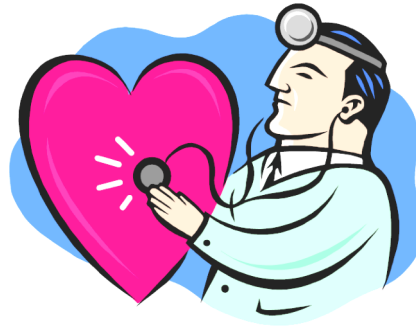




COMMON SENSE RESPIRATORY

## CONGESTIVE HEART FAILURE



*Heart failure affects about 4.8 million Americans and accounts for 200,000 deaths annually*

### **Learning Objectives**

Common Sense Respiratory is a series of articles written for Rotech personnel with the purpose of conveying concepts and terminology of respiratory medicine in every-day language. Increasing understanding of these areas will allow our personnel to provide a higher level of service to the patients, families, physicians, nurses, respiratory care practitioners, discharge planners, and other markets we serve. In “**Congestive Heart Failure**”, we will endeavor to answer the following questions:

**What is the function of the heart?**

**What is heart failure?**

**What causes heart failure?**

**What are the signs and symptoms of heart failure?**

**How is it diagnosed?**

**How is heart failure treated?**

**How can heart failure patients help themselves?**

**What happens during sleep in heart failure patients?**

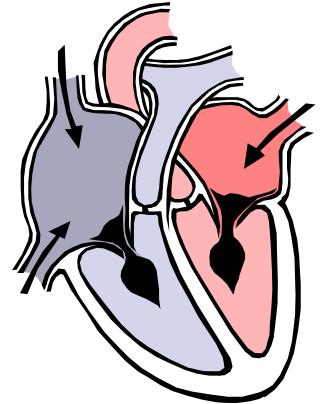
**How are sleep problems identified?**

**How are sleep problems treated?**

All words shown ***bold and italicized*** will be defined at the end of the chapter in the “Glossary of Terms” section. You may also notice the abbreviations e.g. - “for example”, i.e. - “that is”, and aka - “also known as” used in parenthesis.

### What is the function of the heart?

The purpose of the heart is to pump blood to all parts of the body. Blood carries ***oxygen*** and ***nutrients*** out to the body tissues and carries waste products away. The amount of blood that the heart is required to pump depends on the body’s activity level. The heart doesn’t have to pump as much while at rest as during strenuous activity. The harder the body’s tissues are working, the more blood that is pumped by the heart. The heart is comprised of four chambers: the left ***atrium***, the right atrium, the left ***ventricle***, and right ventricle. The two chambers on the left side of the heart pump blood to the body and body ***organs***. The right side pumps blood through the lungs where oxygen is absorbed into the blood and ***carbon dioxide*** (a waste product) is excreted into the ***alveoli*** and exhaled.



### What is heart failure?

Heart failure occurs when the heart is unable to pump enough blood to meet the body’s needs. It is not a disease, but rather the result of disease on the heart muscle. Because many patients with heart failure have excess fluid back up in the lungs and other body systems; the condition was once called ***congestive heart failure***. This term is being abandoned as many patients experience heart failure without the fluid congestion. However, many health professionals still use the terms interchangeably.

### What causes heart failure?

As stated previously, heart failure is not a disease but rather a syndrome that occurs as a result of disease on the heart muscle. Heart failure has a variety of causes, including ***coronary heart disease, heart attacks, high blood pressure, leaky or blocked heart valves, infections*** of the heart, pulmonary diseases, ***congenital*** heart problems, and ***cardiomyopathy*** (i.e. disease of the heart muscle). Behavioral factors may also contribute to the development of heart failure including ***obesity***, smoking, high-fat or high-salt diet, excessive alcohol use, and a sedentary lifestyle.



### What are the signs and symptoms of heart failure?

Signs and symptoms vary from patient to patient, depending somewhat on which side of the heart is affected. When the left side of the heart fails, fluid backs up in the lungs (i.e. pulmonary congestion) causing respiratory problems. The patient may develop ***dyspnea*** (i.e., the sensation of difficult breathing) and fatigue. They may also

experience shortness of breath when laying down (i.e., **orthopnea**) and even wake up short of breath (i.e., **paroxysmal nocturnal dyspnea**). Because of the difficulty in breathing at night, many patients may find it easier to sleep sitting up in a recliner or with several pillows.

Patients with failure of the right side of the heart have fluid back up in other parts of the body. The fluid buildup causes weight gain and swelling in the extremities (legs and/or arms). Fluid may also accumulate in the liver and other organs causing bloating and discomfort of the abdomen. Because patients often develop right-sided heart failure secondary to COPD and other pulmonary diseases, they may already be short of breath.


Failure of one side of the heart often leads to failure of the other side as well. An overlap of symptoms of both left and right-sided heart failure is not uncommon.

### How is heart failure diagnosed?

A **chest x-ray** will show an enlarged heart and possibly fluid accumulation in the lungs (i.e., pulmonary congestion or edema) and even fluid accumulation in the chest cavity (i.e., **pleural effusion**). The **EKG** will also show changes characteristic of changes to the heart. An **echocardiogram** uses sound waves to provide a picture of the functioning heart showing enlargement, malfunctioning valves, pressures within the heart and the amount of blood that is ejected from the heart with each beat. Other testing including laboratory studies of the blood and placing a probe directly inside the heart (i.e., **Swan Ganz Catheter**) may also be performed. Spirometry may also predict patients at risk for heart failure.

### How is heart failure treated?

Medications are used to improve the function of the heart. The most commonly prescribed drugs include:

- **Angiotensin-Converting Enzyme (ACE) Inhibitors** – Open up (i.e., dilate) blood vessels, thereby lowering blood pressure and decreasing the work of the heart.
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- **Diuretics** – Often called “fluid pills,” get rid of excess fluid by increasing the amount of urine produced. Patients may have to take extra potassium along with the fluid pill as potassium is lost with the increase in urine output.
  - **Digoxin** – Slows the heart rate and improves the heart contraction so more blood is pumped per stroke.
- **Vasodilators** – Other vasodilators may be used in addition to the ACE inhibitor to dilate blood vessels thus lowering blood pressure and reducing the workload on the heart.

Other medications may also be used depending upon the patient’s individual needs.

In addition to medication, patients may also require the use of **supplemental oxygen**, **CPAP**, or **NPPV** to manage the breathing difficulties encountered. This is especially true

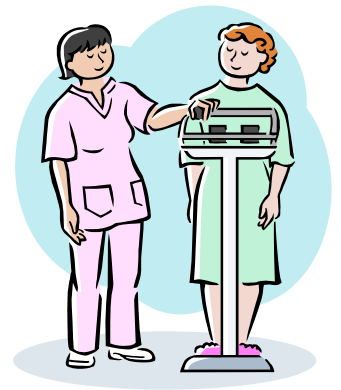
during sleep when changes in breathing may worsen. We will discuss this in more detail later.

Surgical options are also available for the treatment of heart failure. Several procedures have been used including procedures to improve blood flow to the heart muscle, reconstruction of the heart, and even transplanting a donor heart.

## How can heart failure patients help themselves?

There are several steps patients can take to help themselves. Self-help is often directed at changes to behavior that contributed to the development of heart failure in the first place.

- **Weight Loss** – If the patient is overweight, losing weight can help decrease the workload on the heart. A dietitian can provide information on how to reduce calories and still maintain good nutrition.
- **Dietary Changes** – Reducing sodium intake can help reduce fluid retention. Reducing fat can reduce the risk of heart disease. Patients should be taught how to eat a low-fat, low-sodium diet limiting fat to less than 30% of total calories and sodium to less than 2 grams/day. Alcohol intake is also discouraged and should be eliminated or restricted to 1 ounce per day or less.
- **Fluid Restriction** – The doctor may also ask the patient to restrict fluid intake to reduce fluid retention.
- **Improved Activity** – Activity should be encouraged, increasing levels to achieve 30 to 45 minutes of aerobic exercise three to four times per week. Any increase in activity should be done under the doctor's supervision.
- **Smoking Cessation** – If patient continues to smoke, they should be encouraged to stop. Smoking decreases blood flow to the heart muscle, decreases circulating oxygen, and increases the workload on the heart.
- **Reduced Stress** – Emotional stress can worsen the symptoms of heart failure.

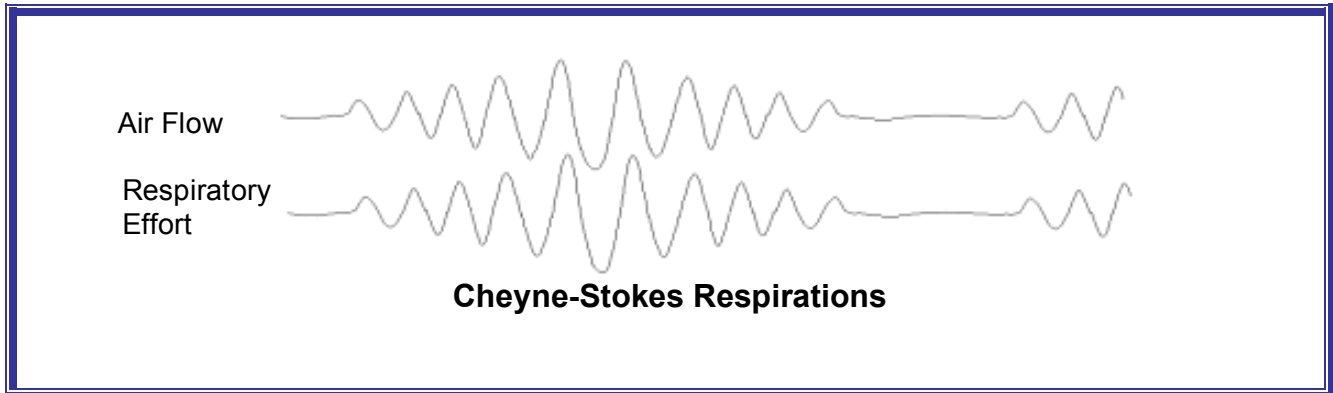


## What happens during sleep in heart failure patients?

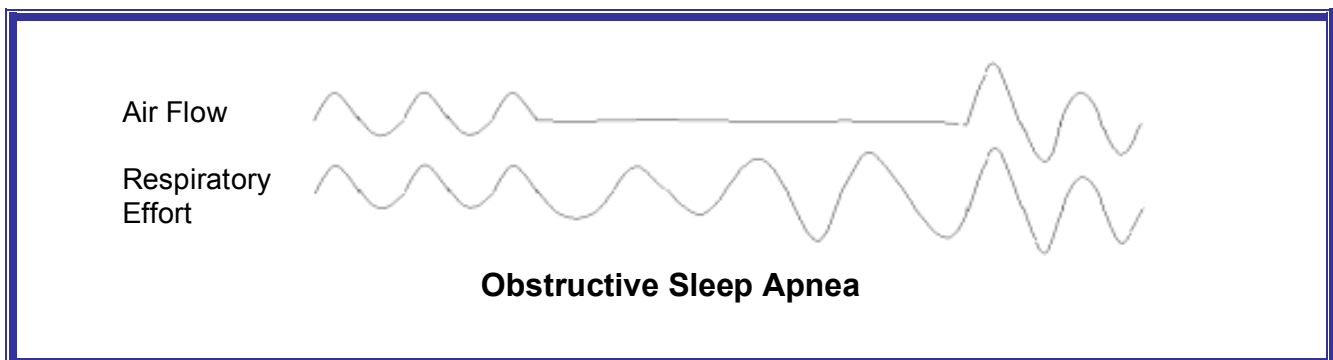
There is substantial evidence that many patients with heart failure have abnormal breathing episodes during sleep. It is believed by some physicians that **sleep-disordered breathing** is part of the cause of heart failure in many patients. In others, the breathing changes may occur after the development of heart failure.

There are two patterns of abnormal breathing observed in patients with heart failure. Studies show that **central apneas** (i.e., periods of no effort to breathe) occur in 40-50% of patients with heart failure, especially in males. Central apneas in heart failure are frequently part of a breathing pattern called **Cheyne-Stokes Respirations (CSR)**. Cheyne-Stokes Respirations are an abnormal breathing pattern characterized by a

repetitive pattern of central apnea, followed by increasing rate and depth of breathing, then a period of decreasing rate and depth, and finally another period of central apnea.

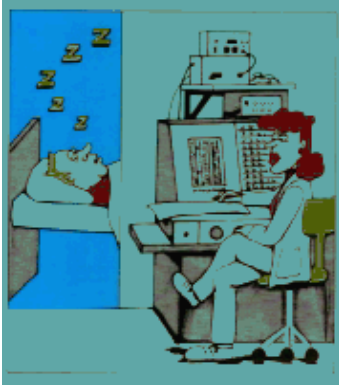


The other pattern observed in some patients with heart failure is **obstructive sleep apnea (OSA)**. OSA is characterized by repetitive episodes where the patient is making an effort to breathe but the upper airway has collapsed, blocking airflow. During obstructive apneas, blood oxygen levels can drop and chemicals are released into the bloodstream as a result of the stress to the body. It is theorized that over time, these mechanisms may contribute to the development of heart disease.



Studies comparing patients that experience sleep-disordered breathing (e.g., OSA, Central Apnea, or CSR) tend to have decreased survival and more problems with their heart failure. Treatment of the sleep problems may be a key component to proper management of the heart failure patient.

Most patients with heart failure are not evaluated for sleep-disordered breathing. Many physicians involved in managing heart failure are not familiar with techniques used to identify and treat these sleep problems. It is imperative to provide information to primary care physicians and cardiologists on the incidence and important role of sleep disordered breathing in heart failure. It is only through improved education that these patients will be identified.



## How are sleep problems identified?

Overnight oximetry recording can be used by the physician to identify patients that are **desaturating** during sleep. If oxygen is ordered, oximetry is sufficient to document medical necessity. If the physician determines it to be necessary, **polysomnography** may be ordered to document the presence of obstructive or central apneas.

## How are sleep problems treated in heart failure?

A variety of techniques have been used to treat sleep-disordered breathing in heart failure. Supplemental oxygen has been shown to decrease, but not alleviate, the amount of Cheyne-Stokes Respirations. Oxygen may also be necessary during activity if the patient shows desaturations during exercise.

If obstructive sleep apnea is documented, **CPAP** or **Bilevel-PAP** is more appropriate. Some authors have used **NPPV** to successfully manage central sleep apnea associated with heart failure. Besides alleviating the sleep-disordered breathing, positive pressure therapy (i.e., CPAP, Bilevel-PAP, or NPPV) has also been shown to improve heart function in appropriate patients. When positive pressure is used, the heart's ability to pump blood may increase.

In patients with coexisting pulmonary disease (e.g., COPD), it may be necessary to utilize oxygen along with positive pressure therapy. Additional medications for the management of the pulmonary disease may also be necessary.

## Summary

Heart failure affects about 4.8 million Americans and accounts for 200,000 deaths annually. It is one of the most common causes of hospitalization and costs for heart failure in the US have been placed as high as \$38 billion, of which \$23 billion is for hospital stays. Cost to Medicare for heart failure exceeded costs for heart attacks and all types of cancer combined.

Management of heart failure is directed toward preventing hospitalizations. Appropriate home care plays an important role in preventing hospitalizations. Sleep-disordered breathing is common in heart failure and often unidentified and untreated.

## Glossary of Terms

**Alveoli** – Microscopic air sacs in the lungs that are responsible for getting oxygen into, and carbon dioxide out of, the bloodstream.

**Atrium** – The upper chamber of the heart. There is a left and right atrium. Plural is atria.

**Bilevel Positive Airway Pressure (aka, Bilevel PAP or BiPAP™)** – Bilevel Positive Airway Pressure is similar to CPAP except that two different pressures are applied to the airway. During inspiration a higher pressure is used (called inspiratory positive airway pressure or IPAP) and during exhalation a lower pressure is applied (called expiratory positive airway pressure or EPAP).

**Carbon Dioxide (CO<sub>2</sub>)** – Carbon dioxide is a waste gas that is produced by our bodies as energy is burned. It is normally carried to the lungs by the blood where it is exhaled.

**Cardiomyopathy** – Disease of the heart muscle (i.e., myocardium).

**Central Apnea** – No airflow in or out of the lungs for a period of time (usually 10-15 seconds or longer) when the patient makes no attempt to breathe.

**Cheyne-Stokes Respirations** – An abnormal breathing pattern characterized by gradually deeper breaths, followed by gradually shallower breathing with periods and periods of central apnea.

**Chronic Obstructive Pulmonary Disease (COPD)** – COPD is a diagnosis that includes conditions such as emphysema, chronic bronchitis, and asthmatic bronchitis, which produce chronic reduction of the airflow out of the lungs. Because these conditions often coexist to some degree, it is often easier to group patients under COPD rather than saying “emphysema with some chronic bronchitis” or “chronic bronchitis with an asthmatic component.”

**Congenital** – A condition that exists from birth.

**Congestive Heart Failure (aka, Heart Failure)** – Heart failure occurs when the heart is unable to pump enough blood to meet the body’s needs. It is not a disease, but rather the result of disease on the heart muscle. Because many patients with heart failure have excess fluid back up in the lungs and other body systems, the condition was once called congestive heart failure.

**Continuous Positive Airway Pressure (CPAP)** – A continuous pressure applied to the airway through a nasal mask. Typically used to prevent collapse of the upper airway that occurs in obstructive sleep apnea.

**Coronary Heart Disease** – Heart disease secondary to poor blood flow to the heart muscle, usually from blockage of the coronary arteries.

**Desaturate/Desaturation** – An abnormal drop in blood oxygen levels. This is typically defined by a drop of at least 4-5% in oxygen saturation.

**Dyspnea** – A sensation experienced by the patient of having difficulty breathing.

**Echocardiogram** – Test that creates a moving view of the heart and heart function by the use of sound waves. Estimates of the heart’s pumping ability and internal pressures are created using computerized models.

**Electrocardiogram (ECG or EKG)** – Recording of the electrical activity of the heart.

**Heart Attack (aka, Myocardial Infarction)** – Death of an area of the heart muscle due to loss of blood flow.

**Heart Valves** – Structures between heart chambers or between the heart and major vessels that prevent backward movement of blood flow during heart contractions and relaxation.

**High Blood Pressure (aka, Hypertension)** – Increased pressure of the blood within the arteries.

**Infection** – Abnormal growth and reproduction of germs (i.e., virus, bacteria, fungus, parasites, etc.) in or on the body.

**Lungs** – The lungs are the organs of gas exchange in the body. Composed of millions of tiny alveoli (air sacs); they are designed to get oxygen into the bloodstream and carbon dioxide out of the blood. Each alveolus is bordered by its accompanying capillary, which allows red blood cells to flow in very close proximity to the fresh air inside the alveoli. This allows for ready movement of oxygen into, and carbon dioxide out of, the blood stream.

**Noninvasive Positive Pressure Ventilation (NPPV)** – A therapy using a small bi-level pressure support ventilator and a noninvasive interface (usually a nasal mask) to augment the patient's spontaneous breathing. It is used in patients with chronic respiratory failure to treat chronic or periodic hypoventilation.

**Nutrients** – A constituent of food that is essential for normal body function.

**Obesity** – Overweight, usually greater than 20% over ideal body weight.

**Obstructive Sleep Apnea (OSA)** – A condition characterized by repetitive episodes when the upper airway collapses during sleep, resulting in no airflow to the lungs despite the fact that the patient has effort (i.e., diaphragm movement) to breathe.

**Organ** – A collection of specialized tissue(s) that performs a function or set of functions. Examples include the lungs, heart, kidneys, or liver.

**Orthopnea** – Increased shortness of breath when lying down compared to standing or sitting.

**Oximetry/Oximetry Recording** – This is a noninvasive (i.e., does not require insertion through the skin or a body orifice) measure of the oxygen saturation of hemoglobin. That is, if 97% of the hemoglobin in blood is completely saturated with oxygen the oximetry reading (i.e., SpO<sub>2</sub>) would be 97%. Oximetry is a useful tool because it allows for continuous recording (18 hours or more) of the blood oxygen level during periods of sleep and activity, when other measures (i.e., ABG's would be very difficult to perform).

**Oxygen (O<sub>2</sub>)** – An element required by the body to metabolize or "burn" energy. Air that we inhale contains 21% oxygen.

**Paroxysmal Nocturnal Dyspnea (PND)** – Sudden awakening during the night due to shortness of breath.

**Pleural Effusion** – Accumulation of fluid in the chest cavity.

**Polysomnography (PSG)** – Testing performed while the patient is asleep that includes monitoring EKG, chest movement, air movement out of the nose and mouth, SpO<sub>2</sub>, EEG, EMG, and other measurements.

**Positive Pressure Therapy** – Therapies such as CPAP, Bilevel PAP, NPPV, or invasive ventilation that create positive pressure inside the lungs and chest cavity.

**Pulmonary** – Relating to the lungs, to the arteries that go to the lungs, or to the opening leading from the right ventricle into the pulmonary artery.

**Pulmonary Congestion (aka, Pulmonary Edema)** – An abnormal accumulation of fluid in the lung tissue.

**Sleep Disordered Breathing** – A generic term used to describe abnormal breathing during sleep. This may include obstructive apneas, mixed apneas, central apneas, Cheyne-stokes respirations, hypoventilation, etc.

**Spirometry Testing** – Basic spirometry is the term typically used to denote the measurement of basic lung function (e.g., volume and airflow) by the use of a spirometer.

**Supplemental Oxygen** – The use of oxygen in addition to oxygen being breathed from room air.

**Swan-Ganz Catheter** – A thin, flexible, hollow tube placed into the heart and pulmonary artery to measure pressures in the heart and pulmonary vessels as well as the pumping action of the heart (i.e., cardiac output).

**Ventricles** – The lower chambers of the heart. The right ventricle pumps blood through the lungs and the left ventricle pumps blood throughout the rest of the body.