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Regional Spinal Cord Injury Center of the Delaware Valley  
NIDRR-designated

# *Spinal Cord Injury Manual*

A publication of the  
Regional Spinal Cord Injury Center  
of the Delaware Valley

The Regional Spinal Cord Injury Center of the Delaware Valley provides a comprehensive program of patient care, community education, and research. It is a federally designated program of Thomas Jefferson University and its affiliated institutions of Thomas Jefferson University Hospital and Magee Rehabilitation Hospital.



# Spinal Cord Injury Patient-Family Teaching Manual

**A Publication of the  
Regional Spinal Cord Injury Center  
of the Delaware Valley**

Researched and prepared by the clinical personnel  
of Thomas Jefferson University Hospital and  
Magee Rehabilitation Hospital

Available online at:

[www.spinalcordcenter.org](http://www.spinalcordcenter.org)

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## **Dedication**

The Handbook Committee of the Regional SCI Center of the Delaware Valley gratefully acknowledges the hard work and dedication of all who contributed to this manual.

## **Credits**

The Handbook Committee of the Regional SCI Center of the Delaware Valley would like to acknowledge the assistance of all of the people in the Center who have helped to develop this Handbook:

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and all of the others who worked so hard to make this Handbook a reality.

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# Respiratory

## Introduction

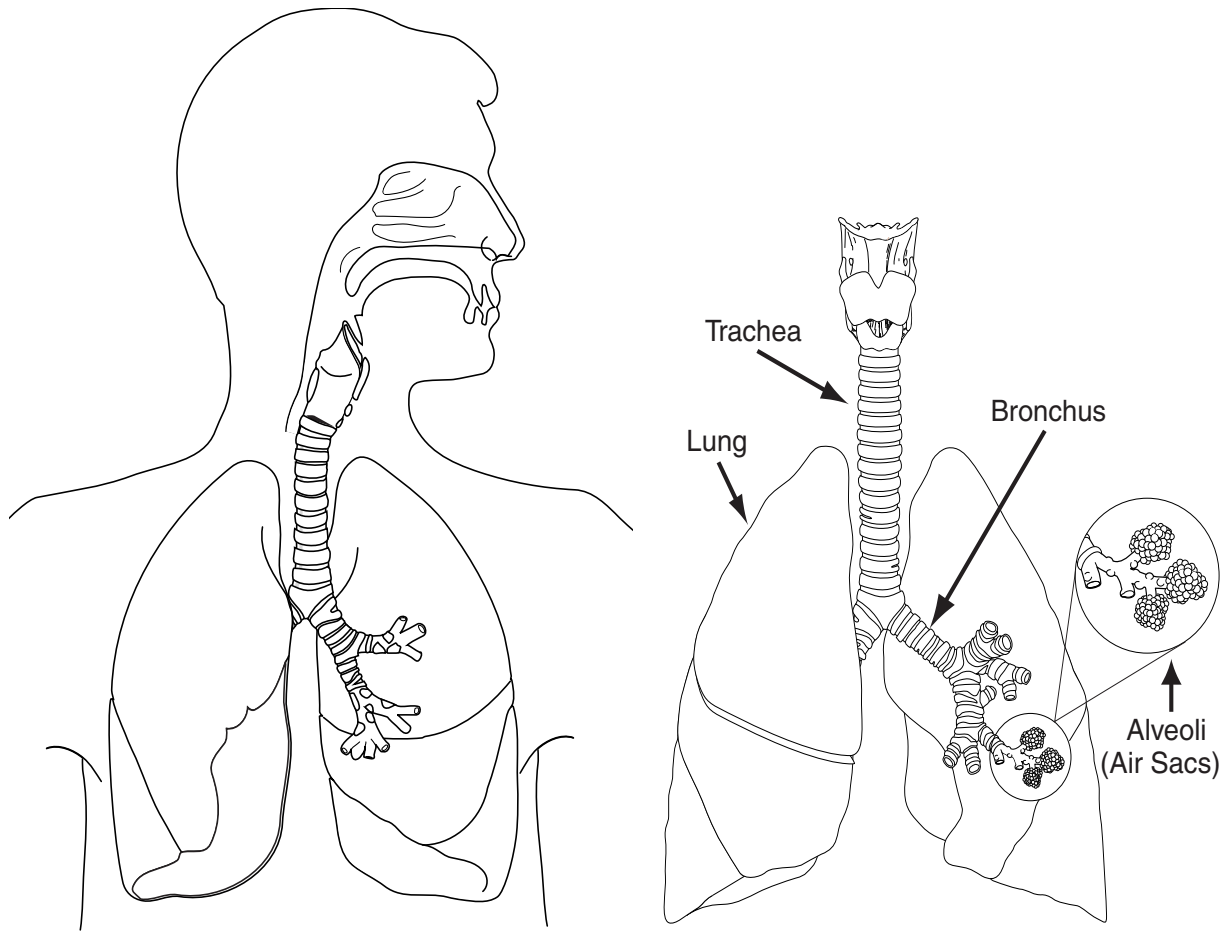
Spinal cord injury can affect normal breathing. The level of your injury will determine the effect it will have. It can be different for everyone. For example, the higher the level of your injury, the more complications you may face. Good pulmonary care can assist in keeping you healthy after your spinal cord injury.

## Normal

The process of breathing (or respiration) is a two-step process: taking in air (inspiration) and exhaling the waste products. The process of taking in air (inhalation) is an active process, requiring the use of many muscles, while the process of exhaling is a passive process, which occurs when the muscles relax. The muscles of respiration include the diaphragm, and a group of muscles called the *accessory muscles*. The muscles included in the “accessory group” include your neck muscles, your chest wall muscles and your abdominal muscles. These muscles are the ones that are used when you run or are stressed and assist the diaphragm in taking in larger amounts of air. If your injury is high enough, the neck accessory muscles may become the primary muscles of respiration. By themselves, these muscles are unable to bring in enough air to maintain life on a daily basis. When this occurs, assisted ventilation is used. This assistance can be in the form of a ventilator, phrenic (a nerve that helps make the muscle of breathing work properly) pacers or other non-invasive methods of breathing. Assisted ventilation is used along with other therapies and treatments to try to maintain good pulmonary condition. Without this assistance, the person could suffer severe tissue damage, brain damage or death.

Diagram of the Lungs and Alveoli Sacs

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**Respiratory Complications**

Respiratory complications with spinal cord injury can occur even with good, every day pulmonary care. Therefore, special attention should be paid to the respiratory system.



## Potential Respiratory Complications

Problem	What is it?	Symptoms	What to do
<b>Congestion</b>	Excess of mucus in the lungs.	Heavy feeling in your chest Noisy breathing Dry cough Weak/tired feeling	<ul style="list-style-type: none"> <li>• Increase fluid intake.</li> <li>• Respiratory treatments as ordered by your doctor.</li> <li>• Get out of bed or at least change your position often.</li> <li>• Use cough assist, chest vest or suction as needed</li> <li>• Do your respiratory exercises.</li> </ul>
<b>Pneumonia / Respiratory Tract Infection</b>	A part of the lung that is invaded by bacteria, food or other substances.	Shortness of breath Excess secretions Heavy feeling in your chest Elevated temperature Pallor	<ul style="list-style-type: none"> <li>• Quad Assist Cough.</li> <li>• Use cough assist, chest vest or suction as needed.</li> <li>• Get out of bed or at least change your position often.</li> <li>• Increase fluid intake.</li> </ul>
<b>Mucus Plug</b>	Airway that is blocked by thick mucus.	Sudden difficulty breathing	<ul style="list-style-type: none"> <li>• Get help <b>immediately</b> to help clear your air passage.</li> <li>• Call 9-1-1.</li> </ul>

## **Pulmonary Embolism**

A blood clot that detaches from a blood vessel and travels to the lung, blocking a portion of it.

Shortness of breath  
Sudden and sharp chest pain  
Bloody secretions  
Sweating  
Fast pulse  
Rapid breathing  
Pulse ox stays low

- Call 9-1-1.

## **Prevention of Complications**

In order to help prevent respiratory complications, there are several things you can do. Many of these things will be taught to you by the nurses and therapists. These prevention measures are things you can do to help prevent problems throughout your lifetime.

### **Coughing**

Coughing helps by clearing thick mucus from the respiratory tract. Make sure you know and understand correct coughing procedures. These include quad assist cough and incentive spirometer.

### **Breathing Exercise**

Deep breathing should be practiced three to four times a day. It may be helpful to have a routine and do it the same time every day. The incentive spirometer should be used.

### **Mobility**

Moving around as much as possible prevents mucus from pooling in one place. Being active helps to keep the secretions thin and moving freely.

### **Fluid Intake**

Liquids help keep your respiratory tract moist. This helps prevent your secretions from becoming too thick. You should drink as much fluid as your Bladder Management Program allows. By looking at the color of your urine, you will be able to tell if your liquid intake is adequate. Your urine should be pale yellow and clear.

**Do not smoke!** Smoking irritates mucus cells and increases mucus.

## **Moisture Humidity**

Moist air helps to prevent drying of respiratory tract. If the air is dry around you, it may be helpful to use a cool mist humidifier.

## **Health**

By being in overall good health, you will not only help your respiratory tract, but your whole body. Therefore, it is essential to have good habits of eating, sleeping and exercising regularly. Also, getting yearly flu shots, pneumonia vaccines and staying away from other sick people helps your health.

## **Pulmonary Care**

Proper pulmonary care is made up of many factors. By performing these, many complications can help to be avoided.

### **Chest Physiotherapy – (CPT) (Clapping)**

To help loosen mucus in your lungs, you may need someone to help you by clapping on your back — over your lungs, and on your sides below your arm pits.

#### *Steps*

1. Have caregiver remove all jewelry.
2. Cover back with towel or sheet.
3. Hold hands in cupped shape with fingers curved and thumb against index finger.
4. Clap on your back along the ribs.
5. Do not clap over breastbone or spine.

**Note:** Clapping should sound hollow — not like you’re slapping someone.

*Chest Physical Therapy - Back Clapping “Target” Areas*



## Postural Drainage

Postural drainage is a way of letting gravity help bring up your secretions.

1. Stay in position for at least five minutes, and then do clapping (CPT)

OR

2. Do clapping while in this position by moving side to side.

**Note:** Postural drainage and CPT are most effective if done in the morning. Do not attempt postural drainage and CPT right before or after a meal because it can upset your stomach.

### Postural Drainage Positions

Figure 1



Figure 4



Figure 2



Figure 5



Figure 3 (Do both sides, only one side shown here)



Depending on the extent and nature of your injury, you may not be able to assume all of the positions as shown. For example, an individual who is on a ventilator is restricted by the air tubes. You may not, for example, be able to get into the position shown in figure 2. Remember the basic principle is to have gravity assist you in clearing your lungs, to allow adequate time for the secretions to move, and to assist their movement by using the clapping or vibration techniques of Chest PT as you are taught by your therapist. Your therapist will help you adapt these general principles based on your particular abilities to meet your individual needs. You may find that using more pillows than shown here is beneficial.

## Quad Assist Cough

This technique is used to help bring up secretions if your diaphragm muscles do not work correctly. The diaphragm muscle is the major muscle of breathing.

### Steps

1. Have a helper place the heel of his or her hand under your rib cage and above your belly button.
2. Place their other hand over the first.
3. The helper should thrust his or her hands up at the same time you try to cough.
4. Repeat that at least three times or until secretions are cleared.
5. This technique assists the diaphragm muscle.

*Quad Assist Cough*



## Deep Breathing with Incentive Spirometer

Deep breathing helps increase the amount of lung you use. It also helps bring up extra secretions that are at the bottom of your lungs.

### Steps

1. Hold the mouthpiece of the Incentive Spirometer between your teeth and close your lips around it.
2. Breath out as much air as you can, then take a deep breath in.
3. Attempt to raise and hold the ball as long as you can.
4. Repeat 10 times.

### **Deep Breathing without Incentive Spirometer.**

1. Take deep breath, and hold it as long as you can.
2. Blow out air in forceful manner.
3. Repeat 10 times.

### **Cough Assist Machine**

The cough assist device is a machine that can help spinal cord injured patients clear their secretions. It is a machine that is similar to a vacuum that when placed on a tracheotomy or over your mouth and nose for a few seconds, can bring up secretions.

The cough assist machine is a non-invasive device, whereas tracheal suctioning is invasive. The cough assist machine works by adding positive air pressure, which in turn inflates the lungs. Quickly, this positive pressure is changed to negative air pressure, which contracts the air sacs to get rid of their sputum (mucus coughed up from the lungs). This produces a cough and brings up secretions. If used often and correctly, the need for invasive suctioning will be minimal.

Benefits of this device include increased patient comfort, improved airway clearance, more cost-effectiveness and caregiver efficiency.

Not all patients with spinal cord injury and tracheotomies would be appropriate for this device. Patients who have a significant history of emphysema, chronic obstructive pulmonary disease, major chest trauma or significant heart rhythm problems are not advised to use this machine. Consult with your doctor.

Caregivers and patients can be taught how to use this device. This machine can be rented or purchased. See [www.coughassist.com](http://www.coughassist.com)

### **The Vest Airway Clearance System**

The Vest Airway Clearance System is a device that can help spinal cord injured patients clear their secretions. It is a non-invasive device consisting of an inflatable vest connected by tubes to an air-pulse generator. The generator rapidly inflates and deflates the vest, compressing and releasing the chest wall. This process is called high frequency chest wall oscillation.

Using the Vest System generates increased airflow that creates repetitive cough like forces and helps the flow of secretions into the upper airways where they can be more rapidly expelled.

Benefits of this device include simplicity of operation, consistently effective and reliable treatments of all lung areas simultaneously, and it permits the use of aerosolized medications and mechanical ventilation while in use.

Typical treatments last from 10 to 20 minutes, and can be used from once a day to every four hours depending on the patient's clinical condition.

Not all patients with spinal cord injury would be appropriate for this device. Patients with unstable head and neck injury or active bleeding would not be advised to use this device. Consult with your doctor.

Caregivers and patients can be taught how to use this device. This machine can be rented or purchased. See [www.thevest.com](http://www.thevest.com)



# Glossary

<b>Bronchioles</b>	Small air sacs within the lungs.
<b>Bronchus</b>	Pathway that air follows into each lung.
<b>Diaphragm</b>	Muscle that helps with breathing.
<b>Emphysema</b>	Abnormal lung condition.
<b>Expiration</b>	Act of exhaling.
<b>Incentive Spirometry</b>	Device used to assist with deep breathing.
<b>Inspiration</b>	Act of inhaling.
<b>Postural Drainage</b>	Technique of positioning the body to drain secretions from the lungs.
<b>Quad Assist Cough</b>	Manual technique using hands underneath the rib cage to assist in clearing secretions.
<b>Respiratory Treatment</b>	Inhaler or aerosol medications used to open bronchioles.
<b>Secretions</b>	Mucus in the lungs.
<b>Sputum</b>	Material coughed up from the lungs.
<b>Tracheostomy</b>	A plastic tube surgically implanted to open the trachea to the lungs.

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# Comments and Feedback

The staff of the center has recently spent a lot of time and effort in revising this manual. However, we realize that those who are actively reading and using the manual can improve it. As a part of our program of continuous quality improvement, we ask you to help guide our efforts to improve the manual.

In the next section of the chapter are two forms. The first form is an overview by chapter that seeks to identify those areas of the manual that could benefit the most from additional work. We also seek to identify any major areas of concern that have not been addressed.

The second section is a more focused questionnaire that has as its goal the specific items that should be targeted. For example, should an item be added to the glossary or the definition changed. Should a drug be added to the discussion of bowel programs?

The more specific the comments are the more likely that we will be able to make the improvements that form the basis of your idea. By communicating with the Regional Spinal Cord Injury Center of the Delaware Valley, however, users grant us permission to use any information, suggestions, ideas, drawings or concerns communicated for any purpose we choose, commercial, public or otherwise, without compensation or acknowledgement whatsoever.

Thank you for taking the time to assist us in improving this manual.

Sincerely,

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# Feedback Form

Rate each chapter by placing an “X” on the scale underneath the term that best captures your opinion. Using the next page, provide specific comments regarding your ratings. Feel free to make copies of the next page.

	No Opinion	Fair	Satisfactory	Good	Excellent
<b>Credits / Front Matter</b>					
<b>Table of Contents</b>					
<b>Introduction</b>					
<b>Spinal Cord Injury</b>					
<b>Bladder</b>					
<b>Bowel</b>					
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<b>Nutrition</b>					
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<b>Recreational Therapy / Resource Guide</b>					
<b>Travel and Transportation</b>					
<b>Sexuality</b>					
<b>Spinal Cord Injury Follow-Up Care System</b>					
<b>Master Glossary</b>					

# Suggestions and Comments

Chapter: \_\_\_\_\_

Page(s): \_\_\_\_\_

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Any terms that need to be added to the glossary? How would you define the terms?

Any section or paragraph that was not clear?

Any drawing or sketch that would help to illustrate the material being covered?

Any additional topic that should be covered?

Any questions you have that you feel should have been answered by the manual?

What is the question?

What is the suggested answer?

Any references that should be added? Any other resources that should be mentioned?

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