

---

# Keeping your lungs healthy

A guide for you after spinal cord injury  
and other neurological conditions

---

Regional Rehabilitation  
Program

This booklet has been written by the health care providers who provide care to people who have a spinal cord injury or illness. At the time of this printing the information was accurate to the best of our knowledge. The information may change due to the rapid changes in health care. It is not intended to replace medical/health advice from your health care providers.

© Hamilton Health Sciences, 2003.  
Revised and reprinted 2004, 2008, 2011, 2015.

---

# Table of Contents

## **BSAC - B**reath **S**tacking **A**ssisted **C**ough

	<b>Page</b>
Keeping your lungs healthy .....	1
Tests to see if BSAC* will help you .....	2
Learning more about BSAC .....	3
Assisted cough.....	5
Why do BSAC? .....	7
When to do BSAC .....	7
How to do BSAC .....	8
Two person method .....	10
One person method .....	12
Chest infection .....	13
Cleaning and testing equipment.....	15
Words to know .....	16
Resources .....	16

---



## Keeping your lungs healthy

Taking deep breaths and coughing up secretions is a good way to keep your lungs healthy. Healthy lungs help to prevent chest infections. Keeping your lungs healthy is important so that you do not get a chest infection. This booklet will help you learn how to improve your cough and get rid of secretions. It will also help maintain your lung size.

Your injury or condition may require a special technique to be used to help keep your lungs clear of secretions. The technique is called **B**reath **S**tacking with **A**ssisted **C**ough, or BSAC. It increases your ability to take deep breaths and cough.

The technique is easy to learn and use. It will help keep your lungs clear of secretions, which if not removed, could lead to a trip back to the hospital.

By doing BSAC as part of your daily routine you can prevent pneumonia or a serious lung infection.

BSAC helps to:

- Keep your lungs clear of infection.
  - Keep the air sacs in your lungs open.
  - Keep your chest wall flexible. This allows you to take bigger breaths on your own.
  - Keep your lungs clear of mucous plugs. Mucous plugs are very thick secretions that can get stuck in your lungs and airways.
  - Mucous plugs can prevent you from getting enough air to breathe.
-

- Improve your ability to cough without thinking about it.
- Increase the amount of air your lungs can hold.

Increase the strength of your voice.

**A good cough gets your secretions out of your lungs! BSAC mimics a cough.**

The 3 steps of a good cough:

1. take a big breath
2. hold the air in your lungs
3. use your stomach muscles to build up pressure as you cough

## Tests to see if BSAC will help you

There are a few tests that need to be done to see if BSAC can help you.

These tests are:

### Vital Capacity

- A breathing test to measure how much air you can blow out. We call this your Vital Capacity or VC. Your VC has to be more than 1.5 litres (l) for a good cough.

### Peak Cough Flows

- Peak Cough Flows or PCFs measure your cough speed. PCFs are measured in liters per second, or l/s. PCFs greater than 5l/s are needed to keep the lungs free of secretions. If your PCFs are less than 5l/s, BSAC may be used.
-

## Learning more about BSAC

You may have already started BSAC at another hospital. We will continue it here. BSAC will need to be done for the rest of your life. Your VC and PCFs will be measured here. We need to see what your VC and PCFs are on your own and what they are with help.

As you progress through your rehabilitation your cough will become stronger. Some changes of BSAC may be made such as:

- Breath Stacking without assisted cough may be enough to reach PCFs of greater than 5l/s.
- using an assisted cough alone may be enough to increase your PCFs to greater than 5l/s.

**Breath Stacking is increasing how much air you can blow out or your Vital Capacity.**

To increase your Vital Capacity we use these different methods:

We will work with you to keep your lungs healthy.

- manual resuscitation bag with a one-way valve
  - use of a volume ventilator or breathing machine – sipping
  - glossopharyngeal breathing - also known as frog breathing
-

With all of these methods you need to hold each breath, one on top of the other, until enough volume is built up in the lungs for a good cough. We can help you get the feel of taking the air into your lungs with a few practice techniques.

The breaths may be given through a mouthpiece or mask. If you have a tracheostomy, an attachment is used that connects to your tube. Nose clips may be used if air leaks out of your nose.

In this booklet we will focus doing BSAC using the manual resuscitation bag with a one-way valve. A one-way valve is used to help build up the volume in your lungs.



**This set up should never be used for emergency breathing.**

Another method that may be used to assist the cough and to expand the lungs is a machine called the CoughAssist™ or Mechanical Insufflator-Exsufflator. Ask your health professional for more information.



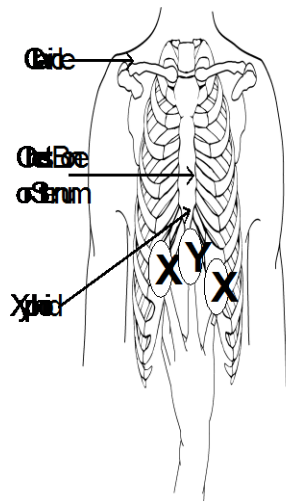
## **Assisted cough**

An injury at L1 and above affects the strength of your stomach and breathing muscles. These muscles help you to take a big breath in. You also need the strength of these muscles to produce enough force for a good cough. To help your stomach muscles produce this force an assisted cough is needed.

An assisted cough is the use of a stomach thrust and is a part of BSAC. The stomach thrust is like the technique used to help a choking person. The heel of the hand is placed in the stomach area, avoiding the rib cage. See Diagram 1 on page 6. An inward and upward thrust is used to drive the diaphragm upwards to compress the lungs and get rid of secretions. The diaphragm is the large muscle under the lungs.

You may apply your own thrust by placing a pillow or crossing your arms over your stomach. As you are ready to cough throw your upper body over the pillow or your arms. This will push the diaphragm upwards as you cough.

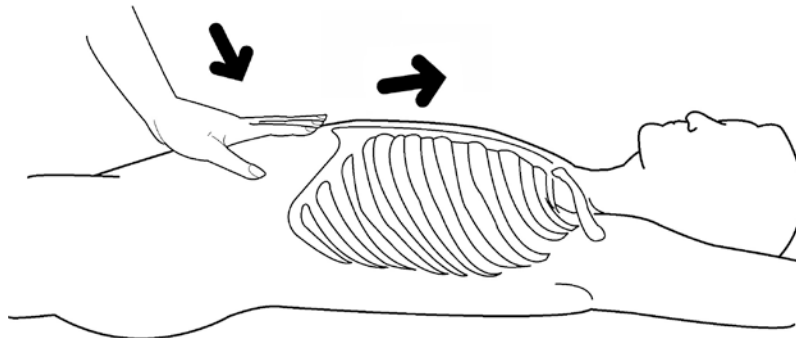
---



Y = Position of Index Finger of Hand

X = Positions of Thumb and Middle Fingers

The hand is well below the xiphoid.



**Diagram 1 - Assisted Cough**

The arrows show the direction of movement for the assisted cough.

## Why do BSAC?

To get rid of secretions and to keep the air sacs open you need to inflate your lungs with enough air and then cough. The use of Breath Stacking helps to give a large amount of air over successive breaths and a stomach thrust assists the cough.

## When to do BSAC

If you normally use an inhaler, it is a good idea to use it before you start BSAC.

- To keep your lungs healthy Breath Stacking with Assisted Cough should be done 4 times a day.
- The stomach thrust may be used at any time to help move secretions. Your Respiratory Therapist will advise you if routine stomach thrusts should be used.
- Your Respiratory Therapist will set up a care plan that best suits your needs.
- In times of an infection it may be done as often as every 10 minutes.
- Breath Stacking may be done with a mouthpiece/mask or through a tracheostomy tube without a cuff or with the cuff deflated.
- You may do your own or assist with your BSAC if you are able to squeeze the bag and/or apply your own thrust.



**It is a good idea to wait 30 minutes after meals before doing BSAC.**

---

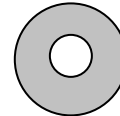
## How to do BSAC

Keep in mind that BSAC is:

1. taking in a series of breaths to fill up your lungs
2. holding the air
3. building up pressure with a stomach thrust or by using your muscles and coughing out secretions as you exhale with or without a thrust

### Equipment

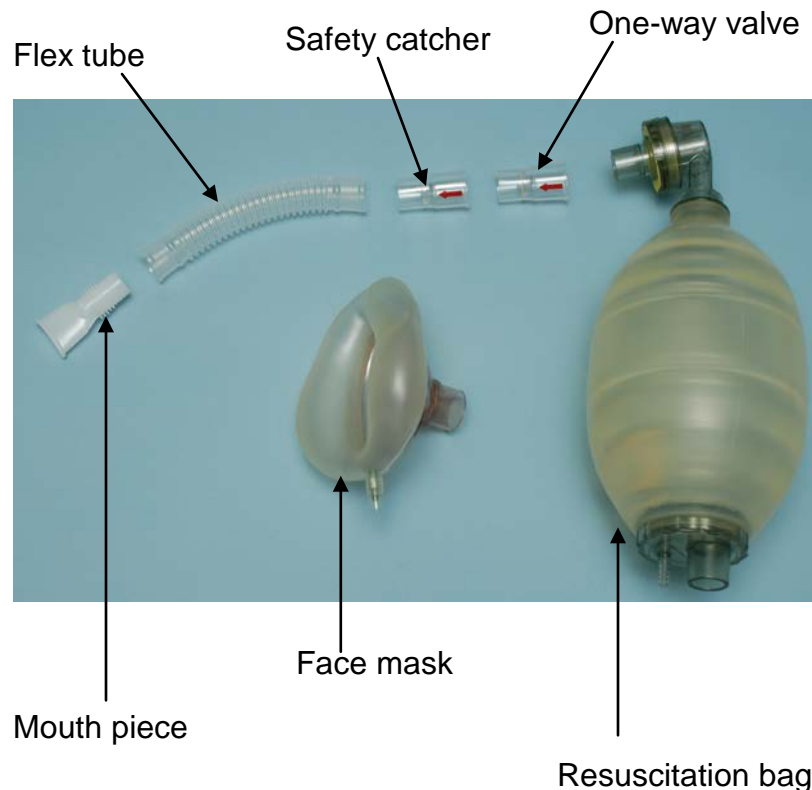
Inside the safety catcher is a small rubber disc.



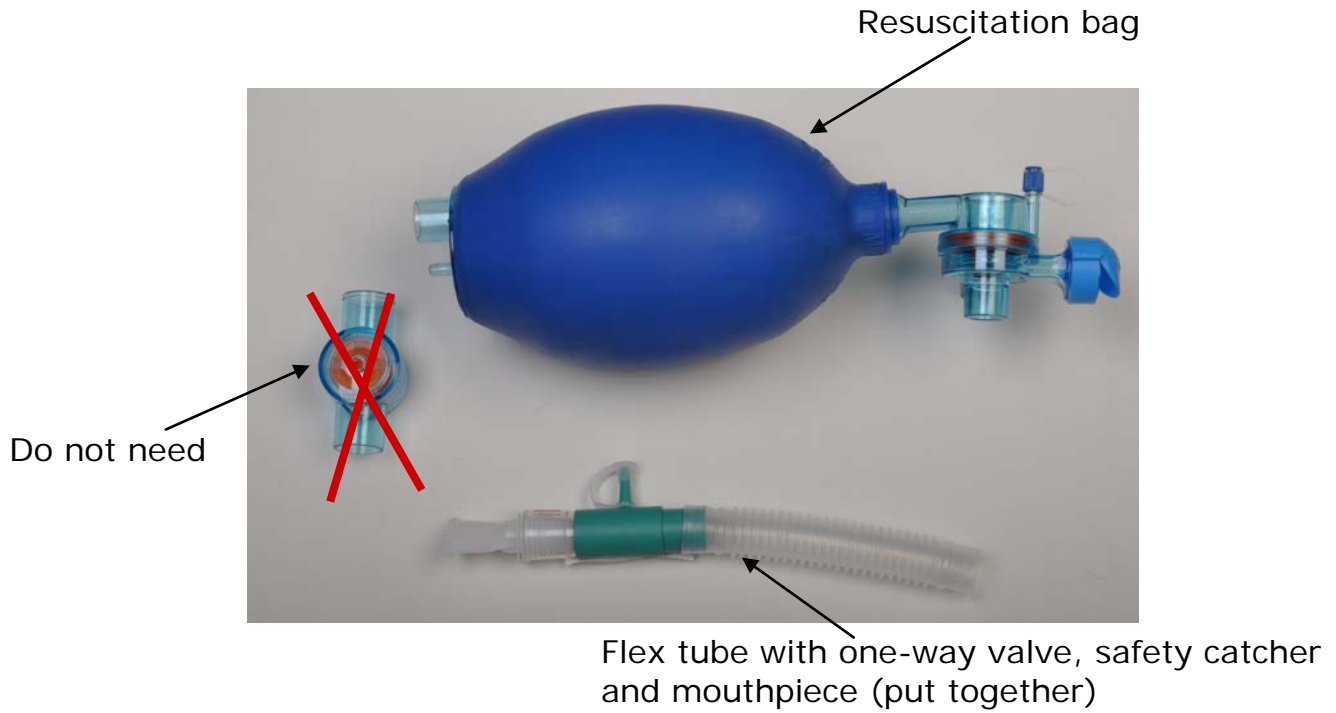
Remove the small rubber disc from the safety catcher only.

Then, connect the safety catcher to the one-way valve as

shown below: the safety catcher **MUST** come after the one-way valve.



A commercially available Lung Volume Recruitment Kit (Breath Stacking Kit) is available from some respiratory home care companies, here is an example of what is in a kit.



**Attach flex tube to resuscitation bag.**

## Let's begin

This can be done with 1 or 2 people.

### Two person method

1. Decide which person will perform the assisted cough and which person will squeeze the bag.
2. The person squeezing the bag is called the bagger and should make sure the bag is working properly (see page 15) and that the flex tube and mouthpiece/mask are connected.
3. Pressure needs to be built up to enhance your cough. The assisted cough person will time the stomach thrust with the bagger.  
The assisted cough person should start the thrust (push) just before you release your stacked breath.

### To start

1. The bagger tells you to take a large breath in on your own. You may take a big breath in from the room before placing the mouthpiece in your mouth or you may breathe in through the mouthpiece.

#### **Hold your air.**

2. The bagger should squeeze the bag to give you successive breaths. The bagger should squeeze the bag with 1 hand or 2 hands until the lungs feel full and you cannot hold any more air. The bagger can tell this by feeling some resistance when squeezing the bag.



**If you feel too full, open your mouth and exhale!**

---

3. Once the lungs are full and just before removing the mouthpiece from your mouth, the stomach thrust is started. You need to cough as the mouthpiece is removed. If successful, a high flow of exhaled air is noticed when removing the mouthpiece.
4. A minimum of 3 cycles of BSAC is suggested.
5. If secretions are present, continue BSAC until your lungs are clear.
6. After BSAC you should do 2 breath holds. The breath hold is done by giving you successive breaths just like Breath Stacking but instead of coughing at the end, you will hold your breath for as long as possible before exhaling.



If you have a problem with low blood pressure you need to limit the breath holding to a **maximum** of 5 seconds when you are in your chair. **If still dizzy, do breath holds only while in bed.**

---

## One person method

With one person, the mouthpiece is placed in your mouth. The caregiver then positions for the stomach thrust with one hand and the bag is squeezed with the other hand. If you are able to squeeze the bag yourself, you do Breath Stacking while the caregiver positions for the stomach thrust.

### To start

1. Take a large breath in on your own. You may take a big breath in from the room before placing the mouthpiece in your mouth or you may breathe in through the mouthpiece. **Hold your air.**
2. The bagger should squeeze the bag to give you successive breaths. The bagger should squeeze the bag with one hand until the lungs feel full and you cannot hold any more air. The bagger can tell this by feeling some resistance when squeezing the bag.



**If you feel too full, open your mouth and exhale!**

3. Once the lungs are full and just before removing the mouthpiece from your mouth, the stomach thrust is started. You need to cough as the mouthpiece is removed. If successful, a high flow of exhaled air is noticed when removing the mouthpiece.
-



4. A minimum of 3 cycles of BSAC is suggested.
5. If secretions are present, continue BSAC until your lungs are clear.
6. After BSAC you should do 2 breath holds. The breath hold is done by giving you successive breaths just like Breath Stacking but instead of coughing at the end you will hold your breath for as long as possible before exhaling.



If you have a problem with low blood pressure you need to limit the breath holding to a **maximum** of 5 seconds when you are in your chair. **If still dizzy, do breath holds only while in bed.**

## Chest infection

Keeping your lungs clear and free of secretions is the best way to prevent a chest infection. Sometimes, an infection does happen.

Here is what you may notice if you have a chest infection:

- increase cough
  - your secretions change in colour and amount
  - fever
  - chills
  - chest rattles
  - feeling short of breath
-

If you think you have an infection increase your BSAC. This will help keep your lungs clear. Contact your family doctor if symptoms persist.

Two important words that we cannot forget to mention:



## **Stop smoking!**

Smoking increases sputum production and stops the way normal secretions are cleared from the lungs. It hurts an already fragile set of lungs.

Hamilton Health Sciences is smoke-free. This means that smoking is no longer allowed anywhere on the grounds, including parking lots, garages and vehicles.

For support or help to stay smoke-free:

- talk to a member of your health care team at Hamilton Health Sciences
- contact Smokers' Helpline toll free at 1-877-513-5333 or [www.smokershelpline.ca](http://www.smokershelpline.ca)

# **Cleaning and testing equipment**

## **Cleaning the Breath Stacking equipment**

The Breath Stacking valve should be cleaned once a week.

If you have a cold or a chest infection you may need to clean the equipment more often.

1. Disconnect the mouthpiece and tubing from the resuscitation bag. Do not take apart the resuscitation bag. Wipe with a damp cloth if needed.
2. Take apart the stacking valve completely.
3. Wash all the pieces in mild soap and water. Rinse in warm water.
4. A solution of 1 part vinegar and 3 parts water may be used to disinfect the pieces of equipment. Soak for 30 minutes.
5. Rinse all the pieces in clean water and let them air dry on a towel. Do not use a hair dryer to dry the pieces.
6. Once all of the pieces are dry, put them back together as shown on page 8.
7. Test the bag (see below).

## **Testing the Breath Stacking equipment**

If it feels like the resuscitation bag is not delivering the full volume of air it may have a leak. To test for leaks:

- With one hand cover the top outlet of the bag, with the other hand squeeze the bag.
  - No air should leak from the bag and the bag should not deflate.
-

- If the bag deflates or if a leak is heard the bag needs to be replaced. Contact your Registered Respiratory Therapist or home respiratory company.

## Words to know

**Pneumonia:** an infection of the lungs

**Glossopharyngeal breathing:** a technique used to fill the lungs with air. The air is moved into the lungs by using movements of the tongue, cheek and throat.

**Respiratory failure:** when the heart and the lungs cannot keep up with the exchange of oxygen and carbon dioxide in the lungs.

**Resuscitation bag:** a device that is used to give manual breaths.

## Resources

For more information about BSAC

Hamilton Health Sciences: [www.hhsc.ca](http://www.hhsc.ca) click on Patient Education and in the search box type the words breath stacking

The Ottawa Hospital Rehabilitation Centre: [www.irrd.ca/education/](http://www.irrd.ca/education/)  
Click on Respiratory Protocols for SCI and Neuromuscular Disease.