

Airway clearance techniques (ACTs) are treatments that help people with cystic fibrosis (CF) stay healthy and breathe easier. ACTs loosen thick, sticky lung mucus so it can be cleared by coughing or huffing. Clearing the airways reduces lung infections and improves lung function. There are many ACTs. Most are easy to do. For infants and toddlers, ACTs can be done by almost anyone. Older kids and adults can do their own ACTs.

ACTs are often used with other treatments, like inhaled bronchodilators and antibiotics. Bronchodilators should be taken **before** or with ACTs to open airways. Inhaled antibiotics should be taken **after** ACTs to treat opened airways. Your CF care team will help you choose the best ACT and other treatments. Each year, review and update your routine with your CF care team.

Learning about breathing and the lungs can help you to see how ACTs work. ACTs move mucus from small to large (more central) airways to be coughed or huffed out. The right lung has three lobes: the upper, middle and lower lobes. The left lung has two lobes: the upper and lower lobes. Lobes divide into smaller segments. ACTs clear these segments. Each segment has airways (bronchi), air sacs (alveoli) and blood vessels (arteries, veins and capillaries). Oxygen and carbon dioxide flow between the blood and air through the air sacs.

The lungs make mucus to help defend against germs. CF changes the mucus, making it thick and hard to clear. This mucus is where infections can occur. Infections cause inflammation or swelling of the lungs. Both infections and inflammation cause more mucus to be made. More mucus in the lungs can lead to more infections. This cycle of infection, inflammation and more mucus can hurt the lungs and lower lung function. Antibiotics treat infections. They make you feel better but, over time, the damage builds. This is why your CF care team may say to do ACTs even when you are well. When you get sick, do them more often.

Mucus moves three ways:

- Mucus builds and lines the bronchi walls. ACTs increase air flow through the bronchi. As air rushes over the mucus in the bronchi, the mucus is pulled toward the large airways. This is like wind on the water making a crest on waves, or wind across a dry plain blowing dust. The faster the air flows, the better it moves mucus.
- Tiny hairs, called cilia, line bronchi. Cilia move back and forth. Mucus is carried on top of cilia. Cilia cannot carry thick, extra mucus as well.
- If air gets behind thick mucus, it can push it into larger airways. More air behind mucus means more air flowing over it, pulling the mucus along. If air does not get behind mucus, mucus is hard to move.

Airway Clearance Techniques

Coughing is the most basic ACT. It is a reflex. It clears mucus with high-speed airflow. But sometimes mucus cannot be cleared just with a lot of coughing. Coughing a lot can make you feel more short of breath and worse, not better. **Huffing** is a type of cough. It also involves taking a breath in and actively exhaling. It is more like "huffing" onto a mirror or window to steam it up. It is not as forceful as a cough but can work better and be less tiring.

Chest Physical Therapy (CPT or Chest PT) or Postural Drainage & Percussion (PD&P) is an ACT that often includes postural drainage and chest percussion. With postural drainage, the person gets in varied positions (postures) that drain mucus from different lung parts.

Gravity pulls mucus from small to large airways where it can be coughed up. With chest percussion the chest is clapped and vibrated to dislodge and move mucus. This is done in varied positions to drain all lung parts.

Oscillating Positive Expiratory Pressure (Oscillating PEP) is an ACT where the person blows all the way out many times through a device. Types of Oscillating PEP devices include the Flutter™, Acapella™, Cornet™ and Intrapulmonary Percussive Ventilation (IPV). Breathing with these devices vibrates the large and small airways. This vibration thins, dislodges and moves mucus. After blowing through the device many times, the person coughs or huffs. This cycle is repeated many times.

High-frequency Chest Wall Oscillation also is called the Vest or Oscillator. An inflatable vest is attached to a machine that vibrates it at high frequency. The vest vibrates the chest to loosen and thin mucus. Every five minutes the person stops the machine and coughs or huffs.

Positive Expiratory Pressure (PEP) Therapy gets air into the lungs and behind the mucus using extra (collateral) airways. PEP holds airways open, keeping them from closing. A PEP system includes a mask or mouthpiece attached to a resistor set by your CF care team. The person breathes in normally and breathes out a little harder against the resistance.

Active Cycle of Breathing Technique (ACBT) involves a set of breathing techniques. It can be changed to meet each person's needs. It gets air behind mucus, lowers airway spasm and clears mucus. It includes:

- Breathing control - normal, gentle breathing with the lower chest while relaxing the upper chest and shoulders.
- Thoracic expansion exercises - deep breaths in. Some use a three-second breath-hold to get more air behind the mucus. This may be done with chest clapping or vibrating, followed by breathing control.
- Forced expiration technique - huffs of varied lengths with breathing control

Autogenic Drainage (AD) means "self-drainage." It uses varied airflows to move mucus. It aims to reach very high airflows in different lung parts. This moves mucus from small to large airways. AD has three parts:

- Dislodging mucus
- Collecting mucus
- Clearing mucus

The person inhales to different levels and then adjusts how they breathe out to heighten airflow and move mucus. At first, AD takes hard work and practice. It is best for people over 8 years old.

This is a brief overview of some of the ACTs used. ACTs can be varied based on your disease, your care center or even your country! Your CF care team will help you choose what is best for you. If you have questions, please contact your local CF care center.