Local Procedure

John Hunter Children's Hospital
CHILDREN, YOUNG PEOPLE AND FAMILIES

NSW GOVERNMENT Health
Hunter New England Local Health District

INPATIENT USE OF COUGH ASSIST (MECHANICAL IN-EXSUFFLATOR)

Sites where Local Guideline and Procedure applies **This Local Guideline and Procedure applies to:**	John Hunter Children's Hospital and Paediatric Intensive Care Unit
Adults	No
Children up to 16 years	Yes
Neonates – less than 29 days	No
Target audience	Physiotherapy, intensive care nursing staff and carer's
Description	Clinical procedure for the prescription and performance of mechanical in-exsufflation techniques within a paediatric patient population
National Standard	Standard 1- Clinical Governance

Go to Procedure

Keywords	Cough, Cough Assist, Mechanical In-exsufflation, Airway Clearance Techniques, Paediatrics, Physiotherapy
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Replaces existing document?	Yes
Registration number and dates of superseded documents	Document number 6.9, April 2012

Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:

NSW Health Policy PD2017_032 Clinical Procedural Safety pdf

NSW Health Policy IB2020_010. Consent to Medical and HealthcareTreatment Manual pdf

NSW Health Policy IB2012_036 Infection Control Policy .pdf

Local Guideline and Procedure note	This document reflects what is currently regarded as safe and appropriate practice. The guideline section does not replace the need for the application of clinical judgment in respect to each individual patient but the procedure/s require mandatory compliance. If staff believe that the procedure/s should not apply in a particular clinical situation they must seek advice from their unit manager/delegate and document the variance in the patient's health record.
Position responsible for and document authorised by	JHCH Clinical Quality Patient Care Committee (JHCH CQPCC)
Contact person	Megan Lombard
Contact details	Megan.Lombard@health.nsw.gov.au
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PURPOSE AND RISKS

The Cough Assist Machine is used to assist the clearance of any retained bronchopulmonary secretions. This machine is used on a small population of patients and may be used infrequently. The risks to the patient include: increased ICP, barotrauma, anxiety, abdominal distention. These risks are minimised by: Correct patient selection to use the cough assist as deemed by a physiotherapy assessment Ensuring the correct settings are being used as per the prescription Cough Assist Machine. Indications - Any patient with retained secretions, that is unable to clear secretions due to reduced peak cough expiratory flow (weak or ineffective cough) e.g. Muscular Dystrophy, Spinal Muscular Atrophy; other neuromuscular conditions with some paralysis of the respiratory muscles e.g. spinal cord injury; and end stage respiratory disease with fatigue. It can be used effectively with patients with a tracheostomy, invasively or non-invasively.
Risk Category: Clinical Care & Patient Safety

GLOSSARY

Acronym or Term	Definition
BiPAP	Bi phasic positive airway pressure
CXR	Chest X-ray
MND	Motor Neuron Disease
MRN	Medical Record Number
NFR	Not for resuscitation
SMA	Spinal Muscular Atrophy

PROCEDURE

This procedure requires mandatory compliance.

CLINICAL PROCEDURE SAFETY LEVEL

Every clinician involved in the procedure is responsible for ensuring the processes for clinical procedure safety are followed as below.

STAFF PREPARATION

It is mandatory for staff to follow relevant:

- "Five moments of hand hygiene", infection control, moving safely/safe manual handling, documentation practices and to use HAIDET for patient/carer communication: Hand hygiene, Acknowledge, Introduce, Duration, Explanation, Thank you or closing comment.
- Correctly identify and verify patients.
- Involve the patient and "person responsible" in the patient verification process, wherever possible.
- Obtain verbal consent from the patient

EQUIPMENT REQUIREMENTS

Equipment required for this procedure:

- Alcohol based hand rub
- Personal Protective Equipment
- Appropriate cough assist device and circuit set-up from the Paediatric Physiotherapy Department.

PATIENT PREPARATION

It is mandatory to ensure that the patient has received appropriate information to provide informed consent, and that patient identification, correct procedure and correct site process is completed prior to any procedure.
Review the patient's history for precautions and contraindications:

CONTRAINDICATIONS

- Undrained pneumothorax
- Cardiovascular instability
- Pulmonary cysts
- Frank haemoptysis
- Bullous emphysema
- Recent barotrauma
- Extreme distress/anxiety secondary to cough assist procedure

PRECAUTIONS

- Drained pneumothorax
- Known susceptibility to pneumothorax
- Head injury
- Very high FiO_2 requirements
- High or variable degrees of airway resistance
- Congestive cardiac failure
- Airway anomalies
- Lung transplant
- Facial fractures or facial surgery
- Known intolerance to mask
- Children with increased tone may work against the Cough Assist Machine and therefore prevent pressure transfer to the lungs.
- Children with poor or no glottis control will not be able to achieve expiratory pressures necessary for effective coughing.
- Abdominal distension due to gas trapping may occur if insufflations are not timed correctly
- Any patients with an NFR (not for resuscitation) order – liaise closely with medical staff
- If the patient requires oxygen, oxygen can be connected into the cough assist mask.

PRE-PROCEDURE

STOP and confirm the following before commencing the procedure:

- Patient identification using three core patient identifiers (Name – family and given names, date of birth and Medical Record Number - MRN)
- Procedure verification – procedure + site/side/level, where appropriate, matches consent
- Allergy/adverse reaction check
- Anticipated critical events
- Verbal consent to be obtained

INDICATIONS

Any patient with retained secretions, that is unable to clear secretions due to reduced peak cough expiratory flow (weak or ineffective cough) e.g. Muscular Dystrophy, Spinal Muscular Atrophy; other neuromuscular conditions with some paralysis of the respiratory muscles e.g. spinal cord injury; and end stage respiratory disease with fatigue. It can be used effectively with patients with a tracheostomy, invasively or non-invasively.

COMMENCEMENT OF COUGH ASSIST MACHINE.

(Consider referral to the Child Life Therapist if the child is anxious)
Perform a complete respiratory assessment including review of CXR to exclude pneumothorax. Decide why the cough is ineffective. In some cases, Cough Assist Machine may not be indicated or be inappropriate e.g.

- Pain only limiting factor
- Abdominal distension preventing any increase in vital capacity
- Effective cough with inspiratory support (e.g. BiPAP, IPPB)
- Effective cough with manual assistance

- Poor glottis control
- Liaise with a Senior Respiratory Physiotherapist to discuss rationale and approve treatment.
- Obtain Consultant consent (Refer to Appendix 1). The Physiotherapist will prescribe the therapeutic pressure settings for in-exsufflation after discussion with the Consultant as to maximum pressures acceptable in the patient.
- There are no established guidelines for pressure settings. Manufacturer recommendations include starting with very low pressures for new and/or small patients (typically 10-15 cmH_2O positive and negative pressure) and increasing to a therapeutic range e.g. adequate chest wall movement on inspiration/facilitation of secretion clearance on expiration (usually inhale pressure 20-40 cm H2O, exhale pressure 40-60cm H2O). Timing needs to be adjusted to patient comfort, ventilatory requirements and therapeutic goals.
- Collect the Cough Assist Machine and the necessary circuit from the Physiotherapy Department (see Assemble the circuit below for detail)
- Explain the procedure to the patient and/or parents. Allow the patient to handle the mask and feel the application of the mask without the airflow to minimize anxiety and distress.
- Position the patient appropriately and comfortably. This can be in sitting or lying. Ensure the patient has adequate monitoring. At minimum, a saturation and HR monitor should be used during initial treatments and when treating 'at risk' patients. The physiotherapist should also closely monitor respiratory rate, breath sounds, work of breathing, and distress or anxiety before, during and after treatment.
- Ensure there is no equipment that may interfere with pressure settings e.g. mobile phones. The Cough Assist Machine has been reported sensitive to this interference.

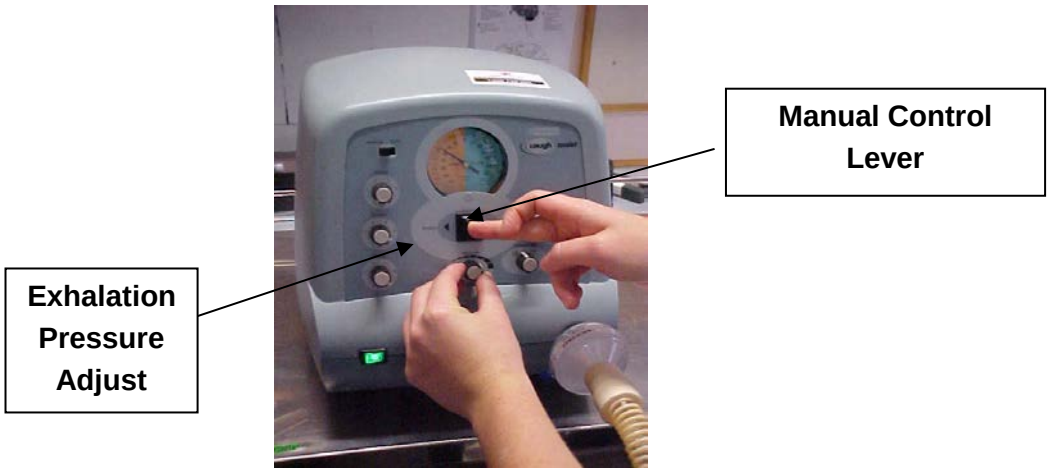
ASSEMBLE THE CIRCUIT:

- Attach the bacterial/viral filter to the patient port on the front panel.
- Attach the 3 foot 22mm ID smooth bore breathing hose to the filter
- Attach the appropriate patient interface to the breathing hose. Options include facemask and adaptor, mouthpiece or tracheostomy tube adaptor.
- Connect the circuit to the Cough Assist Machine.
- Plug in the machine and turn on the power switch.

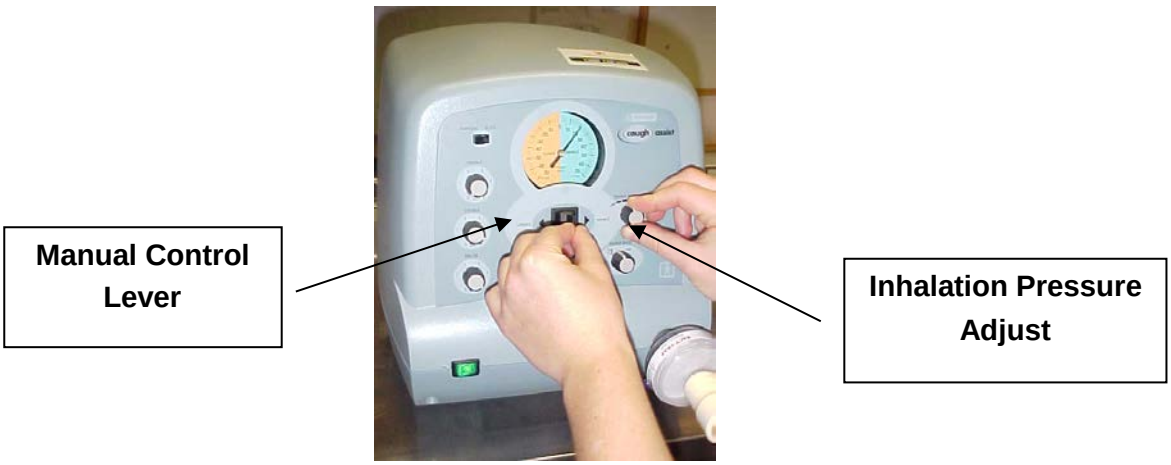
FOR THE EMERSON MACHINE:

Set the pressures for the patient:

- Set the inhale flow to full (three arrows) or reduced (one arrow). If using reduced flow, be aware that the inhale pressure set will be slightly reduced. Reduced flow 3.3L/sec; full flow up to 10L/sec (Actual flow will depend on airway pressure and resistance).
- Set the manual/auto switch to manual.
- Disconnect the face mask and occlude the end of the tubing on a flat, clean surface to enable the pressures to be set.
- The pressure which is largest (usually exhalation) must be set first. Hold the manual control lever to exhalation (left) and simultaneously adjust the exhalation pressure adjust knob to desired reading, as shown below.



- Shift the manual control lever to the opposite side (inhalation). Adjust the pressure reading by simultaneously turning the inhalation pressure adjustment knob (right), as shown below. If both pressures are to be the same adjustment is not usually necessary.



- Cycle the manual control lever from positive to negative and back a few times to ensure the pressure readings are correct. Release the manual control lever to ensure the pressure immediately returns to “0”. Pressures must be checked prior to use on the patient between every cycle. Always monitor the pressures set compared to pressures given during treatment.

USE OF THE MACHINE IN AUTOMATIC MODE

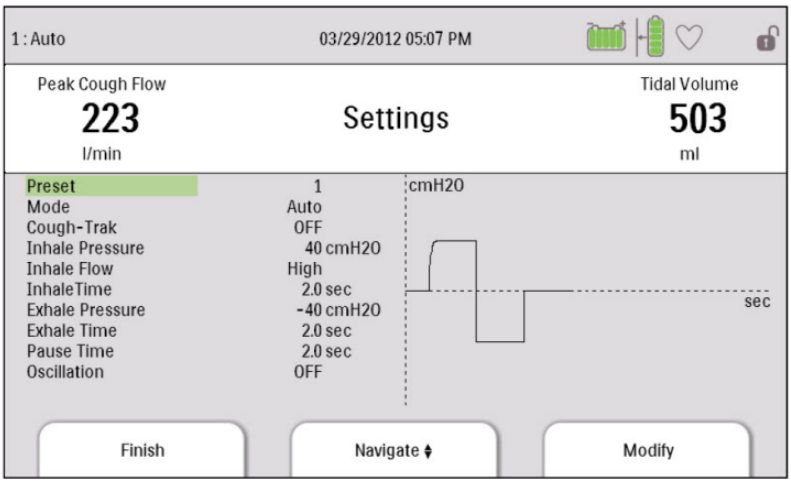
- The machine pressures must be set and checked as above.
- Set the manual/auto switch to auto.
- The time settings on the left hand side of the machine must be set according to the needs of the patient. Normally the inhale and exhale time are 1-3 seconds and the pause time can be set up to 5 seconds, or eliminated by setting the dial on 0, depending on the patient's preference.
- Before applying the machine to the patient, occlude the connector as during the setting up process and switch the machine to automatic to ensure that it cycles appropriately and the pressures are correct.
- A cycle when the machine is in automatic mode consists of one inspiration, one expiration and one pause. This will continue to be repeated by the machine until the machine is taken off automatic mode or switched off. The machine should not be on for longer than 5 minutes.
- Cycles and sets are individualized as per machine use in manual mode and secretions are removed following each set as per machine use in manual mode.
- Once the pressures and time settings have been set and checked, the machine can be applied in automatic mode in two different ways:
- Switch the machine to automatic mode and then place the mask over the child's mouth and nose during one of the pauses.
- Place the mask over the child's mouth and nose and then switch the machine to automatic mode (it will start with an inhalation first).

FOR THE PHILIPS E70 MACHINE:

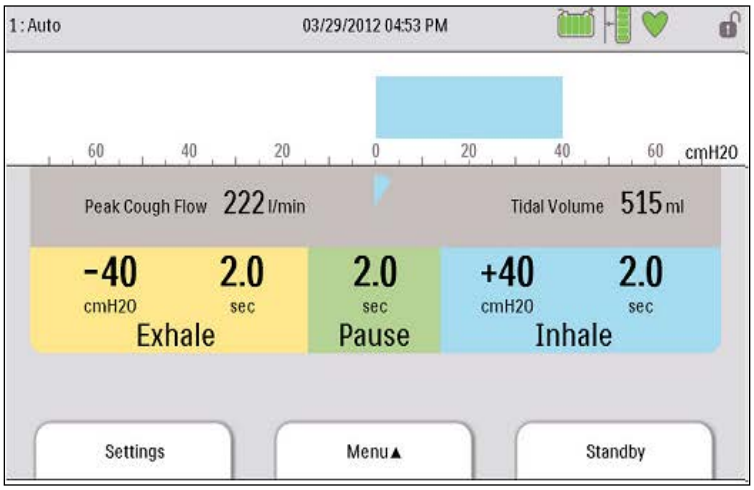
- As outlined above:
- Cough assist cycle is determined on a case by case basis, for example some patients may need three inspirations (positive pressures) per cough (negative pressure), and some patients may only need one or two.
- The number of cycles (each cycle involves at least one inspiration and one cough) per set (time from putting the mask on the patient's face to removing it) is determined on a case by case basis. Some patients may tolerate/need up to 4-5 cycles per set, other may only tolerate/need 1-2 cycles.
- Following each set, any secretions that have been cleared should be removed from the patient's mouth/pharynx by either independent expectoration or oral/oropharyngeal suction.
- The patient will then need a period of rest before commencing another set of cough assist.
- Plug the machine into the wall if battery power is not sufficient
- Turn the machine on with the power button

SET PRESSURES AND TIME BY:

- Clicking settings, scroll using up/down arrows to ‘inhale pressure’, click modify, use up/down arrows to select pressure. Repeat with ‘exhale pressure’. Click finish.
- Set time by scrolling using up/down arrows to ‘inhale time’, click modify, adjust time. Repeat with ‘exhale time’.
- Click finish.



- To commence a cycle, apply mask to patients face and click therapy
- Watch the cycle on the screen and monitor the patient, finish the cycle as per recommended repetitions and sets.



- When treatment is finished turn the machine off at the power button
- Wash the mask with warm soapy water and leave to dry
- After treatment, monitor the patient for any signs of hyperventilation and decreased respiratory effort. Rest periods are ensured between cough cycles to avoid hyperventilation.
- Document the treatment in the patient’s medical record, including the pressures used and a description of cycles/number of cycles.

CONSIDERATIONS

- The use of other airway clearance techniques e.g. positioning, percussion and vibrations can be incorporated with the Cough Assist Machine..
- Until the child gets accustomed to the Cough Assist Machine optimal pressures may not be achieved.
- In infants less than 1 year timing of insufflations can be difficult. Aiming for a ratio of 1:2 or 1:3 to the infant's underlying rate may be better tolerated. Starting with lower pressures is recommended. Infants may not be able to tolerate 40cm H2O expiratory pressure and pressures below this may be used with some success. The length in inhalation and exhalation may need to be shorter due to infants faster respiratory rate e.g. 1 second inspiration and expiration and pause 3 seconds.

CLEANING AND INFECTION CONTROL

- The bacterial filter, connector and face mask are all single patient use. They are to be disposed of when no longer required. If a patient has frequent admissions and is likely to require further treatment with the Cough - Assist, consider keeping their circuit for subsequent admissions.
- The tubing, connector and mask should be washed thoroughly in warm soapy water and air dried. This should be done following each use if there are visible secretions on the mask, connector or tubing. The bacterial filter should also be disposed of and changed if it becomes blocked by sputum or trapped moisture.
- The Cough Assist Machine should be wiped over with wipes (e.g. Clinell Wipes) after each patient use.

REFERENCES

Bach JR. Mechanical insufflation-exsufflation: comparison of peak expiratory flows with manually assisted and unassisted coughing techniques. Chest 1993; 104: 1553-1562.

Bach JR. Mechanical insufflation/exsufflation: has it come of age? A commentary. Eur Resp J 2003; 21: 385-386.

Chatwin M, Ros E, Hart N, Nickol AH, Polkey MI, Simonds AK. Cough augmentation with mechanical insufflation/exsufflation in patients with neuromuscular weakness. Eur Respir J 2003; 21:502-8.

Miske LJ, Hickey EM, Kolb M, Weiner DJ, Panitch HB. Use of the Mechanical in-exsufflator in pediatric patients with neuromuscular disease and impaired cough. Chet 2004; 125: 1406-12

EQUIPMENT USER INFORMATION

- Emerson Cough Assist User's Guide
- Royal Children's Hospital Brisbane Cough Assist Device Clinical Work Instruction (2007)
- Royal Children's Hospital Melbourne Cough Assist Protocol (2009)
- Adelaide Women's and Children's Hospital Cough Machine User Information

USEFUL LINKS

Emerson Cough assist manual- Emerson Cough Assist machine user manual

APPENDICES

- Appendix 1: Protocol for obtaining consent
- Appendix 2: Set of Cough Assist Machine
- Appendix 3: Cough Assist Machine circuit
- Appendix 4: Cough Assist Machine Trouble Shooting

ACKNOWLEDGEMENT

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Emily Glover, Physiotherapist JHCH,
Lauren Thomas, Senior ICU Physiotherapist

FEEDBACK

Any feedback on this document should be sent to the Contact Officer listed on the front page.

APPENDIX 1: PROTOCOL FOR OBTAINING CONSENT

Referral to Physiotherapy

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Physiotherapist assesses patient. If the Physiotherapist believes that Cough Assist could be beneficial then they should discuss its appropriateness of with a Senior Respiratory Physiotherapist prior to implementation.

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If Cough Assist is recommended as an adjunct to physiotherapy – discuss appropriateness with the child's Consultant.

This is particularly important if the child has not received this form of therapy before.

↓

Physiotherapy using Cough Assist proceeds.

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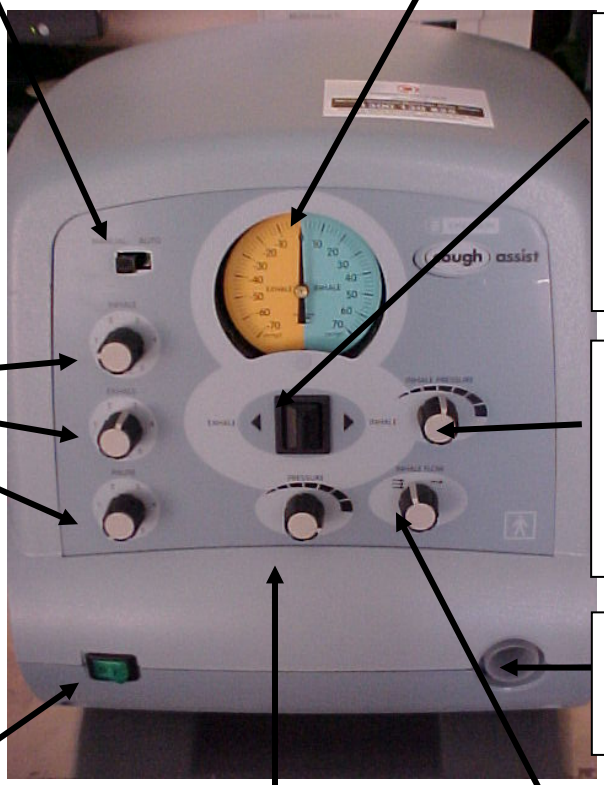
If the Physiotherapist is concerned about the patient's progress or treatment, they should consult the treating team.

APPENDIX 2: SET UP OF COUGH ASSIST MACHINE.

Characteristics

MODE
Manual = Timing of each inhalation and exhalation individually controlled by the operator at pre-determined inhalation and exhalation pressures.
Automatic = Inhale time, exhale time and pause time are pre-determined along with inhalation and exhalation pressures.

PRESSURE MANOMETER
Measured in cmH_2O.



MANUAL CONTROL LEVER
Switch to right = inhalation.
Switch to left = exhalation.

If released always returns to 0

AUTOMATIC MODE
Inhalation time,
Exhalation time
Pause time.

Numbers = time in seconds.

INHALATION PRESSURE ADJUST
To set, hold manual control lever to right whilst simultaneously turning knob.

OUTPUT
Circuit to patient attaches here.

ON/OFF SWITCH
Must be connected to mains at rear of machine – no battery.

EXHALATION PRESSURE ADJUST
To set, hold manual control lever to left whilst simultaneously turning knob.

HIGH/LOW FLOW
Three arrows = high.

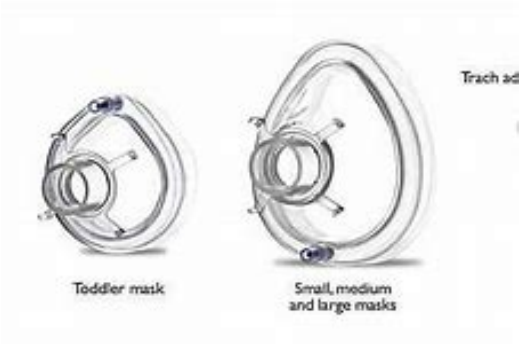
APPENDIX 3: COUGH ASSIST MACHINE CIRCUIT

1. Bacterial filter

2. Tubing

3. Connector

4. Face mask (not required for intubated patients- connector attaches directly to ETT/tracheostomy). Face masks are available in small, medium or large. These masks do not have an expiratory valve as the circuit must remain closed to generate an effective negative pressure i.e. cough. Do not use these masks with BiPAP or CPAP machines. Never use the headgear that is supplied with the mask when using the Cough Assist.



Note: If the patient has an oxygen requirement, they will also require green oxygen tubing to introduce oxygen flow into the circuit. This is attached to the mask i.e. at the patient end.

APPENDIX 4: COUGH ASSIST MACHINE TROUBLESHOOTING

PROBLEM	CAUSE	WHAT TO DO
The patient burps a lot after using the cough machine or feels like they have a bloated stomach	The patient is not breathing in in time with the Cough Machine	Instruct the patient to breath in with the inspiratory phase of the Cough Machine.
	The inspiratory time is too long	Speak to your Physiotherapist.
	The inspiratory pressure is too high	Speak to your Physiotherapist.
The patient complaints, or the carer notices the pressures/times are too high or too low	The dials and switches have been bumped	Check the pressure/time settings given to you by your Physiotherapist and adjust the dials accordingly.
The mask "blows raspberries"	Mask is not sealed on the face	Check position of the mask on the face. Ensure the mask is held firmly.
The mask gets stuck to the face when being removed	Carer is removing the mask during the expiratory (suck out) phase	Remove mask during the pause or the start of the inspiratory phase.
	The mask is dirty	Wash the mask with warm soapy water, rinse with water and leave to air dry ready for next use.