# Care of the Respiratory System

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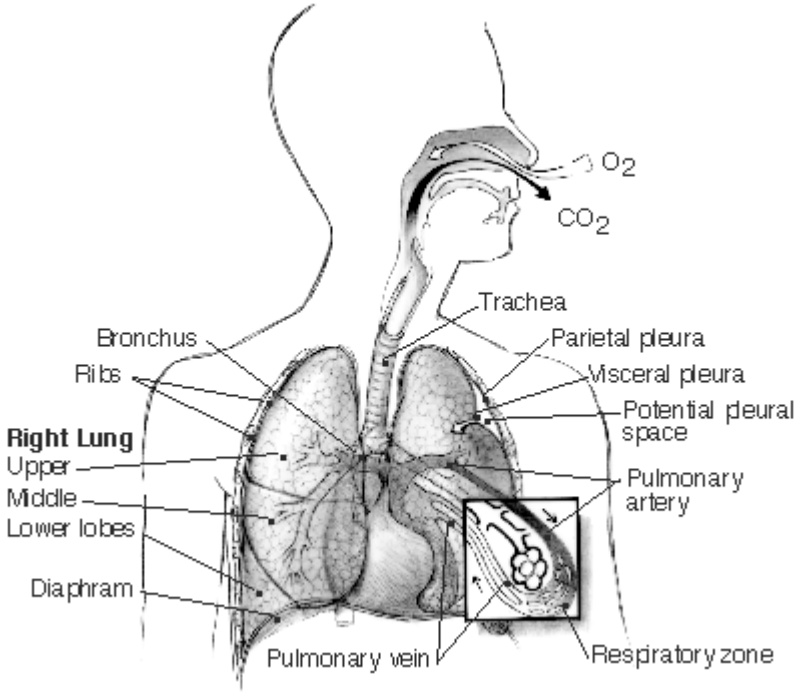
# Respiratory System

## Overview

The respiratory system brings air into the body. In the lungs, oxygen from the air is exchanged for carbon dioxide. The oxygen in the air travels from the alveoli of the lungs through the bloodstream to cells in all parts of the body. The cells use the oxygen as fuel and give off carbon dioxide as a waste gas. This waste is carried by the blood back to the lungs to be eliminated.

The structures of the *upper airway* filter, warm, and humidify the air taken in. Air enters the body through the *nose* and mouth. *Sinuses*, hollow bones of the head, help to warm and humidify the air, while hairs in the nose filter it. The air passes through the *pharynx* at the back of the throat and the *larynx*, which contains the vocal cords.

The air then enters the *lower airway* at the *trachea* (sometimes called the "windpipe"). The trachea divides into two main *bronchi*. The bronchi further divide into *bronchioles*, which divide many times until the *alveoli* are reached. It is in the alveoli, which are covered in tiny capillary blood vessels, that the oxygen in the air is exchanged for carbon dioxide from the body. The respiratory tract is lined with *mucus* and tiny hairs called *cilia* which trap and then push out dust particles. Most of the airways are surrounded by smooth muscle, which can tighten and narrow.




The *diaphragm* is the strong wall of muscles that separates the chest cavity from the abdominal cavity. When the diaphragm and *intercostal muscles* of the ribs contract, they pull downwards, allowing air to enter on inspiration. Nervous centers in the brain and spinal cord control the initiation of breathing by the diaphragm.

## Disorders Involving the Respiratory System

A variety of diseases and conditions can affect the respiratory system and lead to ineffective gas exchange. They can be categorized by the structures they affect:

- Disorders affecting the upper airway
  - Abnormalities of the nasal or oral cavity such as cleft palate

    - Abnormalities of the facial muscles or bones
    - Neuromuscular diseases such as muscular dystrophy and other progressive neurological diseases
    - Conditions which affect swallowing and the protection of the airways from food
- Disorders affecting the lower airway
    - Conditions causing bronchospasm, such as asthma
    - Diseases such as cystic fibrosis which cause excessive mucus that can clog the airways
    - Abnormalities of the trachea and bronchi which can cause narrowing (stenosis), obstruction (swelling or tumors) or abnormally limp airways (tracheomalacia)
- Disorders of the alveoli
    - Bronchopulmonary dysplasia (chronic lung disease)
    - Pneumonia
- Disorders affecting the respiratory muscles
    - Spinal cord injuries
    - Progressive degenerative neuromuscular diseases such as muscular dystrophy
- Disorders affecting the central nervous system's stimulus to breathe
    - Brain damage from birth, trauma, drowning
    - Progressive neurological conditions

**Sources:**

American Lung Association. (2004). *Human Respiratory System.* Available online at www.lungsusa.org.

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**Illustration Source**:

National Heart, Lung, and & Blood Institute, Division of Lung Services. (1997). *The Lungs in Health and Disease*. National Institutes of Health Publication # 97-3279.

# Asthma

## Overview

Asthma is a major public health problem of increasing concern. According to the National Center for Health Statistics, approximately 10% of children in the United States have been reported to have asthma, and asthma prevalence among children has been increasing at an average rate of 4.3% per year. Asthma is one of the leading causes of school absences and the third leading cause for hospitalization. The Centers for Disease Control and Prevention (CDC) estimates that asthma results in 14 million lost school days each year and $3.2 billion in treatment costs per year. The impact of illness and death is disproportionately higher among low-income populations, minorities, and inner city children.

The CDC created the National Asthma Control Program to support the goals and objectives of Healthy People 2010 for asthma. The goals of the program are to reduce the number of deaths, hospitalizations, emergency department visits, school or work days missed, and limitations on activity due to asthma. In Virginia, funding from this program's initiatives was used to develop *Guidelines for Managing Asthma in Virginia Schools: A Team Approach*, which includes additional information for the school team addressing asthma and can be obtained through the Virginia Department of Health.

## Definition

Asthma is a chronic lung disease that causes airway inflammation. Inflamed airways are particularly sensitive and tend to overreact to certain "triggers." Triggers can include numerous physical, chemical, and pharmacologic agents, such as allergens, viral infections, cold air, and exercise. When the airways react to a trigger, three physiologic processes happen:

1. Bronchospasm, contraction or squeezing of the involuntary muscle surrounding the airway
2. Inflammation and edema (swelling) of the mucous membranes of the airways
3. Excessive, thick secretions from mucous glands.

Bronchospasm, edema, and increased mucus narrow the airway and result in less air getting into and out of the lungs thereby causing wheezing, coughing, chest tightness, and/or difficulty breathing. Wheezing is a high-pitched whistling or squeaky sound that can be made when air moves through narrowed airways. These symptoms can be mild or moderate and affect activity levels, or they can be severe and life threatening. Therefore, persons caring for a student with asthma need knowledge and skill to assess and support the student.

## Common Asthma Triggers

Asthma triggers and symptoms vary from one person to another. Several categories of triggers have been identified:

- ***Allergens*** such as pollen, mold, animal dander, dust mites, cockroaches, and grass.
- ***Irritants*** such as cigarette smoke, chalk dust, perfume, pesticides, strong odors, cold air, and weather changes.
- ***Medical conditions*** such as viral respiratory infections and gastric reflux.

- ***Physical exercise***, especially during cold weather. Exercise-induced asthma (EIA) is precipitated by vigorous physical activity and can occur in most children with asthma.

## Environmental Control in Schools

Although triggers to asthma cannot be eliminated, it is important to identify ways to decrease exposure to as many triggers as possible. All schools should be smoke free to avoid secondhand exposure to cigarette smoke. Efforts to minimize environmental irritants in the school setting include decreasing exposure to harsh cleaning supplies, reducing exposure to chalk dust and exposure to chemical irritants in science and art classes, decreasing or eliminating animals in school, using Integrated Pest Management techniques to reduce the need for insecticides, central air conditioning to keep pollen and dust outside, and decreasing mold by controlling moisture problems.

## Monitoring and Use of Peak Flow Meters

The use of a peak flow meter is an important part of asthma care that allows earlier detection of asthma flare ups in order to prevent more serious attacks. The peak expiratory flow meter (PEFM) is a portable, hand-held device used to measure the ability to move air out of the lungs. The PEFM is used frequently over a two-week period to determine the student's normal peak expiratory flow rate, the volume of air that can be forcibly expelled from the airways. This rate can then be used for comparison when the child has signs of breathing difficulty. Students with asthma (especially moderate or severe asthma) or other respiratory conditions can use peak flow readings to help recognize early changes that may be signs of worsening respiratory status or to determine the severity of an asthmatic episode. Altered peak flow readings can sometimes detect airway changes before symptoms appear. (Readings are effort-dependent, meaning that a poor effort will yield poor results.) Readings can be used to guide use of additional medication and to help determine when to seek emergency care.

Peak flow rate monitoring can be performed by the student, school nurse, family, teacher aide, or other staff person who has had general training in its use. General training should cover the student's specific health care needs, how to obtain a peak flow reading, and to use the student's established action plan based on peak flow results. See Procedure for Peak Flow Rate Monitoring and students' individualized plans for further guidelines.

## Administering Medication

There are two basic types of medications used to control asthma symptoms. One type of medication is used for quick relief when a student has asthma symptoms and usually involves bronchodilators to relax the muscles and open the airways. The other type of medication is used to prevent asthma symptoms by decreasing inflammation. It is important to understand the differences between the two types. Each treats different problems associated with asthma and should never be used interchangeably.

> ***Emergency, Quick Relief, or Rescue Medications*** work very quickly and are used to open the airways in asthma attacks. They are usually bronchodilators and work by relaxing the muscles surrounding the airways so that the airways open and allow the

child to breathe easier. They may be used before exercise to keep the airways open. Quick relief medications often are delivered through metered dose inhalers (MDI) and usually work for about four hours. Students should always have ready access to their emergency inhaler. See Procedure for Use of Metered Dose Inhalers. Examples of common bronchodilators that are emergency medications include:

- Albuterol (Proventil, Ventolin)
- Pirbuterol (Maxair)
- Terbutaline (Breathaire)

***Prevention Medications*** include anti-inflammatory and other long-acting medications to prevent asthma symptoms. They work slowly (over 12-24 hours) and keep airways open by decreasing the inflammation or swelling in the airways and the amount of mucus produced. These medications are given on a regular basis (often for weeks or months at a time) and are usually administered outside of school hours. They generally **will not** stop an acute asthma attack. Students may use a combination of more than one long-acting medication to control asthma symptoms. Examples of common prevention medications include:

**Metered Dose or Diskus Inhalers:**

Corticosteroids

- Beclomethasone (QVAR, Vanceril)
- Budesonide (Pulmicort)
- Flunisolide (Aerobit)
- Fluticasone (Flovent)
- Triamcinolone acetonide (Azmacort)

Long-acting beta2-agonists

- Formoterol (Foradil)
- Salmeterol (Serevent)

Nonsteroidal

- Cromolyn sodium (Intal)
- Nedocromil sodium (Tilade)

**Oral Medications**

Corticosteroids

- Methylprednisolone (Medrol)
- Prednisolone (Pediapred, Prelone)
- Prednisone (Orasone, Sterapred)
- Triamcinolone (Aristocort)

Leukotriene modifiers

- Montelukast (Singulair)
- Zafirlukast (Accolate)
- Zileuton (Zyflo)

Theophylline

- Slo-bid
- THEO-DUR

## Treating Asthma Attacks

The most common symptoms of asthma are coughing, wheezing, chest tightness, and shortness of breath. Symptoms may occur after physical exercise or at any time. Other symptoms include having less energy than usual, tightening of neck muscles with breathing, sucking in of the chest with each breath (retractions), and grayish, cyanotic tint to nail beds and lips. Children may have difficulty talking or become anxious when they have an asthma attack. Very young children may complain of stomach aches, headaches, or scratchy throats when their asthma is worsening.

During an asthma attack, it is important to stay calm, have the student sit in a comfortable position, and follow the instructions on the student's Emergency Asthma Action Plan. Do a peak flow reading and administer medication if this is part of the Emergency Asthma Action Plan. Re-assess the student and if no improvement or symptoms worsen, follow the Action Plan, including notifying and getting help from the people identified in the plan. Do not leave the student unattended.

## Stepwise Asthma Treatment

Asthma is divided into four levels or steps based on the seriousness of the symptoms. The symptoms include shortness of breath; wheezing; rapid, shallow breathing; or needing to use stomach muscles to breathe. The step approach to treatment may be used for all infants and children with asthma

With the Step System, children can step up to a higher step if they need more medicine to control their asthma or step down to a lower step if they need less medicine to control their asthma symptoms. The goals of asthma treatment using the step approach are for students to have:

- no symptoms during the day or night;
- no episodes of shortness of breath, wheezing, or difficulty breathing;
- no school missed because of asthma;
- no activities missed because of asthma;
- lung function as normal as possible;
- infrequent need for rescue medicines; and
- no side effects from the medicines.

## Stepwise Asthma Treatment (abbreviated)

### Step 1 Mild Intermittent Asthma

- A child has symptoms on 2 or fewer days a week
  or
- A child has symptoms on 2 or fewer nights a month

Usually, a child only takes asthma medication when he or she has symptoms.

### Step 2 Mild Persistent Asthma

- A child has symptoms on more than 2 days a week but less than once a day
  or
- A child has symptoms on more than 2 nights a month

A child usually takes a medication every day to prevent symptoms when he or she has Mild Persistent Asthma.

### Step 3 Moderate Persistent Asthma

- A child has symptoms every day
  or
- A child has symptoms more than 1 night a week

A child with Moderate Persistent Asthma usually is on 1 or 2 medications every day to prevent asthma symptoms.

### Step 4 Severe Persistent Asthma

- A child has continuous symptoms during the day
  or
- A child has frequent symptoms at night

A child with Severe Persistent Asthma usually is on 2 or 3 long-acting medicines to prevent asthma symptoms.

**Source:** National Institutes of Health: *National Asthma Education and Prevention Program, 2002.*

## Physical Education and Sports Adjustments

Some students have exercise-induced asthma (EIA), which occurs after vigorous exercise or activity. In addition, *any* student with asthma can experience EIA. The goal of managing EIA is to allow students to participate in any activity without asthma symptoms. These students may need inhaled medication prior to exercise. Therefore, medication should be **available and convenient**. Teachers and coaches need to be aware that the student may need medication before participating in vigorous exercise and may need to stop the activity if asthma symptoms occur. Activity may need to be limited for a student who has recently had an asthma attack. Warm-up and cool-down periods may be needed. The student with asthma may not be able to exercise on a recently-mowed field or during very cold weather. Guidelines for physical activity and need for medication should be covered in the student's individualized health care plan. Additional plans may need to be developed for activities occurring after school hours.

## Asthma Education and Training

In general, students should be responsible for managing their own asthma. An asthma education program in the school helps students learn how to control their asthma symptoms and prevent acute attacks. Family and school staff also need to learn about asthma and its management. To provide comprehensive management of asthma in students, there must be collaboration between the student, the family, the health care provider, and the school. Communication and planning is essential to successful collaboration. Guidelines for, and examples of, asthma training programs can be found in *Guidelines for Managing Asthma in Virginia Schools: A Team Approach*, a publication of the Virginia Department of Health, which includes additional information for the school team addressing asthma.

## The Individualized Health Care Plan: Issues for Special Consideration

Each student's IHCP must be tailored to the individual's needs. It is extremely important for the student with asthma to have a **written** plan in place outlining how to manage the student's asthma on a daily basis and what to do in an emergency.

An IHCP for the student with asthma may consist of two components. The first, the Asthma Care Plan is a detailed outline of how to manage the student's asthma, including daily management, monitoring, medications, physical activity guidelines, as well as emergency management and emergency contacts. The second, the Asthma Action Plan (or Emergency Asthma Action Plan) includes only the information that is essential to know if the child needs immediate care for an asthma attack.

It should be noted that Section 22.1-274.2 of the *Code of Virginia* requires local school boards to develop and implement policies to permit a student with asthma to possess and self-administer inhaled asthma medications during the school day, on school property, or at school-sponsored activities. Written permission from both the student's parent and health care provider, as well as an individualized health care plan, are required.

Sample plans follow this section and can be used in developing individual plans. For a student with asthma, the following items should receive particular attention:

- Student's baseline status, including, color, respiratory rate, pulse, and blood pressure and assessment of changes in this status
- Asthma triggers, especially those that might be encountered at school
- Medications, both preventive and emergency medications, including which ones will be kept at school and whether student may carry/use medication outside the school clinic
- Student's self-care skills and knowledge of early signs of respiratory distress
- Need for peak flow monitoring; if used, include student's best peak flow reading, the frequency/timing of measurements, and reasons for obtaining additional measurements
- Symptoms usually exhibited by student at the onset of asthma flare-ups
- Symptoms exhibited by student which require prompt or emergency action
- Protocol for handling increased symptoms or emergency situations
- Determination of peak flow rate values that should be reported to school nurse and family
- Emergency contact information for family and health care provider
- Activity modifications, if any
- Identity of school personnel who need to know the student's Action Plan and identity of personnel who can assist in an emergency
- Schedule and instructions for cleaning of any tubing and equipment needed
- Plan or system for determining when an MDI needs to be replaced
- Maintenance of confidentiality and the student's right to privacy
- Standard precautions

**Sources:**


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## Emergency Asthma Action Plan

**Student:** _____

**Grade/Room:** _____

**Emergency Medication:** _____

**Parent:** _____

**Contact Numbers:** _____

| If you see this: | Do this: |
|---|---|
| • Complains of chest tightness<br>• Coughing<br>• Difficulty breathing<br>• Wheezing | • Stop activity<br>• Have student take 1 puff of rescue inhaler<br>• Wait 1 minute<br>• Have student take 2nd puff of rescue inhaler<br>• Have student rest<br>• If no improvement in 15 minutes, repeat 2 puffs<br>• If still no improvement, call school nurse<br>• If symptoms worsen, call 911 & call parents |

| If you see this: | Do this immediately: |
|---|---|
| • Coughs constantly<br>• Struggles or gasps for breath<br>• Chest and neck pulled in with breathing<br>• Stooped over posture<br>• Trouble walking or talking<br>• Lips or fingernails are gray or blue | • Call 911<br>• Give rescue medication<br>• Call school nurse<br>• Call parents |

**Source:** Praeger & Zickler, 2002.

## SOUTHEASTERN VIRGINIA ASTHMA HEALTH CARE ACTION PLAN & AUTHORIZATION FOR MEDICATION

**TO BE COMPLETED BY PARENT:**

Child's Name _____ Date of Birth _____ School _____ Grade _____

Parent/Caregiver _____ Phone (H) _____ Phone (W) _____ Phone (Cell) _____

Address _____ City _____ Zip _____

Emergency Contact _____ Relationship _____ Phone _____

Name of Physician _____ Office phone number _____

What triggers your child's asthma attack: (Check all that apply)

☐ Illness ☐ Cigarette or other smoke ☐ Food _____
☐ Emotions ☐ Exercise ☐ Allergies ☐ cat ☐ dog ☐ dust ☐ mold ☐ pollen
☐ Weather changes ☐ Chemical odors ☐ Other _____

Describe the symptoms your child experiences before or during an asthma episode: (Check all that apply)

☐ Cough ☐ "Tightness" in chest ☐ Rubbing chin/neck
☐ Shortness of breath ☐ Breathing hard/fast ☐ Feeling tired/weak
☐ Wheezing ☐ Runny nose ☐ Other _____

**TO BE COMPLETED BY PHYSICIAN:**

**The child's asthma is:** ☐ **mild persistent** ☐ **moderate persistent** ☐ **severe persistent** ☐ **EXERCISE-INDUCED**

| **Symptoms** | **Peak Flow Monitoring** OR | **Treatment** | | |
|---|---|---|---|---|
| • No cough or wheeze<br>• Able to sleep through the night<br>• Able to run and play<br>• Usual medications control asthma | **GREEN ZONE**<br>WELL<br>><br>_____ | **Controllers** | **How much** | **When** |
| | | ☐ Advair | | |
| | | ☐ Flovent (with spacer) _____ | | |
| | | ☐ Pulmicort | | |
| | | ☐ Singulair | | |
| | | ☐ Serevent | | |
| | | ☐ Other | | |
| | | **Relievers** | | |
| | | ☐ Albuterol (with spacer/nebulizer) | 2 puffs 1 minute apart prn | ☐ 20 min before exercise |
| | | ☐ Other | | |
| • Increased asthma symptoms (shortness of breath, cough, chest pain)<br>• Wakes at night due to asthma<br>• Unable to do usual activities<br>• Needs reliever medications more often | **YELLOW ZONE**<br>SICK<br>_____ **to** _____ | **1.** ☐ Continue daily controller medications<br>**2.** Give albuterol 2 puffs (one minute between puffs) with spacer or by nebulizer<br>☐ If no improvement, repeat 2 puffs or nebulizer and wait 20 minutes<br>☐ If no improvement, repeat 2 puffs or nebulizer. This will be 3 doses in one hour, proceed to 3<br>**3.** If child returns to Green Zone:<br>☐ Continue to give albuterol 2 puffs every 4 hours for 1 to 2 more days<br>AND ☐ Increase controller to _____ for next 7 days<br>**4.** ☐ No physical exercise ☐ Physical exercise as tolerated<br>**If child remains in Yellow Zone for more than 1-2 days or requires albuterol more than every 4 hours, call your doctor NOW!** | | |
| • Very short of breath, difficulty breathing<br>• Constant cough<br>• Reliever medications do not help | **RED ZONE**<br>EMERGENCY!<br><<br>_____ | **Give albuterol (2 puffs with spacer or by nebulizer) NOW, and repeat every 20 minutes for 2 more doses – Call your doctor**<br>**Seek emergency care or call 911 if:**<br>▪ Child is struggling to breathe and there is no improvement 20 minutes after taking albuterol<br>▪ Trouble talking or walking<br>▪ Lips or fingernails are gray or blue<br>▪ Chest or neck is pulling in with breathing | | |

For inhaled medications:

☐ Student is able to perform procedure alone and may carry the inhaler with them, consult school nurse for local protocol
☐ Student is able to perform procedure with supervision
☐ Student requires a staff member to perform procedure

Notify health care provider if:

☑ More than 2 absences related to asthma per month
☑ Albuterol is being used as a rescue medication 2 times per week at school
☑ The child is persistently in the Yellow Zone

_____ Provider Signature _____ Date ☐ Current school year

I give my permission for school personnel to follow this plan, administer medication and care to my child and contact my physician if necessary. I assume full responsibility for providing the school with prescribed medication and monitoring device. I approve this Asthma Management Plan for my child.

_____ Parent Signature _____ Date

②

**2003 Allies Against Asthma**

# Peak Expiratory Flow Rate Monitoring

## Overview

A peak expiratory flow meter (PEFM) is a portable, hand-held device used to measure the ability to move air out of the lungs. The PEFM is used frequently over a two-week period to determine the student's peak expiratory flow rate. This rate can then be used for comparison when the child has signs of breathing difficulty. Students with asthma (especially moderate or severe asthma) or other respiratory conditions can use peak flow readings to help recognize early changes that may be signs of worsening respiratory status or determine the severity of an asthmatic episode. Altered peak flow readings can sometimes detect airway changes before symptoms appear. Readings can be used to guide use of additional medication and when to seek emergency care.

## Potential Settings

There are no restrictions as to where peak expiratory flow rate monitoring can be done. The setting should be clean and appropriate to the student's need/desire for privacy. Students with peak flow meters can attend a regular classroom and participate in regular school activities.

## Staff Preparation

Peak flow rate monitoring can be performed by the student, school nurse, teacher aide, or other staff person who has had general training in using peak flow meters. General training should cover the student's specific health care needs, how to obtain a peak flow reading, and how to implement the established action plan.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who needs peak flow rate monitoring. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who needs peak flow rate monitoring, the following elements should receive particular attention:

- Need for student to measure peak flow rates
- Student's underlying condition and possible problems associated with the condition or treatment
- Frequency/timing of measurements and reasons for obtaining additional measurements
- Determination of peak flow rate values that should be reported to school nurse, family, and/or health care provider
- Student's baseline status, including color, respiratory rate, pulse, and blood pressure and assessment of changes in this status
- Student's self-care skills and knowledge of early signs of respiratory distress
- Standard precautions

**Sources:**

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# Procedure for Peak Flow Rate Monitoring

**Note: Equipment and supplies provided by parents.**

1. Review standard baseline ratings and assessment ratings from medical provider.
   *Assess student's status: respiratory rate, depth, effort, pulse, restlessness, color, retractions, cough, wheezing, and lung sounds.*
2. Wash hands.
3. Assemble equipment:
   - Peak flow meter
   - Chart or log of student's peak flow readings
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Before each use, make sure the sliding marker or indicator arrow is at the bottom of the numbered scale on the meter (zero or lowest number).
   *Connect mouthpiece to peak flow meter, if not already attached.*
6. Advise the student to **stand** up straight and remove any gum or food from the mouth.
7. Instruct the student take a deep breath, filling the lungs completely.
8. Have the student place the mouthpiece of the meter in the mouth and close the lips tightly around the mouthpiece.
   *Be sure the tongue is kept away from the opening of the mouthpiece.*
9. In one breath, have the student blow out as hard and as quickly as possible—a "fast hard blast"—until he/she has blown as much air as possible out of the lungs.
   *The force of the air coming out of the lungs causes the marker to move along the numbered scale. When exhaling, students should make a "hah" sound, not a "tah" sound. A "hah" sound is just exhaled air, while a "tah" sound is made with the tongue and does not give an accurate measurement.*
10. Note the number achieved by the marker on the numbered scale.
11. Repeat steps 5-10 two more times.
    *The student should obtain similar numbers for all three tries. Inconsistent numbers may indicate incorrect technique. If the student coughs or uses incorrect technique, do not use that number.*
12. Record the highest number achieved in the student's chart or log. Readings should be obtained over several weeks when the student is not having respiratory problems to determine the student's "normal" or usual peak flow rate. Many health care providers advise measuring peak flow rates close to the same time each morning.
13. After these readings have been obtained, the student's peak flow rate can be measured on a regular basis, or, on an "as needed" basis according to student-specific guidelines. Compare any peak flow rates with student's personal best or normal peak flow rate. Follow health care provider's guidelines for any recommended actions. A medical provider's order is needed to use peak flow readings for treatment.

    Generally, three zones (correlated to traffic light colors of green, yellow, and red for easy interpretation) are used to interpret peak flow rates. The following are general guidelines, however, follow the health care provider's specific guidelines for each student:

| Zone | Peak Flow Rate | Action |
|---|---|---|
| Green | 80-100% | Continue regular management plan. No additional action needed. |
| Yellow | 50-80% | Airways are narrowing and may require additional treatment. Symptoms can get better or worse depending on actions taken. Refer to the individualized health care plan or action plan for instructions and medication use. |
| Red | <50% | **Medical Alert**—severe narrowing may be occurring. **Implement action plan** predetermined by health care provider. Notify school nurse, family, and/or health care provider if peak flow rate does not return to yellow or green zone. |

14. Document peak flow reading and any action taken.
    *Report to the school nurse and family any changes from the student's usual pattern.*
15. Care for peak flow meter according to instructions. Meters can be cleaned in mild detergent and hot water. Rinse and dry thoroughly before storage.
    *Dirt collected in the meter can make measurements inaccurate. Germs or mucus can also collect in the meter.*

**Sources:**


American Lung Association. (2002). *Peak flow meters.* Available online at www.lungusa.org/asthma/astpeakflow.html.

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Hockenberry, M.J. (2003). *Wong's Nursing Care of Infants and Children*. (7th ed.). St. Louis: Mosby, pp. 1398-1399.

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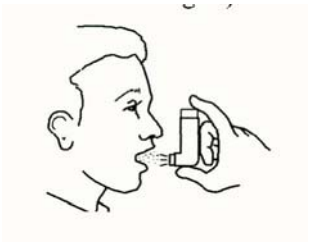
# Procedure for Using a Metered Dose Inhaler (MDI)

A metered dose inhaler (MDI) is a device used to deliver asthma medication directly to the lungs. It consists of a canister of pressurized medication that fits into a plastic sleeve connected to a mouthpiece. The MDI propels aerosolized medication into the airway. In comparison, medications taken in pill form must travel through the body to reach the lungs and generally require much higher doses than the inhaled forms. With an inhaler, the dose is delivered to the lungs where it is immediately absorbed, which also decreases the chance of medication side effects to the rest of the body. However, the medication sprayed from the MDI may not reach the lungs if correct technique is not used. A prescription from the student's health care provider is required for inhalers to be used at school.

It can be difficult to determine how much medication remains in an MDI. ***Putting the canister in water to see if it is empty does <u>not</u> work*** and can harm the inhaler. The number of doses in a canister is written on the MDI. If the MDI is used on a regular basis, the date it will run empty can be calculated by dividing the number of doses by the number of puffs used per day. For example, if the MDI has 200 doses and is ordered 2 puffs four times a day (8 puffs total per day), then it should last 25 days. However, if an MDI is used as an emergency or rescue inhaler, then a running count of how many doses have been used can be kept. Because it can be difficult to keep this count, having two inhalers available so a refill is available when one runs out ensures that the medication will always be available.

**Note: Medication and supplies provided by parents.**

1. Wash hands.
2. Explain procedure at student's level of understanding.
   *By teaching correct technique for using an MDI, the caregiver helps the student achieve maximum self-care skills and ensures that the correct amount of medication is obtained.*
3. Have the student stand, and using the thumb and one or two fingers, hold the inhaler upright, with the mouthpiece end down and pointing towards his face.
4. Remove the cap and shake the inhaler.
5. Tilt the head back slightly and breathe all the way out.
6. Position the inhaler in one of three ways:
   - Hold inhaler 1-2 inches away from open mouth.
   - Use a spacer to hold inhaler. See Procedure for Using Spacers.



7. Press down on the inhaler to release medication while starting to breathe in slowly for 3-5 seconds.
8. Hold breath for 10 seconds to allow medicine to reach deeply into the lungs.
9. Repeat puff as directed by the student-specific order. For emergency, quick-relief, or rescue medicine (beta2-agonists), wait 1 minute between puffs.
   *Waiting one minute allows airway to dilate from first dose of medicine and may allow more of the second puff to penetrate better. There is no need to wait between puffs for other medications (corticosteroids and non-steroidals).*
10. When done, wipe off the mouthpiece and replace the cap.
11. Wash hands.

12. Document medication given in student log (and student response, if specified in plan).

**Sources:**

American Academy of Family Physicians. (2000). *Metered-Dose Inhaler: How to Use It Correctly*. Available at http://familydoctor.org/x2995.xml.

Berger, William. *Metered-Dose Inhalers*. Allergy and Asthma Network, Mothers of Asthmatics. Available at www.aanma.org/pharmacy/ph_dev_metereddose.htm.

National Asthma Education and Prevention Program. (July 2003, revised). *Managing Asthma: A Guide for Schools*. Bethesda, Maryland: National Institutes of Health, National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. NIH Publication No. 02-2650, page 35. Available at www.nhlbi.nih.gov/health/prof/lung/asthma/asth_sch.pdf.

National Asthma Education and Prevention Program. (1997). *Practical Guide for the Diagnosis and Management of Asthma*. Bethesda, Maryland: National Institutes of Health, National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. NIH Publication No. 97-4053, page 44.

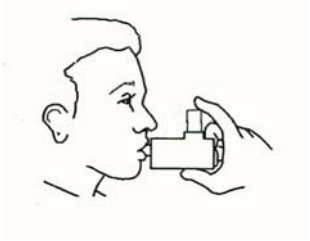
# Procedure for Using Spacers with Metered Dose Inhalers

Many people (especially young children) find it difficult to time the spraying of a metered dose inhaler (MDI) and the inhalation of the medication. Sometimes the puffs are mis-timed and only make it part of the way into the airways, and some of the medication is deposited in the mouth and on the back of the throat instead of the lungs. Spacers and holding chambers place additional space between the patient and the MDI. The medication is sprayed into the spacer instead of the mouth. As the student inhales, the medication passes quickly through the mouth and throat, reducing the amount of medication released into the air and preventing it from being sprayed directly on the mouth or throat.

## Using an Aerochamber Spacer with a Metered Dose Inhaler

**Note: Medications and supplies provided by parents.**

1. Wash hands.
2. Explain procedure at student's level of understanding.
   *By teaching correct technique for using a spacer with an MDI, the caregiver helps the student achieve maximum self-care skills and ensures that the correct amount of medication is obtained.*
3. Remove the plastic cap from the MDI and the Aerochamber.
4. Shake the MDI and insert into the back of the Aerochamber.
5. Breathe out deeply.
6. Put the mouthpiece of the Aerochamber into the mouth between the teeth and close the lips around it.
7. Press down on the MDI to spray one puff from the MDI into the Aerochamber.
8. Take a long slow breath through the mouth and hold breath for 5-10 seconds.
   *If a whistling sound is heard, the student is breathing in too quickly*.
9. Take the Aerochamber out of the mouth and breathe normally.
10. If a second puff is ordered, wait at least one minute between puffs.
11. Document medication given in student log.
12. At least once a week, wash the Aerochamber in warm water and thoroughly dry.

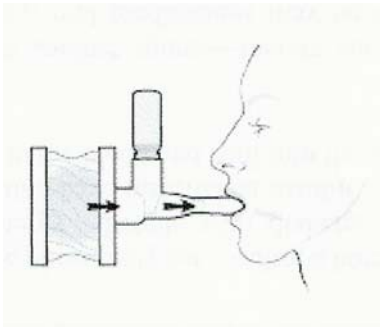


## Using an Inspirease Spacer with a Metered Dose Inhaler

**Note: Medication and supplies provided by parents.**

1. Wash hands.
2. Explain procedure at student's level of understanding.
   *By teaching correct technique for using a spacer with an MDI, the caregiver helps the student achieve maximum self-care skills and ensures that the correct amount of medication is obtained.*
3. Remove the aerosol can from the MDI plastic holder and shake it.
4. The Inspirease spacer consists of a mouthpiece and a reservoir bag. Place the mouthpiece into the opening of the reservoir bag, making sure to line up the locking tabs. Twist to lock.

5. Carefully untwist or extend the reservoir bag until it is completely open.
6. Insert the stem of the canister securely into the adaptor port of the mouthpiece.
7. Breathe out deeply.
8. Place the mouthpiece between the teeth and seal the lips tightly around it.
9. Press down on the MDI to spray one puff from the MDI into the Inspirease.
10. Take a long slow breath through the mouth and hold breath for 5-10 seconds.
    *If a whistling sound is heard, the student is breathing in too quickly*.
11. Breathe out into the bag slowly, keeping the lips around the mouthpiece.
12. Breathe in again slowly and hold breath for 5-10 seconds.
13. If a second puff is ordered, wait at least one minute between puffs.
14. Document medication given in student log.
15. Wash and dry the mouth piece with warm water and try thoroughly once per day. The reservoir bag should not be washed, but needs to be replaced every 2-4 weeks, or sooner if it gets a hole or tear.



**Sources:**


Health Information Center at the Cleveland Clinic. (2001). *How to Use a Metered Dose Inhaler with Inspirease Spacer*. Available at www.clevelandclinic.org/health/health-info/docs/0300/0357.

Pediatric Advisor, University of Michigan Health System. (2003). *Metered-Dose Inhaler Used with an Aerochamber*. Available at www.umich.edu/1libr/pa/pa_mdaeroch_hhg.htm.

Skales, N. (1992). Parent Teaching Guide: Holding Chambers for Aerosol Drugs. In *Manual of pediatric nursing procedures*. (pp. 165-167). Philadelphia: J.B. Lippincott.

University of Massachusetts Pulmonary, Allergy & Critical Care Medicine. (2003). *Instructions for Use of Aerochamber*. Available at www.umassmed.edu/pulmonary/aerochamber.cfm.

# Procedure for Using Dry-Powder Inhalers

Dry-powder inhalers (DPIs) dispense medication in a very fine, powdered form. The medication particles are so small that they can easily reach the tiniest airways. Because every DPI works a little differently, the instructions must be read before using. Some DPIs have dose counters, which can make it easier to tell when the inhaler is almost empty. Cold temperatures don't reduce the effectiveness of DPIs as it might with some MDIs. General instructions for most DPIs:

**Note: Medication and supplies provided by parents.**

1. Wash hands.
2. Follow the manufacturer's instructions to prime the DPI and load a prescribed dose of the dry-powder medicine.
   *Do not shake the DPI. Shaking can result in losing some powder.*
3. Breathe out slowly for 3-5 seconds.
4. Put mouth on mouthpiece and inhale deeply and forcefully.
   *The DPI is breath-activated, so the student can control the rate at which the medication is inhaled. It needs to be inhaled with sufficient force to assure accurate delivery of medication to the lungs. Most DPIs require closing the mouth tightly around the mouthpiece of the inhaler.*
5. Hold breath for 10 seconds and then exhale slowly.
6. If specified in student plan, repeat the procedure for the correct number of doses. One inhalation from a DPI often provides the same dosage as two puffs of a comparable medication from a MDI.
7. Document medication given in student log.

## Using a Rotahaler® Dry Powder Inhaler

**Note: Medication and supplies provided by parents.**

1. Wash hands.
2. Inspect the mouthpiece for presence of foreign objects.
3. While holding the Rotahaler® upright (mouthpiece down), hold the darker colored end in one hand, and turn the lighter colored end as far as it will go in either direction.
4. Insert the clear (thinner) end into the raised hole located in the lighter colored end of the Rotahaler®. Push the new capsule in until it is level with the top of the hole.
   *This will force the previously used capsule shell into the* Rotahaler® chamber.
5. Hold the Rotahaler® level (horizontally) with the white spot up and turn the lighter colored end as far as it will go in the opposite direction.
   *This will open the capsule.*
6. Gently breathe out.
7. Seal lips around the mouthpiece (the darker colored end).
8. Breathe in through the mouth as quickly and as deeply as possible.
9. Hold breath for up to ten seconds.
   *This allows the medication time to deposit in the airway.*
10. Remove Rotahaler® from mouth and resume normal breathing.
11. Repeat steps 2-10 if student is ordered more than one capsule.
12. After each use, pull the two halves of the Rotahaler® apart and throw away the loose capsule shell.

13. Once every two weeks, wash the two halves of the Rotahaler® in warm water (after removing any used shells). Shake off any excess water and thoroughly dry Rotahaler® before reassembling it.
    *Regular cleaning will prevent powder accumulation inside the* Rotahaler®.
14. Document medication given in student log.

**Diskhaler**® and **Diskus**® are two other common types of dry-powder inhalers. However, they are used for preventive medications, which are not likely to be used at school, so more specific instructions for these devices will not be covered here. Instructions can usually be found with the devices and are also available online at http://asthma.nationaljewish.org/treatments/devices/diskus.php and at http://www.asthma.ca/adults/treatment/diskhaler.php.

**Spinhalers** are no longer manufactured in the United States, but may be found in Canada.

**Sources:**

Berger, William. *Dry-Powder Inhalers*. Allergy and Asthma Network, Mothers of Asthmatics. Available at www.aanma.org/pharmacy/ph_dev_drypowder.htm.

National Jewish Medical and Research Center. (2003). *Using a Rotahaler® Dry Powder Inhaler with Asthma Medications*. Available at http://asthma.nationaljewish.org/treatments/devices/rotahaler.php

# Nebulizer Treatments

## Overview

Nebulizers use compressed air to break up medications into super fine particles and deliver them as a mist to be inhaled directly into the lungs. The mist is directed into a mask or mouthpiece, which the student wears while receiving the treatments. Studies have found that inhaling smaller doses of medication directly into the lungs is more efficient and cause fewer side effects than taking the same medication in pill or liquid form. Nebulizers are often used with children because the procedure is easier to coordinate and use than metered dose inhalers.

All nebulizers have the same basic features—an air compressor, connecting tubing, air inlet, air outlet, medication cup, and face mask or T adaptor (fits in the mouth). The mask directs air to the nose and mouth, and the T adaptor directs air to the mouthpiece while allowing exhaled air to escape.

## Potential Settings

The compressor on the nebulizer makes a great deal of noise so nebulizer treatments are best done in a private, clean area such as the school health office. Students who require nebulizer treatments can attend a regular classroom and participate in regular school activities. Physical education activities may need modification if the student is receiving the nebulized medication because of bronchoconstriction.

## Staff Preparation

A nebulizer treatment can be administered by the school nurse (RN or LPN) or health assistant supervised by the registered nurse. Many students can perform nebulizer treatments by themselves. Those who can't should be encouraged to assist with the treatment as much as possible. Any school personnel who has regular contact with a student who requires a nebulizer treatment should receive training covering the student's specific needs, potential problems, and implementation of the established emergency plan.

The basic skills checklist in Appendix B can be used as a foundation for competency-based training in appropriate techniques. It outlines the procedure step by step. Once the procedures have been mastered, the completed checklist serves as documentation of training.

## Components of an Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place with a nebulizer treatment. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student requiring nebulizer treatments, the following elements should receive particular attention:

- Determining the need to receive nebulizer treatment

- Medication to be administered and side effects and precautions
- Action to take if student becomes shaky or jittery during nebulizer treatment
- Frequency of treatments and whether treatments are on a regular or "as needed" basis
- Student's self-care skills and knowledge of need for treatments
- Student's knowledge of early signs of respiratory distress
- Response to treatment and necessity for repeat treatments (per health care provider order)
- Whether there is a need for activity modifications
- Identification of allergens and triggers of wheezing for students with asthma
- Whether there is a need for peak flow readings before and/or after treatment
- Need for chest physical therapy and/or suctioning
- Frequency and type of cleaning for nebulizer components
- Latex allergy alert
- Standard precautions

**Sources:**

Medical Network, Inc., HealthAtoZ.com (2004). *Nebulizer*. Available online at: www.healthatoz.com/healthatoz/Atoz/dc/tp/tpnebulizer_pr.html

National Jewish Medical and Research Center. (2003). *Using a Nebulizer: Instructions for Correct Use*. Available at: http://asthma.nationaljewish.org/treatments/devices/nebulizers_using.php

Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing.

Smith, SF, Duell, DJ, & BC Martin. (2004). *Clinical Nursing Skills*. (6th ed.). New Jersey: Prentice Hall, 546.

# Procedure for Nebulizer Aerosol Treatment

**Note: Parent provides equipment, supplies, and medications.**

1. Determine need for treatment based on health care provider's order. The student may ask for treatment.
   *Assess student's respiratory status: rate, depth, effort, wheezing, cough, retractions, breath sounds, and color.*
2. Wash hands.
3. Assemble equipment:
   - Compressor
   - Connecting tubing
   - Nebulizer medication chamber
   - Mask, or mouthpiece with T adaptor
   - Medication
   - Diluting solution
   - Syringe, if needed for measuring
   - Filter disc/exhalation filter, if needed
4. Place the unit on a firm, flat surface.
   *Most compressors are electrically powered; some may be battery powered.*
5. Attach one end of the connecting tubing to the compressor's air outlet.
6. Unscrew the top from the nebulizer cup.
7. Place the prescribed amount of medicine and diluting solution, if needed, into the nebulizer cup and screw the cup back together.
   *Some medications do not require diluting solution.*
8. Attach the other end of the connecting tubing to the bottom of the medication cup.
9. Keeping the cup vertical, attach face mask or T tube with mouthpiece to the top of the cup.
10. Have the student sit in a comfortable position.
11. Turn on power switch.
    *A fine mist should be visible.*
12. Have student place mouthpiece in mouth and seal lips around mouthpiece, or place mask over nose and mouth (or tracheostomy).
13. Instruct student to breathe normally in and out of the mouthpiece or mask.
14. Every 1-2 minutes have student take a deep breath, hold breath briefly, then exhale slowly and resume normal breathing. Most treatments last 10-15 minutes.
    *Taking some deep breaths ensures that the medicine gets to the lower airways, not just the mouth.*
15. When all the medication has been aerosolized, turn off power.
16. Remove mouthpiece or mask.
17. Assess student's respiratory status. **If student is still having difficulty breathing after nebulizer treatment or is wheezing, follow student's individualized health care plan**.
18. Wash mouthpiece or mask and allow to thoroughly dry before storing. Refer to cleaning instructions for other parts.
19. Wash hands.
20. Document treatment. Report to school nurse and family any changes in the student's usual pattern of tolerating the procedure.

Cleaning and care of equipment: After each use, rinse medication cup, mouthpiece, and mask under warm running water for 30 seconds. Shake off excess water. Allow to dry. When parts are dry, store them in a clean plastic bag. Do not wash tubing. Once or twice a week: Clean nebulizer parts more thoroughly according to manufacturer's instructions. If no instructions, parts can be soaked in solution of 1 cup white vinegar and 2 cups warm water for 30 minutes. Rinse thoroughly after soaking. Some parts may be boiled or cleaned in dishwasher.

*Thorough cleaning can be done at home. Cleaning the equipment prevents clogging and malfunction and reduces infection. Compressors can be used for multiple students. Other parts are student-specific.*

**Sources:**


Medical Network, Inc., HealthAtoZ.com (2004). *Nebulizer*. Available online at: www.healthatoz.com/healthatoz/Atoz/dc/tp/tpnebulizer_pr.html

National Jewish Medical and Research Center. (2003). *Using a Nebulizer: Instructions for Correct Use*. Available at: http://asthma.nationaljewish.org/treatments/devices/nebulizers_using.php

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Smith, SF, Duell, DJ, & BC Martin. (2004). *Clinical Nursing Skills*. (6th ed.). New Jersey: Prentice Hall, 546.

| Problems That May Occur During a Nebulizer Treatment | |
|---|---|
| **Assessment** | **Interventions/Rationale** |
| Chest tightness<br>Coughing<br>Wheezing<br>Shortness of breath<br>Retractions (i.e., pulling in of rib cage) | ***Follow Emergency Asthma Action Plan or other similar plan***.<br>*Give nebulizer treatment, if ordered. Nebulized bronchodilators can act quickly to help with breathing. Notify school nurse and family.* |
| Breathing gets increasingly difficult<br>Cough or wheeze worsens | *Stay calm. Reassure student. Document vital signs.* ***Follow Emergency Asthma Action Plan and notify school nurse and family***. |
| Struggling to breathe or hunching over after treatment is finished | ***Follow Emergency Asthma Action Plan. Call 911.***<br>*Notify school nurse, family, and health care provider.* |
| Dizziness, lightheadedness | *Student may be breathing too rapidly. Encourage student to take slower breaths. If persists, stop treatment and continue when student is feeling better.* |
| Becomes shaky or jittery during bronchodialator treatment | *Medication may be causing increased heart rate. Follow student guidelines for care.* |

**Sources:**


Medical Network, Inc., HealthAtoZ.com (2004). *Nebulizer*. Available online at: www.healthatoz.com/healthatoz/Atoz/dc/tp/tpnebulizer_pr.html

National Jewish Medical and Research Center. (2003). *Using a Nebulizer: Instructions for Correct Use*. Available at: http://asthma.nationaljewish.org/treatments/devices/nebulizers_using.php

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Smith, SF, Duell, DJ, & BC Martin. (2004). *Clinical Nursing Skills*. (6th ed.). New Jersey: Prentice Hall, 546.

## Information for Students
# Who Need Nebulizer Treatments

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student requires nebulizer treatments to deliver medications in a mist form directly into his or her lungs.

The student will have the necessary equipment at school to administer the medication through the nebulizer and this information will be included in the student's individualized health care plan.

The procedure will be conducted by a trained staff member. The student may be able to request a nebulizer treatment and assist with the procedure.

The student may be able to participate in many school activities. Modifications should be approved by the family, health care provider, and school nurse.

Please contact _____ at _____ (phone number/pager) for additional information or if the student experiences any problems with the nebulizer

**Source:**
Adapted from: Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing.

# Oxygen Use

## Overview

Oxygen is needed for all body functions. A student may need supplemental oxygen therapy when hypoxia or hypoxemia results from a respiratory condition, a cardiac condition, or increased metabolic demands.

Early signs of hypoxia:

- Restlessness
- Anxious look
- Confusion or change in behavior
- Headache
- Visual disturbances
- Tachypnea
- Tachycardia
- Dyspnea

Chronic hypoxia:

- Polycythemia
- Clubbing of fingers and toes
- Peripheral edema
- Elevated $pCO_2$
- Chronic $pO_2$ <55
- Right-sided heart failure

Advanced hypoxia:

- Hypotension
- Bradycardia
- Cyanosis
- Metabolic acidosis

## Oxygen Sources

**Oxygen Gas**

A common source of pure oxygen is oxygen gas stored under pressure in a metal tank. This is especially common for students who need oxygen on a standby basis or who use a ventilator. Tanks come in a variety of sizes and portability. The amount of oxygen remaining in a tank is indicated on the pressure gauge of the tank. Regulators or flowmeters are attached to the tank to control the amount of oxygen the student receives. Oxygen delivery tubing is attached to the "Christmas tree" adapter on the regulator or flowmeter. Oxygen cylinders should be secured in an upright position. Because the oxygen is stored under high pressure, the tank can be a safety hazard. Its cumbersome design and need for frequent refills are also disadvantages.

**Oxygen Liquid**

The liquid oxygen system includes a large liquid thermal reservoir that stores the pure oxygen as a liquid at -300º Fahrenheit. These tanks also come in a variety of sizes and portability. A portable unit that can be worn over the shoulder can supply oxygen for several hours.

Equipment for both gas and liquid oxygen include:

- Regulator with pressure gauge and flowmeter
- Tank stand or carrier
- Humidification source
- Oxygen tubing
- Mask or cannula

- Wrench for gas tank valve

**Oxygen Concentrator**
This electronically powered machine extracts oxygen molecules from room air and concentrates it for delivery to the student. It can be used for low oxygen flow less than 4 liter/minute. Its advantage is that it does not require a tank or need refills. However, it does require an electrical outlet so it is not as portable. Units can have a back-up battery that functions during a power outlet or when temporarily portable. The units have air filters that require cleaning.
Equipment for the oxygen concentrator:

- Humidification source
- Oxygen tubing
- Mask or cannula
- Emergency oxygen tank for power failure

## Safety Precautions for Oxygen Use

- **Do not smoke** or allow open flames near oxygen. Post "No Smoking" or "Oxygen in Use" signs at the door. Oxygen supports combustion and a small spark can cause a fire.
- Do not allow oil, grease, or any other highly flammable material to come into contact with any part of the oxygen setup. Do not lubricate any fittings with oil and do not handle equipment with greasy hands or rags.
- Store oxygen away from heaters, radiators, and other heat sources, including the hot sun.
- Avoid use of friction-type toys or battery-operated devices due to chance of sparks.
- Make sure all electrical devices in the area use grounded three-prong plugs.
- Keep fire extinguishers near the classroom and available in other areas of school.
- Never put anything over an oxygen tank.
- Keep a spare oxygen source, extra tubing, and other tank equipment readily available.
- When using a gas tank, make sure that it is secured upright in its stand (including during transport) and cannot be knocked over (it can become a missile).
- Check the alarm system—pinch tubing to obstruct flow and see if alarm sounds when oxygen stopped.
- Make sure that oxygen tubing does not become kinked (except for brief testing), obstructed, punctured, or disconnected.
- Use the flowmeter setting prescribed by the student's health care provider.
- Keep the name of the home oxygen company and its telephone contact posted on/near the oxygen equipment and in the student's individualized health care plan. Contact the company if any equipment does not appear to function correctly.
- Notify the fire department that oxygen is in use at the school.

## Potential Settings

Whenever a student is receiving oxygen therapy:

- **There should be no smoking, open flame, or heat source close to the oxygen because these may increase the risk of fire.**

- **Check equipment and oxygen supply at least daily, or as specified by student's individualized health care plan.**

NOTE: The Virginia Department of Education has taken the position that students who need to be accompanied by a supply of oxygen can be **transported by the school bus** under the following conditions:

- An aide, attendant, school nurse, etc. who has received specific training for administration of oxygen and general training on the student's special needs, shall accompany and sit next to the student;
- Only the driver, aide, and the student should be on the vehicle when oxygen is present;
- The tank or cylinder shall be removed from the bus when the student departs;
- **If a portable oxygen system (backpack) comparable to a "C" or "D" type that holds 200-400 liters is used, then the student can be transported on the same bus as other students;**
- The oxygen equipment (backpack tank) shall be mounted and securely fastened to the bus body in an upright position so that valves are protected from possible breakage and to prevent exposure to intense heat. Mounting should be as near as practical to the student's seating position. If a wheelchair is used, the oxygen may be secured to the properly secured wheelchair. If oxygen is necessary during transportation, instead of removing the cylinder from its mounting, a small amount of regular oxygen extension tubing from the cylinder, which should be adjacent to the student's seating position, to a face mask shall be considered.

(Memo from Barbara Goodman, Principal Specialist, Pupil Transportation, Virginia Department of Education to Frank C. Dixon, Director of Transportation, Fairfax County Schools, April 21, 1994.)

## Staff Preparation

The school nurse (RN or LPN) may administer oxygen through a nasal cannula or mask. Use of a tracheostomy collar may require a registered school nurse or respiratory therapist with training, depending on the care needs of the student with a tracheostomy and as specified in the student's individualized health care plan. Any school personnel who have regular contact with a student who requires oxygen should receive general training covering the student's specific needs, potential problems and implementation of the established emergency plan.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student requiring supplemental oxygen use. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student requiring supplemental oxygen use, the following elements should receive particular attention:

- Student's underlying condition and possible problems associated with the condition or treatment

- Student's baseline respiratory status, including color, breath sounds, respiratory rate, pulse, and blood pressure
- Signs and symptoms shown by the student when not receiving adequate oxygen (e.g., cyanosis, agitation, distress)
- Student's ability to request assistance or extra oxygen when needed
- Percentage and/or liter flow of oxygen prescribed (for both routine use and for emergencies)
- Adaptation of classroom for oxygen equipment and supplies, including storage and transport
- Access to oxygen supply in other areas of the school (i.e., portable or stationary)
- Posting of oxygen safety precautions including "oxygen in use" warnings
- Spare oxygen supply and safe storage when not in use
- Latex allergy alert
- Standard precautions

**Sources:**


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Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 346-351.

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# Procedure for Using a Nasal Cannula

A nasal cannula uses small plastic prongs which fit in the student's nostrils and attach to oxygen delivery tubing. It is easy, comfortable, and usually tolerated well because it allows eating and talking. It cannot be used to deliver oxygen concentrations greater than 40% or when there is an obstruction to the nasal passages, such as from swelling, a deviated septum or polyps.

**Note: Parent supplies equipment, supplies, and oxygen.**

1. Review oxygen safety precautions (see previous section).
2. Wash hands.
3. Assemble equipment:
   - Oxygen source and backup
     *Make sure that tank has enough oxygen.*
   - Cannula and tubing
   - Humidity source, if needed
   - Adaptor for connecting tubing
   - Extra connecting tubing, if needed for mobility
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Securely attach cannula tubing to oxygen source.
   *Usually a "Christmas tree" adaptor is used to attach the tubing to the oxygen source. Attach humidifier, if ordered. Make sure that all connections are secure to prevent leaks.*
6. Turn on the oxygen source. A highly visible information card stating oxygen liter flow should be attached to the regulator.
7. Set flowmeter to the flow rate prescribed by health care provider. **Do not change this setting without first contacting the health care provider.**
   *Oxygen liter flow can be ordered as a set liter flow rate (e.g., 2 liters per minute) or as a range (e.g., 2-4 liters per minute) based on student's needs.*
8. Check cannula prongs to make sure that oxygen is coming out.
   *Hold them up to your hand and feel for flow coming out. If no flow is felt, check oxygen supply (make sure tank still has oxygen), connections for leaks, flow rate, and tubing for obstruction.*
9. Gently place cannula prongs into each of student's nostrils. **Make sure both prongs are in the nostrils**. Loop the tubing over each ear then under the chin. Tubing can be secured by sliding the adjuster up under the chin. Check with the student to make sure it is comfortable. Do not apply too tightly because this can occlude the nostrils and put excess pressure on facial structures.
   *If the student is not comfortable, the cannula tubing can be secured behind the head rather than under the chin. If using an elastic strap to secure the cannula, position it over the ears and around the back of the head.*
10. If ordered, provide nares care with ONLY water-soluble products.
    *Do not use petroleum products such as petroleum jelly because they are combustible and difficult to clear from the mucosa.*
11. Wash hands.

12. Document procedure on student's log sheet. Notify the school nurse and family if there are any changes in student's usual pattern.

**Sources:**


Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 465-472.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 346-351.

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## Procedure for Using an Oxygen Mask

In an oxygen mask, oxygen flows in through tubing at the bottom of the mask and out through large holes on the sides. It is useful when nasal passages are blocked and can be used to deliver higher concentrations of oxygen than the nasal cannula.

**Note: Parent supplies equipment, supplies, and oxygen.**

1. Review oxygen safety precautions (see previous section).
2. Wash hands.
3. Assemble equipment:
    - Oxygen source and backup
      *Make sure that tank has enough oxygen.*
    - Mask and tubing
    - Humidity source, if needed
    - Adaptor for connecting tubing
    - Extra connecting tubing, if needed for mobility
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Securely attach mask tubing to oxygen source.
   *Usually a "Christmas tree" adaptor is used to attach the tubing to the oxygen source. Attach humidifier, if ordered. Make sure that all connections are secure to prevent leaks.*
6. Turn on the oxygen source. A highly visible information card stating oxygen liter flow should be attached to the regulator.
7. Set flowmeter to the flow rate prescribed by health care provider. **Do not change this setting without first contacting the health care provider.**
   *Oxygen liter flow can be ordered as a set liter flow rate (e.g., 2 liters per minute) or as a range (e.g., 2-4 liters per minute) based on student's needs.*
8. Check oxygen mask for flow.
   *Hold mask up to your hand and feel for flow coming out. If no flow is felt, check oxygen supply (make sure tank still has oxygen), connections for leaks, flow rate, and tubing for obstruction.*
9. Place the mask over the student's nose, mouth, and chin. Mold the flexible metal edge to the bridge of the nose. Adjust the elastic band around the student's head to hold the mask firmly but comfortably and without excess pressure on the face.
   *Make sure that the student is comfortable with the mask and that the mask does not touch the eyes.*
10. Wash hands.
11. Document procedure and problems on student's log sheet. Notify the school nurse and family if there are any changes in student's usual pattern.

**Sources:**


Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 465-472.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 346-351.

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## *Possible Problems for Students Requiring Supplemental Oxygen*

| Assessment | Intervention/Rationale |
|---|---|
| Redness, dryness, or bleeding of the nares, face or tracheostomy area | *Check to make sure devices are not attached too tightly and that they have sufficient humidity.*<br>***Never use powders or petroleum products on the student's face**. Petroleum products are combustible and difficult to clear from mucosa. Powders can be aerosolized and irritate the airways.*<br>*Notify school nurse and family who can discuss problem with health care provider.* |
| Rapid breathing or shortness of breath<br>Agitation, confusion, dizziness, or headache<br>Retractions or pulling in of the muscles at the neck or chest<br>Rapid or pounding pulse<br>Blue color or pallor of the lips or nails<br>*With students of African or Mediterranean descent, be careful when assessing for cyanosis, especially around the mouth, because this area may be dark blue normally. Carefully evaluate on an individual basis.* | *Stay calm and reassure student.*<br>*Check student:*<br>• *Check nasal cannula, mask, or tracheostomy collar for correct placement.*<br>• *Make sure student's mouth, nose, or tracheostomy tube is not obstructed by food or mucus and that student is positioned so that airway is not blocked.*<br>• *Check tracheostomy tube placement.*<br>• *Make sure collar is not out of position or obstructing tracheostomy tube.*<br>*Check equipment. Check oxygen flow—if flow is weak or inadequate:*<br>• *Make sure regulator, flowmeter, and valve are on correct settings.*<br>• *Make sure tank still has gas and is working properly. If not, replace with backup.*<br>• *Check all connections.*<br>• *Check that tubing is not kinked or blocked.*<br>• *Make sure tubing is not obstructed by water condensing in the tubing. Empty water from tube frequently when using humidified mist.*<br>*Increased oxygen flow may be needed. Notify school nurse, family, and/or health care provider.* |
| Continues to show signs of respiratory distress, becomes unconscious, or has a respiratory arrest. | ***Initiate school emergency plan** and notify school nurse and family. Begin cardiopulmonary resuscitation if needed.* |

**Sources:**

Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 465-472.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 346-351.

Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing. .

Smith, SF, Duell, DJ, & BC Martin. (2004). *Clinical Nursing Skills*. (6th ed.). New Jersey: Prentice Hall, 888-896.

Smith-Temple, J & JY Johnson. (2002). Nurses' Guide to Clinical Procedures. (4th ed.). Philadelphia: Lippincott Williams & Wilkins, 113.

## General Information for
# Students with Supplemental Oxygen

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student needs to use additional oxygen during the school day.

The oxygen usually is administered through a mask or tubing inserted into the student's nose or into a tracheostomy collar. The oxygen is kept in a small tank and should always remain with the student. Students may use oxygen continuously or intermittently, depending on their care plan.

This student may be able to participate in many school activities. Modifications should be approved by the family, health care provider, and school nurse.

Open flames and smoking should be prohibited in rooms in which a student is using oxygen.

Please contact _____ at _____ (phone number/pager) for additional information or if the student experiences any problems with the use of oxygen.

**Source:**

Adapted from: Porter, S., Haynie, M., Bierle, T., Caldwell, T. H., & Palfrey, J. S. (Eds.). (1997). *Children and youth assisted by medical technology in educational settings: guidelines for care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing

# Pulse Oximetry

## Overview

Pulse oximetry measures the percentage of hemoglobin saturated with oxygen. Students with ventilation/perfusion abnormalities such as asthma or congestive heart failure may benefit from pulse oximetry and the measurement of oxygen saturation ($SaO_2$). The pulse oximeter consists of a probe with a light-emitting diode (LED) and a light-sensitive photodetector, connected by cable to an oximeter. The oximeter measures the absorption (amplitude) of two wavelengths of light passing through body parts with a high perfusion of arterial blood. The procedure is noninvasive, painless, and reliable.

It is important to remember that pulse oximetry measures oxygen saturation ($SaO_2$), not the actual amount of oxygen in the blood. The partial pressure of oxygen ($PaO_2$) can be correlated with the $SaO_2$ by means of the oxyhemoglobin dissociation curve. A $SaO_2$ reading of 90% correlates with a $PaO_2$ reading of approximately 60 mmHg. In most students, normal oxygen saturation is expected to be equal to or greater than 95%, with 90% as the lowest acceptable value. However, many health care providers prefer a $SaO_2$ of 93% as the lowest acceptable value (correlates to $PaO_2$ of 70 mmHg). Anemia, pH, and body temperature changes can impact oxygen saturation values. Some students with chronic anemia, heart conditions, or other conditions may normally run lower oxygen saturations. **Acceptable values for students requiring pulse oximetry should be specified in their individualized health care plans.**

## Potential Settings

There are no restrictions as to where pulse oximetry can be done. The setting should be clean and appropriate to the student's need/desire for privacy. Students with oximeters can attend a regular classroom and participate in regular school activities, with modifications as needed and as determined by the family, health care provider, school nurse, and school staff.

## Staff Preparation

Pulse oximetry can be performed by the school nurse, teacher aide, or other staff person with general training in pulse oximetry. General training should cover the student's specific health care needs, how to select a sensor site and apply the probe/sensor, reporting values to the proper person, potential problems, how to obtain assistance should problems occur, and how to implement the established emergency plan. The most complex aspect of pulse oximetry is interpreting the results. Guidelines should be specified in the student's individualized health care plan. If there are questions or concerns about a value, the school nurse, family, and/or health care provider should be contacted for assistance.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who requires pulse oximetry. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who requires pulse oximetry, the following elements should receive particular attention:

- Need for student to receive pulse oximetry
- Whether oximetry is to be continuous or intermittent
- Frequency of measurements if intermittent and alarm limits if continuous
- Student's underlying condition and possible problems associated with the condition or treatment
- Determination of oxygen saturation values that should be immediately reported to school nurse, family, and/or health care provider
- Determination of oxygen saturation values that require specific interventions, such as oxygen or medication administration
- Student's baseline status, including color, respiratory rate, pulse, and blood pressure and assessment of changes in this status
- Student's self-care skills and knowledge of early signs of respiratory distress
- Latex allergy alert—if child is latex sensitive, clip-on probes (not adhesive probes) should be used
- Standard precautions

**Sources:**


Bartow, SL. (2000). Home Care Oximetry: A Practice Under Scrutiny. *AARC Times* 24 (11): 51-55.

Bindler, R.C., Ball, J.W., London, M.L., & Ladewig, P.W. (2003). *Clinical Skills Manual for Maternal-Newborn and Child Nursing.* Upper Saddle River, NJ: Prentice Hall, pp.118-119.

Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 524-527.

Child Health Corporation of America's Cooperative Pulse Oximetry FORUM. (2002). The FORUM Offers Recommendations on Best Practices in Pediatric Pulse Oximetry. *AARC Times* 24(4): 36-38, 40-44.

Hockenberry, M.J. (2003). *Wong's Nursing Care of Infants and Children*. (7th ed.). St. Louis: Mosby, pp. 1313-1317.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 355-357.

Potter, P.A., & Perry, A. G. (2001). *Fundamentals of Nursing.* (5th ed.). St. Louis: Mosby, pp.702-705, 1150-1153.

Skales, N. (1992). Pulse oximetry. In *Manual of Pediatric Nursing Procedures*. (pp. 220-222). Philadelphia: J.B. Lippincott.

Smith, SF, Duell, DJ, & BC Martin. (2004). *Clinical Nursing Skills*. (6th ed.). New Jersey: Prentice Hall, 888-889.

Smith-Temple, J & JY Johnson. (2002). *Nurses' Guide to Clinical Procedures*. (4th ed.). Philadelphia: Lippincott Williams & Wilkins, 168-171.

# Procedure for Measuring Pulse Oximetry

**Note: Parent supplies equipment and supplies.**

1. Determine need for oximetry. The student may ask for a measurement.
   *Assess student's status: respiratory rate, depth, effort, pulse, restlessness, color, retractions, cough, wheezing, and lung sounds.*
2. Wash hands.
3. Assemble equipment:
   - Oximeter
   - Oximeter probe or sensor
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Position student as recommended.
   *Usually performed while the student is sitting to decrease motion artifact that can interfere with measurement. Should not be performed in direct sunlight or under bright lights because these lights can interfere with the performance of the saturation sensor. Sensors can be covered to protect from bright lighting.*
6. Instruct student to breathe normally, if necessary.
   *Normal breathing prevents large fluctuations in minute ventilation and possible changes in oxygen saturation.*
7. Select appropriate site to apply sensor/probe based on peripheral circulation. Site must have adequate capillary refill and be free of moisture. It must not be edematous, hypothermic, or have nail polish. Fingers, toes, and earlobes are the most commonly used sites.
   *Nail polish and moisture can affect light transmission and falsely alter saturation. Hypothermia can cause vasoconstriction altering saturation.*
8. Attach pulse oximeter sensor/probe to selected site. The light-emitting diode (LED) and photodetector must face each other with a tissue pad in between. The light source (LED) is usually positioned on top of the nail. The clip-on probe attaches like a clothespin to a fingertip. Adhesive sensor must be applied so that light source is on one side of finger and detector is directly opposite facing it.
9. Attach sensor cable to oximeter and turn machine on. Observe waveform display and listen for audible beep.
   *Light or waveform fluctuates with each pulsation and reflects pulse strength. Poor light waveform may indicate signal is too weak to give accurate oxygen saturation readings.*
10. Correlate oximeter pulse rate with client's apical or radial pulse.
    *Oximeter pulse rate, student's radial pulse, and apical pulse rate should be similar. If differences exist, inaccurate oxygen saturation readings may be obtained. Reevaluate the site and placement of sensor/probe.*
11. Read saturation level on digital display when readout reaches constant value (after at least 10 seconds) and pulse display is strong.
12. If continuous oxygen saturation monitoring is ordered, verify the alarm limits and alarm volume. Limits should be set as ordered in student-specific plan. Assess

sensor/probe site every 2-4 hours and rotate site every 4-8 hours to prevent burns from the sensors.

13. If intermittent monitoring is ordered, remove probe and turn off oximeter power after reading. If adhesive sensor is used, place on the plastic backing for future use. Store probe and oximeter in appropriate location.
14. Wash hands. If the oximeter probe is used for more than one student, it should be cleaned between uses according to manufacturer recommendations.
15. Record oxygen saturation readings in student log. Note any change in respiratory status at this time.
16. Compare readings with student baseline and acceptable values. Report to the school nurse and family any changes from the student's usual pattern.

**Sources:**


Bartow, SL. (2000). Home Care Oximetry: A Practice Under Scrutiny. *AARC Times* 24 (11): 51-55.

Bindler, R.C., Ball, J.W., London, M.L., & Ladewig, P.W. (2003). *Clinical Skills Manual for Maternal-Newborn and Child Nursing.* Upper Saddle River, NJ: Prentice Hall, pp.118-119.

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Hockenberry, M.J. (2003). *Wong's Nursing Care of Infants and Children*. (7th ed.). St. Louis: Mosby, pp. 1313-1317.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 355-357.

Potter, P.A., & Perry, A. G. (2001). *Fundamentals of Nursing.* (5th ed.). St. Louis: Mosby, pp.702-705, 1150-1153.

Skales, N. (1992). Pulse oximetry. In *Manual of Pediatric Nursing Procedures*. (pp. 220-222). Philadelphia: J.B. Lippincott.

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Smith-Temple, J & JY Johnson. (2002). *Nurses' Guide to Clinical Procedures*. (4th ed.). Philadelphia: Lippincott Williams & Wilkins, 168-171.

## *Possible Problems with Pulse Oximetry*

| Assessment | Intervention/Rationale |
|---|---|
| No reading on oximeter | *Check to see if sensors are properly aligned. Make sure wires are intact and securely fastened. Check that oximeter is plugged in and electrical outlet is functioning.* |
| Low oxygen saturation readings but student has no signs of respiratory distress. | *Check:*<br>• *Correlation between pulse rate and oximeter pulse reading. If they differ, re-position probe.*<br>• *Capillary refill. Loosen any tight-fitting clothes. If circulation decreased, choose different site for probe.*<br>• *Light source on probe.*<br>• *If limb is being moved during reading. May need to switch to another site.*<br>• *Adhesion of sensor/probe to skin site.*<br>• *Assess for hypothermia. If extremity is cold, move probe or warm extremity.*<br>• *Lighting in the room. Bright direct lighting or bright sunlight can affect readings.*<br>• *Probe/sensor site for sweating, nail polish.* |
| Low oxygen saturation readings and student has signs of respiratory distress. | *Follow guidelines in student's individualized health care plan. Administer oxygen or suction student, if prescribed. If distress persists, notify school nurse, family, and/or health care provider. Be prepared to implement school emergency plan.* |
| Irritation at probe/sensor site | *Move probe/sensor. Assess site every 2-8 hours as needed or specified. Notify school nurse and family of irritation.* |

**Sources:**


Bindler, R.C., Ball, J.W., London, M.L., & Ladewig, P.W. (2003). *Clinical Skills Manual for Maternal-Newborn and Child Nursing.* Upper Saddle River, NJ: Prentice Hall, pp.118-119.

Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 524-527.

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Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 355-357.

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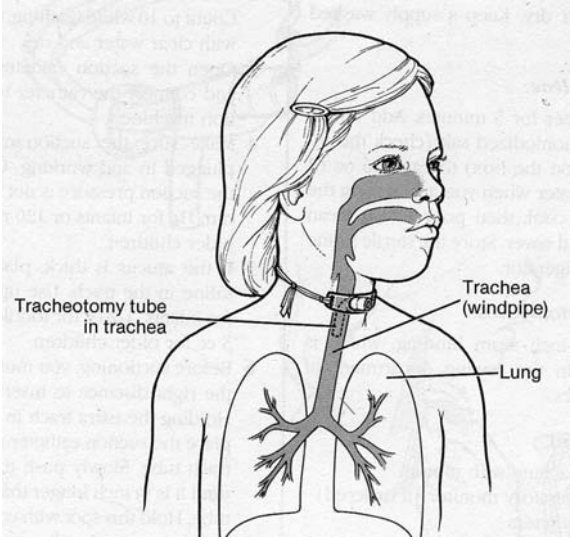
# Tracheostomy

## Overview

A tracheostomy is a surgically-created opening (stoma) in the neck and trachea (windpipe). It provides a way for air to go into and out of the lungs. A curved plastic tube is inserted into the stoma to keep it open for breathing. In children without tracheostomies, air is filtered, moistened, and heated as it passes through the nose or mouth. Children with tracheostomies bypass the upper airway and need extra care to moisten and protect their lower airway. Most students with tracheostomies are able to speak, eat, and drink, but require careful monitoring.

There are a variety of conditions that may necessitate a tracheostomy. Some children are born with a trachea whose walls collapse easily occluding the airway (tracheomalacia). Others have neuromuscular conditions, laryngeal spasm, vocal cord paralysis, or congenital anomalies which compromise the airway. Children who require long-term respiratory support (e.g., ventilators) because of such disorders as spinal cord injuries or chronic lung disease (CLD) frequently receive tracheostomies. Other reasons for a tracheostomy include subglottic stenosis, Treacher Collins or Pierre Robin Syndrome, severe neck or mouth injuries, facial or airway burns, and anaphylaxis (severe allergic reaction).




## Equipment Needed for Tracheostomy Care

The student with a tracheostomy should always have access to the equipment listed below. The equipment should be checked daily and may be carried in a backpack. It must be carried with the student **at all times.**

- Spare tracheostomy tube (same size as current one) and obturator
- One size smaller tracheostomy tube
- Gauze pads
- Tracheostomy ties or Velcro ties
- Suction machine
- Suction catheters
- Sterile or clean gloves, per student-specific guidelines
- Sterile or clean cotton-tip swabs, if required
- Pipe cleaners, if needed for cleaning of an inner cannula
- Saline dosettes, only if prescribed—no longer routinely used with suctioning
- Manual resuscitator with adaptor (Ambu bag)
- ½ strength hydrogen peroxide (diluted with saline or distilled water) or saline

- Scissors, blunt nosed
- Heat Moisture Exchanger (HME), more commonly known as artificial nose, for protecting tracheostomy from dry or cold air and dust or other particles, if specified. *The artificial nose must be changed if it appears to be saturated with moisture or secretions.* ***Do not rinse****. Discard if saturated.*
- Device to deliver humidity, if prescribed
- Device to deliver oxygen, if prescribed
- Hand-powered suction device (back-up suction)
- Syringe to inflate or deflate tracheostomy cuff, if needed
- Hand sanitizer
- List of emergency phone numbers
- Note with child's brief medical history

## Potential Settings

Students with tracheostomies can usually attend general classes with their peers. Participation in other school activities must be decided on an individual basis by the health care provider, family and school professionals. Some children with tracheostomies require a trained caregiver to accompany them at all times. Staff who work with children who have tracheostomies should receive special training in how to recognize breathing difficulty and specialized CPR. They should also know how to activate the student's emergency plan.

Students with tracheostomies should avoid areas where there might be excessive dust. This includes chalk dust and playground dust. Normally the nose and mouth filters, warms, and moistens the air before it reaches the lungs. Students with tracheostomies do not have this filtering system and take air directly into the trachea (windpipe) and then the lungs.

Routine tracheostomy care, including such procedures as stoma care and tube changes, should be performed at home. If additional routine care is necessary, it should be done in a clean, private area such as the school health office. In an emergency, the care can be done wherever the patient is at that moment. For this reason, a suction machine and a complete set of supplies and equipment for tracheostomy care should accompany the student at all times (see above). This can be transported in a backpack or "go bag."

## Staff Preparation

Tracheal care for students who require care in school, such as suctioning, use of a tracheostomy collar, or other daily care, should be provided by a registered school nurse, licensed respiratory therapist, or licensed practical nurse under the supervision of a registered school nurse. These caregivers should have proven, competency-based training in appropriate techniques and problem management. **All staff in contact with students who have tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the student's emergency plan.**

Under some circumstances, after a student with a tracheostomy has been in the school setting for a period of time and it is clear that the student's medical condition is stable, it may be appropriate for the health care team and the family to consider using a nonmedical caregiver

who has received appropriate training and supervision by a school nurse who is in the building at all times to perform suctioning.

Some students need less frequent care or require no routine tracheostomy care at all. The decision regarding the placement of the caregiver for such a student must be made by the family, health care provider, and school nurse and be based on the student's medical condition, tracheal care needs, and adaptation to school. Such decisions should be included in the student's individualized health care plan and be well known to all the caregivers involved.

If the trained caregiver and back-up personnel are unable to be available on a given school day, the student should not attend school. However, an optional arrangement can be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student with a tracheostomy must receive general training covering the student's specific needs, potential problems, and implementation of the established emergency plan.

The basic skills checklists in Appendix B can be used as a foundation for competency-based training in appropriate techniques and problem management. They outline specific procedures step by step. Once the procedures have been mastered, the completed checklists serve as a documentation of training.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who has a tracheostomy. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student with a tracheostomy, the following elements should receive particular attention:

- Underlying condition and possible problems associated with the condition or treatment
- Size and type of tracheostomy tube
- Student's baseline color, respiratory rate, pulse, blood pressure, secretions
- Student specific signs of respiratory distress
- Need for filtering or humidity (e.g., artificial nose)
- Suctioning guidelines—frequency, size of catheter, special instructions
- Equipment and supplies needed
- Back up equipment and personnel
- Portable equipment and responsibility for transporting equipment
- Student's self care ability and ability to request assistance
- Emergency action plan, including all phone numbers
- Identification of individuals capable of assisting student or caregivers
- Staffing needs to provide safe care for the student and plan for absences

- Avoidance of small particles in the air, such as chalk dust, aerosols, glitter, small toys, and sand
- Need for additional fluids
- Speech and communication needs
- Means of communicating between school personnel when immediate help is needed (e.g., walkie-talkies, intercoms, telephones)
- Latex allergy alert
- Standard precautions

**Do not** use powders, aerosols (i.e., room deodorizers), small particles, such as sand, glitter, lint, chalk dust, and animal hair, small pieces of food and water, or glue or chemicals with strong fumes near a student with a tracheostomy. Students who may have accidental contact with any of these potential hazards should have some kind of protective covering for the tracheostomy.

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**Illustration Source:**


Wong, DS & Hess CS. (1990). *Wong and Whaley's Clinical Manual of Pediatric Nursing*. (3rd ed.) St. Louis: Mosby, 573.

## *Potential Problems for Students with Tracheostomies*

| Assessment | Intervention/Rationale |
|---|---|
| Signs of respiratory distress:<br>• Difficulty breathing<br>• Increased respiratory rate<br>• Increased heart rate<br>• Wheezing, grunting, or noisy breathing<br>• Pale blue color around lips, eyes, nails<br>• Restlessness, agitation<br>• Retractions<br>• Anxious, frightened look | *Tracheostomy tube may be blocked with mucus or foreign matter. Suction tracheostomy. Change tracheostomy tube if needed. Check placement of tracheostomy tube and air movement from tracheostomy. Reassure student.* ***If symptoms do not clear with suction or tube change, activate emergency plan. Do not leave student alone.*** |
| Tracheostomy tube becomes dislodged | ***Stay calm and do not leave student alone****. Reposition tracheostomy tube, if possible. If unable to reposition or tube has come totally out, insert new (spare) tracheostomy tube using obturator* ***immediately.*** *If regular size tube cannot be inserted, use one size smaller. If spare trach is not available, replace with the one that came out. Check air movement. Give breaths with resuscitation bag, if indicated. Administer oxygen if prescribed in emergency plan.* ***Initiate school emergency plan*** *and begin cardiopulmonary resuscitation, if necessary. Notify school nurse, family, and health care provider.* |
| Suction catheter cannot be inserted into tracheostomy tube. | ***Do not leave student alone****.*<br>*Reposition head/neck and try again.*<br>*Change inner cannula (if present) or replace tracheostomy tube. Give breaths with resuscitation bag, if needed. Check for air movement. Give oxygen, if prescribed in emergency plan.* ***Initiate school emergency plan*** *and begin cardiopulmonary resuscitation, if necessary. Notify school nurse, family, and health care provider.* |
| Aspiration of foreign material (e.g., food, sand) into tracheostomy | ***Do not leave student alone****.*<br>***Suction first. Do not give breaths with resuscitation bag because forcing air could push aspirate further into lungs.*** *Give breaths with resuscitation bag after initial suctioning. Check for air movement. If tube remains blocked, replace with new trach tube.*<br>*If mucus is very thick* ***and*** *saline has been* |

| Assessment | Intervention/Rationale |
|---|---|
| | *prescribed, saline may be added. However, saline is no longer routinely recommended and may cause more harm than good.*<br>*If student experiences bronchospasm causing wheezing, medications may be required, if prescribed.*<br>***If respiratory distress continues, initiate school emergency plan**. Begin CPR, if needed. Notify school nurse, family, and health care provider.* |
| Distress during suctioning | *Limit suctioning to 10 seconds or less. Suction more frequently for shorter periods. Make sure catheter is no more than ½ the diameter of the tracheostomy. Hyperinflate the lungs with oxygen prior to suctioning, if prescribed (no longer routinely recommended). Activate emergency plan if distress persists.* |
| Dressing becomes wet | *Replace dressing with similar dressing. Use pre-slit gauze if possible. If pre-slit gauze is not available, use 4"x4" gauze unfolded to 8"x4." Fold lengthwise, then fold gauze corners up in a "U" shape and slide under tracheostomy ties around outer opening of tracheostomy tube.* |
| Excessive secretions requiring frequent suctioning | *May require more frequent suctioning or more humidity. Suction as needed. Encourage fluid intake to thin mucus. Yellow or green mucus may indicate infection and should be reported immediately to school nurse and family..* |
| Fever; yellow or green secretions; foul odor, congested lung sounds; listlessness, increased mucus | *Possible signs of infection. Notify school nurse and family.* |
| Redness or skin breakdown at the stoma | *Clean site as specified and make sure dressing stays dry. Check that ties are not too tight (should allow one finger to be inserted comfortably between tie and neck). Document appearance of site in student log and notify school nurse and family of any changes.* |
| Bleeding or pain at stoma site | *Notify school nurse and family. May be due to infection, trauma, or excessive coughing.* |
| Pink or red streaked secretions from tracheostomy | *May occur as a result of suctioning. Check suction pressure (should always be less than 120). Limit suctioning to 5 seconds at a time. Notify school nurse and family**. If actual bleeding observed, notify school nurse and*** |

| Assessment | Intervention/Rationale |
|---|---|
| | ***family immediately and activate school emergency plan.*** |

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## General Information for
# Students with Tracheostomies

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student has a tracheostomy, or opening in the neck to allow the student to breath through an opening in the windpipe. A tube may be inserted into the opening and secured to the neck with Velcro or ties. Other tracheostomy openings may not be covered.

This student:

- ❑ Is able to eat and drink normally by mouth
- ❑ Is not able to eat and drink normally by mouth
- ❑ Is able to speak normally
- ❑ Is unable to speak normally
- ❑ Does tracheostomy care at home
- ❑ Has a caregiver with him or her to do tracheostomy care at school

This student may be able to participate in many school activities. Modifications should be approved by the family, health care provider, and school nurse.

The student may need to avoid certain activities (such as swimming) and should avoid exposure to other students with respiratory infections (such as colds). Specific recommendations will be included in the student's Individualized Health Care Plan.

School staff in frequent contact with this student are encouraged to complete cardiopulmonary resuscitation (CPR) training and specialized training for people with tracheostomies.

Please contact _____ at _____ (phone number/pager) for additional information or if the student experiences any problems with the tracheostomy.

**Source:**

Adapted from: Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing.

# Tracheal Suctioning

## Overview

A tracheostomy tube bypasses the upper airway's filtering, humidifying, and warming mechanisms. In response to this, the body produces more mucus. The tracheostomy tube usually needs suctioning to remove mucus from the tube and the trachea to allow for more effective breathing. Suctioning involves passing a vacuum-type tube into the tracheostomy to remove excess mucus and debris. Many students need suctioning every 4-6 hours. New tracheostomies may need more frequent suctioning. Some children may be able to request suctioning when it is needed; others must rely on caregivers to assess the need.

Indications that suctioning might be needed include:

- Fast breathing, increased difficulty breathing
- Increased coughing
- Noisy, rattling breath sounds
- Bubbles of mucus visible in the tracheostomy
- Whistling noise from tracheostomy
- Irritability, anxious look
- Poor color
- Decreased air movement into and out of the tracheostomy
- Congestion prior to eating or drinking
- After nebulizer treatments, chest percussion and drainage

## Potential Settings

Routine suctioning can be done in a classroom if a clean area is available, but in most cases is done in a clean, private area to protect student's privacy and to protect the classroom from disruptions involving the noisy suctioning procedure. Emergency suctioning should be done as soon as possible wherever the student might be. If an electric suction machine is used, a grounded electric outlet must be available. Portable suctioning equipment should accompany the student at all times.

## Staff Preparation

Tracheal suctioning should be provided by a registered school nurse, licensed respiratory therapist, licensed practical nurse under the supervision of a registered school nurse, or other specifically trained paraprofessional under the supervision of a registered school nurse. These caregivers should have proven, competency-based training in appropriate techniques and problem management. **All staff in contact with students who have tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the student's emergency plan.**

Under some circumstances, after a student with a tracheostomy has been in the school setting for a period of time and it is clear that the student's medical condition is stable, it may be appropriate for the health care team and the family to consider using a nonmedical caregiver

who has received appropriate training and supervision by a school nurse who is in the building at all times to perform suctioning.

Some students need less frequent care or require no routine tracheostomy care at all. The decision regarding the placement of the caregiver for such a student must be made by the family, health care provider, and school nurse and be based on the student's medical condition, tracheal care needs, and adaptation to school. Such decisions should be included in the student's individualized health care plan and be well known to all the caregivers involved.

If the trained caregiver and back-up personnel are unable to be available on a given school day, the student should not attend school. However, an optional arrangement can be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student with a tracheostomy must receive general training covering the student's specific needs, potential problems, and implementation of the established emergency plan.

The basic skills checklists in Appendix B can be used as a foundation for competency-based training in appropriate techniques and problem management. They outline specific procedures step by step. Once the procedures have been mastered, the completed checklists serve as a documentation of training.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who requires tracheal suctioning. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who requires tracheal suctioning, the following elements should receive particular attention:

- Underlying condition and possible problems associated with the condition or treatment
- Size and type of tracheostomy tube
- Student's baseline color, respiratory rate, pulse, blood pressure, secretions
- Student specific signs of respiratory distress
- Need for filtering or humidity (e.g., artificial nose)
- Suctioning guidelines—frequency, size of catheter, special instructions
- Length of tracheostomy tube measured to determine depth of suctioning
- Appropriate pressure settings if suction machine has a vacuum setting
- Need for breaths with a manual resuscitation bag
- When and if saline is to be instilled, no longer routinely recommended
- Equipment and supplies needed
- Back up equipment and personnel

- Portable equipment and responsibility for transporting equipment
- Student's self care ability and ability to request assistance
- Emergency action plan, including all phone numbers
- Identification of individuals capable of assisting student or caregivers
- Staffing needs to provide safe care for the student and plan for absences
- Avoidance of small particles in the air, such as chalk dust, aerosols, glitter, small toys, and sand
- Latex allergy alert
- Standard precautions

**Sources:**


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# Procedure for Tracheal Suctioning

**<u>Equipment for suctioning must be available for use at ALL times</u>.**

**Note: Parents supply equipment and supplies.**

1. Wash hands.
2. Gather equipment and materials:
    - Suction machine and manual backup
      *Student should also have a portable suction machine or manual device that can travel with them throughout school and during transport to and from home. A manual means of suctioning should also be available as a back up at all times in case of power failure, equipment malfunction, or lack of electrical outlet.*
    - Correctly-sized suction catheter
      *Suction catheters should be no greater than ½ the diameter of the tracheostomy tube. To determine how deep the suction catheter should be inserted, determine the length of the tube from the package, family or health care provider. Pre-marked suction catheters are recommended.*
    - Sterile saline or sterile water to clear catheter
    - Container for saline or water
    - Disposable gloves, powder free; sterile or clean according to student's individualized health care plan
    - Self-inflating manual resuscitation (Ambu) bag with adaptor for tracheostomy
    - Plastic bag for disposal of materials
    - Saline dosettes, ONLY if prescribed—no longer routinely used
3. Position student as specified in their individualized health care plan. Although not required, it is advisable to have another person available for assistance if needed.
   *Most students are suctioned while seated upright at school.*
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Encourage student to cough up any secretions. If nebulizer treatment, postural drainage, or percussion is ordered for the student, it may be beneficial to do these prior to suctioning.
   *Coughing may eliminate the need for suctioning.*
6. Turn on suction machine. A suction of 80-100 mm Hg is usually recommended (may go as low as 60 and as high as 120, depending on size of child). Put finger at end of connecting tube to confirm suction.
7. Wash hands.
8. Open suction catheter or kit.
   *Peel paper back without touching the inside of the package to maintain sterility.*
9. Open saline dosette **ONLY** if instillation is ordered, but do **<u>not</u>** routinely instill saline.
10. Pour a small amount of sterile saline or sterile water into container.
    *This will be used to moisten the catheter and to clear out secretions in the catheter.*
11. Don gloves. A mask, goggles, or face shield may be required with some students to fully protect caregiver from coughed-up mucus.

12. Holding the connecting end of the suction catheter in the dominant hand, secure it to the suction machine tubing (held in nondominant hand). Leave the other end of catheter in its covering.
    *The dominant hand should remain "sterile/clean." It should not touch anything but the sterile catheter. The nondominant hand should be used to turn on switches or touch other objects.*
13. Do **NOT** manually ventilate with resuscitation bag and/or hyperoxygenate prior to suctioning **unless** prescribed.
    *There is some controversy over whether this intervention is helpful. Delivering a manual breath when secretions are in the tracheostomy tube can serve to force this mucus deeper into the airway. Stable children without a ventilator typically do not require extra oxygenation prior to suctioning.*
14. Holding suction catheter 2-3 inches from tip with dominant hand, insert tip of catheter in sterile saline or sterile water.
15. Cover vent hole with thumb of nondominant hand to suction a small amount of saline through catheter.
    *This tests that suction is functioning. This also helps to lubricate the tip of the catheter and clear out any secretions in the connecting tubing. Do not use lubricant other than water because the lubricant can dry and cause airway occlusion.*
16. With thumb <u>off</u> vent hole, gently but quickly insert catheter into tracheostomy. ***Do not suction while catheter is being inserted*** because it can damage tracheal mucosa, as well as increase hypoxia. Do not insert catheter beyond the distal end of the tracheostomy tube.
    *Guide catheter with sterile, dominant hand. If the catheter is inserted too deeply, this can cause irritation/injury to the trachea, as well as bronchospasm. Determine the length of the tracheostomy tube from the package, family, or health care provider prior to suctioning. Coughing indicates that the suction catheter possibly has passed the end of the tracheostomy tube.*

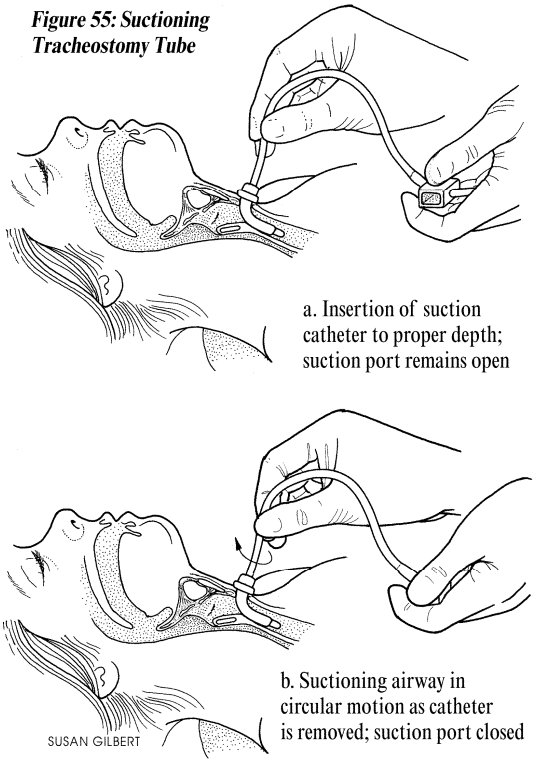

***Figure 55: Suctioning Tracheostomy Tube***

17. Cover vent hole intermittently with thumb while withdrawing catheter. Rotate catheter gently between thumb and index finger while suctioning and withdrawing.
    *This helps to reach all secretions in the tracheostomy tube and prevent injury to tracheal mucosal lining. Uncovering intermittently and rotating catheter helps prevent damage to mucosal lining.*
    ***Each insertion and withdrawal of the catheter must take no longer than 5-10 seconds. Extended suctioning can block the airway and cause a serious drop in student's oxygen level.***

18. Allow the student to rest and breathe or give breaths with resuscitator bag between suctioning passes. The timing of each suctioning pass and the length of the rest period depend on student's tolerance of the procedure and absence of complications. Suction saline again through catheter to rinse secretions from catheter and tubing.
    *This helps student get new oxygen/air into lungs.*
19. **Do not routinely use saline to loosen secretions**. Only if prescribed, insert several drops of saline into tracheostomy with nondominant hand. Manually ventilate with resuscitation bag to disperse saline, only if ordered.
    *Saline may push secretions back down the airway. It was once used to loosen or thin thick or dry secretions. New research indicates it may increase airway contamination, decrease oxygen saturations, and do a poor job of thinning secretions.*
20. If moist, gurgling noises or whistling sounds are still heard, or if mucus is seen at the tracheostomy opening, repeat suctioning procedure (steps 16-19). Assess student's color and respiratory status throughout the procedure. If student was receiving oxygen by mask before suctioning, reapplication of mask between passes might be needed.
    *If appropriate, ask the student if he or she needs repeat suctioning.*
21. The nose and back of the mouth may be suctioned if needed after completion of tracheal suctioning.
    *After the nose and mouth are suctioned, the catheter **cannot** be reused to suction the tracheostomy.*
22. Rinse catheter and connecting tubing with normal saline until clear. Use continuous suction.
    *Remove secretions in the tubing. Secretions left in tubing decrease suctioning efficiency and provide environment for growth of microorganisms.*
23. Disconnect catheter from suction tubing. Wrap catheter around gloved hand. Pull glove off inside out so that catheter remains rolled in glove. Place first glove in remaining gloved hand. Pull off other glove over first glove to seal in contaminated tubing.
    *For each suctioning session, a new catheter should be used. Sleeved catheters (see next procedure) may be reused as long as they are not used to suction nose and mouth. Consult family and health care provider for student-specific use.*
24. Discard used suction catheter in appropriate receptacle. Turn off suction. Wash hands.
25. Note color, consistency (e.g., thin, thick), and quantity of secretions. Compare student's respiratory assessments before and after suctioning. Document procedure on student's log sheet and notify school nurse and family of any changes from student's usual pattern.
26. Be sure suction equipment and supplies are restocked, checked daily, and ready for immediate use.

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**Illustration Source:**

The Center for Pediatric Emergency Medicine (CPEM). Teaching resource for instructors in prehospital pediatrics. Illustrations by Susan Gilbert. Available at http://www.cpem.org/html/giflist.html

# Procedure for Tracheal Suctioning Using a Sleeved Catheter

Sleeved suction catheters may be used for tracheal suctioning. A sleeved catheter consists of a sterile suction catheter inside a clear plastic sheath or "sleeve." The catheter can be threaded into the trachea and retracted back into the sleeve after suctioning. The catheter never comes in contact with the environment, only the inside of the sleeve and the inside of the trachea. Therefore, the catheter can be used for multiple suctionings. Usually the sleeved catheter is used for a 24 hour period and then discarded; however, some sleeved catheters have now been designed to be used for 72 hours before being discarded. Research studies have demonstrated that people using sleeved catheters generally have less risk of developing a lung infection than those using conventional disposable catheters. The cost of each sleeved catheter is many times the cost of a single-use catheter. However, most studies have found that when the number of catheters, sterile gloves, and school nurse's time are factored into the costs, sleeved catheters are less expensive, or comparable, in cost. Other studies have found that suctioning is done more frequently on patients with sleeved catheters because the setup and procedure are easier. Additionally, sleeved catheters designed for ventilators can be attached to the ventilator tubing to form a *closed tracheal suctioning system*, allowing suctioning to take place without opening the system. This closed system has been found to decrease the risk of infection, as well as minimize oxygen desaturation during suctioning because the tubing system does not need to be opened to accomplish suctioning.

## Procedure

**Note: Parent provides equipment and supplies.**

1. Follow steps 1-10 for tracheal suctioning.
2. Don gloves.
3. Attach the control valve of the sleeved catheter to the connecting suction tubing (if not already connected).
4. Turn on machine to appropriate vacuum setting for student.
5. Suction a small amount of sterile water or saline.
   *This lubricates the tube, ensures that the tubing is clear of secretions, and tests the functioning of the suction system.*
6. If student is ventilator dependent, attach a T-piece to the ventilator breathing circuit and connect the T-piece to the student's tracheostomy.
7. Using the thumb and index finger of the dominant hand, advance the catheter through the tracheostomy tube and into the tracheobronchial tree. It may be necessary to gently retract the catheter sleeve as the catheter is advanced.
   ***Do not suction while catheter is being inserted*** because it can damage tracheal mucosa, as well as increase hypoxia. Do not insert catheter beyond the distal end of the tracheostomy tube.
8. Cover vent hole intermittently with thumb while withdrawing catheter. Rotate catheter gently between thumb and index finger while suctioning and withdrawing.
   *This helps to reach all secretions in the tracheostomy tube and prevent injury to tracheal mucosal lining. Uncovering intermittently and rotating catheter helps prevent damage to mucosal lining.*

***Each insertion and withdrawal of the catheter must take no longer than 5-10 seconds. Extended suctioning can block the airway and cause a serious drop in student's oxygen level***.

9. Allow the student to rest and breathe or give breaths with resuscitator bag between suctioning passes. The timing of each suctioning pass and the length of the rest period depend on student's tolerance of the procedure and absence of complications. Suction saline again through catheter to rinse secretions from catheter and tubing.
   *This helps student get new oxygen/air into lungs.*
10. **Do not routinely use saline to loosen secretions**. Only if prescribed, insert several drops of saline into tracheostomy with nondominant hand. Manually ventilate with resuscitation bag to disperse saline, if ordered.
    *Saline may push secretions back down the airway. It was once used to loosen or thin thick or dry secretions. New research indicates it may increase airway contamination, decrease oxygen saturations, and do a poor job of thinning secretions.*
11. If moist, gurgling noises or whistling sounds are heard or if mucus is seen at the tracheostomy opening, repeat suctioning procedure (steps 7-9). Assess student's color and respiratory status throughout the procedure.
    *If appropriate, ask the student if he or she needs repeat suctioning.*
12. Rinse the catheter and connecting tubing with normal saline until clear.
    *This step is particularly important with sleeved catheters because they are reused and any secretions left in the catheter can provide an environment for growth of microorganisms.*
13. Sleeved catheters can be reused for up to 24-72 hours. Follow manufacturer-specific and student-specific guidelines. They can not be reused in the trachea if they are used to suction the mouth and nose.
14. Remove gloves. Wash hands.
15. Note color, consistency (e.g., thin, thick), and quantity of secretions. Compare student's respiratory assessments before and after suctioning. Document procedure on student's log sheet and notify school nurse and family of any changes from student's usual pattern.
16. Be sure suction equipment and supplies are restocked, checked daily, and ready for immediate use.

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## *Possible Problems When Suctioning*

| Assessment | Intervention/Rationale |
|---|---|
| Student develops signs of respiratory distress:<br>• Difficulty breathing<br>• Increased respiratory rate<br>• Increased heart rate<br>• Wheezing, grunting, or noisy breathing<br>• Pale blue color around lips, eyes, nails<br>• Restlessness, agitation<br>• Retractions<br>• Anxious, frightened look | *Limit suctioning to 10 seconds or less. Suction more frequently for shorter periods. Make sure catheter is no more than ½ the diameter of the tracheostomy. Hyperinflate the lungs with oxygen prior to suctioning, if prescribed (no longer routinely recommended).*<br>*Tracheostomy tube may be blocked with mucus or foreign matter. Suction tracheostomy. Check placement of tracheostomy tube and air movement from tracheostomy. Reassure student. Change tracheostomy tube if suctioning does not clear.*<br>***If symptoms do not clear with suction or tube change, activate school emergency plan.***<br>***Do Not Leave Student Alone.*** |
| Tracheostomy tube or inner cannula becomes dislodged | ***Stay calm and do not leave student alone.***<br>*Reposition inner cannula or tracheostomy tube, if possible. If unable to reposition or tube has come totally out, insert new (spare) tracheostomy tube using obturator* ***immediately*** *(replacing inner cannula will not require use of obturator). If regular size tube cannot be inserted, use one size smaller. If spare trach is not available, replace with the one that came out. Check air movement. Give breaths with resuscitation bag, if indicated. Administer oxygen if prescribed in emergency plan. I****nitiate school emergency plan*** *and begin cardiopulmonary resuscitation, if necessary. Notify school nurse, family, and health care provider.* |
| Bleeding during suctioning:<br>• Pink or blood streaked secretions<br>• A large amount of blood is suctioned or the student develops respiratory distress while being suctioned | *Check suction pressure (should always be less than 120). Limit suctioning to 5 seconds at a time. Notify school nurse and family.*<br>***Activate the school emergency plan*** *and notify school nurse and family. Reassure student.* |
| Suction catheter cannot be inserted into tracheostomy tube. | ***Do not leave student alone.***<br>Reposition head/neck and try again.<br>*Change inner cannula (if present) or replace tracheostomy tube. Give breaths with* |

| Assessment | Intervention/Rationale |
|---|---|
| | *resuscitation bag, if needed. Check for air movement. Give oxygen, if prescribed in emergency plan.* ***Initiate school emergency plan*** *and begin cardiopulmonary resuscitation, if necessary. Notify school nurse, family, and health care provider.* |
| Bronchospasm during suctioning | *May be due to excessive suctioning. Reassure student and help student to calm down. If unable to withdraw catheter, disconnect from connecting tubing and hold oxygen near end of suction catheter. If bronchospasm relaxes, remove catheter. If bronchospasm remains, student may require medication (e.g., bronchodilator). Notify school nurse, family, and health care provider.* ***Be prepared to initiate school emergency plan.*** |

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## Information for Students
# Who Need Tracheal Suctioning

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student has a tracheostomy to allow the student to breath through an opening in the windpipe. A tube may be inserted into the opening and secured to the neck with Velcro or ties. Other tracheostomy openings may not be covered.

Occasionally, the tracheostomy tube may need to be cleared of mucous and other secretions through tracheal suctioning. The student may be able to assist with the procedure.

If a student needs suctioning, the equipment must be available to the student at all times. In addition, a trained staff member will help the student suction the tracheostomy.

This student may be able to participate in many school activities. Modifications should be approved by the family, health care provider, and school.

School staff in frequent contact with this student are encouraged to complete cardiopulmonary resuscitation (CPR) training and specialized training for people with tracheostomies.

Please contact _____ at _____ (phone number/pager) for additional information or if the student experiences any problems with the tracheal suctioning.

**Source:**

Adapted from: Porter, S., Haynie, M., Bierle, T., Caldwell, T. H., & Palfrey, J. S. (Eds.). (1997). *Children and youth assisted by medical technology in educational settings: guidelines for care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing

# Tracheostomy Tube Changes

## Overview

Tracheostomy tubes are typically changed every 1-4 weeks to prevent mucus or bacteria buildup. However, a tube may need to be changed if it becomes blocked or accidentally dislodged. **At school, tracheostomy tube changes should only be done in an emergency situation.** Two people should be present during the procedure unless this is not practical in an emergency.

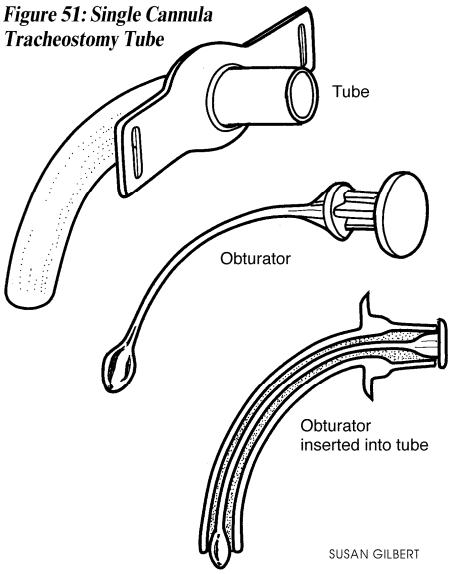

*Figure 51: Single Cannula Tracheostomy Tube*

## Potential Settings

Routine tracheostomy tube changes should be performed at home, ideally on an empty stomach when the airway is relatively free of mucus. If a tracheostomy becomes blocked or accidentally comes out, the tube must be changed or reinserted immediately--wherever the student is, even if conditions are not ideal.

## Staff Preparation

Tracheostomy tube changes should be provided by a registered school nurse or licensed practical nurse only in emergency situations. These caregivers should have proven, competency-based training in appropriate techniques and problem management. **All staff in contact with students who have tracheostomies should have specialized cardiopulmonary resuscitation training. They should be able to recognize signs of breathing difficulty and should know how to activate the student's emergency plan.**

If the trained caregiver and back-up personnel are unable to be available on a given school day, the student should not attend school. However, an optional arrangement can be made between the school and the family so someone from the family would be available to attend school to function as the caregiver for the student.

Any school personnel who have regular contact with a student with a tracheostomy must receive general training covering the student's specific needs, potential problems, and implementation of the established emergency plan.

The basic skills checklists in Appendix B can be used as a foundation for competency-based training in appropriate techniques and problem management. They outline specific procedures step by step. Once the procedures have been mastered, the completed checklists serve as a documentation of training.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who needs a tracheostomy tube change. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who needs a tracheostomy tube change, the following elements should receive particular attention:

- Underlying condition and possible problems associated with the condition or treatment
- Size and type of tracheostomy tube
- Use of an obturator
- Type of ties, gauze, and/or skin care
- Portable equipment and supplies and responsibility for transporting them with student
- Student's baseline color, respiratory rate, pulse, blood pressure, secretions
- Student specific signs of respiratory distress
- Student's self care ability and ability to request assistance
- Emergency action plan, including all phone numbers
- Identification of individuals capable of assisting
- Student's need for support during reinsertion
- Student's ability to breathe without a tracheostomy tube
- Any known difficulties that might be encountered during reinsertion
- Latex allergy alert
- Standard precautions

**Sources:**

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**Illustration Source:**

The Center for Pediatric Emergency Medicine (CPEM). Teaching resource for instructors in prehospital pediatrics. Illustrations by Susan Gilbert. Available at http://www.cpem.org/html/giflist.html

# Procedure for Changing a Tracheostomy Tube

**Note: Parent provides equipment and supplies.**

1. Wash hands.
2. Gather equipment and materials:
    - Exact size and type of tracheostomy tube ordered for student
      ***Always have a spare clean tracheostomy tube available and ready for use.***
    - Tracheostomy tube one size smaller than currently being used.
      *Used if difficulty encountered with insertion of regular-sized tube*
    - Velcro ties, twill tape, or other ties
    - Obturator, if needed (used as a guide for insertion)
    - Blunt scissors
    - Syringe to inflate and deflate cuff, if tube has a cuff
    - Sterile water-soluble lubricant or sterile saline
      ***Never*** *use Vaseline or oil-based lubricants.*
    - Resuscitation bag
    - Blanket roll, if needed, to position student's neck
    - Stethoscope
    - Oxygen, if ordered
    - Suctioning device and supplies
    - Gloves
    - Another person to assist, if possible
3. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
4. Position student as recommended/ordered.
   *Best positioning is usually to have student lie on back with a blanket roll under the shoulders.*
5. Wash hands.
6. Have spare Velcro ties or pre-cut tracheostomy ties ready.
7. Open tracheostomy tube package. Keep tube clean. **Do not touch** curved part of tube that is inserted into trachea.
8. Put on gloves. Protective facial gear may be needed if student has excessive secretions and coughs during insertion.
9. Insert obturator into clean tracheostomy tube.
10. Attach Velcro holder or tracheostomy ties to one side of new tube.
11. If ordered, lubricate end of tracheostomy tube with water-based lubricant or sterile saline sparingly.
    *Lubrication may decrease the trauma to tracheal tissue, but sometimes is not used due to possibility of aspiration.*
12. Administer supplemental oxygen, if ordered.
13. Have assistant hold old tube in place while cutting/removing the ties. If tube is being changed by one person, do not remove ties until clean tracheostomy tube is in hand. **Always hold the tube when ties are not secure because a cough can dislodge the tube**.

14. When the new tube is ready (in hand), have assistant remove old tube.
15. Gently and quickly insert the new tube in a smooth curving motion directing the tip of the tube toward the back of the neck in a downward and inward arc. **Hold in place until secured because changing the tracheostomy tube will usually cause the child to cough**.
    *Back and downward motion follows the natural curve of the trachea.* ***Do not force the tube*** *as this could damage the trachea. Reposition neck and try again.*
16. If an obturator is used, stabilize the flanges of the tracheostomy tube and **immediately remove the obturator after the tube is inserted**. Insert inner cannula, if it is used, at this time. Continue to hold in place until secured with ties.
    *Hold the tracheostomy tube in place at all times. A person is unable to breathe when the obturator is in place in the tracheostomy tube.*
17. Listen and feel for air movement through tracheostomy tube. Observe the student for signs of respiratory distress. Assistant may listen with stethoscope for breath sounds.
18. Secure tube in place with ties or Velcro holder. The tracheostomy ties should be tied in a double or triple knot. They should never be tied in a bow. The ties should be loose enough that one finger can be slipped in between the ties and the neck.
19. Listen with stethoscope to assess breath sounds. Watch chest rise with breath. Give 2-4 breaths with resuscitation bag or provide oxygenation as ordered, if indicated based on student's respiratory status.
    *A small amount of bleeding may occur around tube or be in secretions after tracheostomy change. If unusual or persistent bleeding is present, notify the school nurse, family, and health care provider.*
20. Do skin care, if needed (see student-specific guidelines), and reapply gauze around and under tracheostomy tube and ties.
    *Use pre-slit gauze or commercially-prepared tracheostomy dressings. Do not cut regular gauze to fit because tiny fibers from cut gauze can enter tracheostomy.*
21. Discard used equipment according to standard precautions guidelines.
22. Remove gloves and wash hands.
23. Document procedure and problems or concerns on student's log sheet. Notify school nurse and family of tracheostomy change.

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## *Possible Problems with Tracheostomy Tube Changes*

| Assessment | Intervention/Rationale |
|---|---|
| If the tracheostomy tube comes out and:<br>• Student is not showing signs of distress. | *Call for assistance. Do not leave student alone. Follow procedure for tracheostomy tube change.* |
| • Student shows signs of respiratory distress | *As soon as possible, attempt to insert tracheostomy tube as outlined in procedure.* |
| • Tube has been inserted and the student is still having difficulty | *Listen for breath sounds and assess airway. Tube may need to be repositioned or reinserted. Administer oxygen via the tracheostomy. Suction tracheostomy. Consider using bronchodilators, if ordered.* ***If distress persists, initiate school emergency plan****. Begin cardiopulmonary resuscitation (CPR), if necessary. Use manual resuscitation bag, if indicated.* |
| Tracheostomy tube cannot be reinserted | ***Never leave student alone. Call for assistance.*** *This may be due to a bronchospasm or poor positioning:*<br>• *Reassure and reposition the student. Retry.*<br>• *Try using obturator if it has not been used.*<br>• *Try to insert one size smaller tracheostomy tube.*<br>• *Encourage the student to take a deep breath—be prepared to insert tube if stoma opens.*<br>• *Administer flow of oxygen directly to the tracheostomy stoma.* |
| **If tracheostomy tube cannot be inserted and the student has increasing respiratory distress and/or respiratory arrest.** | ***Initiate the school emergency plan. Begin CPR with mouth-to-mouth or mouth-to-mask breathing, using standard precautions. Tracheostomy stoma may be covered with thumb if an air leak is present.*** |
| *Aspiration of foreign material into tracheostomy* | ***Always suction first. If the manual resuscitator bag is used prior to suctioning, it can force the foreign material further into the lungs.*** *Check air movement. If tracheostomy tube remains blocked by matter, change tracheostomy tube. Give breaths with resuscitation bag after initial suctioning. Check for air movement and give breaths with resuscitation bag if indicated. Administer oxygen if prescribed in emergency plan. If bronchospasm occurs, give medication, if prescribed.* |

| Assessment | Intervention/Rationale |
|---|---|
| | *Respiratory distress or arrest can occur with any aspiration. Be prepared to initiate emergency plan. Begin CPR after suctioning, if needed. Notify school nurse, family, and health care provider.*<br><br>*Wearing a Heat Moisture Exchanger (HME), also known* as *an artificial nose or tracheostomy filter, can help prevent aspiration of foreign materials into the trachea..* |

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## Procedure for Using Oxygen with a Tracheostomy Collar

A tracheostomy collar is used to deliver oxygen or humidified air to a tracheostomy. It is often used with a humidifying device to prevent development of dry, thick secretions which can plug the tracheostomy.

**Note: Parent provides equipment, supplies, and oxygen.**

1. Review oxygen safety precautions (see previous section).
2. Wash hands.
3. Assemble equipment:
   - Tracheostomy collar
   - Humidifier
   - Heating device, if indicated
   - Oxygen tubing
   - Wide bore tubing
   - Nipple adaptor
   - Oxygen source, if needed
4. Set up humidification device according to student-specific guidelines.
5. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
6. Securely attach tubing to air or oxygen source. Some students may only require humidified room air and not need oxygen.
   *Usually a "Christmas tree" adaptor is used to attach the tubing to the oxygen source or compressed air. Attach humidifier, if ordered. Make sure that all connections are secure to prevent leaks.*
7. If oxygen prescribed, turn on the oxygen source. A highly visible information card stating oxygen liter flow should be attached to the regulator.
8. Set flowmeter to the flow rate specified by health care provider. **Do not change this setting without first contacting the health care provider.**
   *Oxygen liter flow can be ordered as a set liter flow rate (e.g., 2 liters per minute) or as a range (e.g., 2-4 liters per minute) based on student's needs.*
9. Connect to heater and/or humidifier, if ordered. Place one end of the wide bore tubing on the collar and the other on the humidifier or heater.
   *Some students may use cool mist.*
10. With prolonged humidification, moisture condensates and collects in the tubing. When this happens, the flow of air/oxygen may be blocked. Therefore, the water in the tubing requires periodic emptying.
11. With compressed air/oxygen on, look for mist coming out of the end of tubing (hold up to light for easier viewing).
    *If this is not present, check that all connections are secure and compressed air/oxygen is flowing. Briefly turn on higher flow to see if mist is present, and then return to ordered flow.*
12. Place collar on student's neck over tracheostomy tube in the midline.
    *Adjust tracheostomy collar so that it is snug but not uncomfortable for student.*
13. Wash hands.

14. Document procedure on student's log sheet. Notify the school nurse and family if there are any changes in student's usual pattern.

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# Manual Resuscitation Bag

## Overview

A manual resuscitation bag (e.g., Ambu bag) is a hollow, football-shaped, self-inflating bag used to give breaths of air and oxygen to a student who is unable to take adequate breaths on his or her own. The bag can be used with a mask that covers the student's mouth and nose, or it can be attached to a tracheostomy tube. When squeezed, the air is pushed out of the bag and into the student. When the bag is released, air flows out of the lungs through the exhalation (nonrebreathing) valve.

**Students with tracheostomies and students who use ventilators should have manual resuscitation bags with them at all times**. Resuscitation bags can be used when the student is having difficulty breathing or if the student stops breathing on his or her own. They may also be used to give extra breaths or oxygen during tracheostomy or ventilator care. They frequently are used to give extra oxygen after suctioning. They may also be used to give breaths if a ventilator fails or loses power.

## Potential Settings

In emergency situations, manual resuscitation bags should be used wherever the student might be. Routine care using resuscitation bags should be done in a clean, private area such as the health office.

## Staff Preparation

Manual resuscitation should be performed by a registered school nurse or a respiratory therapist or a specially-trained adult with proven competency-based training in appropriate techniques and problem management.

Any school personnel who have regular contact with a student who may require the use of a manual resuscitator should receive training covering the student's special needs, potential problems, and implementation of the established emergency plan.

If a trained caregiver and back-up personnel are unavailable on a given school day, the student should not attend school. However, special arrangements can be made between the family and the school to allow a family member to attend school with the child and function as backup caregiver.

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## Procedure for Using a Manual Resuscitator with a Tracheostomy

**Note: Parent provides equipment and supplies.**

1. Wash hands.
2. Assemble equipment:
   - Manual resuscitator bag (e.g., Ambu bag)
   - Adaptor for tracheostomy tube
   - Oxygen source with appropriate tubing, if needed
   - Tracheostomy or ventilator supplies, as appropriate
3. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
4. Keep bag near the student for quick access. Make sure tracheostomy connector is in place. If oxygen is to be used, connect oxygen tubing to the oxygen port of the bag and make sure oxygen is flowing at the prescribed flow rate.
5. Attach the tracheostomy connector part of the bag snugly to the tracheostomy tube. Steady tracheostomy tube with nondominant hand while securing connector to prevent accidental dislodgement.
6. Squeeze the bag to deliver breaths. Squeeze hard enough to make the student's chest rise. Two hands may be needed to squeeze for larger students. Try to coordinate with the student's own breathing efforts. As the student starts to breathe in, squeeze the bag. **If resistance is felt, or the student looks distressed, make sure the tube is patent and the breaths are being coordinated with the student's own breaths.**
   If the student is unable to breathe on his or her own, squeeze the manual resuscitator at a regular rate to deliver the student-specified number of breaths per minute. If no rate is specified, give 16-20 breaths for younger students and 12-16 for older students and adolescents.
7. Assess respiratory status, including skin color, for effectiveness of bagging.
8. When "bagging" is no longer needed, carefully remove resuscitation bag from tracheostomy tube. Hold tracheostomy tube steady with nondominant hand to prevent pulling or accidentally dislodging it. If student requires a tracheostomy collar with oxygen, be sure to re-connect this when resuscitation bag no longer needed.
9. Wash hands.
10. Document procedure on student's log sheet. Notify school nurse and family of any problems.

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# Nose and Mouth Suctioning

## Overview

The nose and/or mouth can be suctioned when the student needs assistance in removing secretions from the airway. Some students may be able to request suctioning and assist with the procedure. Other students will need the caregiver to recognize when suctioning is needed. Suctioning may be needed when student's breathing becomes noisy or excess secretions are seen in the mouth or at the back of the throat. Gurgling, bubbling, or rattling breath sounds may be heard. The student may show signs of respiratory distress, such as increased respirations, difficulty breathing, excessive coughing, choking, anxiousness, irritability, or color changes.

## Potential Settings

Emergency suctioning should be done wherever the student is located. For this reason, students should have portable suctioning equipment with them during transport and when traveling through school. Routine suctioning should be done in a clean, private area with accessibility to an electrical outlet. It can be done in a corner of a classroom, but tends to be noisy and disruptive to class so it is usually done in a school health office.

## Staff Preparation

Suctioning of the nose and mouth can be performed by a caregiver with proven competency-based training in appropriate techniques and problem management. Pharyngeal suctioning should be done by a school nurse (RN or LPN), respiratory therapist, or trained health assistant under the supervision of a registered school nurse. School personnel who have regular contact with a student who requires nose and mouth suctioning should receive training that covers the student's special needs, potential problems, and implementation of the established emergency plan.

The basic skills checklist in Appendix B can be used as a foundation for competency-based training in appropriate techniques. It outlines specific procedures step by step. Once the procedures have been mastered, the completed checklist serves as a documentation of training.

## Components of the Individualized Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who needs suctioning of the nose and mouth. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who needs suctioning of the nose and mouth, the following elements should receive particular attention:

- Student's underlying condition and the possible complications arising from the condition or treatment
- Student's baseline respiratory status, including respiratory rate and usual amount of secretions

- Student-specific signs of respiratory distress (e.g., noisy breathing, agitation)
- Ability of the student to request assistance or suctioning
- Frequency of suctioning and routine indications for suctioning
- Indications for additional suctioning
- Position of student during suctioning
- Depth of suctioning
- Type of suction catheters (size and whether they can be reused)
- Cleaning of Yankauer or tonsil tip suction, if prescribed
- Latex allergy alert
- Standard precautions

**Sources:**


Bowden, VA & CS Greenberg. (2003). *Pediatric Nursing Procedures*. Philadelphia: Lippincott William & Williams, 424-427.

Houska AE, Doyle, R, Priff, N, & JF Walker, (Eds.). (2003). *Nursing Procedures & Protocols*. Springhouse, Pennsylvania: Lippincott Williams & Wilkins, 341-344.

Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing .

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## Procedure for Nose and Mouth Suctioning Using Suction Machine

**Note: Parent provides equipment and supplies.**

1. Wash hands.
2. Gather equipment and materials:
    - Suction machine and tubing
      ***Equipment for suctioning must be assembled and ready for quick use at all times. It should be checked daily by specified personnel***.
    - Suction catheter of the appropriate size, or Yankauer or tonsil tip suction catheter (oral suction catheters)
    - Saline dosettes, if prescribed
    - Bulb syringe or other manual backup suction
    - Disposable gloves
    - Plastic bag for disposal of materials
    - Water or saline to clean and lubricate catheter, with container
3. Position student as recommended/ordered. Most students are suctioned in the semi-Fowler's (head elevated, semi-recumbent) position or in a sitting position.
   *Position may vary and should be recommended in student's individualized health care plan.*
4. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
5. Switch on suction machine and check for suction by placing finger at end of connecting tubing. Set suction as specified, usually between 60-120 mmHg pressure.
6. Encourage student to cough and expel secretions.
   *Coughing may eliminate need for suctioning or bring secretions up for easier suctioning.*
7. Open suction catheter or kit, being careful not to touch the inside of the package.
   *Keeps catheter clean and reduces risk of infection.*
8. Don gloves.
9. Holding the connecting end of the suction catheter in the dominant hand, secure it to the suction machine tubing (held in nondominant hand). Leave the other end of catheter in its covering.
   *The dominant hand should remain clean/sterile. It should not touch anything but the catheter. The nondominant hand should be used to turn on switches and touch other objects.*
10. Remove covering from end of suction catheter with nondominant hand while holding catheter in dominant hand.
11. Hold suction catheter 2-3 inches from its tip with dominant hand and insert tip in water.
12. Cover vent hole with thumb of nondominant hand to suction a small amount of saline through catheter.
    *This tests that suction is functioning. This also helps to lubricate the tip of the catheter and clear out any secretions in the connecting tubing. Do not use lubricant other than water because the lubricant can dry and cause airway occlusion.*
13. With thumb off vent hole, insert catheter gently into the nose to the prescribed depth specified in student guidelines. Always suction the nose first because there are more bacteria in the mouth.

*Many students may only need to have the anterior part of the nose suctioned. Be gentle because the nose bleeds easily. If the nose secretions are too thick, few drops of saline can be put in each nostril.*

14. Cover vent hole with nondominant thumb while suctioning and withdrawing catheter. Gently rotate catheter between thumb and index finger while suctioning and withdrawing. *Rotating the suction catheter prevents it from attaching to the mucosa and damaging the mucous membrane. If the catheter sticks, remove thumb from vent hole to release suction.*
15. If student is still congested, repeat nasal suction. Between passes, suction water to rinse secretions out of catheter.
16. With thumb off vent hole, insert catheter gently into the mouth.
17. Cover vent hole with nondominant thumb. Gently rotate catheter between thumb and index finger while suctioning and withdrawing to minimize damage to the oral mucosa.
18. If oral suctioning only is being done with a Yankauer suction catheter, insert Yankauer into mouth along gum line and move around mouth until secretions are cleared. Yankauer is a plastic, rod shaped catheter with holes at the end. It provides continuous suction and is not controlled with a finger adaptor.
    *Parts of the mouth to be suctioned include the back of the throat, the cheeks, and under the tongue. Be careful when suctioning the back of the throat as this may cause the student to gag and vomit.*
19. If gurgling noises persist, repeat mouth suctioning procedure with same catheter. Monitor student's respiratory status throughout the procedure.
    *If appropriate, ask the student if he or she needs repeat suctioning. If suctioning of the nose is needed after suctioning of the mouth, a clean catheter should be used.*
20. Rinse catheter and connecting tubing with water until clear, using continuous suction. *Secretions left in tubing decrease suctioning efficiency and provide environment for growth of microorganisms.*
21. Disconnect catheter from suction tubing. Wrap catheter around gloved hand. Pull glove off inside out so that catheter remains rolled in glove. Place first glove in remaining gloved hand. Pull off other glove over first glove to seal in contaminated tubing. If Yankauer (or tonsil tip) suction catheter only is used for oral suctioning, it may be stored in clean container for future use. Follow student-specific guidelines.
22. Discard used suction catheter with gloves in appropriate receptacle. Turn off suction. Wash hands.
23. Note color, consistency (e.g., thin, thick), and quantity of secretions. Document procedures on student's log sheet and notify school nurse and family of any changes or problems.
24. Be sure suction equipment and supplies are restocked and checked daily and are ready for immediate use.

**Sources:**


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# Procedure for Nose and Mouth Suctioning with a Bulb Syringe

**Note: Parent provides equipment and supplies.**

1. Wash hands.
2. Gather and assemble equipment:
    - Bulb syringe (nasal aspirator)
    - Saline
    - Tissues
    - Disposable gloves
3. Explain procedure using explanations the student can understand. Encourage the student to do as much of the procedure as is capable, so as to achieve maximum self-care skills.
4. Position student as recommended in student's individualized health care plan.
5. Don gloves.
6. Hold bulb syringe in palm of hand with long tip between index and middle finger. Squeeze the bulb syringe flat with thumb. Place the tip gently into the nose or mouth, where secretions are visible or audible, and let the bulb fill up.
   *When suctioning the mouth, suction under the tongue, inside the cheeks, and in the back of the throat. Be careful in suctioning the back of the throat because this may cause the student to gag and vomit.*
7. Remove the bulb syringe from the nose or mouth. Hold the syringe over a tissue or basin and squeeze the bulb to push out the secretions; then let it refill with air.
8. Repeat steps 6 and 7 as needed until nose and mouth are clear.
9. If nose secretions are too thick, a few drops of saline can be put in each nostril before suctioning with bulb syringe.
10. Clean bulb syringe in hot soapy water, rinse with fresh water, let dry, and store.
11. Dispose of tissues in appropriate receptacle.
12. Remove gloves.
13. Wash hands.
14. Note color, consistency, and amount of secretions on student's log sheet and notify school nurse and family of any changes or problems.

**Sources:**


Porter, S, Haynie, M, Bierle, T, Caldwell, TH, & Palfrey, JS (Eds.). (1997). *Children and Youth Assisted by Medical Technology in Educational Settings: Guidelines for Care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing.

Wong, DS & Hess CS. (2000). *Wong and Whaley's Clinical Manual of Pediatric Nursing.* (5th ed.) St. Louis: Mosby.

## *Possible Problems with Nose and Mouth Suctioning*

| Assessment | Intervention/Rationale |
|---|---|
| Nosebleed during suctioning | *Stop suctioning. Gently squeeze bridge of nose and hold for 5 minutes.*<br>*After bleeding has stopped, refrain from using that side of the nose for suctioning until cleared by family or health care provider.* |
| Gagging or vomiting during suctioning | *Gagging is probably caused by catheter going down too far. Withdraw a little and try to finish suctioning. If vomiting occurs, remove catheter and position student to keep airway open. Calm student and make sure that he or she is breathing without problems. If student still needs suctioning, proceed carefully and try suctioning less deeply.* |

**Sources:**


Bindler, R., Ball, J., London, M., & Ladewig, P. (2003). *Clinical Skills Manual for Maternal-Newborn & Child Nursing.* Upper Saddle River, NJ: Prentice Hall, pp. 133-135.

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## Information for Students
# Who Need Nose and Mouth Suctioning with a Bulb Syringe

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student requires occasional suctioning with a bulb syringe to clear secretions and mucous from the airway to help the student breathe better.

The procedure will be conducted by a trained staff member. The student may be able to request suctioning and assist with the procedure.

If a student needs suctioning, the suctioning equipment must be with the student at all times.

The student may be able to participate in many school activities. Modifications should be approved by the family, health care provider, and school nurse.

Please contact _____ at _____ (phone number/pager) for additional information or if the student experiences any problems with the suctioning procedure.

**Source:**
Adapted from: Porter, S., Haynie, M., Bierle, T., Caldwell, T. H., & Palfrey, J. S. (Eds.). (1997). *Children and youth assisted by medical technology in educational settings: guidelines for care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing

# Chest Physiotherapy Postural Drainage and Percussion

## Overview

Chest physiotherapy (CPT) can be an important part of treatment of acute and chronic respiratory conditions, such as bronchitis, cystic fibrosis, pneumonia, and asthma. CPT is performed to improve pulmonary hygiene and to maintain normal airway function by promoting the drainage and coughing up of secretions from the lungs. The student is placed in various positions to allow gravity to be used to promote drainage of secretions from the lungs and percussion of the chest wall is done to help loosen secretions for removal.

## Potential Settings

CPT should be performed in a setting that allows for proper positioning and privacy of the student. Small students can be placed in the lap of a staff person. Older and larger students can be placed on a slant board, a padded wedge board, or a bed or couch with pillows to position the student. CPT should generally not be performed for at least one hour after feeding or meds.

## Staff Preparation

CPT may be administered by the school nurse (RN or LPN), health assistant, teacher aide, or other staff person who has had general training in CPT of the student. General training should cover the student's specific health care needs, potential problems, how to obtain assistance should problems occur, and how to implement the established emergency plan.

The basic skills checklist in Appendix B can be used as a foundation for competency-based training in appropriate techniques. The checklist outlines specific procedures. Once the procedures have been mastered, the completed checklist serves as documentation of training.

## Components of the Individual Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who needs chest physiotherapy. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A. For the student who needs CPT, the following elements should receive particular attention:

- Student's underlying condition and possible problems associated with the condition or treatment
- Student's baseline status, including color, respiratory rate, pulse, and blood pressure
- Positions to be used during CPT
- Use of airway clearance assistive devices such as vests or mechanical vibrators
- Timing of CPT in relation to feeding schedule
- Frequency of CPT
- Student's tolerance of CPT
- Contraindications to CPT, such as the presence of fractured ribs or bleeding disorder

- Signs and symptoms shown by the student when not receiving adequate oxygen (e.g., cyanosis, agitation, distress)
- Possible need for pulse oximeter readings during CPT
- Standard precautions

**Sources:**


Bindler, R., Ball, J., London, M., & Ladewig, P. (2003). *Clinical Skills Manual for Maternal-Newborn & Child Nursing*. Upper Saddle River, NJ: Prentice Hall, pp. 137-141.

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# Procedure for Chest Physiotherapy (CPT)

**Note: Parent provides equipment and supplies.**

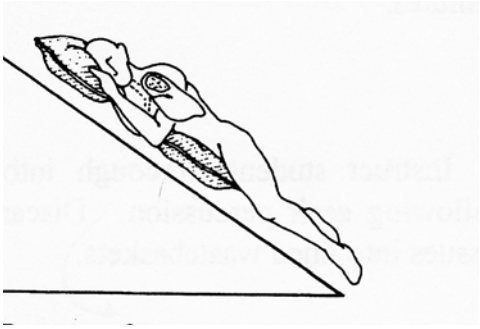
1. Wash hands.
2. Assemble the equipment:
    - Pillows
    - Tissues
    - Suction equipment, if needed
    - Wastebasket with plastic liner
    - Vest airway clearance system, if prescribed

   *Choose a time for the procedure when several hours have passed since the student has eaten.*
3. Perform a baseline respiratory assessment.
   *Student may be placed on a pulse oximeter during CPT because desaturation may occur during CPT.*
4. Explain procedure using explanations the student can understand. Emphasize that the staff person is not "hitting" the student.
   *Smooth muscles of the tracheobronchial tree may constrict because of fear, tension, or discomfort. Therefore, a relaxed, cooperative student will receive more effective CPT.*
5. Place vest airway clearance system on student according to student's individualized health care plan for percussion and vibration, if it has been prescribed.
   *Vest airway clearance systems generally consist of an inflatable fitted vest, connected by hoses to an air pulse generator, which gently compress and release the chest wall 5-20 times per second. This process moves mucus toward the large airways where the mucus can be cleared by coughing or suctioning.*
6. Use the following sequence for percussing and/or vibrating (if prescribed) each lobe of the lung:
    - Place the student in one of the 10 positions.
      *To percuss all the lobes of the lungs, the student should be placed in 10 different positions. The different positions use the principle of gravity to promote drainage of the tracheobronchial tree. The student is positioned so that the mucus collected in each bronchus is able to drain downward toward the trachea where it can be coughed out or suctioned out. Placing the student in a head down position facilitates drainage of the lung bases. Placing the student in a sitting position facilitates drainage in the apical segment of the upper lobe. In the unstable student, these positions may be modified (i.e., the head down position would be inappropriate for a student with increased intracranial pressure or abdominal distention).*
    - Percuss over selected area for 1-2 minutes or student-specified amount of time.
      *Percussion facilitates drainage by jarring the secretions. A cupped hand or soft mask creates an air pocket that softens the blow of the percussion and transfers the energy from the percussion into the lung. When using the hands to percuss, hold the hands cupped with fingers and thumb together. The cupped hand striking the chest wall should create a hollow sound. Keep the wrists loose and elbows partially flexed. Strike the chest rapidly with alternating hands. Percussion is performed over a single layer of clothing, not over buttons, snaps, or zippers.*

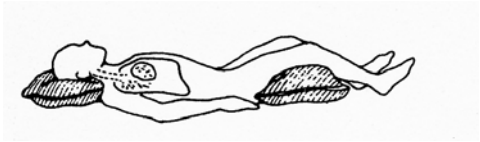
- If ordered, use vibration over specified areas.
  *Vibration is done with a firm, shaking pressure applied to the chest wall during exhalation. Vibration may shake mucus loose or increase the velocity and turbulence of exhaled air, facilitating mucus removal.*
- Instruct student to cough into tissue following percussion of each location. Discard used tissues into lined wastebaskets.
  *Coughing is most effective if the student is sitting up so that diaphragmatic excursion is maximal. Ideally, the student should take several deep breaths and then follow the last breath with a deep cough. Initial coughing attempts may not produce sputum. As further positioning and percussion are provided, coughing will become more productive. Students with ineffective or suppressed coughs can be suctioned. (Use of vibration may break bones when students have abnormal bone conditions or are receiving medication such as steroids.)*

7. For percussing students over 40 pounds, the following positions may be used:
   - Position 1—student on stomach with right side of torso and right arm elevated on pillow—*used for percussing posterior segment of right, upper lobe, over right scapular area. Depending on the student's weight, additional pillows may be needed to obtain desired elevation in all positions.*

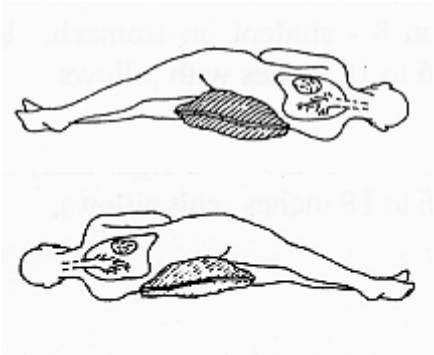
   - Position 2—student on stomach with left side of torso and left arm elevation on pillow—*for posterior segment of left upper lobe, over left scapular area. The left bronchus is more vertical, thus requiring a nearly 45 degree elevation.*



   - Position 3—student flat on back with pillows placed under head and knees—*anterior segments of the right and left upper lobes, between the clavicle and nipple area.*

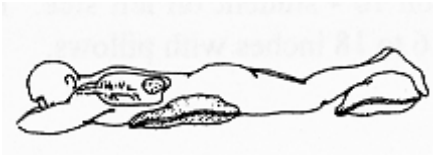


   - Position 4—student on back. Turn hips ¼ turn to the right. Elevate hips 10-12 inches with pillows. Use additional pillows as needed to hold hips to the right—*for percussing lingular process of the left lung, from left armpit to nipple area.*
   - Position 5—student on back. Turn hips ¼ turn to the left. Elevate hips 10-12 inches with pillows. Use additional pillows as needed to hold hips to



the left—*for percussing the right middle lobe, from right armpit to nipple area.*

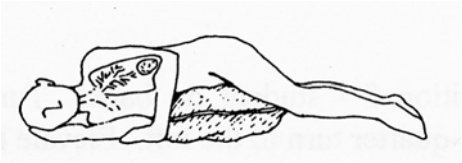
- Position 6—student flat on stomach with pillows under stomach and lower legs/feet—*for apical segments of right and left lower lobes, over lower scapular area.*



- Position 7—student on back with hips elevated 16-18 inches with pillows—*for anterior basal segment of right and left lower lobes, over lower chest area below nipples.*

- Position 8—student on stomach with hips elevated 16-18 inches with pillows—*for basal segments of right and left lower lobes, over lower chest areas (avoid kidneys).*

- Position 9—student on right side with hips elevated 16-18 inches with pillows —*for lateral basal segment of left lower lobe, over left side from beneath armpit to end of rib cage.*



- Position 10—student on left side with hips elevated 16-18 inches with pillows—*for lateral basal segment of right lower lobe, over right side from beneath armpit to end of ribcage.*

8. The techniques for percussing students under 40 pounds (18 kg) and other students in a sitting position are as follows:
   - Person who is performing the percussing sits in a chair with legs outstretched at a 45 degree angle and with the bottom of your feet braced against a solid, upright object. A pillow is placed in front of your knees. The student is placed face down on your lap with the student's chin resting on the pillow.
     *This position is correct for percussing posterior basal segments of lower lobes, over area from lower scapulae to end of ribcage. Note: Young children and infants usually have no upper lobe involvement requiring percussion. Percuss with light pressure.*
   - Seated as before, hold student face up on your lap with the student's head resting on the pillow.

*This position is correct for percussing anterior segments of lower lobes, over the area from below nipple to end of rib cage.*

9. At the end of the procedure, have wastebaskets contents disposed of utilizing standard precautions.
10. Document CPT on student's health record or treatment log.

**Sources:**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# Use of Mechanical Ventilators

This section on mechanical ventilators provides a general overview of ventilators, their components, parameters, ventilation modes, alarms, and possible problems. It is NOT intended to be a comprehensive guide to understanding, maintaining, or troubleshooting ventilators. Other manuals and training are available for this. Also, each student on mechanical ventilation should have a plan describing student-specific guidelines.

## Overview

Mechanical ventilators deliver air to the lungs when the student is not able to do so. They may use either positive or negative pressure to ventilate the student. *Positive pressure ventilators* exert a positive pressure on the airway to **push** air into the lungs. *Negative pressure ventilators* act by creating negative pressure, which **pulls** air into the lungs. Ventilators help to sustain life when a student cannot breathe adequately on his or her own.

Most ventilators are positive pressure ventilators that deliver air through a mask, cannula, endotracheal tube, or tracheostomy tube. In the school setting, the student almost always has a tracheostomy and may need a ventilator due to lung damage, neurological damage (e.g., spinal cord injuries), or muscle weakness (e.g., muscular dystrophy). The ventilator is small enough to be portable and usually mounts on the back of a wheelchair. Negative pressure ventilators, such as the iron lung, body shell (cuirass) ventilator, and the body wrap (raincoat) ventilator are much larger and used primarily for neuromuscular disorders. They are much larger and rarely encountered in the school setting.

The ventilator can provide total respiratory support for the student who cannot breathe unassisted or can assist the student who is able to breathe, but whose respiratory ability is not adequate. The student may breathe partially on his or her own just requiring extra breaths by the ventilator or needing positive end expiratory pressure (PEEP) to keep the alveoli open. Humidification is also needed for the student who has a tracheostomy requiring ventilation.

Families with ventilator-dependent children need much support. They usually have nursing and other support services coming into the home. They may experience burnout or stress regarding the student's multiple needs. The student on mechanical ventilation is dependent on others for many things. Anxiety related to this dependence on others and to communication difficulties may present many challenges and needs.

## Potential Settings

Most students who require ventilators will need them at all times, including transport to and from school. Maintaining a power source will be critical wherever the student may be. Any potential site should have a back-up power source and grounded electrical outlets available.

Any student at school with a ventilator must also have a "go bag" or other supply kit containing a manual resuscitation bag, a spare tracheostomy tube, and suction equipment and supplies. See "go-bag" checklist in Appendix B.

## Staff Preparation

The student who uses a ventilator should have a trained caregiver at all times. This care should usually be performed by a qualified school nurse (RN or LPN with RN supervision) or respiratory therapist. Any health professional caring for a student assisted by a ventilator, should have taken a competency-based training program and be certified in cardiopulmonary resuscitation (CPR). Decisions regarding personnel who will care for the ventilated student should be discussed with the school nurse, family, health care provider, and other school personnel as needed. Determinations should be included in the guidelines developed for the student's care. The caregivers should be immediately available to the student (including transport) and should have information regarding the student's specific care guidelines and equipment.

If the trained caregiver and back-up personnel are unavailable on a given school day, the student should not attend school. However, an optional arrangement may be made between the school and the family so that someone from the family would attend school to function as the caregiver for the student.

All school personnel who have regular contact with a student requiring mechanical ventilation must receive training covering the student's specific needs, potential problems, and implementation of the established emergency plan.

The basic skills checklists for troubleshooting the ventilator machine and ventilator alarms in Appendix B can be used as a foundation for ventilator training. However, their use alone does not constitute comprehensive competency-based training. Additional training in student-specific techniques, equipment, and health care needs is essential and should be documented.

## Components of the Individual Health Care Plan

The student's individualized health care plan must be adapted to individual needs. The following section discusses some possible problems or emergencies that might take place for a student who requires mechanical ventilation. The information should be reviewed prior to developing the individualized health care plan.

A sample individualized health care plan is included in Appendix A, which may be copied and used to develop a plan for each student. For the student who requires mechanical ventilation, the following elements should receive particular attention:

- Underlying condition and the possible problems arising from the condition or treatment
- Degree of ventilator dependency
- Ventilator settings and the frequency that settings should be checked
- Ability to request assistance
- Baseline respiratory status
- Signs and symptoms of respiratory distress
- Appropriate response to ventilator alarms
- Personnel needed to provide qualified care; plan for caregiver absences

- Back-up power supply available at all times
- Written emergency plan
- Emergency card with ventilator settings posted near ventilator at all times
- Phone list with numbers of family, health care provider, home care agency, and medical equipment supplier
- Routine suctioning schedule and guidelines/indications for additional suctioning
- Tracheostomy tube size and type
- Plans for tracheostomy care and supplies (see section on tracheostomies)
- Need for humidification and/or oxygen
- Use of pulse oximetry
- Measures to prevent respiratory infection
- Notification of EMS, power company, phone company, and fire department of ventilator dependent student and /or oxygen use at school
- Plan for transport to and from school
- Latex allergy alert
- Standard precautions

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# Ventilator Equipment

Standard ventilator features should be checked each day when student arrives at school and more often as specified by student's individualized health care plan. Check the following:

**Note: Parent provides equipment and supplies.**

1. Power source:
   Power source must be available and **must be connected for machine to function.**
   - Accessible, functioning grounded outlets
   - Internal battery
     *Internal battery is generally a 12-volt DC battery intended for emergency use only.*
   - External battery
     *External battery is connected to the ventilator via a cable and will operate for approximately 10 hours if fully charged.*
   - Back-up battery
     *The back-up battery may be kept at home.*
   - Emergency power supply
2. Ventilator circuit: Drain tubing of excess water. Inspect for wear and cracks. Check connections for tightness. Make sure tubing is routed to prevent water from draining into the student's airway or back into the humidifier or ventilator.
   Tubing and spare tubing required:
   - Pressure tubing
     *The ventilator circuit consists of the tubing that is attached to the ventilator and the student's tracheostomy tube and other components such as the humidifier and the exhalation and PEEP valves. The tubing carries the air from the ventilator to the student.*

   Valves:
   - Exhalation valve
     *Caution should be taken not to block or obstruct the exhalation valve with the student's clothing or equipment.*
   - PEEP valve
   - Other adaptors needed for a particular student including spares of each one
     *Routine cleaning of ventilator circuits should be done at home daily or as needed.*
3. Oxygen source (if prescribed for the student):
   - Adequate supply of oxygen, functioning gauge and a spare tank
     *Ensure adequate supply of oxygen is available for the day. Identify flow in liters per minute (LPM) and percentage of oxygen.*
   - Connection to ventilator and spare tubing
4. Humidification source:
   The student whose nose and mouth is bypassed by a tracheostomy tube needs a humidifier. The humidifier must have an adequate amount of water and be set at a safe temperature. Some students may use a heat-moisture exchanger for humidification.
   - Passive condenser
   - Heat-moisture exchanger

5. Patient pressure manometer
6. Alarms:
   ***Alarms should never be turned off.*** *All ventilator alarm settings should be written on the emergency card posted visibly on the ventilator.*
   - High and low pressure
   - Volume
   - Power source
7. Other equipment that should be checked daily:
   *Each student with a ventilator should have a "go bag" containing all of these supplies.*
   - Manual resuscitator bag and adaptor or mask
   - Spare tracheostomy tube and supplies
   - Suctioning equipment

**Sources:**


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# Ventilator Parameters

Ventilator parameters are prescribed for each student requiring ventilator assistance. They should be checked upon arrival at school and several times during the day as specified in student individualized health care plan, or more frequently if student's status changes. A clearly-visible card stating the student's ventilator settings should be mounted on the ventilator.

| Parameters | Points to Remember |
|---|---|
| 1. Tidal volume ($V_T$) | *The amount of air passing in and out of the lungs with each breath. Based on child's size. Usually 6-10 cc/kg for children, but may be 8-12 for adolescents.* |
| 2. Respiratory rate | *Number of breaths per minute delivered by the ventilator; also called frequency.* |
| 3. Oxygen percentage ($FiO_2$) | *Percentage of air which is oxygen. Room air is 21%. Rate may be higher based on student needs.* |
| 4. Peak inspiratory pressure (PIP) | *Amount of pressure needed to inflate the lungs to the specified tidal volume.* |
| 5. Positive end expiratory pressure (PEEP) | *Amount of pressure needed to keep the lungs from collapsing during exhalation.* |
| 6. Inspiratory time ("I" Time) | *The amount of time in the vent cycle used to deliver a breath. The I:E ratio describes the amount of inspiratory versus expiratory time taken with each breath and can be adjusted to fit the individual student's needs.* |
| 7. Sigh volume | *Ventilator-delivered breath that is 1 ½ times as large as the tidal volume.* |

**Sources:**


*A Parent's Guide to Pediatric Tracheostomy Home Care*. (2002). St. Louis: Mallinckrodt, Inc, 26-27

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# Ventilator Modes

Ventilator mode describes the type of respiratory support administered by the ventilator. The mode is determined by the student's respiratory ability.

| Ventilator Modes | Points to Remember |
|---|---|
| 1. Assist control (AC) | *With each spontaneous breath the student takes, a preset tidal volume is triggered and delivered. If the student does not take spontaneous breaths, the ventilator automatically delivers a breath at a preset rate and tidal volume.* |
| 2. Intermittent mandatory ventilation (IMV) | *Delivers a preset number of mechanical breaths at a preset tidal volume but allows the student to breathe in between the ventilator breaths at their own tidal volume.* |
| 3. Synchronized intermittent mandatory ventilation (SIMV) | *A mandatory number of mechanical breaths are synchronized with the student's spontaneous breaths at a preset frequency and volume. Allows the student to breathe in between the ventilator breaths at his or her own tidal volume. The ventilator senses the student's spontaneous breath and synchronizes the timed ventilator breath with the student's inspiratory effort, reducing competition between machine breaths and spontaneous breaths.* |
| 4. Control Mode; Controlled mandatory ventilation (CMV) | *A mechanical breath is automatically given at a preset rate and tidal volume. Used for apneic or chemically paralyzed students.* |
| 5. Pressure regulated volume control (PRVC) | *A preset peak inspiratory pressure and preset tidal volume are maintained during each spontaneous breath. May be used as a supplement, such as with a student who has muscular dystrophy.* |

**Sources:**


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# Ventilator Alarms

**Ventilator alarms must remain on at all times.**

| Alarms | Points to Remember |
|---|---|
| 1. High-pressure alarm | *Reflects an excessive inspiratory pressure. May indicate increased resistance or obstruction.* |
| 2. Low-pressure alarm | *Indicates a too-low inspiratory pressure. Warns of a leak in the system; may signal that adequate volume is not being delivered.* |
| 3. Power source alarm | *Indicates a change in power.* ***Alarms should never be turned off.*** |
| 4. Temperature alarm | *The majority of home care ventilators* ***do not*** *have temperature alarms built into the humidifier unit. The temperature of inspired gas can be checked with an in-line thermometer.* |
| 5. High-pressure alarm | *Reflects an excessive inspiratory pressure. May indicate increased resistance or obstruction.* |

**Sources:**


*A Parent's Guide to Pediatric Tracheostomy Home Care*. (2002). St. Louis: Mallinckrodt, Inc, 26-27

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## *Possible Problems When Using a Ventilator*

| Assessment | Intervention/Rationale |
|---|---|
| Respiratory Distress:<br>• Increased shortness of breath<br>• Agitation<br>• Blueness or pallor of lips or nail beds<br>• Retractions (e.g., pulling in of chest muscles)<br>• Rapid or pounding pulse<br>• Confusion | ***Immediately*** *check and reassure the student. Call for assistance.* ***Never leave the student alone.***<br>*Check:*<br>• *If student needs suctioning*<br>• *For occlusion of the tracheostomy tube by a plug or secretions*<br>• *Whether student may be coughing or doing something else to raise pressure transiently*<br>• *For a dislodged tube or other airway problems*<br>• *Connections to the ventilator.*<br>• *Exhalation valve to see if it is obstructed.*<br>• *Power source for ventilator.*<br>• *Adequacy of oxygen supply.*<br><br>*Student may be disconnected from the ventilator and ventilated by a manual resuscitation bag if needed while being checked.* |
| Dislodged tracheostomy | *Change the tracheostomy tube.* |
| Blocked tracheostomy | *Suction tracheostomy. If still blocked, replace trach.* |
| Increased secretions | *Suction tracheostomy more frequently.* |
| Wheezing | *Check student's individualized health care plan. Administer bronchodilators or give nebulizer treatment, if ordered. Notify school nurse and family if continued wheezing.* |
| Respiratory distress persists or student becomes unconscious | ***Activate school emergency plan immediately.***<br>*Continue using manual resuscitator.* |
| Distress is relieved by disconnecting from ventilator and using manual resuscitation | *While using the manual resuscitator to ventilate student, check, or have assistant check, ventilator.*<br>*Check:*<br>• *Water condensation*<br>• *Connections*<br>• *Leaks*<br>• *Valves, tubing, circuit for obstruction*<br>• *Power supply*<br>*If unable to locate and correct problem, continue using manual resuscitator and call the home care company, school nurse, family, and others as specified in the student plan.* ***Activate school emergency plan****.* |

| Assessment | Intervention/Rationale |
|---|---|
| Interrupted power supply (outage, equipment malfunction) | *Use manual resuscitator to ventilate student until back-up power supply is in operation.* |
| **High-pressure alarm** goes off. This is usually an **intermittent alarm** accompanied by a flashing red light.<br><br>Note**:** If the condition that caused this alarm to be triggered is stopped, the audible alarm may stop but the visual alarm may need to be reset. The high pressure alarm should be set to student's prescribed setting, usually 5-10 cm $H_2O$ above the peak inspiratory pressure. | ***Always check the student first.***<br>• *The student may have mucus plugging the tracheostomy tube and need suctioning.*<br>• *Check position of tracheostomy tube and correct as needed. New tube may be needed.*<br>• *If the student is coughing, sneezing, talking, or laughing, pressure may temporarily be raised enough to activate the alarm.*<br>• *Assess for bronchospasm and follow student's individualized health care plan.*<br>• *If student is anxious and "fighting" the ventilator, the high pressure alarm may be activated. Attempt to calm student.*<br>***Remove the student from ventilator and give breaths with resuscitator bag and then check ventilator.***<br>*Check:*<br>• *Tubing for kinks.*<br>• *For condensation (water) in the tubing.*<br>• *Exhalation valve to make sure it is not being obstructed.*<br>• *Ventilator settings for accidental change. .*<br>*Test system after cause of problem is found and fixed. Place student back on ventilator.* |
| **Low-pressure alarm** or apnea alarm goes off. This is a **continuous audible alarm** and is usually accompanied by a flashing red light on the ventilator front panel.<br><br>The low pressure alarm should be set to student's prescribed setting, usually 5-10 cm $H_2O$ below the peak inspiratory pressure. | ***Always check the student.***<br>• *Tube may be disconnected from ventilator. Reconnect.*<br>• *Check for loose connections, leaks or cracks in system. Tighten, if needed.*<br>• *Check tracheostomy tube for correct placement*<br>• *If student has a cuffed tube, check for leak in cuff.*<br>• *Exhalation valve may be wet or punctured.*<br>• *Check for accidental change in ventilator settings.*<br>***Remove the student from ventilator and give breaths with resuscitator bag and check the ventilator.***<br>*Test system after cause of problem is found and* |

| Assessment | Intervention/Rationale |
|---|---|
| | *fixed. Place student back on ventilator.* |
| **Power alarm** sounds**.** This is a **continuous** alarm**,** usually accompanied by a flashing light as well. | *The alarm may sound whenever power source is interrupted (e.g., battery change).* ***Check to see that power source is functioning*** *(e.g., AC power, external and internal battery). Make sure ventilator plugged in outlet and power supply available if using AC power. If all three power sources fail, remove student from ventilator.* ***Give breaths with resuscitator bag and activate the school emergency plan.*** |

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## Information for Students
# Who Use Mechanical Ventilators

**Date:** _____

**To:** _____ (Teachers, Instructional assistants, Bus drivers, etc)

**Name of Student:** _____

This student requires a ventilator, or breathing machine, to push air into the lungs. The ventilator usually is attached through a tracheostomy tube (see tracheostomy care).

The ventilator is powered by a battery or other power source and must be with the student at all times, including during transportation.

Ventilator care will be conducted by a trained caregiver who will be with the student at all times.

The student's individualized health care plan will address care needs during the day, feeding issues; and avoidance of exposure to respiratory infections including colds.

Please contact _____ at _____ (phone number/pager) for additional information about ventilators or if the student experiences any difficulty with the ventilator.

School staff in frequent contact with this student are encouraged to complete cardiopulmonary resuscitation (CPR) training and specialized training for people with tracheostomies.

**Source:**

Adapted from: Porter, S., Haynie, M., Bierle, T., Caldwell, T. H., & Palfrey, J. S. (Eds.). (1997). *Children and youth assisted by medical technology in educational settings: guidelines for care*. (2nd ed.). Baltimore: Paul H. Brookes Publishing