Aim

To develop the skills of the student caring for a child with a tracheostomy tube safely and effectively in the hospital and community setting.

Objectives

- Review the physiology of the upper airway.
- Discuss the altered physiology post tracheostomy.
- Identify reasons why tracheostomies may be performed in children.
- Examine the available tracheostomy tubes and assess their suitability for the child.
- List the appropriate equipment necessary for caring for a child with a tracheostomy.
- Outline the care of a tracheostomy tube.
- Discuss the resources required for a child with a tracheostomy to be discharged home.
- Outline the community support available and the roles of the health care professionals.
- Assess and identify potential problems that may occur and how these may be addressed.

Physiology

- The upper airway consists of the nose, mouth, pharynx and larynx.
- In children the larynx is higher in the neck compared to adults (Shinkwin and Gibbin 1996).
- The trachea is short and soft.
- Cartilaginous support is less firm.
- The trachea is narrowest at the cricoid ring which due to having a mucosal lining is more likely to swell as a result of trauma or inflammation (Corbidge 2004).
- The function of the respiratory tract is to warm, moisten and filter the air (Wilson et al 2002).
- During inspiration air gains heat and moisture from tissue of the respiratory tract equal to the core body temperature. On expiration heat and water vapour are lost through condensation (Sherman et al 2000).

What is a Tracheostomy?

“A tracheostomy is an artificial opening into the anterior wall of the windpipe (trachea) which is held open by the insertion of a tracheostomy tube”.

(Barnett 2005).
Indications for a tracheostomy

A tracheostomy may be temporary (used for a short time) or permanent. Here are some possible reasons for a tracheostomy:

- Need for long-term use of a ventilator (a machine that helps with breathing)
- Obstruction in the airway due to an accident, paralysis, surgery, or malformation:
  - Foreign Body
  - Severe infection
  - Trauma
  - Stenosis from prolonged intubation
- Allergic reaction
- Facial injury
- Cancer
- Prior to elective ENT surgery

Complications of a tracheostomy

- Reduction in the amount of respiratory effort (Woodrow 2003).
- Loss of humidity resulting in potential long-term complications (Corbridge 2004).
- Thick secretions.
- Tuberculosis.
- Bypassing of the nasal cavities - increased risk of pulmonary infections (Archer 2000).
- Reduction in intra-abdominal pressure resulting in a loss effective cough reflex.
- Irritation of the trachea - increased production of secretions, potential risk of aspiration.
- Loss of speech.

Types of Tracheostomy tubes

There are various types of tracheostomy tubes currently available:

- Divided into two main groups:
  - Cuffed
  - Uncuffed

- These are subdivided into:
  - Fenestrated (Hole in the outer cannula)
  - Un-fenestrated
  - with inner tubes
  - without inner tubes

Cuffed Tubes

- The tracheal cuff on an artificial airway provides a seal that allows positive pressure ventilation and may prevent aspiration (Cimick et al 1996).
- In children it is unusual for cuffed tubes to be used. If used it is mainly with the cuff deflated.
- If cuffed tubes are in use it is vital that a cuff pressure gauge is used to inflate and regularly check the pressure cuff on the tube.
- Over inflation of the cuff can lead to:
  - severe mucosal damage
  - Necrosis (tissue death)
  - Stenosis (abnormal narrowing of the trachea).
- As little as 15 minutes of excessive cuff pressure will destroy epithelial tissue (Mapp 1988).
- Cuff pressure shouldn’t exceed 25mH2O/18mmHg. This will occlude blood flow to the tracheal tissues.
Methods of Tracheostomies

There are four different methods of tracheostomy formation dependent on the clinical indications for the procedure.

1. Surgical
2. Permanent
3. Cricothyroidotomy (mini tracheostomy)
4. Percutaneous tracheostomy

Surgical tracheostomy.
- Usually performed in theatre.
- Planned procedure.
- Anatomy is clearly defined.
- Long term ventilation.
- Head and neck surgery.
- Congenital abnormalities.

Permanent tracheostomy.
- The trachea is sutured in position and forms a permanent structure known as a laryngectomy.

Cricothyroidotomy
- An emergency procedure for airway obstruction.
- Can be carried out in the ward environment.
- Does not provide airway protection or aid mechanical ventilation.
- Tubes are very small (4.0mm internal diameter).

Percutaneous tracheostomy
- Quick to perform.
- Tube is often sutured into place.
- Can be performed in an HDU environment.
- Useful for patients who may not tolerate transfer to theatre.
- Lower incidence of wound infection than surgical method.
- Increased risk of surgical emphysema / pneumothorax.
- Difficult for surgeons to view the anatomy.

Care of a Tracheostomy in Hospital

It is important to continually assess the child especially for the first few days post operatively. These children usually remain on PICU for the first week or until after the first initial tube change. If negotiated and appropriate skill mix then possibly nursed on the ward as a HDU patient.

- Respirations: rate, depth, pattern, changes, effort.
- Breath sounds on auscultation.
- Amount/frequency of suctioning.
- Sputum, amount, colour, character, odour, any changes.
- oxygen saturation.
- vital signs: pulse, cardiac rhythm.
- skin colour, pale, flushed, temperature.
- fluid intake, level of hydration.

Care of a Trachy in the community

The carer must be competent in the main activities involved in caring for the tracheostomy.

These are:
- Suctioning.
- Tape changing.
- Care of the stoma.
- Tube change.
- Care of the equipment and supplies.
- How to deal with difficulties.
- Resuscitation.

Equipment by the bed side

- Oxygen – working!
- Trachy mask and normal oz mask
- Trachy tapes
- Suction with appropriate size catheters
- 0.9% saline
- Spare trachys x 2 one smaller in size
- 2ml syringe
- Aquea gel
- Tracheal dilators
- Sterile gloves
- Scissors
- Cleaning brush
- HME’s (Swedish Noses)
- Foil containers for water
- Small yellow rubbish bag
- Nebuliser
**Equipment in the community**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracheostomy tubes x3</td>
<td>Saline ampoules (optional)</td>
</tr>
<tr>
<td>Smaller Tracheostomy tube</td>
<td>Tracheal Dilators</td>
</tr>
<tr>
<td>Suction Catheters</td>
<td>Scissors</td>
</tr>
<tr>
<td>Suction Machines x2</td>
<td>Lubricating Jelly</td>
</tr>
<tr>
<td>Filters</td>
<td>HME’s (Swedish Nose)</td>
</tr>
<tr>
<td>Suction Tubing</td>
<td>Speech Values</td>
</tr>
<tr>
<td>Oxygen Tubing (optional)</td>
<td>Gloves</td>
</tr>
<tr>
<td>Tracheostomy Tape</td>
<td>Alcohol Gel</td>
</tr>
<tr>
<td>1ml Syringes (optional)</td>
<td>Gauze</td>
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**Suctioning**

This is the first skill to learn. Carers gradually recognise when to suction and how much.

Why is it important:
- Maintains clear and patent airway (Serra 2000).
- We need our larynx to be able to cough properly and get rid of lung secretions that can block the airway. The tracheal tube is situated below the larynx, which means the child will not be able to cough out secretions so well.
- The tube is an irritant and may cause excess mucus to be produced in the lung. Suction is required regularly to remove these excess secretions.

**Education**

- **Who:**
  - Nursing Staff
  - Parents
  - Secondary carer’s (relatives, close friends, nannies, respite)
  - Nurseries and school staff

- **When:**
  - Main carer taught prior to discharge
  - All other family members and secondary carers taught post discharge.

**How to suction**

- Evaluate and measure child throughout the procedure appropriate to age.
- Wash hands and apply gloves.
- Optimise oxygen if necessary prior to procedure to reduce risk of hypoxia and cardiac arrhythmia (Day 2000).
- Suction on withdrawal of catheter to minimise trauma (Russell & Matta 2004).
- Always pre-measure suction catheter against tracheal tube to ensure suctioning 1 cm before the end of the tracheal tube. This prevents trauma and minimises mucosal damage (Russell & Matta 2004 and Griggs 1998).
- Allow to recover to minimise potential complications associated with suctioning (Glass & Grasp 1995).
- Limit suctioning to a maximum of three at any one time (Russell & Matta 2004).
- Document, assess and evaluate the child’s status at the end of the procedure.

**Secretions**

<table>
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<tr>
<th>Equation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRACHEOSTOMY SIZE IN mm = ½ x 2</td>
<td>Tracheostomy tube size in mm is calculated by halving the internal diameter of the tube and multiplying it by 2.</td>
</tr>
<tr>
<td>Kg = 4cm TRACHEOSTOMY X cm (aged) / 2</td>
<td>Catheter size in kg is calculated by dividing the age of the child in cm by 2 and then multiplying it by the diameter of the tracheostomy tube in cm.</td>
</tr>
</tbody>
</table>

**Potential dangers:**
- Initially post op the tracheostomy tube causes irritation to the trachea resulting in an increase production of secretions and an increase need for suctioning.
- Potentially dangerous procedure which can cause trauma, hypoxia, infection and cardiac arrest (Buglass 1999).
- The higher the suction pressure used the greater the degree of mucosal damage to the trachea (Buglass 1999).
When to suction
Suction is required if the child asks for it or shows any of the following signs:
- Noisy breathing (the sound of air bubbling through secretions)
- Visible secretions at the tracheostomy tube opening
- A cough with the sound of secretions in the tube
- Restlessness, crying (crying increases the secretions)
- Increased respiratory rate, working hard to breathe.

Saline instillation
- No longer recommended. Traditional but unsupported nursing intervention thought to aid in the removal of respiratory secretions (Blackwood 1999).
- Adverse effect on oxygen saturation (Ackerman & Mick 1998).
- May actively contribute to respiratory tract infections by dislodging organisms and colonising the tube and the trachea (Eckland & Ackerman 1995).
- Research consistently shown saline instillation is a potentially dangerous procedure and should be undertaken with care (Clarke 1995).
- Many think it should be abandoned (Ackerman & Mick 1998).
- Proper attention to maintaining humidification and hydration will be more successful in preventing thick secretions than using normal saline.

Humidification
- The protective system of the upper respiratory tract is by passed following a tracheostomy procedure.
- Dry gasses can damage ciliary function (Docherty 2002).
- Warm air carries more moisture than cold air (Woodrow 2002).
- To prevent potential life threatening problems some form of humidification must be provided.
- Humidification prevents tracheal secretions becoming hard and crusty, aids respiratory exchange therefore preventing consolidation, obstruction and atelectasis (Sheppard & Wright 2000).

Types of humidification
- Hot water humidifiers
  E.g. Fisher paykel
- Heat and moisture exchanges (HMEs)
  E.g. Swedish noses
- Buchanan bibs/ protectors
- Nebulisers

Fisher Paykel
Advantages
- Ideal initially post operatively
- Allow the delivery of warm, moist high flow oxygen
- Provides 100% humidity if temperature maintained
Disadvantages
- Requires close supervision
- May scorch airways if incorrectly set up
- Ideal environment for microbiological contamination
- Can over humidify which can saturate and impair ciliated mechanisms leading to secretion or partial atelectasis. (Russell & Matta 2004)
- Limited mobility especially feeding, hygiene and holding
- Psychological impact on parent

Swedish Noses
Disposable plastic attachments fitted onto the inner tube of the tracheostomy. Need to change HMEs at least every 24 hours.

Advantages
- Provides 75% humidity (Russell & Matta 2004).
- Some can be attached to oxygen.
- Cheap.
- Non restrictive.
- Provides some protection to airway.

Disadvantages
- Careful observation of infants airway can impose an added resistance to breathing as well as extra dead space.
- Secretions can remain in the HME until changed, may result in increased risk of inhalation of secretions.
- Very easy to accidently remove especially for infants!
Buchanan Bibs

- Fabric loose cover mainly used in adults to conceal the tube and protect the entrance to the stoma.

Nebulisers

- Provides fully saturated air with a fine mist of moisture into the tracheostomy tube (Wilson 2005).
- Saline nebulizers can be an alternative option to boost humidity (Woodrow 2002).
- Effective, simple and non restrictive.
- Nebulisers for community use can be loaned by Airproducts.

Cleaning and securing

- Secretions from around the tracheostomy tube can cause irritation to the skin around the stoma site.
- Important for the area to remain clean and dry.
- Wet skin is prone to infection.
- Use clean technique.
- Associated with lower infection rate compared to aseptic technique (Russell & Matta 2004).
- Use 0.9% saline and gauze.
- Saline does not irritate the tracheal mucosa.
- Fibres are less likely to break off and enter the stoma (Serra 2000).

Hospital Advice:
- Tracheostomy tubes are rinsed through with hot water.
- Soaked in sterile 0.9% saline.
- Air dried.
- Stored ready taped in clean sealed plastic containers.
- Each tube should be kept in use for a named child for a maximum of 28 days before replacing.

Tape changes

- A tracheostomy is held in place by cotton ties which will need to be changed when soiled or wet.
- It is essential that the knot is secure and the tension is correct.
- It is easier to change tapes with two people.

Care of Stoma

- When you are changing the tapes, check the skin around, above, below, and behind the stoma for red or irritated areas. If the skin is sore a sterile keyhole dressing can be applied.
- Tracheostomy tubes can cause the skin to develop granulation tissue in and around the opening to the stoma. This can cause bleeding and can sometimes make it difficult to change the tube. Granulation needs to be cauterised or removed.
**Tube change**
- Secretions from the lungs coat the inside of the tracheostomy tube. It is recommended that the tube is changed weekly or more often if secretions become very dry, or if the child has a chest infection.
- To maintain safety, it is important to plan to do it when two people are present.
- The tube should not be changed just after meals as they may cough and vomit.
- Do not change the tube if the child is tired or irritable.

**Emergency tube change kit**
- Tracheostomy ready taped
- Smaller tracheostomy ready taped
- Scissors
- Tracheal dilators
- Lubricating Jelly

**THIS KIT MUST BE WITH THE CHILD AT ALL TIMES**
(normally stored with the portable suction machine)

**Infection**
A child with a tracheostomy tube is at risk of infection being introduced into the lungs. You can reduce the onset of infection by:
- Not letting secretions remain bubbling in the child’s tube or lungs
- Washing hands thoroughly
- Keeping equipment clean and well maintained
- Using catheters once, discarding after use and new one for the next occasion

**Recognising infection**
When suctioning, observe the secretions. Recognise what normal secretions look like to notice change:
- They have changed colour
- They are thicker than usual
- You are suctioning more than usual
- They have an unpleasant smell
- They are tinged with small specks of blood

**Communication**
- Having a tracheostomy temporarily affect the child’s speech and language development. Early speech and language therapy intervention will aid in the child’s understanding of the spoken language and will catch up.
- A tracheostomy alters the child’s communication by affecting the passage of air through the larynx and mouth for speech. Air from the lungs passes out of the tracheostomy tube instead of passing up through the voice larynx and out of the mouth.
- A speaking value is a one-way valve which sits on the end of the tracheostomy tube. This allows the child to create words and sounds.
- Makaton

**Eating and Drinking**
- Children with tracheostomies can eat and drink normally, but watch that finger foods are not placed in the tracheostomy accidentally.
- Give plenty of fluid to help keep secretions thin.
- Avoid using suction right after a meal if possible in case it makes the child vomit.
- Some children may find it hard to swallow saliva or cough during feeding. Food or fluid may come out from the tracheostomy. A SALT referral is required for these children.
Potential dangers

Bathing and hair washing

- Always stay with the child when he or she is near water. Make sure that the water line is well below the tracheostomy and avoid too much splashing. Ensure the suction pump is handy just in case.
- For hair washing the child should be laid back and the hair washed by spraying or pouring water from a cup.
- An older child can take a shower with care to avoid the spray going into the tracheostomy.

Clothing

- Avoid covering the tracheostomy with tight clothing and avoid clothing that shed a lot of fibres that could get into the tube.

Smoke and fumes

- Avoid cigarette smoke, fumes and aerosols around children with tracheostomies, as they can irritate the child’s lungs.

Play

- The child can take part in most activities.
- It is not recommended that the child plays with dry sand as it may get into the tracheostomy. However the child can play with wet sand under supervision. Coving the tracheostomy loosely or Swedish nose will help.
- It is not recommended that the child does rely poly’s as he/she will block off their airway.
- The child can not go swimming.

Family support

- This is a frightening experience.
- The whole family need considerable support.
- Teaching extended family tracheostomy care prevents isolation.
- The family’s existing way of life needs to be totally changed.
- Loss of child’s speech has devastating consequences
- Simple things require forward planning
  - Travel/Trips
  - Holiday
  - Shopping
  - Friends
  - School
  - Parties
- Whole disruption to their lives.

Nursery and School

- Children with a tracheostomy are successfully placed in mainstream education.
- Children with a tracheostomy are considered to have educational needs. This does not mean they have difficulty with learning but that with special provision (a trained carer) they can not attend educational settings.
- Funding is required for a school carer this takes time to arrange.
- Input from Early Years Support Team/Portage from a years age to aid integration into nursery.
- The funded carer must be with them at all times ready to carry out suction and to perform an emergency tube change, if necessary.
- The carer must be trained in tracheostomy care and must not have other duties which would take them away from the child.

Summary

- Due to their anatomy children are more prone to airway compromise than adults.
- Tracheostomies are more hazardous in children than adults(Sheikin & Gibbins 1996).
- Children have a lower reserve of oxygen so any obstruction can cause a significant cyanotic episode in seconds.
- Important to provide adequate humidification and encourage oral hydration to help prevent thick secretions.
- Suctioning is a potentially dangerous procedure.
- Remember to check suction pressures are below 50mmhg.
- Suction no more than 3 times in one session and for no more than 15 seconds.
- Communication, family support and teaching as vital to successful management.