



Paediatric Tracheostomy

This learning module is intended as a review of foundational knowledge for practitioners in the community working with children with a tracheostomy and their family. In order for the associated workshop to be effective it is recommended this module be completed prior to the session.

Contents

Introduction

Learning Outcomes

Paediatric Respiratory System

Conditions leading to airway compromise in children

Types of Tracheostomy Tubes

Caring for the child with a Tracheostomy

Developmental Considerations

Potential complications

Emergency equipment

Cardiopulmonary Resuscitation

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Learning Outcomes

- ✓ Review the anatomy and physiology of the paediatric respiratory system
- ✓ Identify indications for a tracheostomy
- ✓ Describe implications of developmental stages
- ✓ Summarize key child safety factors when caring for a child with a tracheostomy.
- ✓ Describe evidence based care for a tracheostomy.
- ✓ Identify emergent situations and appropriate interventions

Suggested Supplemental Resource

Trach/Vent Caregiver Manual <https://www.aboutkidshealth.ca/trachvent>

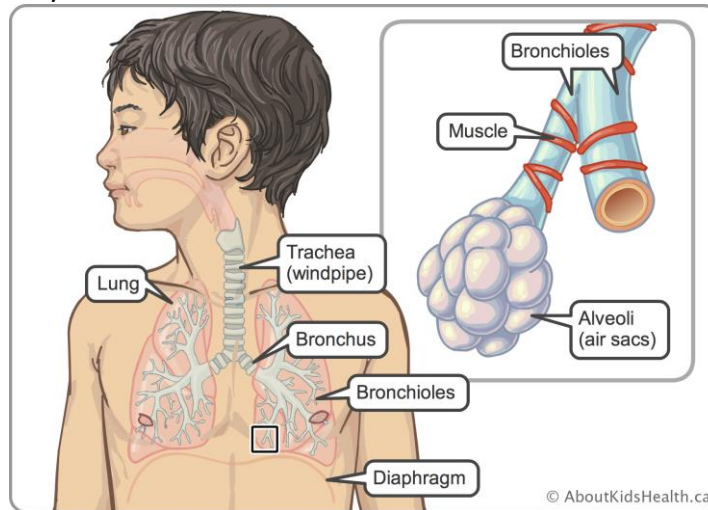
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The Paediatric Respiratory System

Understanding how a child [breathes](#) is an important part of learning how to care for your child's tracheostomy.

A child's respiratory system can be broken down into the:

- upper respiratory tract
- lower respiratory tract



Anatomy

Upper respiratory tract

Nasal cavity

Air is warmed, moisturized and cleaned. Tiny hairs called **cilia** line the inside of the nose and filter the air.

Oral cavity

Air is warmed and moisturized however, there are no cilia in the oral cavity, so the air is **not** filtered.

Pharynx

The **pharynx** is a muscular tube between the nose and the mouth.

Larynx (voice box)

The larynx (voice box) is between the pharynx and the trachea. It contains the vocal cords. When air is breathed in and out, voice sounds are created here. *The vocal cords* can be closed to build up pressure in the lungs and create a strong cough.

Epiglottis

The epiglottis is a flap that hangs over the larynx. When you swallow, this flap covers the larynx so food and/or drink will go into the esophagus and not into the trachea and lungs.

Esophagus

The esophagus is the feeding tube that connects the pharynx and the stomach.

Lower Respiratory Tract

Lungs

The lungs are the two organs used for breathing in the body. The lungs take in oxygen from the air and release carbon dioxide.

Trachea

The trachea is the breathing tube that connects the larynx to the lungs. This is where a tracheostomy tube is inserted.

Bronchi and bronchioles

The trachea divides into two hollow tubes called bronchi, which supply air to each lung. The bronchi divide into smaller and smaller hollow tubes called bronchioles. These are the smallest air tubes in the lungs.

Alveoli

The alveoli are tiny sac-like structures at the tip of the bronchioles. They allow oxygen and carbon dioxide to move in and out of the lungs.

Pleura

The *pleura* are membranes that surround the lungs. The *parietal pleura* is the outside membrane. The *visceral pleura* is the inside membrane, attached to the lungs.

Capillaries

The capillaries are blood vessels in the walls of the *alveoli*. Blood flows through the capillaries, removing carbon dioxide and picking up oxygen.

Respiratory Muscles

Diaphragm

The diaphragm is a large, sheet-like muscle. The diaphragm is the main muscle involved in breathing. It is **always** active.

Neck muscles

If a child is having difficulty breathing, the muscles of the neck can help.

Intercostal muscles

The intercostal muscles are the muscles between the ribs.

Abdominal muscles

The abdominal muscles help move air in and out of the lungs. They also help to create a good strong cough.

Respiratory Distress in Children

When a child is having difficulty breathing (respiratory distress), you may see one or more of the following signs.

Early signs of respiratory distress

- Coughing
- Abnormal breathing sounds such as wheezing
- Anxiety or restlessness in your child that cannot be calmed with normal comforting
- Faster heart rate or breathing than normal
- Fever

If the child has an increased heart rate or breathing, try to calm them down and see if their heart rate and breathing rate return to normal.

Late signs of respiratory distress

- “Rattling” in the child’s chest or back
- Obvious distress or agitation
- Retractions
- Nasal flaring
- Tripod position (sitting or standing while leaning forward and supporting the upper body with hands on the knees or on another surface)
- Cyanosis
- Sleepiness or unresponsiveness

If there is a “rattling” sound when the child breathes, encourage them to try to cough up the mucus to clear their lungs. Cyanosis indicates that the child is not getting enough oxygen. Unresponsiveness indicates that the child has a high level of carbon dioxide in their lungs.

Indications for a Tracheostomy

There are several broad categories of anomalies that could lead to airway obstruction in infants and children resulting in the need for a tracheostomy tube. They include:

1. Syndromes and congenital deformities that may lead to chronic airway obstruction
2. Traumatic Injuries which may lead to damage of the airway or neurologic injury preventing the child from protecting their airway or removing secretions
3. Inflammatory and infectious diseases that cause permanent or temporary swelling or irritation leading to acute obstruction.

Types of Tracheostomy Tubes

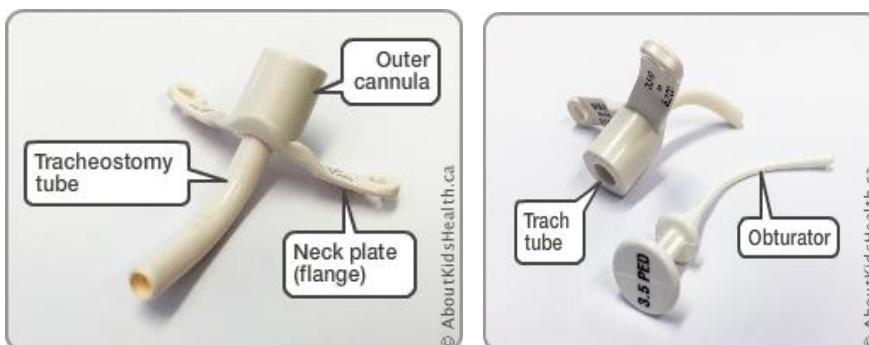
Tracheostomy Tube

This is a curved hollow tube that can be made of polyvinyl chloride (PVC), polyurethane, silicone or a combination. PVC is the most commonly used material. Although less common, tracheostomy tubes can also be made of stainless steel or silver. Tracheostomy tubes are inserted into the trachea through the stoma in the neck. They can have two or three parts. Two-part tracheostomy tubes are most commonly used in children.

Two-part tracheostomy tube

A two-part tracheostomy tube consists of an

- obturator
- outer cannula with a flange (neck plate)



Three-part tracheostomy tube

A three-part tracheostomy tube consists of an:

- obturator
- outer cannula with a flange (neck plate)
- inner cannula.

The obturator fits inside the tracheostomy tube and helps guide the tracheostomy tube through the stoma during insertion. The inner cannula sits inside the outer cannula and can be

removed and re-inserted without having to do a complete tracheostomy tube change. This type of tracheostomy tube is beneficial for children with a lot of secretions.

A tracheostomy tube can be uncuffed, cuffed, re-enforced or custom made or have an extended flange.

Cuffed Tracheostomy Tubes

A cuffed tracheostomy tube has a balloon on the outside of the tube. When the balloon is inflated, it gently seals the airway to prevent air or fluid from passing around the cuff. One result of this is that air cannot reach the child's voice box, meaning that the child cannot speak when the balloon is inflated. However, the tracheostomy tube balloon is sometimes deflated to allow them to speak. If a cuffed tracheostomy tube is used, a plan will be developed for when the cuff should be inflated or deflated.

Uncuffed Tracheostomy Tubes

When a tracheostomy tube is uncuffed, some air may be able to pass up and around the tracheostomy tube, the vocal cords, the mouth and nose. Some children can make sounds around their tracheostomy, but others cannot.

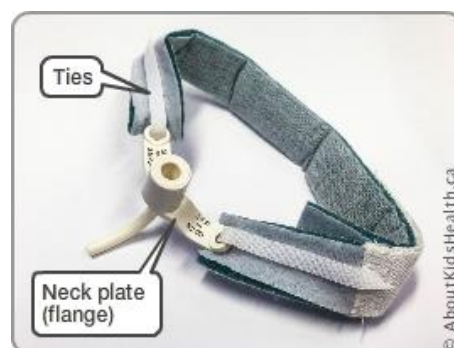
Fenestrated Tracheostomy Tube

A fenestrated tracheostomy tube is similar to other tracheostomy tubes, but it has holes in the outer cannula to allow air to pass from the child's lungs up through their vocal cords and out through their mouth and nose. It can also be used as a step on the way to removing the tracheostomy tube. The fenestrated tracheostomy tube lets your child:

- speak using their vocal cords because it allows air to pass through the larynx and between the vocal folds
- cough out secretions (mucus) through their mouth

Securement

The tracheostomy tube is secured with tracheostomy ties. These ties can be made of cotton, foam or nylon padding or, most commonly, Velcro. They attach to either side of the neck plate and go around the neck. Some ties also offer a moisture wick lining to keep skin dry and reduce breakdown.



Speaking Valve

A speaking valve, for example a Passy Muir valve™ (PMV), is a one-way valve connector that is placed on the end of a child's tracheostomy tube to allow for speech.

The speaking valve allows the child to breathe in through the tracheostomy tube but does not allow air to pass through the tracheostomy tube when they breathe out. Instead, airflow is redirected through the vocal folds, mouth and nose, which allows for vocalizations and speech.

The tracheostomy tube cuff must be deflated to allow air to pass through the vocal folds. The valve opens while the child breathes in and then closes. All the air is breathed out through the vocal folds, mouth and nose. This way the air cannot pass through the tracheostomy tube on its way out.

Caring for the Child with a Tracheostomy

The following information will provide you with an overview of the important aspects of care for a child with a tracheostomy. **It is important to note that children with a tracheostomy require 24/7 eyes on care by an awake, alert and trained caregiver.**

The procedures required to care for a child with a tracheostomy will be discussed and demonstrated in more detail in class. All procedures must be practised under the supervision of someone with appropriate knowledge, skill and judgement to perform the procedures before you would care for a child with a tracheostomy independently. It is important to note the child's developmental stage when providing care. Monitoring for potential safety hazards and incorporating play and independence when appropriate is an important aspect of care.

Caregiver support and education

It can be very frightening to families when they learn that their child's breathing and their survival will depend upon a small tube. It is important to allow families to discuss how they feel and to ask questions about their child before and after the tube is inserted.

The child's nurse and respiratory therapist can assist in the education by demonstrating expert care and supporting the family members as they continue to practice. Family members will eventually provide care independently in the hospital before going home.

Tracheostomy Tube Care

Child Monitoring

Children who are unable to protect their own airways must be cared for in a location where they can be constantly observed and assessed by care providers who are competent in artificial airway management. Electronic monitoring, such as an oxygen saturation monitor should also be used when the child is sleeping or in bed.

Stoma Care

The skin around the stoma must be kept clean and dry to prevent irritation, breakdown and infection. Do not use lotions and powders because there is a risk the child can breathe this into the lungs. Assess the stoma for signs of an infection. Signs to watch out for include redness, swelling, yellow or green mucous, dry mucous, unpleasant smell, pain, tenderness or extra tissue growth. Discuss with the child's caregiver if any of these are noted. Clean the stoma twice a day and ensure the area is clean and dry at all times. If the skin around the stoma appears red, swollen or is tender to touch, clean the stoma more often (i.e. every 8 hours).

Tube Changes

Tracheostomy tubes are routinely changed once a week, but can be changed more frequently as needed. Tracheostomy tubes may also need to be changed in what would be considered an emergency situation if the tube is blocked and unable to be cleared by suctioning or if the tube falls out. In this case, take out emergency tracheostomy kit and locate same size backup tube and reinsert. If unable to reinsert, then proceed to a size smaller tracheostomy tube. If still unable to insert, call 911 and intervene with CPR if indicated. Routine tracheostomy tube changes should be performed by two people: a main person and an assistant. In case of emergency, one person may perform a tracheostomy tube change.

Keeping the tracheostomy ties clean and dry will prevent skin irritation, sores and infections in the skin around the neck. Ties should be changed daily or more often if they are dirty. There should always be two people present when changing the ties. One person will hold the tracheostomy tube in place while the other person cleans the skin and changes the ties. If a second person is not around to help, attach the clean ties first and then remove the old ties.

Tube Cleaning

Proper cleaning technique is important to prevent infection. The child with a tracheostomy does not have many of the natural infection preventing physiological aspects that the upper airway provides, such as cilia, mucus in the nasal passages, and the ability to effectively sneeze out irritants.

The caregiver for the child with a tracheostomy is responsible for ensuring all equipment is clean, dry and available for use as all times. Tracheostomy tubes must be cleaned and new ties attached securely as soon as possible after changing so that it is available for any possible emergency involving the tracheostomy.

Plastic (PVC) tracheostomy tubes and obturators: Clean these every time tracheostomy tube is changed

Silicone tracheostomy tubes and obturators: Clean these every time tracheostomy tube is changed

Reusable inner cannulas: Clean 2–3 times per day or more often if dirty or if there is a lot of mucus

Disposable inner cannulas: Do not clean or re-use these

Disposable corks or caps: Do not clean and or re-use these

Reusable corks/caps: Clean daily

Proper cleaning of tracheostomy equipment helps prevent lung infections.

Plastic reusable tracheostomy tubes (e.g. Shiley), inner cannulas, obturators and corks can be cleaned and re-sterilized up to *three times* before discarding them. Silicone tracheostomy tubes (e.g. Bivona) can be cleaned and re-sterilized up to *five times* before discarding them. These tubes have a special Superslick® coating that keeps mucus from sticking to them. Do not scrub tubes too hard or the coating will come off.

Suctioning

Suctioning the tracheostomy tube keeps the airway clear. The following signs may indicate that suctioning is required:

- Not able to cough up mucous
- Breathing sounds harsh or the child is having difficulty breathing
- Mucous is visible in the tracheostomy tube
- Difficulty maintaining oxygen saturation

There are five ways to suction the parts of your child's airway:

- nasal suction (suctioning the nose)
- oral suction (suctioning the mouth)
- tracheostomy tube: tip suctioning
- tracheostomy tube: tube suctioning
- tracheostomy tube: deep suction

Nasal suctioning

With nasal suctioning, a catheter is passed through the nose to the back of the throat.

Oral suctioning

For oral suctioning, a large, plastic suction catheter called a Yankauer is used to suction secretions in the mouth.

It is useful when the child is:

- unable to remove secretions by coughing (for example, they have a weak cough)
- drooling because they cannot swallow.

Tip suctioning

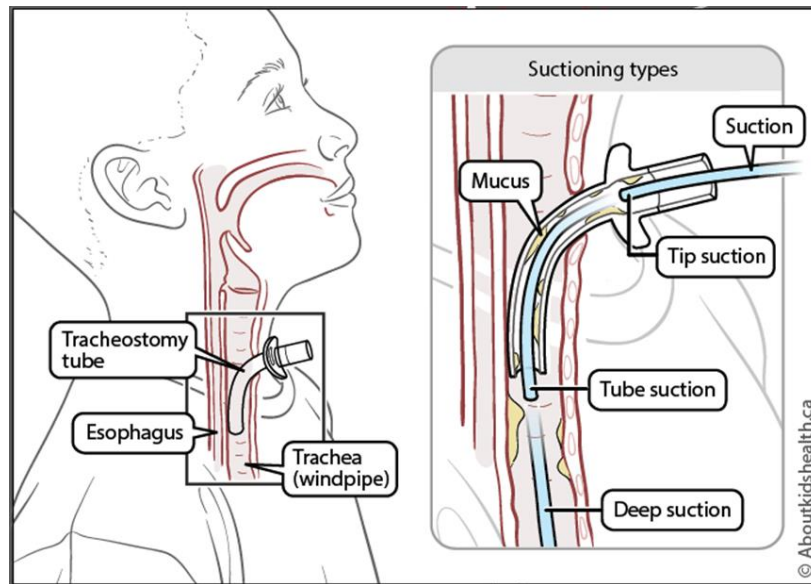
Tip suctioning involves using a catheter to suction mucus from just the opening of the tracheostomy tube.

Tube suctioning

Tube suctioning involves removing mucus from the full length of the tracheostomy tube, including just past the far end of the tube. The depth for suctioning can be obtained by inserting the catheter into the spare tube to the distal end. One easy method is to record the correct measurement on a piece of tape and attach it to the child's bed for quick reference. Except when necessary, tube suctioning should not be done within 1 ½ hours after meals to prevent inducing vomiting. The suction catheter should not be greater than half the diameter of the tracheostomy tube.

Deep suctioning

Deep suctioning removes mucus from the child's airway between the end of the tube and the carina (the part where the trachea splits into the bronchi, the tubes that go into the lungs). Deep suctioning has a greater tendency to cause tissue damage in the bronchi, therefore, should only be performed when prescribed by an MD/NP.



Suction machines

No matter what type of suctioning is performed, a suction machine will be required.

There are portable suction machines and stationary suction machines. At least two suction machines should be available in the home, in case one machine breaks down. At least one of these suction machines should be portable.

Humidification

Proper humidification keeps mucous thin and makes it easier for the child to cough up. If the air is too dry, the child may have:

- thick secretions
- an ongoing cough
- secretions that are slow to move up the suction catheter during suctioning
- secretions that collect on the outside of the catheter during suctioning
- secretions that collect on the inside of the tracheostomy tube (mucus plugs), causing partial or complete blockage

There are four types of humidifiers:

- heat and moisture exchanger (HME)
- non-heated humidifier (large volume nebulizer)
- heated high flow humidifier (for example, Airvo)
- heated humidifier (for example, Pass-over).

Heat and Moisture Exchangers (HME)

A heat and moisture exchanger (HME) is a filter-like sponge that attaches to the tracheostomy tube.

Points to note about HMEs

- HMEs provide less humidification than the other devices.
- Children with a lot of secretions are sometimes not able to use an HME because their secretions cannot be properly cleared with the HME in place.
- For some children, using an HME makes it harder to breathe.
- Discuss with the caregiver/healthcare team about whether an HME is the right choice

Non-heated Humidifiers (Large Volume Nebulizers)

In a non-heated humidification system, the air is humidified, or moistened. With this type of humidifier, the air is humidified but *not* warmed. If necessary, oxygen can also be provided as part of this type of humidification system. Mist is formed as water passes into a nebulizer bottle. This mist travels through tubing to a mask that goes over the tracheostomy.

Precautions when using a non-heated humidifier

- The cool air from this humidifier can lead to bronchospasm and wheezing.
- Over-hydration (too much water) can lead to increased suctioning.
- If secretions are thick and stuck in the airway, sometimes humidification can cause them to expand and block the airway.
- *Never* drain the water from the tubing into the nebulizer bottle.

Heated High Flow Humidifiers

In a heated high flow (HHF) humidification system (e.g. Airvo), the air is both humidified and warmed. If necessary, your child can also receive oxygen as part of this type of humidification system.

Points to note about heated high flow humidifiers

- The government does not provide funding for this type of humidifier, so the family must pay all equipment costs.

Heated Humidifiers

Heated humidifiers (e.g. Pass-over) are used for children who use a ventilator attached to a tracheostomy tube. The air from the ventilator passes over heated water to become warmed and humidified before it enters the child's lungs.

Oxygen Therapy

Some children with a tracheostomy will require oxygen therapy. There are multiple ways to deliver oxygen to a child, such as nasal cannula, venture device, tracheostomy mask, HME with oxygen or heated high flow. It is important to understand which method the child is receiving in the home. Oxygen saturation monitoring using an oximeter may be required while the child is receiving oxygen. Ensure the oxygen probe is placed correctly on the child. Safety precautions should be taken when using oxygen therapy. This includes notifying the local fire department about the use of home oxygen therapy, keeping the oxygen supply at least six feet away from sources of heat or fireplaces, storing oxygen supply in a well ventilated area and avoiding the use of petroleum based products (e.g. Vaseline) on the face.

Types of home oxygen therapy systems

There are three types of home oxygen therapy systems:

- concentrator (stationary or portable)
- oxygen cylinders
- liquid systems

Concentrator (stationary or portable)

- This machine makes oxygen by taking in room air and sifting out the oxygen.
- It is electrically or battery operated.
- Because the oxygen concentrator "makes" the oxygen, it does not need to be replaced or refilled regularly.
- A stationary unit is often placed in the home with backup oxygen cylinders in the event of a power failure.
- Portable oxygen concentrators (POX). It is also often used as a short term solution for traveling.

Oxygen cylinders

- The cylinders are made of either aluminum or steel. They contain oxygen in a gaseous form.
- There are different cylinder or tank sizes. Larger tanks (sizes E and H) are used in hospitals or as a back up to concentrators in the home. Smaller tanks (sizes E or smaller) can be used inside the home, for outings or for travel.
- Regardless of the size of the cylinders, each comes with a pressure gauge to let you know how much pressure there is in the tank. This gives you an idea of how much oxygen is left in the tank. When full, the gauge reads 2200 pounds per square inch (psi) and when empty, it will read 0 psi.
- PSI is a measurement of pressure of a gas or liquid.
- The length of time the oxygen cylinder will last depends on the child's oxygen flow rate. Ask your medical vendor how long one cylinder will last based on the flow rate you/your child is using as recommended by your healthcare team.
- The disadvantage with cylinders is that they can run out quickly when used continuously at a high flow rate.

- Hot temperatures can affect tanks and liquid units.

Always, check the portable tanks before you leave the home to ensure you will have a sufficient supply of oxygen based on your anticipated time being away from home. Make sure you plan for unexpected delays!

Liquid system

- It is gaseous oxygen that has been cooled and compressed until it becomes a liquid
- The liquid is kept in large stationary containers called reservoirs.
- The liquid turns into gas before it leaves the container and it remains a gas when it is breathed in
- The liquid reservoirs must be refilled on a regular basis by the oxygen supply company
- There are 2 main advantages to using the liquid oxygen system:
 1. Lasts longer than the oxygen cylinders
 2. The families can fill a portable unit from the large liquid reservoir for travels outside the home
- The biggest disadvantage of liquid oxygen systems is the oxygen will eventually warm up and evaporate even if not used. If you are away from home for an extended period of time you may need to have the oxygen refilled.

Potential Complications

Tracheostomy Tube Blockage

A mucous plug is a common source of obstruction in a child with a tracheostomy tube, but can also be caused by foreign objects in the tube. If the tracheostomy tube cannot be cleared by tube suctioning or if the suction catheter cannot be inserted:

- If the tracheostomy has an inner cannula, remove it and attempt suctioning
- If unable to clear due to suspected obstruction, prepare to change the tracheostomy tube

Accidental De-cannulation

This may occur due to several reasons such as loose tracheostomy ties, sponges that are too thick or the child has pulled the tube out. If de-cannulation occurs:

- Prepare the child for a tracheostomy tube insertion and change tube
- If unable to get tube in, take out emergency tracheostomy kit and locate same size backup tube and reinsert. If unable to reinsert, attempt with ½ size smaller tracheostomy tube. If still unable to insert, call 911 and intervene with CPR if indicated.
- Observe child after for further signs of respiratory distress

Preventing Emergencies/Complications

- Ensure adequate humidity and suctioning to prevent the tracheostomy tube from plugging
- Ensure monitoring with an oximeter
- Ensure 24 hours eyes on care with an alert and awake caregiver
- Ensure that your child/infant is not pulling the tracheostomy out
- Ensure your child/infant is not putting anything into their tracheostomy
- Ensure that your child/infant is not unsupervised with another small child that may put objects in the tracheostomy or pull it out

Emergency Equipment

Tracheostomy Emergency Kit

- Spare tracheostomy tube with obturator of current size ensuring the tracheostomy ties are in place
- one size smaller tracheostomy tube
- Scissors
- Water soluble lubricant
- Normal saline nebulas
- Stoma care supplies (pre-cut or specialty gauze as needed, Q-tips, saline)
- 20 mL syringe with feeding tube attached (in case suction machine malfunctions)

Additional Travel Bag Equipment

- Manual resuscitation bag
- Suction machine
- Suction catheters of the appropriate size
- Oximeter with probes
- Plastic bag
- Wipes
- Spare oxygen tank (if applicable)

Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) is a lifesaving procedure that combines chest compression and artificial ventilation in a child/infant who is having/about to have a cardiac arrest. It is indicated for any child/infant who is unresponsive with no breathing or abnormal breathing.

CPR is important because it:

- preserves brain function
- restores blood circulation
- restores breathing

When a child or infant's heart stops beating it is usually not caused by a problem in the heart itself, unless your child has a primary heart problem. Most often, it is the result of a breathing emergency.

The causes of breathing emergencies can be broken into 3 groups:

1. There is not enough oxygen in the air
2. The heart and lungs are not working properly
3. The airway is blocked:
 - airway obstruction (choking or blocked tracheostomy tube)
 - allergic reactions
 - upper respiratory infection

When breathing stops or is ineffective, the body is deprived of oxygen. Immediate action to restore or assist breathing is important.

Breathing has stopped when:

- The chest does not rise and fall
- Air movement cannot be heard or felt

Ineffective breathing is when your child/infant has:

- Very slow and shallow breaths
- Very fast and shallow breaths
- Laboured and noisy breathing, gasping for air
- Sweaty skin
- Fatigue
- A bluish colour to the skin
- Decreased level of consciousness

****Refer to current Paediatric Basic Life Support guidelines**

Manual Resuscitation Bag

The manual resuscitation bag is a football-shaped device that can be attached to a tracheostomy tube and squeezed to help give breaths to the child via tracheostomy when they need help breathing or if they are unable to take breaths on their own. It can be disposable or reusable.

If a child decannulates and you cannot reinsert the same size or half size smaller tracheostomy tube, call 911 and provide supportive breaths via mouth to mouth or mouth to stoma breaths. If someone else is with you, have them call 911 while you provide the breaths or CPR as per current guidelines. If you are providing mouth to mouth breaths, the second person can also assist by gently placing their finger over the tracheostomy stoma site to prevent air leaking.

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