Chapter 6: Care of the Respiratory System

Asthma

Peak Expiratory Flow Rate Monitoring

Inhalers and Spacers

Nebulizer Treatments

Oxygen Use

Nasal Cannula

Oxygen Mask Pulse

Oximetry

Tracheostomy

Tracheal Suctioning

Tracheostomy Tube Changes

Tracheostomy Oxygen Administration

Manual Resuscitator

Nose and Mouth Suctioning

Chest Physiotherapy Postural Drainage and Percussion Mechanical Ventilators

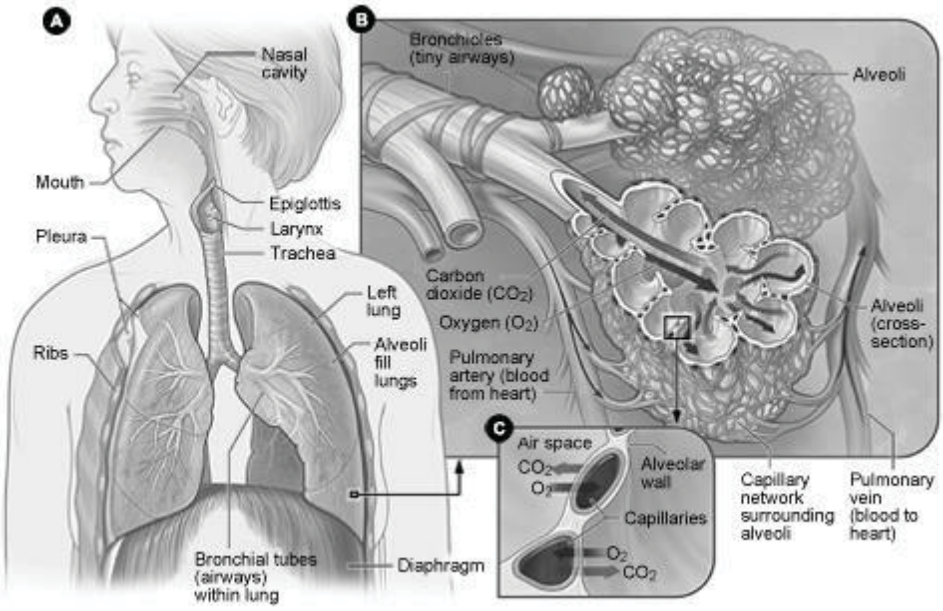
Respiratory System

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 (with the help of hemoglobin) 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 average adult takes 15-20 breaths per minute--over 20,000 breaths per day.

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"). A flap of tissue called the *epiglottis* covers the windpipe during swallowing so that food and drink do not enter the lungs. 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 a dome-shaped muscle 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
    - Infectious diseases such as bronchitis which cause a buildup of mucus of fluid that narrows the airways and limits airflow
    - 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)
    - Chronic obstructive pulmonary disease (COPD) which is usually caused by smoking or air pollutants which damage the airways and alveoli
- 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
    - High spinal cord injuries

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Illustration Source:

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Asthma

Overview

Asthma is a major public health problem of increasing concern. Asthma is a common chronic health condition affecting 1 in 11 children. Asthma is one of the leading causes of school absences and the third leading cause of hospitalization for children. According to the Centers for Disease Control and Prevention (CDC) asthma symptoms result in an estimated loss of 10.5 million school days each 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 2020 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.

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. The CDC describes it as "trying to breathe through a straw stuffed with cotton." 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, and cockroaches.
- ***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, chemical irritants in science and art classes, and exhaust fumes from idling buses, 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.

Recommendations of Expert Panel Report-3 Asthma Guidelines

The National Asthma Education and Prevention Program (National Heart, Lung, and Blood Institute of the National Institutes of Health) have established guidelines for diagnosis and management of asthma since 1991. Its (third) Expert Panel Report 3 was presented in 2007 (most recent update as of April 2016). The six key messages from the EPR-3 Asthma Guidelines are:

1. Inhaled corticosteroids are the most effective anti-inflammatory medication for long term management of persistent asthma.
2. Use written action plans to guide patient self-management.
3. Asthma severity should be assessed at the initial visit to determine initial treatment.
4. Assess and monitor asthma control at all follow up visits and adjust treatment as necessary.
5. Schedule periodic, follow up visits (at least every 6 months).
6. Act to control environmental exposures that worsen asthma.

In addition, four other key messages have been identified by asthma care groups:

All patients should also receive:

1. Asthma education by a qualified health professional
2. Referral to an asthma specialist, when appropriate
3. Education regarding the danger of overuse of short-acting beta-agonists
4. Information regarding risk factors for death from asthma.

Managing Asthma in Schools

The National Asthma Education and Prevention Program School Asthma Subcommittee have developed guidelines for schools to use in developing a plan to assist their students with asthma. Copies of *Managing Asthma: A Guide for Schools* can be downloaded or mailed without charge (see Resources in this section). The action items identified for school asthma management are:

1. Establish an asthma management team.
    - designate one person to coordinate and oversee asthma management activities
    - involve staff from across the school to ensure coordination
2. Identify students who have asthma.
    - identify and track students who have asthma and the services they need
    - ensure that students with asthma have a written asthma action plan on file
3. Provide care, support, and resources.
    - provide students who have asthma with access to appropriate support services, resources, and assistance from trained personnel (including case management)
    - assess students' asthma control (e.g., peak flow meter, medication use)
    - encourage interaction with the student's health care provider
    - document and evaluate services provided to students who have asthma
4. Ensure quick and easy access to prescribed medications.
    - ensure medication access during all school and school-sponsored activities
    - support students who have asthma who carry and administer their own medications (Title 70 Chapter 1 Article 1 Section 1-116.3)
5. Maintain a school-wide plan for emergencies.
    - develop clear emergency procedures for responding to asthma attacks
    - ensure availability of appropriate asthma medications and devices in case of emergency
    - facilitate re-entry to school following an asthma attack
6. Provide a healthy school environment.
    - establish an indoor air quality program
    - regularly assess environmental risks
    - reduce allergens, irritants, and other asthma triggers
7. Enable full participation.
    - encourage and support full participation of students who have asthma
    - modify activities when necessary
    - watch for reluctance or inability to participate in activities
8. Educate students, staff, and families.
    - provide asthma education to students who have asthma and their families to help improve their asthma self-management skills
    - conduct in-services for all staff about managing asthma and allergies
    - provide asthma education for the entire student body
9. Promote partnerships.
    - facilitate open and cooperative exchange of information among school staff, parents, and guardians, students, and health care providers

- coordinate school asthma activities as much as possible with other school programs and with community service organizations that can provide additional resources

Studies have found that school nurses can play a significant role in helping students manage their asthma. The following page outlines specific roles and responsibilities the National Asthma Education and Prevention Program recommended for school nurses in a school's Asthma Management Plan:

Participate on a team to develop, implement, and monitor the asthma management program

- Provide leadership and technical expertise to school asthma management team.

Identify and track students who have asthma

- Facilitate the development, communication, and use of asthma action plans with students, parents and guardians, staff, and health care providers.
- File asthma action plans in a secure location with easy access in an emergency, and share copies with relevant staff in accordance with privacy laws.

Provide care, support services, and resources for students who have asthma

- Oversee, deliver, and document care: Administer medication, monitor asthma control, develop individualized health service plans, coordinate care, and maintain records.
- Delegate care to staff only in accordance with your State Nurse Practice Act and other prevailing laws, rules, and regulations.

Ensure quick and easy access to prescribed medications

- Provide safe storage and easy access to prescribed medication when needed.
- For students who carry their own asthma inhalers, ask parents or guardians if they would like to provide a second inhaler to store at school.
- Provide feedback to parents and health care providers about a student's readiness to carry and self-administer medication.
- Periodically review students' technique to ensure proper use of inhalers.
- Train designated back-up staff to provide quick and easy access to students' medications when you are unavailable.

Maintain a school-wide plan for asthma emergencies

- Help establish a school-wide plan for asthma emergencies.
- Train staff to follow the plan, including whom to contact and how when a student has an asthma attack.
- Track and report asthma attacks, calls to 9-1-1, and related emergency events.
- Assess the response after each event, and recommend changes to the emergency plan and protocols as needed.

Provide a healthy school environment and reduce asthma triggers

- Train teachers, coaches, and other staff to help students avoid or reduce exposure to their asthma triggers in line with students' asthma action plans.
- Help the school's indoor air quality team prioritize key health and safety issues to tackle.
- Refer student to his or her health care provider to identify or test for asthma triggers if student's asthma is not controlled.
- Use the student's asthma action plan to guide individual recommendations.

Enable full participation by students who have asthma

- Advise teachers, instructors, and coaches on modifying activities to match students' current asthma status or based on students' asthma action plans.
- Teach staff how to use metered-dose inhalers to assist students, as appropriate, to pre-medicate before exercise.

Educate students, staff, and parents and guardians about asthma

- Obtain continuing education in asthma and consider becoming a certified asthma educator.
- Provide asthma education to students who have asthma and their families to help them improve asthma self-management skills.

Promote partnerships among school staff, students, parents and guardians, health care providers, and the community

- Communicate policies, procedures, and other information related to asthma management to staff, parents and guardians, students, and health care providers and listen to their concerns and feedback.
- Coordinate with community organizations that can provide additional resources and support to school staff, students, and families.

From: *Managing Asthma: A Guide for Schools.* Copies available from NHLBI

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Oklahoma Guidelines for Healthcare Procedures in Schools

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 commonly used 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, ProAir)
> - Levalbuterol (Xopenex)

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)
- Ciclesonide (Alvesco)
- Flunisolide (Aerospan)
- Fluticasone (Flovent)
- Mometasone (Asmanex)

Nonsteroidal

- Cromolyn sodium (Intal)

Combined medication (inhaled corticosteroid + long-acting beta-agonist)

- Fluticasone/Salmeterol (Advair)
- Budesonide/Formoterol (Symbicort)
- Mometasone/Formoterol (Dulera)

Oral Medications

Corticosteroids

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

Leukotriene modifiers

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

Theophylline (rarely used)

- Slo-bid, Theo-Dur, Elixophyllin, Theochron

Immunomodulators

- Omalizumab (Xolair subcutaneous injection, 1-2 times/month)
- Mepolizumab (Nucala subcutaneous injection monthly)

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 after exposure to an allergen, irritant, or weather change. 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. Get a peak flow reading, if a peak flow meter (PFM) is available, and administer medication if that 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.**

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 (IHP). Additional plans may need to be developed for activities occurring after school hours.

Asthma Education and Training

In general, students should be taught to be responsible for managing their own asthma. Asthma education programs 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. See Resources at the end of this section.

Individualized Health care Plan (IHP)

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

An IHP for the student with asthma should 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 Title 70 Chapter 1 Article 1 Section 1-116.3 of Oklahoma Law 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.

A sample Asthma Action Plan follows this section and can be used in developing individual action plans.

In developing an IHP 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
- Health care provider's orders for management of asthma
- 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 (with health care provider's orders)
- Student's self-care skills and knowledge of early signs of respiratory distress
- Emergency contact information
- 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 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 identification 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

http://www.lung.org/lung-disease/asthma/creating-asthma-friendly-environments/asthma-in-schools/back-to-school-with-asthma/back-to-school-with-asthma-toolkit.html.

School Nurse Evidence-Based Clinical Guidelines: Asthma, National Association of School Nurses. These evidence-based guidelines are sold as an eBook and provide current information for caring for students with asthma.

Asthma Home Environment Checklist. Environmental Protection Agency (EPA). Checklist to use at home to assess for allergens.

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AsthmaActionPlan

For:_____ Doctor:_____ Date: _____

Doctor's Phone Number_____ Hospital/Emergency Department Phone Number _____

G O

Doing ell

- No cough, wheeze, chest tightness, or shortness of breath during the day or night
- Can do usual activities

And, if a eak flow meter is used,

Peak flow more than _____
(80 percent or more of my best peak flow)

My best peak flow is: _____

ake these long-term control medicines each day include an anti-inflammatory .

edicine	**ow much to take**	**hen to take it**
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
Before exercise	❒ _____	❒ 2 or ❒ 4 puffs _____ 5 minutes before exercise

Y O O

Asthma Is Getting orse

- Cough, wheeze, chest tightness, or shortness of breath, or
- Waking at night due to asthma, or
- Can do some, but not all, usual activities

-Or-

Peak flow_____to _____
(50 to 79 percent of my best peak flow)

irst **Add uick-relief medicine and kee taking your G O medicine.**

_____ ❒ 2 or ❒ 4 puffs, every 20 minutes for up to 1 hour
(short-acting beta$_2$-agonist) ❒ Nebulizer,once

Second **If your sym toms and eak flow, if used return to G O after 1 hour of a o e treatment**

❒ Continue monitoring to be sure you stay in the green zone.

-Or-

If your sym toms and eak flow, if used do not return to G O after 1 hour of a o e treatment

❒ Take:_____ ❒ 2 or ❒ 4 puffs or ❒ Nebulizer
(short-acting beta$_2$-agonist)

❒ Add:_____mg per day For_____(3–10)days
(oral steroid)

❒ Call the doctor ❒ before/ ❒ within_____hours after taking the oral steroid.

D O

edical Alert

- Very short of breath, or
- Quick-relief medicines have not helped, or
- Cannot do usual activities, or
- Symptoms are same or get worse after 24 hours in Yellow Zone

-Or-

Peak flow less than _____
(50 percent of my best peak flow)

ake this medicine

❒ _____ ❒ 4 or ❒ 6 puffs or ❒ Nebulizer
(short-acting beta$_2$-agonist)

❒ _____mg
(oral steroid)

hen call your doctor O . Go to the hospital or call an ambulance if:

- You are still in the red zone after 15 minutes AND
- You have not reached your doctor.

DA G SIG S

- **rou le walking and talking due to shortness of reath**
- **i s or fingernails are lue**

- **ake ❒ or ❒ uffs of your uick-relief medicine A D**
- **Go to the hos ital or call for an am ulance_____O**
(phone)

See the reverse side for things you can do to avoid your asthma triggers.

How To Control Things That Make Your Asthma Worse

This guide suggests things you can do to avoid your asthma triggers. Put a check next to the triggers that you know make your asthma worse and ask your doctor to help you find out if you have other triggers as well. Then decide with your doctor what steps you will take.

Allergens

❒ Animal Dander

Some people are allergic to the flakes of skin or dried saliva from animals with fur or feathers.

The best thing to do:

- Keep furred or feathered pets out of your home.

If you can't keep the pet outdoors, then:

- Keep the pet out of your bedroom and other sleeping areas at all times, and keep the door closed.
- Remove carpets and furniture covered with cloth from your home. If that is not possible, keep the pet away from fabric-covered furniture and carpets.

❒ Dust Mites

Many people with asthma are allergic to dust mites. Dust mites are tiny bugs that are found in every home—in mattresses, pillows, carpets, upholstered furniture, bedcovers, clothes, stuffed toys, and fabric or other fabric-covered items.

Things that can help:

- Encase your mattress in a special dust-proof cover.
- Encase your pillow in a special dust-proof cover or wash the pillow each week in hot water. Water must be hotter than 130º F to kill the mites. Cold or warm water used with detergent and bleach can also be effective.
- Wash the sheets and blankets on your bed each week in hot water.
- Reduce indoor humidity to below 60 percent (ideally between 30—50 percent). Dehumidifiers or central air conditioners can do this.
- Try not to sleep or lie on cloth-covered cushions.
- Remove carpets from your bedroom and those laid on concrete, if you can.
- Keep stuffed toys out of the bed or wash the toys weekly in hot water or cooler water with detergent and bleach.

❒ Cockroaches

Many people with asthma are allergic to the dried droppings and remains of cockroaches.

The best thing to do:

- Keep food and garbage in closed containers. Never leave food out.
- Use poison baits, powders, gels, or paste (for example, boric acid). You can also use traps.
- If a spray is used to kill roaches, stay out of the room until the odor goes away.

❒ Indoor Mold

- Fix leaky faucets, pipes, or other sources of water that have mold around them.
- Clean moldy surfaces with a cleaner that has bleach in it.

❒ Pollen and Outdoor Mold

What to do during your allergy season (when pollen or mold spore counts are high):

- Try to keep your windows closed.
- Stay indoors with windows closed from late morning to afternoon, if you can. Pollen and some mold spore counts are highest at that time.
- Ask your doctor whether you need to take or increase anti-inflammatory medicine before your allergy season starts.

Irritants

❒ Tobacco Smoke

- If you smoke, ask your doctor for ways to help you quit. Ask family members to quit smoking, too.
- Do not allow smoking in your home or car.

❒ Smoke, Strong Odors, and Sprays

- If possible, do not use a wood-burning stove, kerosene heater, or fireplace.
- Try to stay away from strong odors and sprays, such as perfume, talcum powder, hair spray, and paints.

Other things that b ring on asthma symptoms in some p eople include

❒ Vacuum Cleaning

- Try to get someone else to vacuum for you once or twice a week, if you can. Stay out of rooms while they are being vacuumed and for a short while afterward.
- If you vacuum, use a dust mask (from a hardware store), a double-layered or microfilter vacuum cleaner bag, or a vacuum cleaner with a HEPA filter.

❒ Other Things That Can Make Asthma Worse

- Sulfites in foods and beverages: Do not drink beer or wine or eat dried fruit, processed potatoes, or shrimp if they cause asthma symptoms.
- Cold air: Cover your nose and mouth with a scarf on cold or windy days.
- Other medicines: Tell your doctor about all the medicines you take. Include cold medicines, aspirin, vitamins and other supplements, and nonselective beta-blockers (including those in eye drops).

U.S. Department of Health and Human Services
National Institutes of Health

National Heart Lung and Blood Institute

For More Information, go to: www.nhlbi.nih.gov

NIH Publication No. 07-5251

FIGURE 6. SAMPLE ASTHMA ACTION PLAN—CHILD

ENGLISH

Child Asthma Action Plan

0–5 years of age

Patient Name: _____

Medical Record #: _____

Health Care Provider's Name: _____ DOB: _____

Health Care Provider's Phone #: _____ Completed by: _____ Date: _____

Long-Term-Control Medicines (Use Every Day To Stay Healthy)	How Much To Take	How Often	Other Instructions (such as spacers/masks, nebulizers)
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	

Quick-Relief Medicines	How Much To Take	How Often	Other Instructions
		Give ONLY as needed	NOTE: If this medicine is needed often (_____ times per week), call physician.

GREEN ZONE

Child is ***well*** and has no asthma symptoms, even during active play.

PREVENT asthma symptoms every day:

- Give the above long-term-control medicines every day.
- Avoid things that make the child's asthma worse.

☑ Avoid tobacco smoke; ask people to smoke outside.

☐ _____

☐ _____

YELLOW ZONE

Child is ***not well*** and has asthma symptoms that may include:

- Coughing
- Wheezing
- Runny nose or other cold symptoms
- Breathing harder or faster
- Awakening due to coughing or difficulty breathing
- Playing less than usual
- _____
- _____

Other symptoms that could indicate that your child is having trouble breathing may include: difficulty feeding (grunting sounds, poor sucking), changes in sleep patterns, cranky and tired, decreased appetite.

CAUTION. Take action by continuing to give regular asthma medicines **every day** AND:

☐ Give _____

(include dose and frequency)

If the child is not in the ***Green Zone*** and still has symptoms after 1 hour, then:

☐ Give more _____

(include dose and frequency)

☐ _____

(include dose and frequency)

☐ Call _____

RED ZONE

Child ***feels awful!*** Warning signs may include:

- Child's wheeze, cough, or difficulty breathing continues or worsens, even after giving yellow zone medicines.
- Child's breathing is so hard that he/she is having trouble walking/talking/eating/playing.
- Child is drowsy or less alert than normal.

MEDICAL ALERT! Get help!

☐ Take the child to the hospital or call 9–1–1 immediately!

☐ Give more _____ until you get help.

(include dose and frequency)

☐ Give _____

(include dose and frequency)

Call 9–1–1 if:

- The child's skin is sucked in around neck and ribs, or
- Lips and/or fingernails are grey or blue, or
- Child doesn't respond to you.

Danger! Get help immediately!

Adapted and reprinted with permission from "The Asthma Action Plan" developed by a committee facilitated by the Regional Asthma Management and Prevention (RAMP) initiative, a program of the Public Health Institute.

Source: http://www.calasthma.org/uploads/resources/actionplanpdf.pdf; San Francisco Bay Area Regional Asthma Management Plan, http://www.rampasthma.org

Alternate plan for younger children
Source: National Asthma Education and Prevention Program Expert Panel Report 3 (2007)

IS THE ASTHMA ACTION PLAN WORKING?
A Tool for School Nurse Assessment

Assessment for:_____ Completed by:_____ Date: _____
(Student) (Nurse or Parent)

This tool assists the school nurse in assessing if students are achieving good control of their asthma. Its use is particularly indicated for students receiving intensive case management services at school.

With good asthma management, students should:

- Be free from asthma symptoms or have only minor symptoms:
  - no coughing or wheezing
  - no difficulty breathing or chest-tightness
  - no wakening at night due to asthma symptoms.
- Be able to go to school every day, unhampered by asthma.
- Be able to participate fully in regular school and daycare activities, including play, sports, and exercise.
- Have no bothersome side effects from medications.
- Have no emergency room or hospital visits.
- Have no missed class time for asthma-related interventions or missed class time is minimized.

Signs that a student's asthma is not under good control:

Indicate by checking the appropriate box whether any of the signs or symptoms listed below have been observed or reported by parents or children within the past 6 months. If any boxes are marked, this suggests difficulty with following the treatment plan or need for a change in treatment or intervention (e.g., different or additional medications, better identification or avoidance of triggers).

- ❑ Asthma symptoms more than twice a week that require quick-relief medicine (short-acting beta$_2$-agonists, e.g. albuterol):
- ❑ Symptoms get worse even with quick relief meds
- ❑ Waking up at night because of coughing or wheezing
- ❑ Frequent or irregular heartbeat, headache, upset stomach, irritability, feeling shaky or dizzy
- ❑ Missing school or classroom time because of asthma symptoms
- ❑ Having to stop and rest at PE, recess, or during activities at home because of symptoms
- ❑ Symptoms require unscheduled visit to doctor, emergency room or hospitalization
- ❑ 911 call required

If "yes" to any of the above, use the following questions to more specifically ascertain areas where intervention may be needed.

Probes	**Responsible Person/site**	**Yes**	**No**	**N/A**
Medications:				
• Are appropriate forms completed and on file for permitting medication administration at school?	**By school staff**	❑	❑	❑
	Self-carry	❑	❑	❑
• Has a daily **long-term-control** medication(s) (controller*) been prescribed?		❑	❑	❑
• Is **controller** medication available to use as ordered?	**Home**	❑	❑	❑
	School	❑	❑	❑
• Is the student taking the **controller** medication(s) as ordered?	**Home**	❑	❑	❑
	School	❑	❑	❑
• Has a **quick-relief** (short-acting B_2-agonist) medication been prescribed?		❑	❑	❑
• Is **quick-relief** medication easily accessible?	**Home**	❑	❑	
	Personal inhaler (s) at school health office	❑	❑	
	Self-carry	❑	❑	
• Is the student using **quick-relief** medication(s) as ordered…				
o Before exercise?	**Home**	❑	❑	❑
	School	❑	❑	❑
o Immediately when symptoms occur?	**Home**	❑	❑	❑
	School	❑	❑	❑
Medication Administration:				
• Does the student use correct technique when taking medication?		❑	❑	❑
• Does the person administering the medication use correct technique?		❑	❑	❑

	Responsible Person/site	Yes	No	N/A
Monitoring: • Can the student identify his/her **early** warning signs and symptoms that indicate onset of an asthma episode and need for quick-relief medicine?		❑	❑	❑
• Can the student identify his/her asthma signs and symptoms that indicate the need for help or medical attention?		❑	❑	❑
• Can the student correctly use a peak flow meter or asthma diary for tracking symptoms?		❑	❑	❑
• Are the students' asthma signs and symptoms monitored using a Peak Flow, verbal report or diary? o Daily?	**Home**	❑	❑	❑
	School	❑	❑	❑
o For response to **quick-relief** medication?	**Home**	❑	❑	❑
	School	❑	❑	❑
o During physical activity?	**Home**	❑	❑	❑
	School	❑	❑	❑
Trigger Awareness: • Have triggers been identified?		❑	❑	
• Can student name his/her asthma triggers?		❑	❑	❑
• Can parent/caregivers list their child's asthma triggers?		❑	❑	
• Are teachers, including physical educators, aware of this student's asthma triggers?		❑	❑	
Trigger Avoidance: • Are triggers removed or adequately avoided or managed?	**Home**	❑	❑	❑
	School	❑	❑	❑

* Long-term-control medications (controllers) include inhaled corticosteroids (ICS), leukotriene receptor antagonists (LTRA), or combination medicine (long-acting B_2-agonists and ICS), Cromolyn, or theophylline.

School nurses provide appropriate asthma education and health behavior intervention to students, parents, and school personnel when signs and symptoms of uncontrolled asthma and other areas of concern are identified. If there is an indication for a change in asthma medications or treatment regimen, refer the student and family to their primary care provider or asthma care specialist or help families to find such services as soon as possible.

National Asthma Education and Prevention Program

NASN National Association of School Nurses

Peak Expiratory Flow Rate Monitoring

Overview

A peak flow meter (PFM) is a portable, hand-held device used to measure Peak Expiratory Flow Rate (PEFR), or the ability to move air out of the lungs. To determine a student's baseline air flow, the PFM is used frequently over a two-week period to determine the student's PEFR. 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. Peak flow measurement is dependent on both the effort and technique utilized so it should not be the only measure used in assessing a student's respiratory status. It should be noted that flow rates are generally slightly lower in the mornings than the afternoons.

Settings and Staff

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.

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 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.

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for the student who needs peak flow rate monitoring, the following items should be considered:

- Need for student to measure peak flow rates
- Health care provider orders for peak expiratory flow rate monitoring
- 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 family and/or health care provider
- Development of an action plan using peak flow values to guide interventions
- 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

Procedure for Peak Flow Rate Monitoring

1. Determine need for peak flow rate monitoring. The student may ask for a measurement.

   Review orders for obtaining baseline ratings and assessment ratings. Assess student's status: respiratory rate, depth, effort, pulse, restlessness, color, retractions, coughs, 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 "personal best" or usual peak flow rate. Many health care providers advise measuring peak flow rates close to the same time each morning. Peak flow rates may be lower in the mornings than late afternoons.

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 guidelines in the student's IHP. 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.

    Generally, three zones (correlated to traffic light colors of green, yellow, and red for easy interpretation) are used to interpret peak flow rates. Be aware of the following general guidelines, but follow 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 asthma 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.

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Illustration source:

National Heart lung and Blood Institute. (2014). *How to use a peak flow meter*. In *Managing Asthma: A Guide for Schools*, NIH publication #14-2650, p. 55.

Procedure for Using a Metered Dose Inhaler (MDI)

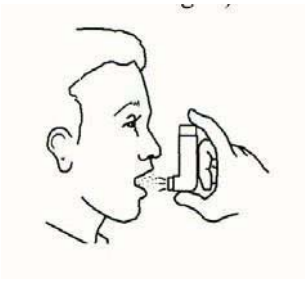
A metered dose inhaler (MDI) is a device used to deliver asthma medication directly to the lungs. It consists of a canister of pressurized medication that fits into a plastic sleeve connected to a mouthpiece. The MDI propels aerosolized medication into the airway. In comparison, medications taken in 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. A prescription from the student's health care provider is required for inhalers to be used at school.

However, the medication sprayed from the MDI may not reach the lungs if correct technique is not used. Research has shown that many students (and adults) do not know how to correctly use their inhaler. It is important to assess technique and not just assume those with asthma know the correct way, no matter how long they have been using an inhaler.

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. Most MDI's now have counters. 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 twice a day (4 puffs total per day), then it should last 50 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.

Title 70 Chapter 1 Article 1 Section 1-116.3 – *Policy Regarding Asthma Medication* 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/guardian and health care provider, as well as an individualized health care plan, are required. Asthma rescue medication should always be easily accessible in an emergency.

Using a Metered Dose Inhaler



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 10-15 times.

   This mixes the medication with the propellants. Check medication to see how much shaking is needed. A few brands (Alvesco, QVAR) do not require shaking.
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--OR--
   - Place inhaler in mouth and form a seal with lips--OR--
   - Use a spacer to hold inhaler. See Procedure for Using Spacers. This method is preferred as it delivers twice as much medicine to the lungs.
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. Then breathe out slowly.
9. Repeat puff as directed by the student-specific order. For emergency, quick-relief, or rescue medicine (beta 2-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 (corticosteroid and non-steroidal).
10. When done, wipe off the mouthpiece and replace the cap.
11. Rinse out mouth with water, if possible.
12. Document medication given in student log (and student response, if specified in plan).

Inhalers should be stored in a cool, dry place. Never store in the glove compartment of a car because the inhaler begins to lose effectiveness at high temperatures. It is best to store the inhaler in a plastic bag while carrying in a pocket or purse. The MDI may need to be primed if is new or hasn't been used for a long time to ensure the correct amount of medication is in each puff. Follow specific MDI instructions for how many sprays/puffs into the air are needed to prime the inhaler.

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Procedure for Using Spacers with Metered Dose Inhalers

Many people (especially young children) find it difficult to coordinate the spraying of a metered dose inhaler (MDI) and the inhalation of the medication. Sometimes the puffs are miss-timed and only make it part of the way into the airways, and some of the medication is deposited in the mouth or on the back of the throat instead of the lungs.

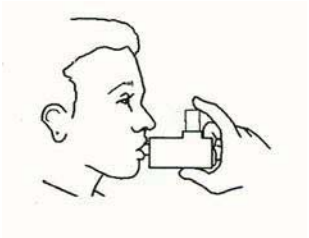
A spacer is a hollow tube that attaches to a MDI. It slows down or "holds" a dose of medication until a student is able to take it in. The medication is sprayed into the spacer instead of the mouth. As the student inhales, the medication passes quickly through the mouth and throat, reducing the amount of medication released into the air and preventing it from being sprayed directly in the mouth or throat. It helps a student get the most from their inhaled asthma medicine. The spacer usually has a one-way valve that prevents the student from exhaling into the spacer. Some studies have shown that the larger volume spacers delivered more medication than the small volume spacers. Some spacers have masks which cover the nose and mouth for younger children enabling more medicine to be inhaled. Spacers without masks should not be used until the child is 7-8 years of age.

Using a Spacer with a Metered Dose Inhaler

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 spacer.
4. Shake the MDI and insert into the back of the spacer.
5. Breathe out deeply.
6. Put the mouthpiece of the spacer 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 spacer.
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 spacer out of the mouth and breathe normally.

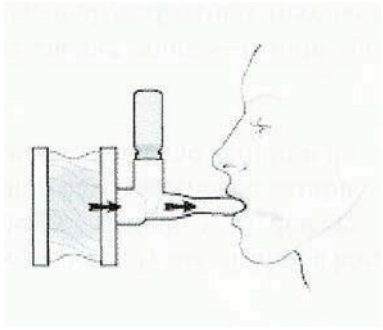


10. If a second puff is ordered, wait at least one minute between puffs.
11. Rinse mouth with water and spit out.
12. Document medication given in student log.
13. At least once a week, wash the spacer in warm water and thoroughly dry.

Using an InspirEase® Spacer with a Metered Dose Inhaler

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.

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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 they might with some MDIs. General instructions for most DPIs:

1. Wash hands.
2. Follow the manufacturer's instructions to prime the DPI and load a prescribed dose of the dry-powder medicine.

   There is no need to shake the DPI. Shaking can result in losing some powder.
3. Stand up.
4. Breathe out slowly for 3-5 seconds.
5. Place mouthpiece of inhaler in mouth and close lips around it to form a tight seal. 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.

6. Hold breath for 10 seconds and then exhale slowly.
7. If specified in the student IHP, 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.
8. Wipe the mouthpiece at least weekly with a dry cloth. Do NOT use water to clean the dry powder inhaler.
9. Document medication given in student log and student response.

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 administered 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://www.asthma.ca/adults/treatment/diskus.php

http://www.asthma.ca/adults/treatment/diskhaler.php

http://www.nhlbi.nih.gov/files/docs/public/lung/asthma_tipsheets.pdf

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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 compressed air is forced through a cup with liquid medication, forming a mist. 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 causes 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 either a face mask or a T-adaptor (which fits in the mouth). The mask directs air to the nose and mouth and is easier for younger children to use. The T adaptor directs air to the mouthpiece while allowing exhaled air to escape.

Settings and Staff

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 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.

A nebulizer treatment can be administered by the school nurse, family, teacher, or other adult with proven competency-based training in appropriate techniques and problem management. 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.

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student requiring nebulizer treatments, the following items should be considered:

- Determining the need to receive nebulizer treatment
- Health care provider order

- Medication to be administered and side effects and precautions
- Frequency of treatments and whether treatments are on a regular or "as needed" basis
- Action to take if student becomes shaky or jittery during nebulizer treatment
- 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 of nebulizer components
- Latex allergy precautions
- Standard precautions

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Illustration Source:

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Procedure for Nebulizer Aerosol Treatment

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. Most nebulizer cups unscrew from the top.
7. Most nebulized medication comes premixed and packaged in a unit-dose dosettes so the entire contents should be squirted into the bottom half of the nebulizer cup and then the top screwed back on.

   If the medication requires mixing, place the prescribed amount of medicine and diluting solution into the nebulizer cup and screw the cup back together.

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, if applicable).

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. Keep the nebulizer cup upright. The cup may require gentle tapping to make sure the entire dose is utilized.
16. When all the medication has been aerosolized, turn off power.
17. Remove mouthpiece or mask.
18. Assess student's respiratory status. **If student is still having difficulty breathing after nebulizer treatment or is wheezing, follow student-specific action plan**.
19. Wash mouthpiece or mask and nebulizer cup. Allow to thoroughly dry on a paper towel before storing. Do not wash tubing with water. Refer to cleaning instructions for other parts.
20. Wash hands.
21. 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. Replace tubing if it becomes cloudy, discolored, or wet inside. 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, malfunction and reduces infection. Compressors can be used for multiple students. Other parts are student-specific.

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Possible Problems That May Occur During Nebulizer Treatments

- **Chest tightness, coughing, wheezing, shortness of breath, retractions (pulling in of rib cage)**

  Follow Emergency Asthma Action Plan. Give nebulizer treatment, if ordered. Nebulized bronchodilators can act quickly to help with breathing. Notify school nurse and family.

- **Breathing gets increasingly difficult. 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, if necessary.

  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 bronchodilator treatment**

  Medication may be causing increased heart rate. Follow student guidelines for care.

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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 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.

Contact_____at_____(phone number) 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

Note: Oxygen is considered a medication and requires health care provider orders.

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

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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.
- Liquid oxygen can evaporate while in a portable unit--check the level often.
- To check if an oxygen tank is empty, look at the red area on the dial. If it reads less than 500 pounds per square inch (PSI), the tank is empty and needs replacing.
- Keep the name of the home oxygen company and its telephone contact posted on/near the oxygen equipment and in the student's health care plan. Contact the company if any equipment does not appear to function correctly.
- Notify the local fire department and emergency medical services that oxygen is in use at the school.

Settings and Staff

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 care plan.**

NOTE: 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, 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.

NOTE: Students who need to be accompanied by a supply of oxygen can be **transported by the school bus** under the following conditions:

- It is strongly recommended that an aide, attendant, nurse, etc. who has received specific training for administration of oxygen and general training on the student's special needs, accompany and sit next to the student;
- Oxygen should only be carried when medically necessary and specified in a student's IEP or IHP. Emergency plans should be developed in advance of need.
- Oxygen cylinders should be checked for cracks, leaks, or other defects
- Carry the cylinder carefully using both hands--the cylinder is susceptible to valve damage if dropped or carried by the valve or regulator
- Each cylinder should be secured upright to prevent movement, stored away from sources of potential sparks or heat, and in a location that allows all passengers free egress from emergency exits. It should not be secured in a location where a wheel chair occupant could strike against it in a crash situation.
- It is recommended that a decal indicating compressed oxygen is on board the bus should be placed in a visible place on the exterior of the bus.

The school nurse or other adult with proven competency-based training in appropriate techniques and problem management may administer oxygen through a nasal cannula or mask. Use of a tracheostomy collar may require a registered 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.

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student requiring supplemental oxygen use, the following items should be considered:

- Student's underlying condition and possible problems associated with the condition or treatment
- Health care provider's order for oxygen including how and when it is to be administered
- Student's baseline respiratory status, including color, breath sounds, respiratory rate, pulse, and blood pressure
- Need and frequency for pulse oximetry readings
- 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 and other oxygen safety precautions
- Need for transportation of oxygen to and from school
- Spare oxygen supply and safe storage when not in use
- Latex allergy precautions
- Standard precautions

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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.

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 and ordered
   - 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. Humidification of low flow oxygen is often not needed and may contribute to bacterial growth. 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. Assess skin integrity frequently for signs of skin breakdown.

   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, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 526-533.

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Wisconsin Improving School Health Services Project. (2015). *Administering oxygen*. Available online: http://www.wishesproject.org/?page_id=132/?tab=4

Oklahoma Guidelines for Healthcare Procedures in Schools

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.

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 and ordered
    - 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 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.

10. *Make sure that the student is comfortable with the mask and that the mask does not touch the eyes.* Assess skin integrity frequently for signs of skin breakdown.
11. Wash hands.
12. 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.

Possible Problems for Students Requiring Supplemental Oxygen

- **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, if ordered. **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. Notify school nurse and family who can discuss problem with health care provider.

- **Rapid breathing or shortness of breath**

- **Agitation, confusion, dizziness, or headache**

- **Retractions or pulling in of the muscles at the neck or chest Rapid or pounding pulse**

- **Blue color or pallor of the lips or nails**

  Stay calm and reassure student.

  Check student:

  - Check nasal cannula, mask, or tracheostomy collar for correct placement.
  - 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.
  - Check tracheostomy tube placement.
  - Make sure collar is not out of position or obstructing tracheostomy tube.
  - 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.

  Check equipment. Check oxygen flow--if flow is weak or inadequate:

  - Make sure regulator, flowmeter, and valve are on correct settings.
  - Make sure tank still has gas and is working properly. If not, replace with backup.
  - Check all connections.
  - Check that tubing is not kinked or blocked.
  - Make sure tubing is not obstructed by water condensing in the tubing. Empty water from tube frequently when using humidified mist.

  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:

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Wisconsin Improving School Health Services Project. (2015). *Administering oxygen*. Available online: http://www.wishesproject.org/?page_id=132/?tab=4

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.

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

Contact_____at_____(phone number) 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. For a student with asthma, a decrease in oxygenation is a very late sign of distress, so relying on pulse oximetry could be falsely reassuring during an asthma attack. It is important to use pulse oximetry as just one component of a complete respiratory assessment. **Acceptable values for students requiring pulse oximetry should be specified in their individualized health care plans.**

Settings and Staff

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.

Pulse oximetry can be performed by the school nurse, family, teacher aide, or other staff person who has had 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.

Individualized Health Care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who requires pulse oximetry, the following items should be considered:

- 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 precautions—if child is latex sensitive, clip-on probes (not adhesive probes) should be used
- Standard precautions

Sources:

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Wisconsin Improving School Health Services Project. (2015). *Pulse oximetry monitoring*. Available online: http://www.wishesproject.org/?page_id=219/?tab=4

Procedure for Measuring Pulse Oximetry

1. Determine need for oximetry. The student may ask for a measurement.

   Assess student's status: respiratory rates, depth, effort, pulse, restlessness, color, retractions, cough, wheezing, and lung sounds.

2. Wash hands.

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. Pulse oximetry is *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.*

5. Instruct student to breathe normally, if necessary.

   Normal breathing prevents large fluctuations in minute ventilation and possible changes in oxygen saturation.

6. Select appropriate site to apply sensor/probe bases 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.

7. 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.

8. Attach sensor cable to oximeter and turn machine on. Observe waveform display and listen for audible beep or watch for reading.

   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.

9. 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.

10. Read saturation level on digital display when readout reaches constant value (after at least 10 seconds) and pulse display is strong.
11. 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.
12. 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.
13. Wash hands. If the oximeter probe is used for more than one student, it should be cleaned between uses according to manufacturer recommendations.
14. Record oxygen saturation readings in student log. Note any change in respiratory status at this time.
15. Compare readings with student baseline and acceptable values. Report to the school nurse and family any changes from the student's usual pattern.

Sources:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 606-611.

Connecticut State Department of Education. (2012). *Clinical procedure guidelines for Connecticut school nurses*. Middlebury, CT: CSDOE, 99-100.

DeSisto, M. (n.d.). *The ABCs of using pulse oximeters in schools*. NASN Radio **recording** available at: http://www.jackstreet.com/jackstreet/WNASN.DeSisto.cfm

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Possible Problems with Pulse Oximetry

- **No reading on oximeter**
  Check to see if sensors are properly aligned or clip is securely on finger.

  Make sure wires are intact and securely fastened.

  Check that oximeter has charged batteries or is plugged in and electrical outlet is functioning.

- **Low oxygen saturation readings but student has no sign of respiratory distress**
  Check:

  - Correlation between pulse rate and oximeter pulse reading. If they differ, re-position probe.
  - Capillary refill. Loosen any tight-fitting clothes. If circulation decreased, choose different site for probe.
  - Light source on probe.
  - If limb is being moved during reading, may need to switch to another site.
  - Adhesion of sensor/probe to skin site (unless using clip type).
  - Assess for hypothermia. If extremity is cold, move probe or warm extremity.
  - Lighting in the room. Bright direct lighting or bright sunlight can affect readings.
  - 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 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.

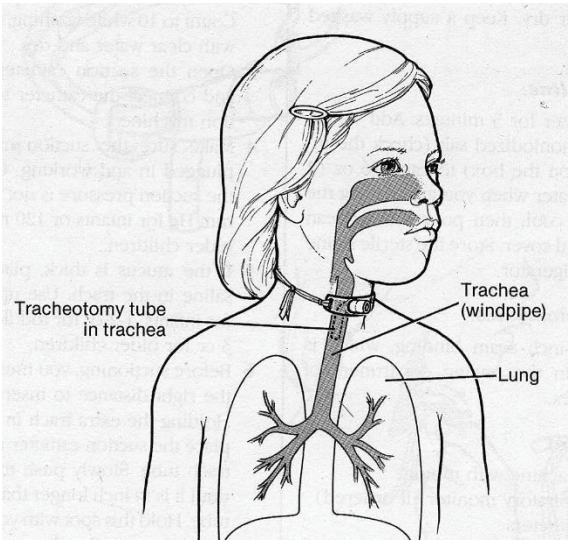
- **Irritation of probe/sensor site**
  Move probe/sensor. Assess site every 2-8 hours as needed or specified. Notify school nurse and family of irritation.

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 bronchopulmonary dysplasia 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 is supplied by the family and 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 guidelines in student's individualized health care plan (IHP)
- Sterile or clean cotton-tip swabs, if required
- Pipe cleaners, if needed for cleaning of an inner cannula

- Water-based lubricant
- Manual resuscitator with adaptor (Ambu bag)
- Saline or ½ strength hydrogen peroxide (diluted with saline or distilled water)
- 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 and replace 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

Settings and Staff

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 works 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 a lot of 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. Most students who have a tracheostomy will wear a heat moisture exchanger (may be called an artificial "nose") to protect from this.

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 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."

Tracheal care for students, who require care in school, such as suctioning, cleaning, use of a tracheostomy collar, or other daily care, should be provided by a registered school nurse, licensed respiratory therapist, licensed practical nurse or other specifically trained unlicensed assistive personnel under the supervision of a registered 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.**

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

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student with a tracheostomy, the following items should be considered:

- Underlying condition and possible problems associated with the condition or treatment
- Health care provider's order for tracheostomy and its care
- 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, including instructions for use
- 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
- Disaster care planning
- Means of communicating between school personnel when immediate help is needed (e.g., walkie-talkies, intercoms, telephones, cellular phones)
- Latex allergy precautions
- Standard precautions

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Potential Problems for Students with Tracheostomies

- **Signs of Respiratory distress:**

Difficulty breathing	**Pale blue color around lips, eyes, nails**
Increased respiratory rate	**Retractions**
Increased heart rate	**Anxious, frightened look**
Wheezing, grunting, noisy breathing	**Restlessness, agitation**

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 school 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. Reposition child and tilt head back if difficulty inserting. 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.

- **Suction catheter cannot be inserted into tracheostomy tube**
Do not leave student alone. Reposition head/neck and try again. 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 (CPR), 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. ***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. If mucus is very thick **and** saline has been prescribed, saline may be added. However, saline is no longer routinely recommended and may cause more harm than good. If student experiences bronchospasm causing wheezing, medications may be required, if prescribed. **Initiate the school emergency plan if respiratory distress continues.** Begin CPR, if needed. Notify school nurse, family and health care provider.

- **Distress during suctioning**
  Limit suctioning to 5-10 seconds or less. Suction more frequently for shorter periods. Make sure catheter is no more than ½ the diameter of the tracheostomy. Activate school emergency plan if distress persists. Notify school nurse and family.

- **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. (Fibers from freshly-cut gauze can enter site so do not use cut gauze).

- **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.

- **Fever or chills; yellow or green secretions; foul odor, congested lung sounds; listlessness, increased mucus**
  Possible signs of infection. Document and notify school nurse and family.

- **Redness or skin breakdown at the stoma**
  Clean site as specified in student's individualized health care plan and make sure dressing stays dry. (Studies have shown that most sites should be cleaned with just water or soap and water). 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 100 mmHg for children and 120 mmHg for adolescents). Limit suctioning to 5 seconds at a time. Notify family**. If actual bleeding observed, notify school nurse and family immediately and activate school emergency plan.**

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 breathe through an opening in the windpipe. A tube may be inserted into the opening and secured to the neck with Velcro or ties. Some 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.

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.

Contact_____at_____(phone number) 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 or chest percussion and drainage

Settings and Staff

Routine suctioning can be done in a classroom if a clean, non-busy 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.

Tracheal suctioning should be provided by a registered school nurse, licensed respiratory therapist, or licensed practical nurse or other specifically trained unlicensed assistive personnel 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.**

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.

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who requires tracheal suctioning, the following items should be considered:

- Underlying condition and possible problems associated with the condition or treatment
- Health care provider's order for suctioning
- 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)
- Type of suction catheter (one-time use versus sleeved or inline)
- 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
- 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 precautions
- Standard precautions

Sources:

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Procedure for Tracheal Suctioning Using One-Time Use Catheter

Equipment for suctioning must be available for use at ALL times.

Note: Family supplies 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 backup 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, latex and powder free; sterile or clean according to student IHP
    - 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. Determine depth to be suctioned **prior** to suctioning. This should be in student's IHP and/or noted on suction catheters.

   Suctioning should normally be shallow, only to the end of the tracheostomy tube, to avoid damage to respiratory tissues.
4. Position student as specified in their IHP. Although not required, it is advisable to have another person available for assistance if needed.

   Most students are suctioned while seated upright at school.
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. 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.

7. Turn on suction machine. A suction of 80-100 mmHg is usually recommended for children and 80-120 mmHg for adolescents. Put finger at end of connecting tube to confirm suction.

8. Wash hands.

9. Open suction catheter or kit.

   Peel paper back without touching the inside of the package to maintain sterility.

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. Put on 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 non-dominant 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 non-dominant 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** it is specifically prescribed.

    There is controversy over whether this intervention is helpful and usually is no longer done. 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 non-dominant hand to suction a small amount of saline through catheter.

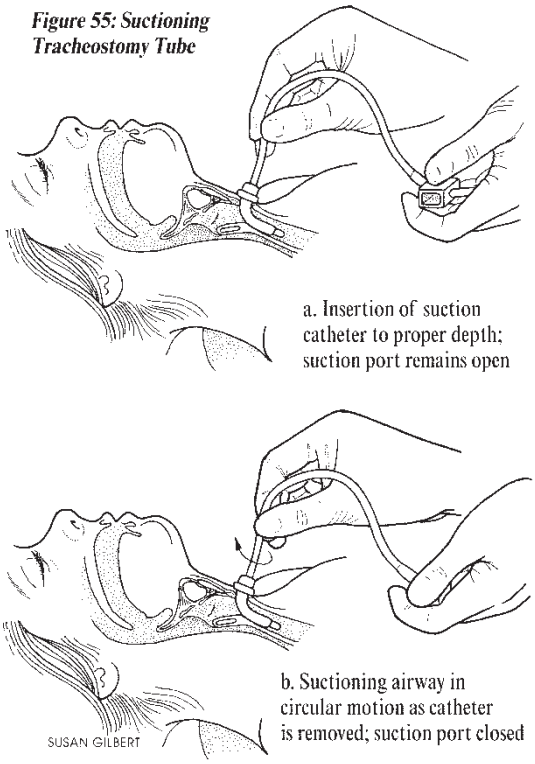

Figure 55: Suctioning Tracheostomy Tube

To ensure the 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 off 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.*

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 non-dominant 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. Research indicates it may increase airway contamination, decrease oxygen saturations, and do a poor job of thinning secretions. It is **not** recommended unless it is specifically ordered.*

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). Usually there should be no more than three suctioning passes. 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 to 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.

Tracheal Suctioning Using a Sleeved or Inline Suction Catheter

Overview

Sleeved or inline 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 suctioning. Usually the sleeved catheter is used for a 24 hour period and then discarded; however, some sleeved catheters have 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 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.

Note: Family provides equipment and supplies.

Procedure

1. Follow steps 1-10 for tracheal suctioning.
2. Put on 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, usually 80-100 mmHg for children and 80-120 mmHg for adolescents.
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.

8. ***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.

9. 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.

10. 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. *This helps student get new oxygen/air into lungs.* Suction saline again through catheter to rinse secretions from catheter and tubing.

11. **Do not routinely use saline to loosen secretions**. Only if prescribed, insert several drops of saline into tracheostomy with non-dominant 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. Research indicates it may increase airway contamination, decrease oxygen saturations, and do a poor job of thinning secretions.

12. 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.

13. 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.

14. Sleeved catheters can be reused for up to 24-72 hours. Follow manufacturer-specific and guidelines in student's IHP. They cannot be reused in the trachea if they are used to suction the mouth and nose.
15. Remove gloves. Wash hands.
16. 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.
17. Be sure suction equipment and supplies are restocked, checked daily, and ready for immediate use.

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Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 672-677.

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Possible Problems When Suctioning

- **Signs of Respiratory distress:**

Difficulty breathing	**Pale blue color around lips, eyes, nails**
Increased respiratory rate	**Retractions**
Increased heart rate	**Anxious, frightened look**
Wheezing, grunting, noisy breathing	**Restlessness, agitation**

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 school 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. Reposition child and tilt head back if difficulty inserting. 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.

- **Suction catheter cannot be inserted into tracheostomy tube**
Do not leave student alone. Reposition head/neck and try again. 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 (CPR), if necessary. Notify school nurse, family and health care provider.

- **Bleeding during suctioning**
If pink or blood-streaked secretions, check suction pressure (should always be less than 120 mmHg). Limit suctioning to 5 seconds at a time. Notify school nurse and family.

If a large amount of blood is suctioned or the student develops respiratory distress while being suctioned, a**ctivate the school emergency plan** and notify school nurse and family. Reassure student.

- **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.**

Information for Students
Who Need Tracheal Suctioning

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 breathe 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.

Contact_____at_____(phone number) 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 2-4 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.

Settings and Staff

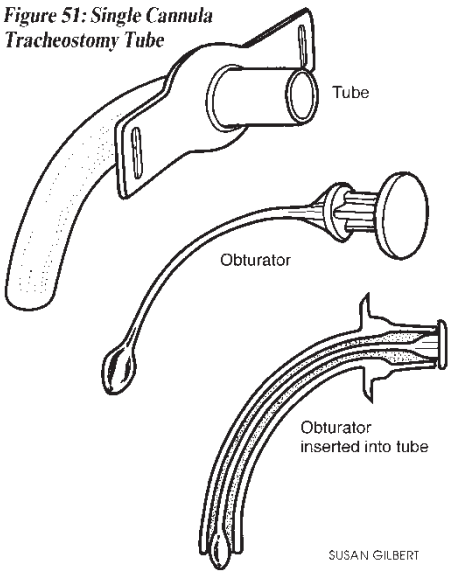

Figure 51: Single Cannula Tracheostomy Tube

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.

Tracheostomy tube changes 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.**

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 school emergency plan. The tracheostomy checklist in the appendices can be used as a baseline for competency based training in performing the procedure and problem management.

Individualized Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who needs a tracheostomy tube change, the following items should be considered (most should already be in the IHP for the student's tracheostomy):

- Underlying condition and possible problems associated with the condition or treatment

- Health care provider's order for tracheostomy care and tube change
- 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
- Staffing needs to provide safe care for the student and plan for absences
- Latex allergy precautions
- Standard precautions

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Illustration Source: The Center for Pediatric Emergency Medicine (CPEM). Teaching resource for instructors in prehospital pediatrics. Illustrations by Susan Gilbert.

Procedure for Changing a Tracheostomy Tube

Note: Family 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 to hold tracheostomy tube in place
    - 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 and mask
    - 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 sterile 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. If using ties, the tracheostomy ties should be tied in a double or triple knot. They should never be tied in a bow because they can accidentally become untied. The ties should be loose enough that one finger can be slipped in between the ties and the neck. Note: some students may have a metal chain trach holder instead.
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. Suction, if needed.

    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. Most tracheostomy tubes used at schools will not require cuff inflation or an inner cannula, but follow student's IHP for guidance on this.
21. Do skin care, if needed (see guidelines in student's IHP), 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.
22. Discard used equipment according to standard precautions guidelines.
23. Remove gloves and wash hands.
24. Document procedure and problems or concerns on student's log sheet. Notify school nurse and family of tracheostomy change.
25. Replenish supplies.

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Possible Problems with Tracheostomy Tube Changes

- **If the tracheostomy tube comes out and student is not showing signs of distress.**
  Call for assistance**.** Do not leave student alone. Follow procedure for tracheostomy tube change.

- **If the tracheostomy tube comes out and student shows signs of respiratory distress**
  As soon as possible, attempt to insert tracheostomy tube as outlined in procedure.

- **If the tracheostomy tube comes out and new 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**.** Initiate the emergency school plan if distress persists. 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:

  - Reassure and reposition the student. Retry.
  - Try using obturator if it has not been used.
  - Try to insert one size smaller tracheostomy tube.
  - Encourage the student to take a deep breath—be prepared to insert tube if stoma opens**.**
  - Administer flow of oxygen directly to the tracheostomy stoma.
  - Give rescue breathing through natural airway and tape over tracheal 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. Never leave student alone. Call for assistance.**

- **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 for air movement. Change tracheostomy tube if it remains blocked by matter. 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.

Respiratory distress or arrest can occur with any aspiration. Be prepared to initiate school emergency plan. Begin CPR after suctioning, if needed. Notify school nurse, family and health care provider. 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.

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: Family 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
   - Gloves
4. Set up humidification device according to guidelines in student's IHP.
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. Put on gloves.
7. 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.
8. If oxygen prescribed, turn on the oxygen source. A highly visible information card stating oxygen liter flow should be attached to the regulator.
9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. Remove gloves and wash hands.

15. 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 (non-rebreathing) 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.

Settings and Staff

Routine care using resuscitation bags should be done in a clean, private area such as the health office.

In emergency situations, manual resuscitation bags should be used wherever the student might be.

Emergency care should be addressed in the student's individualized health care plan and appropriate training should be provided to personnel.

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

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Procedure for Using a Manual Resuscitation Bag with a Tracheostomy

Note: Family provides equipment, supplies, and oxygen.

1. Wash hands.
2. Assemble equipment:
   - Manual resuscitation 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 non-dominant 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 number of breaths per minute specified in the student's IHP. 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 non-dominant 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 if there are any changes in student's usual pattern.

Sources:

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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.

Settings and Staff

Emergency suctioning should be done wherever the student is located. For this reason, students likely to need suctioning 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.

Suctioning of the nose and mouth can be performed by unlicensed assistive personnel 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 unlicensed assistive personnel 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 covering the student's special needs, potential problems, and implementation of the established emergency plan.

Individualized Health Care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who needs suctioning of the nose and mouth, the following items should be considered:

- 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)
- Health care provider's order for suctioning
- 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
- Suction machine and pressure settings
- Latex allergy precautions
- Standard precautions

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Procedure for Nose and Mouth Suctioning Using Suction Machine

Note: Family 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)
    - 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 IHP.
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. Put on gloves.
9. Holding the connecting end of the suction catheter in the dominant hand, secure it to the suction machine tubing (held in non-dominant 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 non-dominant hand should be used to turn on switches and touch other objects.

10. Remove covering from end of suction catheter with non-dominant 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 non-dominant 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, a few drops of saline can be put in each nostril.
14. Cover vent hole with non-dominant 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 non-dominant 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 or tonsil tip 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 noise persists, repeat mouth suctioning procedure with same catheter. Between passes, water can be suctioned to rinse secretions out of 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 only Yankauer (or tonsil tip) suction catheter is used for oral suctioning, it may be stored in clean container for future use. Follow guidelines in student's IHP.
22. Discard disposable 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:

Connecticut State Department of Education. (2012). *Clinical procedure guidelines for Connecticut school nurses*. Middlebury, CT: CSDOE, 101-103.

Hockenberry, M., & Wilson, D. (2015). *Wong's nursing care of infants and children* (10th ed.). St. Louis: Elsevier Mosby, 1152-1153.

Porter, S., Branowicki, P., & Palfrey, J. (2014). *Supporting students with special health care needs: Guidelines and procedures for schools* (3rd ed.). Baltimore: Paul H. Brookes Publishing, 346-350.

Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis, 1048-1053.

Procedure for Nose and Mouth Suctioning with a Bulb Syringe

Note: Family 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 plan.
5. Put on 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 the edge of 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:

Connecticut State Department of Education. (2012). *Clinical procedure guidelines for Connecticut school nurses*. Middlebury, CT: CSDOE, 101-103.

Hockenberry, M., & Wilson, D. (2015). *Wong's nursing care of infants and children* (10th ed.). St. Louis: Elsevier Mosby, 1152-1153.

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Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis, 1048-1053.

Possible Problems with Nose and Mouth Suctioning

- **Nosebleed during suctioning**
  Stop suctioning. Gently squeeze bridge of nose and hold for 5 minutes.

  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:

Connecticut State Department of Education. (2012). *Clinical procedure guidelines for Connecticut school nurses*. Middlebury, CT: CSDOE, 101-103.

Hockenberry, M., & Wilson, D. (2015). *Wong's nursing care of infants and children* (10th ed.). St. Louis: Elsevier Mosby, 1152-1153.

Porter, S., Branowicki, P., & Palfrey, J. (2014). *Supporting students with special health care needs: Guidelines and procedures for schools* (3rd ed.). Baltimore: Paul H. Brookes Publishing, 346-350.

Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis, 1048-1053.

General 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.

Staff working with the student should know what signs the student displays when suctioning is needed.

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.

Contact_____at_____(phone number) 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.

In the traditional manual method, 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. However, most students who need CPT on a regular basis (e.g., students with cystic fibrosis) have it done using a mechanical vest that provides high-frequency chest wall oscillation. Using a vest saves caregiver time and promotes greater independence for students in providing their own therapy.

Settings and Staff

Manual 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. CPT using a mechanical vest can be performed wherever the privacy concerns of the student are respected. Some students may prefer remaining in the classroom.

CPT may be administered by the school nurse, family, 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.

Individual Health Care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who needs CPT, the following items should be considered:

- Student's underlying condition and possible problems associated with the condition or treatment
- Health care provider orders for chest physiotherapy
- 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
- Possible need for suctioning
- Standard precautions

Sources:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 188-193.

UTMB Respiratory Care Services. (2014). *Chest physiotherapy using the vest*. Available online: http://www.utmb.edu/policies_and_procedures/Non-IHOP/Respiratory/Respiratory_Care_Services/07.03.11%20Chest%20Physiotherapy%20Using%20the%20Vest.pdf

Hockenberry, M., & Wilson, D. (2015). *Wong's nursing care of infants and children* (10th ed.). St. Louis: Elsevier Mosby, 1143-1145.

Porter, S., Branowicki, P., & Palfrey, J. (2014). *Supporting students with special health care needs: Guidelines and procedures for schools* (3rd ed.). Baltimore: Paul H. Brookes Publishing, 376-378.

Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis, 1053.

Oklahoma Guidelines for Healthcare Procedures in Schools

Procedure for Manual Chest Physiotherapy (CPT)

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 at least one hour has passed since the student has eaten.
3. Check health care provider orders for CPT and frequency prescribed.
4. Perform a baseline respiratory assessment.

    Student may be placed on a pulse oximeter during CPT because desaturation may occur during CPT.
5. 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.
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 amount of time specified in student's IHP.

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, not a slapping 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.

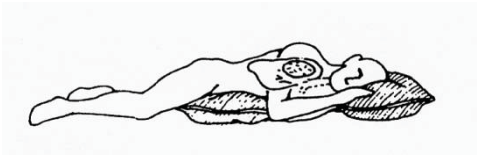
  Vibration is done with a firm, shaking pressure applied to the chest wall during exhalation. Vibration may shake mucus loose or increase the velocity and turbulence of exhaled air, facilitating mucus removal.

- Instruct student to cough into tissue following percussion of each location. Discard used tissues into lined wastebaskets.

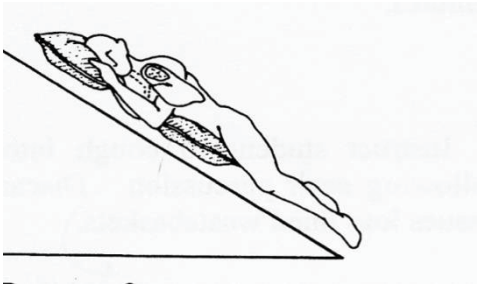
  Coughing is most effective if the student is sitting up so that diaphragmatic excursion is maximal. Ideally, the student should take several deep breaths and then follow the last breath with a deep cough. Initial coughing attempts may not produce sputum. As further positioning and percussion are provided, 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:

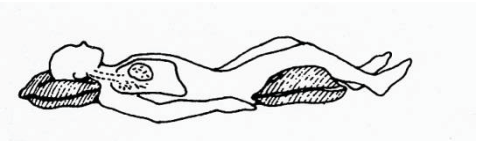
   - Position 1—student on stomach with right side of torso and right arm elevated on pillow—*used for percussing posterior segment of right, upper lobe, over right scapular area. Depending on the student's weight, additional pillows may be needed to obtain desired elevation in all positions.*



   - 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.*

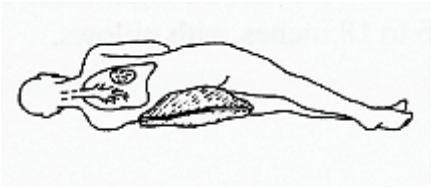


- Position 3—student flat on back with pillows placed under head and knees—*anterior segments of the right and left upper lobes, between the clavicle and nipple area.*



- 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.*

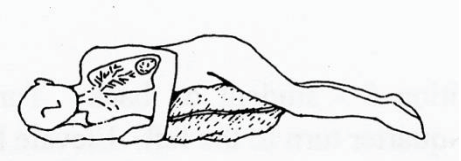


- Position 6—student flat on stomach with pillows under stomach and lower legs/feet—*for apical segments of right and left lower lobes, over lower scapular area.*

- 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.

Procedure for Chest Physiotherapy (CPT) Using a Vest

CPT performed in school is usually now done by a vest using high frequency chest oscillation. The student puts on a vest which rapidly fills and deflates, gently compressing and releasing the chest wall 10-25 times per second. The process, High Frequency Chest Wall Oscillation, helps thin thick mucus and creates mini-coughs that dislodge mucus from the bronchial walls and makes it easier to move out of the airways. A typical treatment takes 15-20 minutes, does not require special positioning, and is not as labor intensive as manual CPT. It promotes independent functioning as students learn to perform the procedure on their own.

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

    Choose a time for the procedure when at least one hour has 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. Check health care provider's order for CPT using a vest and note pressure and frequencies prescribed.
5. Connect air hoses as directed for the brand of vest being used.
6. Have student put on the vest.
7. Begin treatment by pressing the on button.

    Some vests require pressing the button twice--once to inflate and a second time to start the oscillations.
8. Some brands turn off automatically when the prescribed time of treatment has passed.
9. Have student remove the vest and cough up any mucus.
10. Document CPT on student's health record or treatment log.

Sources:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 188-193.

UTMB Respiratory Care Services. (2014). *Chest physiotherapy using the vest*. Available online: http://www.utmb.edu/policies_and_procedures/Non-IHOP/Respiratory/Respiratory_Care_Services/07.03.11%20Chest%20Physiotherapy%20Using%20the%20Vest.pdf

Hockenberry, M., & Wilson, D. (2015). *Wong's nursing care of infants and children* (10th ed.). St. Louis: Elsevier Mosby, 1143-1145.

Porter, S., Branowicki, P., & Palfrey, J. (2014). *Supporting students with special health care needs: Guidelines and procedures for schools* (3rd ed.). Baltimore: Paul H. Brookes Publishing, 376-378.

Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis, 1053.

Use of Mechanical Ventilators

This section provides a general overview of basic ventilator terminology, appropriate personnel, and possible problems and emergency management. It is NOT intended to be used as 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 detailed individualized health care plan describing specific guidelines for that student's ventilator and care.

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, shell (cuirass) ventilator, and the body wrap (raincoat) ventilator are much larger and used primarily for neuromuscular disorders. They are rarely encountered in the school setting.

The ventilator can provide total respiratory support for a person 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.

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 the Appendix.

Staff Preparation

Care of the student assisted by a ventilator should be performed by a qualified registered school nurse or respiratory therapist, or licensed practical nurse or other specifically trained unlicensed assistive personnel under the supervision of a registered school nurse.

Providing educational services to a student assisted by mechanical ventilation is a complex and challenging commitment. There are various health care delivery service models, and some utilize nonmedical personnel to provide ventilator care.

All caregivers should:

- Be aware of state nurse practice acts that may specify current care delivery and delegation issues
- Be trained in student-specific ventilator procedures due to the technical and unique nature of care
- Be immediately available to the student who is dependent on mechanical ventilation in all school environments, including the classroom and transportation vehicle
- Understand the amount of assistance each student requires from the ventilator
- Know specialized cardiopulmonary resuscitation for students with tracheostomies

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.

Individual Health care Plan (IHP)

Each student's IHP must be tailored to the individual's needs. A sample plan is included in Appendix A. When preparing an IHP for a student who requires the use of a ventilator, the following items should be considered:

- Underlying condition and the possible problems arising from the condition or treatment
- Health care provider's orders for ventilation and settings
- Degree of ventilator dependency
- Ventilator settings and the frequency that settings should be checked
- Student's ability to request assistance
- Baseline respiratory status
- Signs and symptoms of respiratory distress (e.g., cyanosis, agitation)
- Appropriate response to ventilator alarms
- Personnel needed to provide qualified care
- Plan for caregiver absences
- Back-up power supply available at all times (e.g., battery, generator)
- Written emergency plan
- Emergency card with ventilator settings posted near ventilator at all times
- Phone list with numbers of family, health care providers, home care agency, and medical equipment supplier
- Routine suctioning schedule and guidelines/indications for additional suctioning
- Tracheostomy tube size and type
- Plan 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 precautions
- Standard precautions

Source:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

California Thoracic Society. (2010). *Home care of children on ventilators: A parent's guide*. Available online: http://www.calthoracic.org/sites/default/files/Vent_Dependant_Children_booklet_0.pdf

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McDonald, J. (2004). *Ventilator Awareness: An Educational Resource for School Teachers*. Tracheostomy.com. Available online: http://www.tracheostomy.com/resources/pdf/ventilator_awareness.pdf

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Ventilator Safety Checks

Standard ventilator features should be checked each day when the student arrives at school and more often as specified by the student's IHP. Setting up a routine is highly recommended.

Note: Family provides equipment and supplies.

1. Before focusing on the machines and devices, focus first on the student--assess breathing and general health.
2. Are the ventilator settings the same as ordered by the health care provider? Check each setting. Make sure a card with ventilator settings is posted near the ventilator at all times. Keep the ventilator out of direct sunlight.
3. Check the power source:

   Power source must be available and **must be connected for machine to function.** Outlets must be accessible and grounded**.** No other devices should be plugged into the outlet (to help to avoid a short from occurring).

   - 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. Make sure the external battery is not touching the ventilator because the battery might heat up and be damaged.

   - Back-up battery

     The back-up battery may be kept at home.

   - Emergency power supply
4. Check ventilator circuit. Drain tubing of excess water. Check for kinks in the tubing. 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 equipment 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 always 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.

5. Check oxygen source (if prescribed for the student):
    - Adequate supply of oxygen, functioning gauge, and 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
6. Check humidification source:

   Any student whose nose and mouth are bypassed by a tracheostomy tube needs a source of humidification. The humidifier must have an adequate amount of water and be set at a safe temperature. Make sure the student's head is higher than the humidifier. Many students use a heat-moisture exchanger (HME) for humidification. Check the "artificial nose" (HME) to make sure it is not wet or dirty (can set off the high-pressure alarm).
    - Heat-moisture exchanger
    - Passive condenser
7. Check alarms:

   Alarms should never be turned off. *All ventilator alarm settings should be written on the emergency card posted on a visible side of the ventilator.*
    - High and low pressure
    - Volume
    - Power source
8. Other equipment that should be checked daily:

   Each student with a ventilator should have a "go bag" containing all of these supplies.
    - Manual resuscitation bag and adaptor or mask
    - Spare tracheostomy tube and supplies
    - Suctioning equipment

Source:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

California Thoracic Society. (2010). *Home care of children on ventilators: A parent's guide*. Available online: http://www.calthoracic.org/sites/default/files/Vent_Dependant_Children_booklet_0.pdf

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Selekman, J. (2013). *School nursing: A comprehensive text* (2nd ed.). Philadelphia: F.A. Davis1053-1054.

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 the student's IHP, or more frequently if the student's status changes. A clearly-visible card, stating the student's ventilator settings, should be mounted on the ventilator.

- **Tidal Volume (V_T)**
  The amount of air (cc's) in each breath, is determined by the student's size.

- **Respiratory rate**
  Number of breaths per minute delivered by the ventilator; also called frequency.

- **Oxygen**
  Delivered in liters/minute. Order usually specifies desired O_2 saturation level.

- **Peak inspiratory pressure (PIP)**
  Amount of pressure required to inflate the lungs to the prescribed tidal volume.

- **Positive end expiratory pressure (PEEP)**
  Amount of pressure needed to keep the lungs from collapsing after exhalation.

- **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.

- **Sigh volume**
  Large, ventilator-delivered breath that is usually 1 1/2 times as large as the tidal volume

Sources:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

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Ventilator Modes

- **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.

- **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. This 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.

- **Pressure support ventilation (PSV)**
  When the child takes a spontaneous breath, the ventilator delivers a preset sustained peak pressure throughout the inspiratory phase, thus resulting in increased tidal volume. the higher the pressure support, the larger the tidal volume.

- **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.

- **Continuous positive airway pressure (CPAP)**
  A constant elevated level of airway pressure is maintained during inspiration and expiration with each spontaneous breath the child takes. Essentially PEEP without ventilator-delivered breaths of any type. It is student triggered and terminate.

- **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.

- **Pressure regulated volume control (PRVC)**
  A preset peak inspiratory pressure and preset tidal volume are maintained during each spontaneous breath. This may be used as a supplement, such as with a student who has muscular dystrophy.

Ventilator Alarms

Ventilator alarms must remain on at all times.

- **High-pressure alarm**
  This reflects an excessive inspiratory pressure. This may indicate increased resistance or obstruction. Commonly caused by:

  - Coughing--can briefly cause "back pressure" in the tubing
  - Airway obstruction--can be caused by a mucous plug
  - Bent or kinked tubing
  - Excessive water in the tubing
  - A new piston seal that is tight
  - Changes in student's breathing--e.g., breathing hard and fast

- **Low-pressure alarm**
  This indicates a too-low inspiratory pressure. Warns of a leak in the system; may signal that adequate volume is not being delivered. Commonly caused by:

  - ventilator tubing becoming disconnected
  - loose connection in the tubing circuit
  - leaks in the exhalation valve
  - humidification jar not tightly closed
  - exhalation and pressure tubing have been accidentally switched
  - cracks, tears, or holes somewhere in the tubing

- **Power source alarm**
  Indicates a change in power. Alarms should never be turned off. This may provide warning when battery source is getting low.

- **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. Check water level and assess connections.

Possible Problems When Using a Ventilator that Requires Immediate Attention

- **Respiratory distress**
  - **increased shortness of breath**
  - **agitation**
  - **blueness or pallor of lips or nail beds**
  - **retractions (pulling in of chest muscles)**
  - **rapid or pounding pulse**
  - **confusion**

  Immediately check and reassure the student. Call for assistance. **Never leave the student alone.**

  Check:

  - if student needs suctioning
  - for occlusion of the tracheostomy tube by a plug or secretions
  - whether student may be coughing or doing something else to raise pressure transiently for a dislodged tube or other airway problems
  - connections to the ventilator
  - exhalation valve to see if it is obstructed
  - power source for ventilator
  - adequacy of oxygen supply

  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. (See tracheostomy section).

- **Blocked tracheostomy**
  Suction tracheostomy. If still blocked, replace trach.

- **Increased secretions**
  Suction tracheostomy more frequently.

- **Wheezing**
  Check student's IHP. Administer bronchodilators or give nebulizer treatment, if ordered. Notify school nurse and family if continued wheezing. Consider tracheostomy tube change if not resolved with nebulizer and suction. This may be partially occluded by retained secretions.

- **Respiratory distress persists or student becomes unconscious**
  Activate school emergency plan immediately. 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--check:

  - water condensation
  - connections
  - leaks
  - valves, tubing, circuit for obstruction
  - power supply

  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's IHP. **Activate school emergency plan**.

- **Interrupted power supply (outage, equipment malfunction)**
  Ventilate student with manual resuscitator 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**

  Always check the student first.

  - The student may have mucus plugging the tracheostomy tube and need suctioning.
  - Check position of tracheostomy tube and correct as needed. New tube may be needed.
  - If the student is coughing, sneezing, talking, or laughing, pressure may temporarily be raised enough to activate the alarm.
  - Assess for bronchospasm and follow student's IHP.
  - If student is anxious and "fighting" the ventilator, the high pressure alarm may be activated. Attempt to calm student.

  Remove the student from ventilator and give breaths with manual resuscitation bag and then check ventilator.

  - Check tubing for kinks.
  - Check for condensation (water) in the tubing.
  - Check exhalation valve to make sure it is not being obstructed.
  - Check ventilator settings for accidental change.

  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.**
  Always check the student first.

  - Circuit tubing may be disconnected from ventilator. Reconnect.
  - Check for loose connections, leaks or cracks in system. Tighten, if needed.

- Check tracheostomy tube for correct placement.
- If student has a cuffed tube, check for leak in cuff.
- Replace exhalation valve if it is wet or punctured.
- Check for accidental change in ventilator settings.

Remove the student from ventilator and give breaths with manual resuscitation bag and check the ventilator.

Test system after cause of problem is found and 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.** 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 manual resuscitation bag and activate the school emergency plan.**

Source:

Bowden, V., & Greenberg, C. (2012). *Pediatric nursing procedures* (Third ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

California Thoracic Society. (2010). *Home care of children on ventilators: A parent's guide*. Available online: http://www.calthoracic.org/sites/default/files/Vent_Dependant_Children_booklet_0.pdf

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Checking the Ventilator

The California Thoracic Society has developed an "A-B-C-D" acronym to help in remembering what to check first in an emergency with a ventilator.

A is for Airway

1. Check the tracheostomy tube is in place. Ventilator alarms might not go off even if a tracheostomy tube has fallen partly—or all of the way—out.

2. Suction the trach and make sure that air is moving through it.
3. When in doubt, change the tracheostomy tube.
4. If none of these steps help, then start CPR.

B is for Breathing Machine (i.e., mechanical ventilator)

1. If the trach isn't plugged and it is in the right place, then check the ventilator.
2. Are the settings right?
3. Which alarm is going off?
4. Is the ventilator working at all? Make sure the electrical cord is plugged all the way in to the back of the ventilator and into the wall outlet.
5. Check to make sure that the ventilator tubing is free of excess moisture.
6. Check the battery.
7. **When in doubt—and if your child looks blue or lethargic—use the manual resuscitation bag (Ambu-bag™) to resuscitate by hand, and then switch to the back-up ventilator. Use oxygen with the Ambu-bag™.**

C is for Child

1. Once you are sure that there is no problem with either the airway or the breathing machine, look at the child from head to toe. Is he coming down with an illness? Is the child irritable or less alert? Does the child interact with caregivers? Notice if a fever, an increase or change in secretions, sweating, or fast heartbeat are present.

D is for Discussion with your doctor

1. If the child is in extreme distress, call 9-1-1.
2. If the child seems okay, but showing some respiratory symptoms such as coming down with a cold, notify the parent. Recommend that the parent call the doctor to let him/her know the child is behaving differently than normal. The health care team is relying on daily caregivers to provide information about changes in assessment.

California Thoracic Society. (2010). *Home Care of Children on Ventilators: A Parent's Guide.* p. 39-40.

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

Contact_____at_____(phone number) for additional information or if the student experiences any problems 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.