs, chronic cough, blueness of lips, respiratory infections, fatigue, unintentional weight loss and edema this can often be observed through a Nutrition Focused Physical Exam (NFPE).

The main cause of COPD is chronic smoking and tobacco use but can be related to those who have long-term exposure to heavy fumes such as those in third world countries. Some other potential causes include genetic susceptibility, secondhand smoke, air pollution and workplace exposure to dust, smoke and fumes. COPD can also be caused by a deficiency in protein called AAt or alpha-1-antitrypsin but is only found in 1% of those who are diagnosed (Nelms, et al., 2016).

## EPIDEMIOLOGY

Lower respiratory lung diseases especially COPD is the third leading cause of death in Americans. Death rates due to COPD have declined in America for men but have not significantly changed for women and highest rates of COPD are found in southern states. Deaths from COPD can still occur in individuals who have successfully quit smoking due to the associated inflammatory stress that continues to damage the lungs. Normal lung function declines with age but those who smoke or are exposed to air pollutants develop symptoms more rapidly and twice the rate. I have experienced the effects of lung disease and the tolls it takes on the body. My uncle has successfully quit smoking, but it has done little to aid in his symptoms of COPD. He struggles to do the normal tasks of those who are able bodied from walking up the stairs to getting himself to shower depending on his oxygen. He has had to adjust to his limitations but coping mentally with the terms of his condition has been the hardest. Some days are better than others, but he has learned to take it one step at a time (COPD Foundation, 2019), (Mayo Clinic, 2017).

## COMPLICATIONS & PREVENTION

COPD can cause many side effects or complications of daily living. I have witnessed this in my uncle, but every individual is different and experiences the disease differently. The most common complications include activity limitations, dependency on oxygen devices, increased confusion or memory loss, respiratory infections, comorbidities of heart, lung and artery diseases as well as depression. As for prevention, COPD is unique in that there is a direct cause to the disease, preventing the use of tobacco or quitting decreases the chances of COPD ten-fold (Nelms, et al., 2016).

## NUTRITION ASSESSMENT

The nutrition assessment is used by the RDN to formulate a complete overview of the nutritional health of the patient. Every patient is a unique individual and requires treatment that is catered to their specific nutritional needs. Careful consideration of each assessment piece is crucial to providing accurate and adequate care for the patient. The nutrition assessment provides data from client histories, food and nutrition-related history, anthropometric and biochemical data. All data can be both subjective meaning information comes from the patient, family or caregivers as well as objective in which information comes from verifiable sources such as medical records.

### Client History

Nutritional status can be impacted by factors relating to socioeconomic status, social support systems, family relations and lifestyle factors. Information gathered from the nutrition assessment especially the client's history will impact the course of action for nutrition education and intervention. For patients with COPD their client history assessment should include any current and past medical diagnoses including surgeries, psychological status, education (literacy and primary language), current stage of diagnosis and any other concerning medical histories.

My uncle has lived a tough life and has not treated his body with the care that it deserves. He struggled to support himself and often found himself homeless or living in shelters, he entered a life where tobacco and alcohol use were the only thing he depended on. His socioeconomic status varied throughout the years, mostly due to job hopping, he currently is living with us and is the most stable he's been in in years. Other than us (his immediate family) and hospice my uncle does not have any other social support, back where he was living, he only relied on himself and food that we would send him to eat. This was done through a community-based project like meals on wheels that would bring him meals to where ever he was living. He was able to utilize some government funded resources such as food stamps, and low-income housing but it was always a struggle trying to get him to stick with it and fully utilize them. His current diagnoses include stage 4 COPD, lung disease, osteoporosis (history of many severe broken bones including the back and femur), depression, confusion and hallucinations, heart disease and histories of strokes. He's currently on Hospice and has been for the last eight months and has entered end of life care (Nelms, Sucher, Lacey, 2016).

#### Food and Nutrition Related History

Many factors of COPD impact patient's nutritional intake so designing a nutrition care plan is crucial to ensure adequate nutrition and minimize symptoms of the disease. Possible factors that may inhibit adequate nutritional intake include anorexia, early satiety, dyspnea, bloating and fatigue. Some important areas that the RDN should considered is whether the patients taste perception has been altered, appetite loss due to depression, unintentional weight loss, cachexia and fatigue that comes with difficulty breathing while eating. My uncle experiences a lot of these complications, when he first moved in with my family, he gained 35 pounds and was on a road to better health. He then experienced a transient ischemic attack (TIA) and from there his health severely declined his weight being majorly affected.

Antioxidant intake, increased respiratory health and increasing oral health play key roles in protecting against COPD and progression of COPD. It has been shown for some COPD patients that consuming fewer carbohydrates and more essential fatty acids and protein may help them breathe better. According to the American Lung Association some nutritional recommendations that they offered included limiting simple carbohydrates, eating 20-30 grams of fiber daily specifically from fruits, whole grains and vegetables, choosing mono- and poly saturated fats, limiting sodium intake to decrease edema and increasing fluid to help constipation that may be due to medications or increasing fiber intake (American Lung Association, 2018). From here assessing their ability to feed themselves, cook and prepare foods and overall food security should be noted for any potential limiting factors to adequate oral intake.

My uncles past included years of food insecurity and once he finally was in stable environment where food was at his access at all times, he was able to put on a healthy amount of weight, since then it has declined. Medication usage must be evaluated to determine if any are impacting appetite, side affects and oral intake. Careful attention to glucocorticosteroids decrease intestinal absorption of key nutrients that can lead to osteoporosis. Many of these patients are recommended to also receive bisphosphonates to prevent the onset of osteoporosis. My uncle takes an abundance of medications that really affect his overall appetite and he often struggles with constipation as a symptom of medication usage.

Utilizing a 24-hour recall, diet history and food frequency will help give the RDN an idea of what a typical diet may look like for the patient. Gaining this understanding can help later on when determining a diagnosis and intervention plan that ensures adequate intake orally. The diet history can establish usual intake, food preferences, alcohol intake, any type of supplementation and food allergies. This is important as recommendations can be made to adjust oral intake to small, frequent meals with modified textures if needed. As mentioned before all patients diagnosed with COPD are all



individualized and at different stages in their progression of COPD, this meaning that oral intake may be different with each patient. It is critical to understand where they are in their progression, it can be helpful for the RDN to utilize these assessment tools (Nelms, Sucher, Lacey, 2016).

#### Anthropometric Data

Anthropometric data is often obtained through the use of medical records and provides the patients height, age, current weight, weight history including usual body weight, and BMI. Weight loss and low BMI are commonly associated with mortality in patients with COPD. Unintentional weight loss is also a common side effect of emphysema and is related to the increased resting energy expenditure needed for altered breathing. Depletion of lean body mass is normal with the progression and can be assessed through BMI and history of body weight. These data markers come into play later when determining goals for intervention and monitoring the progress through observation of anthropometric data (Nelms, Sucher, Lacey, 2016). As mentioned, my uncles' weight initially increased by about 35 pounds with his usual body weight for that time being around 130-140 pounds, and his health significantly improved. After his most recent TIA his weight, appetite, ability to consume foods and overall health declined and he now currently weighs around 90 pounds. He is very frail and relies on a walker or wheeler chair for mobilization, I know he presents with major signs of malnutrition especially muscle wasting, fat loss, unintentional weight loss and edema.

#### Biochemical Data

Biochemical data indicates nutritional markers for laboratory findings including acid-base balances, electrolyte and renal profiles, gastrointestinal profiles, glucose and endocrine levels, inflammatory response, metabolic rate, mineral-vitamin intake, deficiencies, total macronutrient intake and urine profiles. These markers can be assessed and indicated through evaluation of organ function, blood, urine, feces and tissue samples. Every disease state and diagnosis will present with different biochemical data findings and associations, understanding what these lab values mean is important to

understanding the overall state of the patient. My uncle since his admission to Hospice often gets his blood drawn, urine and feces output checked and observance of his skin to assess where he is at and what kind of end of life treatment is to be given. Standard laboratory indicators used for patients with COPD range from different medical lab tests, procedures and assessments. Visceral protein assessment is standard to interpret carefully during periods of systemic inflammation, hematological tests, electrolytes, pH, glucose and arterial blood gases are often checked. Often times inflammatory markers are checked such as C-reactive protein (CRP: normal range: below 3.0mg/L), fibrinogen (normal range: 160-450mg/dL) and erythrocyte sedimentation (ESR: normal range: males-1-13mm/hr., females-1-20mm/hr.), these are important to monitor during bouts of inflammation. Many vitamins and minerals can be monitored as well to help indicate nutritional status these include vitamin D (normal range-12-20ng/mL), vitamin K (normal range: 0.2-3.2ng/mL), vitamin A (RDA: men-900ug/RAE., women-700ug/RAE), vitamin E (RDA: 15 mg alpha-tocopherol) and Zinc (RDA: men-11mg, women-8mg) (Meditec, 2019), (Nelms, Sucher, Lacey, 2016).

Assessment of anemia is important in the evaluation of dyspnea, along with pulmonary function tests (PFTs) especially spirometry to assess the severity of airflow limitations, response to certain medications and progression of the disease. Other tests than can be included in assessing COPD patients include: lower limit of normal FEV1/FVC, forced expiratory volume in six seconds, peak expiratory flow, lung volume, diffusing capacity, pulse oximetry and arterial blood gases. Below is the chart for forced expiratory volumes.

GOLD 1- Mild: FEV1 >80% predicted

GOLD 2- Moderate: 50% < FEV1 < 80% predicted

GOLD 3- Severe: 30% < FEV1 <50% predicted

GOLD 4- Very Severe: FEV1 < 30% predicted

\*FEV1- Forced Expiratory Volume in 1 second\*

All common medications prescribed for patients with COPD can have side effects that affect the patient's ability to stay nutritionally adequate (Nelms, Sucher, Lacey, 2016).

- Corticosteroids: Prednisone and Solu-Mefrol- used to reduce inflammation in the bronchial tubes, can be used in the form of an inhaler or taken orally. Side effects depend on the dosage, length of use, and form. Side effects for inhalers include sore mouth, hoarse voice, infection in the throat and cough. Orally include altered fluid/electrolyte balance, hypertension, mood swings, increased appetite, weight gain, hyperglycemia, osteoporosis, hyperlipidemia, poor wound healing.
- Bronchodilators: B2-agonists, Anticholinergics, Theophyllines- open or relax the bronchial tubes and relieve shortness of breath, this can also be taken orally or through an inhaler. Side effects include fast heartbeat, shakiness, cramping of the hands, legs or feet, dry mouth, severe nausea and vomiting.
- Leukotriene Inhibitors: Zafirlukast, Aileuton, Montelukasts- mediates the inflammation associated with COPD. Side effects include headache, nausea, diarrhea, infection and caution with intake of grapefruit.
- Mucolytics: Acetylcysteine- helps make the mucus in the lungs thinner and less sticky. Side effects include nausea, vomiting, runny nose, drowsiness and clammy skin.
- Antibiotics: are used to treat bouts of respiratory infections, some side effects include nausea, vomiting and diarrhea.

I am not aware of all the medications that my uncle is taking, his Hospice nurses and my parents take care of all the administration of them. I do see them often times leaving syringes of morphine for him when he feels he needs to take them for his pain and every night my mom crushes up his meds and places them in his favorite homemade applesauce, he struggles to swallow them

otherwise. He struggles with constipation and nausea, so I know he is prescribed to take stool softeners every day and nausea medication to help him with his appetite.

#### NUTRITION DIAGNOSIS

The RDNs role in the nutrition diagnosis is to identify and label existing nutrition problems that the RDN is properly able to treat through intervention and treatment. Standard terminology exists for this section of the nutrition care process and three prominent domains exist for possible diagnoses for patients. These include the intake domain relating to the energy needs being consumed or not consumed, clinical relating to medical or physical conditions and behavioral-environmental domain where knowledge attitudes, beliefs, environment and food accessibility play a role. Shortness of breath, chronic coughing and chest discomfort often times causes patients with COPD difficulty eating enough and maintaining their weight. Major diagnoses often times include statements relating to finding ways to increase energy intake and avoidance of unintentional weight loss. In COPD hypermetabolism increases a patient daily REE which may be a side effect increased thoracic muscle use, inflammation from elevation of C-reactive protein, fibrinogen and leukocytes as well as possibly thermogenic effects of medication use. Optimal energy balance is crucial to preserve body weight, lean body mass and overall daily living of COPD patients. According to the AND Evidenced Analysis Library it is important that each individual receives sufficient calories and protein and it has been recommended that energy intake of 125-156% (average of 140%) above basal energy expenditure and protein intake of 1.2-1.7 g/kg/body weight are adequate to avoid deficiencies. If patient is malnourished already, it could be important to increase needs even more for repletion of adequate nutrient stores. Using 25-35 kcal/kg of body weight is appropriate with approximately 20-25% of calories coming from protein. It was once thought that carbohydrate intake could impact respiratory function due to increased CO<sub>2</sub> production and complicate ventilation, but it is now thought that primary concern is overfeeding of patients.

Many nutrition diagnoses can be appropriate for a patient with COPD and can range in all three different domains. Some common diagnoses include malnutrition, inadequate energy or oral intake, inadequate fluid intake, inadequate protein intake, inadequate vitamin-mineral intake, increased nutrient needs, food-medication interactions, swallowing difficulty, unintended weight loss, impaired ability to prepare food/meals, self-feeding difficulty, poor nutrition quality of life (Nelms, Sucher, Lacey, 2016).

#### Possible PES Statements

- Inadequate energy intake related to unintentional weight loss as evidenced by <50% of intake of estimated energy requirements, weight loss of 7.5% in 3 months and increased REE requirements due to hypermetabolism
- Chronic disease or condition related malnutrition related to loss of appetite as evidenced by unintentional weight loss of 7.5% in 3 months, early satiety, altered taste perceptions, muscle and fat wasting and edema
- Inadequate protein intake related to decreased appetite as evidenced by decreased immune function, chronic infections, decreased wound healing, <20% of daily intake of protein and decreased lean body mass/muscle
- Food-Medication interaction related to use of Corticosteroids (Prednisone and Solu-Mefrol) as evidenced by mouth sores, increased appetite, unintentional weight gain, hyperglycemia and hyperlipidemia
- Swallowing difficulty related to COPD as evidenced by dyspnea, chronic mouth breathing, chronic mucous production, chronic coughing, mouth sores, dry mouth and in some cases, dysphasia often from TIAs or Strokes

In my opinion I believe my uncle would be diagnosed with malnutrition, difficulty swallowing, and inadequate energy intake including symptoms of unintentional weight loss, loss of appetite, TIA side

## CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

13

effects, edema, muscle wasting, dysphasia, decreased wound healing, chronic mucous production, chronic coughing and decreased immune function.

### POSSIBLE INTERVENTIONS & TREATMENT

There are four categories of nutrition intervention they include food and/or nutrient delivery, coordination of care, nutrition education and nutrition counseling. For patients with COPD I would recommend choosing treatment pertaining to the food and/or nutrient delivery and coordination of care and nutrition education. With that, depending on what stage of COPD they are in I would utilize nutrition education and counseling if necessary. If a patient is in the beginning stages these may be important to helping the patient slow the progression of their disease but if a patient is further along in the progression of COPD nutrition education and counseling are not going to be as effective. Some possible interventions and treatments include:

- Increase intake of nutrient dense foods consuming foods high in protein and calories.
- Decrease sodium intake to decrease changes of edema and hypertension
- Dietary education regarding nutrient dense foods, and important of high calorie/protein foods for overall health
- Educating patients on the importance of resting before meals to avoid fatigue and tiredness while eating
- Eating smaller meals, more frequent meals rather than three big meals throughout the day will help to alleviate the feeling of fullness and fatigue
- Nutritional supplementation to provide additional calories, protein and mineral/vitamin intake, focuses should be on vitamin D, calcium and antioxidants
- Increasing physical activity or rehabilitation for patients to increase lean body mass and lung strength (performing ADL exercise to increase quality of life for patient)

- Avoiding beverages that are filling but do not calories or protein such as coffee, tea and diet soft drinks
- If dysphagia is present modification of textures can be introduced for easier swallowing while eating
- For constipation related to medication use, increasing fiber intake may be useful
- If able to prepare own food, education on easy to prepare foods for patients or adapting a system to help patient prepare food for themselves
- Coordination of care to Speech language pathologist (SLP) for any swallowing or dysphagia difficulty
- Coordination of care to social work for any potential resources for the client
- Nutrition Counseling using MI, transtheoretical stages of change model and health belief models to help gear patient towards a better attitude towards health, nutrition and understanding of slowing the progression of the diagnosis

I have been able to witness my uncle during meal times and since his TIA he has struggled with major fatigue, appetite loss, and dysphagia while eating. He is able to do some cooking but not a lot, my family and his nurses often times will make him food to eat when he is feeling up to it. We keep a lot of easy to prepare food on hand for him and often keep foods such as whole milk, butter and high calorie options to add to his meals to increase his calorie intake. He enjoys hot chocolate, ice cream, homemade applesauce, soups and (of all things) fish! We are aware of his dysphagia and difficulty swallowing but he has expressed that he does not want a swallow study done or modified textured foods. To combat we often cut up his foods to smaller bite sized pieces or serve foods that can be easily mashed and chewed for him. He usually consumes about 25% or less of his meals but sometimes he will have bouts of increased appetite in which we try to have him eat more. I think overall, he is aware of the importance of eating and getting in proper nutrition, but he struggles do so which is expected at his

stage of COPD. He eats when he can and often eats small frequent meals throughout the day to combat his tiredness and fatigue with meal times.

#### MONITORING & EVALUATION

In relation to the patient's fatigue, altered taste perception, oral intake, increased caloric intake, mineral intake (sodium primarily), swallowing difficulty, medication induced constipation, nausea and overall malnutrition it is key for the RND to provide proper monitoring and evaluation to assess the patient's progression of COPD. Toward the latter stages of COPD, it may be decided the enteral nutrition be induced if ethical to provide adequate nutrition. Monitoring of energy intake throughout can help to assess if this is necessary or to determine future course of nutrition intervention. Some ways to monitor the patient's nutritional status is through weight, (if in a care home) food intakes (0-100% intakes), observance of malnutrition status through NFPEs and appetite to name a few (Nelms, Sucher, Lacey, 2016).

Right now, hospice does most of the evaluation of my uncle, assessing his nutritional status and progress with his COPD. Since he is on hospice, RDNs are not used at this stage of life and therefore nursing, doctors and my family are in charge of keeping track of his nutritional status. It can be difficult at times, because he is not always truthful about his nutritional intake when we are not there to observe him at meal times.

Through the nutrition care process, I have been able to outline a typical process in which a patient diagnosed with COPD would experience with an RND. With that being said, each patient is individualized and will most likely all be at different stages in their progression requiring different plans of nutritional treatment to best care for them. Keeping this in mind will be crucial to assessing what is going to be best for the particular patient at hand. I think COPD can be difficult because there is not cure and will ultimately progress to the furthest stage which can be hard not only on the family but the care



## CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

16

providers in their treatment. Having an open mind and being open to trying all things to best treat the patient is the best route to go with patients who are experiencing chronic disease.

References

- (1) American Lung Association. (2018). Lung Health & Disease. *Nutrition and COPD*. Retrieved from <https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/copd/living-with-copd/nutrition.html>
- (2) Center for Disease Control and Prevention [CDC]. (2019). Chronic Obstructive Pulmonary Disease (COPD). *Basics about COPD*. Retrieved from <https://www.cdc.gov/copd/basics-about.html>
- (3) Center for Disease Control and Prevention [CDC]. (2019). Chronic Obstructive Pulmonary Disease (COPD). *Data and Statistics*. Retrieved from <https://www.cdc.gov/copd/data.html>
- (4) COPD Foundation. (2019). What is COPD? Retrieved from <https://www.copdfoundation.org/What-is-COPD/Understanding-COPD/What-is-COPD.aspx>
- (5) Mayo Clinic. (2017). COPD. Retrieved from <https://www.mayoclinic.org/diseases-conditions/copd/symptoms-causes/syc-20353679>
- (6) Meditec. (2019). A Comprehensive Guide to Normal Lab Values. Retrieved from <https://www.meditec.com/resourcestools/medical-reference-links/normal-lab-values/>
- (7) Nelms, M., Sucher, P. K., Lacey, K. (2016). *Nutrition Therapy and Pathophysiology*. Boston, MA: Cengage Learning pg. 644-750.