



Oxygen Therapy and Respiratory Devices - Adults Clinical Practice Standard

1. Purpose

The purpose of this policy is to establish minimum practice standards for the care and management in adults for oxygen therapy and respiratory devices throughout the WA Country Health Service (WACHS).

For paediatric patients, refer to Perth Children's Hospital (PCH) Clinical Practice Manual:

- [Oxygen Administration Guideline](#)
- [Oxygen and Suction Equipment Maintenance Procedure](#)
- [Humidified High Flow Nasal Cannula Therapy Guideline](#)

For neonates, refer to the Child and Adolescent Health Service (CAHS) [Humidified High Flow \(HHF\) Nasal Cannula Therapy](#).

Excluded from this document are closed systems such as:

- Continuous positive airway pressure (CPAP) – refer to WACHS [Neonatal and Paediatric Continuous Positive airway Pressure \(CPAP\) Guideline](#)
- Non-invasive ventilation (NIV) - refer to WACHS [Ventilation \(Non-Invasive and Invasive Mechanical\) Clinical Practice Standard](#)
- Endotracheal tube (ETT) – refer to WACHS [Airway Suctioning Clinical Practice Standard](#) and WACHS [Ventilation \(Non-Invasive and Invasive Mechanical\) Clinical Practice Standard](#)

Removing unwanted variation in clinical practice and following best practice guidelines has been found to reduce inappropriate care (overuse, misuse and underuse) thus improving health outcomes, reducing preventable harm and decreasing wastage.

2. Scope

All medical, nursing, midwifery and allied health staff employed within the WACHS.

All health care professionals are to work within their scope of practice appropriate to their level of training and responsibility.

Further information may be found via [HealthPoint](#) or the [Australian Health Practitioner Regulation Agency](#) as appropriate.

3. Procedural Information

Appendix 1 [Oxygen Therapy Management](#)

- Indications for oxygen
- Safety precautions
- Oxygen prescription and dose
- Humidification
- Oxymizer pendant
- Special considerations (pregnancy, poison and posture)
- Domiciliary oxygen
- Oxygen concentrators

Appendix 2 [Uncontrolled Oxygen Delivery Devices](#)

- Nasal cannulae (simple)
- High flow nasal prongs / cannulae (humidified) Airvo2™
- Simple face masks
- Non-rebreather mask and bag
- Tracheostomy oxygen devices

Appendix 3 [Controlled Oxygen Delivery Devices](#)

- Venturi mask

Appendix 4 [Replacement and Disposal of Oxygen Delivery System](#)

Appendix 5 [Nebulisation](#)

- Types of nebulisers
- Hypertonic saline nebulisation
- Induced sputum procedure
- Filtered nebuliser system
- Nebuliser via tracheostomy tube

Appendix 6 [Inhaler Devices](#)

- Pressurised metered dose inhaler (MDI)
- Dry powder inhaler (DPI)
- Soft mist inhaler (SMI)

Appendix 7 [Spirometer](#)

Appendix 8 [Peakflow meter](#)

4. Considerations

Oxygen Therapy:

- Should be initiated without delay for any patient with suspected or known tissue hypoxia¹
- No patient is to be denied oxygen therapy in an emergency situation¹. If any patient meets medical emergency team calling criteria initiate medical emergency response according to WACHS Clinical Escalation of Acute Physiological Deterioration including Medical Emergency Response Policy
- Once patient is stabilised, oxygen therapy must be prescribed as per the [Oxygen Prescription section](#) in Appendix 1
- Oxygen therapy should be prescribed cautiously to patients with severe chronic lung disease and other conditions at risk of hypercapnic respiratory failure¹

Respiratory Devices:

- **COVID-19:** guidelines state that Nebulisers are not recommended for use and should be replaced by dedicated single patient use spacers where possible (source: [COVID-19 Infection Prevention and Control in WA Healthcare Facilities](#) [version 8, 31 August 2020] Appendix 3 Aerosol generating procedures)
- **Exposure risk:** All staff either attempting to conceive or pregnant should avoid exposure to Pentamidine
- **Equipment checking:** bedside oxygen and suction and ward/ unit/ area resuscitation equipment to be checked regularly as per the WACHS Clinical Escalation of Acute Physiological Deterioration including Medical Emergency Response Policy
- **Medication administration:** to prevent errors, draw up and administer nebuliser medications separately to intravenous medications. Label as per the Australian Commission on Safety and Quality in Health Care (ACSQHC) [National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines](#)
- **PPE:** Glaucoma patients should be provided with protective eye wear while receiving a nebuliser to avoid increased intra ocular pressure.

5. General Information

Oxygen is a colourless, odourless gas with prescribed therapy being administered to patients to prevent or treat hypoxia. The cause of hypoxia should be established and treatment instituted as appropriate. Hypoxia may occur because of arterial hypoxemia (inadequate arterial oxygen content) or failure of the oxygen-haemoglobin transport system.

Indications of inadequate oxygenation present as nasal flaring, use of accessory muscles, changes in vital signs, respiration and skin cyanosis². Neurological signs include impaired judgement and motor incoordination. Oxygen is measured in either litres or as a percentage/a fraction of inspired oxygen concentration (FiO₂)².

Staff are to comply with the specific requirements in alignment with the following WACHS policy documents:

- [Aseptic Technique Policy](#)
- [Hand Hygiene Policy](#)
- [Infection Prevention and Control Policy](#)
- [Personal Protective Equipment \(PPE\) Procedure](#)

6. Patient Monitoring

Hypoxaemia is a result of a disease process therefore improving the oxygenation saturation by itself will not change the disease state. Careful monitoring and further investigations may be indicated depending upon clinical circumstances.

If signs of deterioration are noted and/or a patient meets the escalation criteria on the observation and response charts, or if you or the patient, family member or carer are worried, initiate escalation of care process specific to your area.

Ensure early recognition of and response to hypoxaemia. If the patient meets medical emergency team calling criteria, initiate a medical emergency response according to WACHS Clinical Escalation of Acute Physiological Deterioration including Medical Emergency Response Policy.

An individualised management plan is to be documented in the patient’s health records as soon as practicable, and in relation to the specific requirements for clinical risk prevention and management.

A management plan, including ongoing assessment and communication should be in place for patients whose oxygen administration/flow has been increased to maintain saturations.

- Monitor oxygen therapy effect by:
 - Pulse oximetry or arterial blood gas measurements (pulse oximetry may not be accurate in patients with some medical conditions e.g. heart failure, hypothermia, diabetes mellitus).
 - Respiratory rate and distress.
 - Level of consciousness.
- Capillary and venous (peripheral oxygen) PvO₂ measurements are not a substitute for arterial PaO₂. However, bicarbonate, peripheral carbon dioxide (PvCO₂) and venous pH correlate with arterial measurements when collected correctly¹.
- Factors affecting the accuracy of pulse oximetry:

Factor	Specific	Effect
Venous pulsation	Tricuspid regurgitation or venous congestion	False low
Anaemia	Hb<8gdl and low SpO ₂ or haematocrit <10%	Effect unclear
Reduced Pulsatile Component	Secondary to hypotension, vasoconstriction, hypothermia, limb ischaemia. Ear probe or fore head sensor may be more accurate	Inaccurate, unobtainable or falsely low
Hypoxaemia	More inaccurate with SpO ₂ <75- 80%	False low
Ambient Light	Minimal interference in well-designed probes	False low
Skin Pigmentation	Use finger probe on people with deeply pigmented skin	False high or unobtainable
Fingernail Polish	Remove prior to oximetry	False low
Motion Artefact	Tremor, voluntary movement	False low

- Oxygen saturation on room air should be monitored for at least 5 minutes after discontinuing oxygen therapy and should be rechecked in an hour.
- For nebulisers - patient should be monitored as per nebulisation section ([Appendix 5](#)) during administration of first dose of inhaled medication or hypertonic saline nebulisation for any reaction. If any wheeze or bronchospasm occurs, cease nebuliser and initiate escalate of care process specific to the site, setting and area

Management plan, as a minimum to also include:

- Patient history and presence of comorbidities.
- Diagnosis and treatments for clinical conditions.
- Medications, psychosocial and cultural factors that could influence patient monitoring.
- Site requirements, patient education and consent e.g. any restrictions to interventions associated with advance health directives (AHD) or similar

7. Equipment Required

- Oxygen tubing should be labelled with patient identification sticker. If intermittent use, and sharing wall access to oxygen/air, disconnect tubing when not in use and locate on patient's bedside locker (or similar) to avoid use with incorrect patient.
- Equipment must be appropriate for the age/size of the patient.
- Equipment must be checked, serviced and calibrated in accordance with manufacturer's recommendations to ensure reliability and accuracy.
- Staff must follow the manufacturer's operating instructions.

8. Clinical Communication

Clinical Handover

Information exchange is to adhere to the Operational Directive MP0095/18 Clinical Handover Policy using the iSoBAR framework.

Critical Information

Critical information, concerns or risks about a consumer are communicated in a timely manner to clinicians who can make decisions about the care.

Documentation

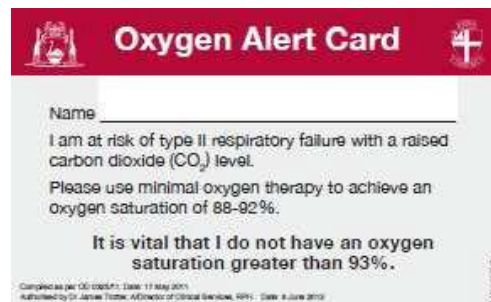
Failure to accurately and legibly record and understand what is recorded in patient health records contribute to a decrease in the quality and safety of patient care.

- Refer to WACHS Documentation Clinical Practice Standard.
- Aerosol drug delivery - record administration on medication chart. Note any issues or difficulties in the health records.

Related Documents / Forms

Oxygen Alert Cards:

All patients with chronic lung disease and other at-risk conditions who have had an episode of hypercapnic respiratory failure should be issued with an Oxygen Alert Card and a 24 and 28% Venturi mask¹.



The card should state:

- that the patient has had an episode of hypercapnic respiratory failure
- Oxygen therapy should be commenced with a Venturi mask
- Oxygen saturations should be maintained between 88- 92%.

Patient should be instructed to show the card to their local doctor, ambulance crew and emergency department staff in the event of an exacerbation.

Consumer information

There are a number of ways consumers can obtain specific information relating to hospital admissions, transfers and discharge from hospital. Relevant documents can be located via Healthy WA [Asthma medications and inhaler devices](#) resources:

- [How to use a turbuhaler](#)
- [How to use an accuhaler](#)
- [How to use an autohaler](#)
- [How to use an inhaler \(puffer\) with large volume spacer](#)
- [How to use an inhaler \(puffer\) with small volume spacer](#)

The National Asthma Council Australia provides information for [Health professionals](#), and [Consumers](#)

9. Compliance Monitoring

Evaluation, audit and feedback processes are to be in place to monitor compliance.

Failure to comply with this policy may constitute a breach of the WA Health Code of Conduct (Code). The Code is part of the [Integrity Policy Framework](#) issued pursuant to section 26 of the [Health Services Act 2016](#) (HSA) and is binding on all WACHS staff which for this purpose includes trainees, students, volunteers, researchers, contractors for service (including all visiting health professionals and agency staff) and persons delivering training or education within WACHS.

WACHS staff are reminded that compliance with all policies is mandatory.

10. Records Management

[Records Management Policy](#)
[Health Record Management Policy](#)

11. Relevant Legislation

Accessible via: Government of Western Australia ([State Law Publisher](#) or [ComLaw](#))

- *Carers Recognition Act 2004* (WA)
- *Children and Community Services Act 2004* (WA)
- *Equal Opportunity Act 1984* (WA)
- Equal Opportunity Regulations 1986 (WA)
- *Guardianship and Administration Act 1990* (WA)
- *Health Practitioner Regulation National Law (WA) Act 2010*
- *Occupational Safety and Health Act 1984* (WA)
- Occupational Safety and Health Regulations 1996 (WA)
- *State Records Act 2000* (WA)

12. Relevant Standards

[National Safety and Quality Health Service Standards](#)

Clinical Governance Standard: 1.27

Australian Commission on Safety and Quality in Health Care (ACSQHC) [National Standard for User-applied Labelling of Injectable Medicines, Fluids and Lines](#)

13. Related WA Health System Policies

MP0095/18 [Clinical Handover Policy](#)

MP0122/19 [Clinical Incident Management Policy](#)

MP0086/16 [Recognising and Responding to Acute Deterioration Policy](#)

MP0053/17 [WA Clinical Alert MedAlert Policy](#)

OD0657/16 [WA Health Consent to Treatment Policy](#)

14. Relevant Policy Documents

PCH [Oxygen Administration Guideline](#)

PCH [Oxygen and Suction Equipment Maintenance Procedure](#)

PCH [Humidified High Flow Nasal Cannula Therapy Guideline](#)

WACHS [Recognising and Responding to Acute Deterioration \(RRAD\) Policy](#)

WACHS [Documentation Clinical Practice Standard](#)

WACHS [Infection Prevention and Control Policy](#)

WACHS [Inter-hospital Clinical Handover Form Procedure](#)

WACHS [MR184 WACHS Inter-hospital Clinical Handover Form](#)

WACHS [Personal Protective Equipment \(PPE\) Procedure](#)

WACHS [Provision of Domiciliary Oxygen for Travel in WA Guideline](#)

WACHS [Storage and Handling of Gas in Cylinders Procedure](#)

WACHS [Waste Management Policy](#)

CAHS [Humidified High Flow \(HHF\) Nasal Cannula Therapy](#)

15. WA Health Policy Framework

[Public Health Policy Framework](#)

16. Acknowledgement

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18. Definitions

Carer	Carers provide unpaid care and support to family members and friends who have a disability, mental illness, chronic condition, terminal illness, an alcohol or other drug issue or who are frail aged (Carers Australia, 2015)
Consumer	<p>A person who uses, or may potentially use, health services. Depending on the nature of the health service organisation, this person may be referred to as a patient, a client, a consumer, a customer or some other term.</p> <p>Consumers also include families, carers, friends and other support people, as well as representatives of consumer groups</p>

FiO₂	Fraction of inspired oxygen (FiO ₂) is the percentage concentration of oxygen in the gas entering the lungs. It is written as a part of a whole, for example 0.88 which is equal to 88%. Percentage of oxygen and FiO ₂ are used interchangeably in this document
High flow oxygen therapy	Traditional oxygen therapy is up to 16L/min and high flow oxygen therapy is up to 60L/min

19. Appendices

- Appendix 1: [Oxygen Therapy Management](#)
- Appendix 2: [Uncontrolled Oxygen Delivery Devices](#)
- Appendix 3: [Controlled Oxygen Delivery Devices](#)
- Appendix 4: [Replacement and Disposal of Oxygen Delivery System](#)
- Appendix 5: [Nebulisation](#)
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- Appendix 8: [Peakflow meter](#)

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Appendix 1: Oxygen Therapy Management Indications for Oxygen

Indication	Examples	Initial O2 Therapy	Target Oxygen Saturation
Critical Illness	Major Trauma Shock CO poisoning	Reservoir (non rebreather mask 15 L/min)	94% -100%
Suspected Type I (hypoxemic) respiratory failure	Pulmonary embolism Pulmonary oedema Pneumonia Diffuse lung disease Severe asthma	Nasal prongs 2-4 L/min or Hudson/simple face mask 5-10 L/min Consider use of Non-rebreather mask	94-98%
Suspected Type II (hypercapnic) respiratory failure	Severe COPD Severe bronchiectasis Morbid obesity Sleep apnoea Neuromuscular disease Kyphoscoliosis or other chest wall deformity	Nasal prongs or Venturi mask 24-28%	88-92%
Conditions where O ₂ therapy is not required (unless the patient is hypoxaemic)	Coronary artery disease Stroke Pregnancy and obstetric emergencies Drug overdoses	Nil	94-98%

Breathlessness is not an indication for oxygen therapy¹⁷

Safety Precautions

- Oxygen supports combustion, and there is a risk of fire or explosion, especially if patients or carers should smoke or light matches near the oxygen source³. No naked flames or friction toys must be within two (2) meters of an oxygen cylinder or delivery equipment including wall outlets, mask and tubing in use.
- Oxygen cylinders must be stored in a secure, cool, dry place away from heat and direct sunlight. WACHS Storage and Handling of Gas in Cylinders Procedure.
- May cause or aggravate hypercapnic respiratory failure and should be prescribed cautiously to patients with severe chronic lung disease and other conditions at risk of hypercapnic respiratory failure^{1, 3}.
- Patients with paraquat and bleomycin lung injury may be harmed by oxygen therapy so it should be avoided as it accentuates lung damage in these conditions⁶. If the patient is hypoxaemic and oxygen therapy is required, the target oxygen saturation is 88-92%¹.

- Long term use of oxygen delivery devices may lead to the development of pressure sores and skin irritation².
- Oxygen therapy can have a drying effect on oral mucosa. Regularly assess oral mucosa, offer fluids and perform regular mouth care on the patient ².

Oxygen Prescription and Dose

Oxygen therapy is to be prescribed once the patient is stable, except in:

- critically unwell patients in the emergency department
- operating theatres
- immediate post procedure recovery - up to 2 hours following discharge from theatre recovery to the ward with time commencing at the point of discharge from recovery (not the end of the procedure). Oxygen should be weaned off as clinically appropriate. If the patient still requires oxygen after 2 hours they should be reviewed by a medical officer and oxygen prescribed if clinically appropriate. Use nasal prongs if the patient does not tolerate a Hudson™/ face mask
- physiotherapy and respiratory / sleep laboratories
- procedures performed outside of main theatre or that require sedation only. Except if it is expected that a patient will require ongoing oxygen therapy post procedure.

The prescription should be reviewed daily and should define:

- Indication
- Target oxygen saturation
- Delivery device
- Range for oxygen flow or percent of inspired oxygen
- When oxygen is to be applied
- Commencement date
- Signed and dated with prescriber’s name printed legibly

A WACHS oxygen sticker is to be placed on the patient’s medication chart (unless an endorsed regional oxygen prescribing chart is in use).

The WACHS oxygen sticker can be ordered via iProc.
UCN Number is 145100B.

OXYGEN THERAPY Indications: _____

Flow Rate: _____ litres/minute or _____ % of oxygen Target SpO₂>_____

Frequency: Continuous As required Sleep Exercise

Delivery: Nasal Prongs Hudson Mask Venturi Mask HHF

Device: CPAP _____ cm pressure BiPAP/ETT Humidification

Tracheostomy mask/T Piece Other _____

Commenced date/time: _____ / Cease date/time: _____

Dr (sign): _____ Dr (print name): _____

Date: ____ / ____ / ____

Dose of Oxygen Therapy

Prescribe at a dose to achieve normal or near normal saturation of 94 - 98% for acutely ill patients excluding those with or at risk of hypercapnic respiratory failure¹.

Titrate to the lowest concentration that meets oxygenation goals:

- 88 - 92% for patients with or at risk of hypercapnic respiratory failure.
- 94 - 98% for all other patients.

- Should be reduced if the patient is clinically stable and the oxygen saturation is above the target range or has been at the upper end of the target range for at least 4 hours. This may require a change to the oxygen delivery device¹.
- Must be ceased when the patient is able to maintain oxygen saturation in the target range when breathing room air. Oxygen saturation on room air should be monitored for at least 5 minutes after discontinuing oxygen therapy and should be rechecked in an hour. Recommence if saturation level falls below the target range¹. Document all attempts at weaning in the healthcare record.
- Should be continuous as intermittent is harmful. Arterial oxygen levels can fall dramatically when oxygen is withheld.

Humidification¹⁷

The upper airway normally humidifies inspired gases.

Humidified oxygen is required when the upper airway is bypassed by tracheostomy or other artificial airway. A passive or active humidification system (HME) should be used. A heated pass over humidifier should be used for:

- Patients using high flow nasal cannulae.
- High flow oxygen (> 5-6L/min) via face masks used for more than 24 hours.
- Patients who report upper airway discomfort due to dryness when using oxygen therapy.
- Recent haemoptysis.
- Sputum retention.

Humidification may not be required in patients with intact upper airways using low flow oxygen therapy or short term use of high flow oxygen.

Considerations for the use of humidification:

- Proposed duration of oxygen therapy, flow rate and delivery device in use.
- Type, amount and tenacity of secretions.
- Oxygen therapy has a drying effect which is exacerbated in patients with tachypnoea.

Unhumidified oxygen can cause drying of the nose and mouth and can result in the chest secretions becoming sticky and difficult to expectorate.

Equipment for humidification:

- Humidification tubing (commonly known as ‘elephant tubing’).
- Aerosol mask.
- Humidifier / Fisher and Paykel®
- Bags of sterile water and manufacturer recommended giving set

Key points:

- Humidification circuitry to be changed weekly or more frequently if visibly soiled
- The humidifier should be filled on a slow continuous feed through a closed system
- The heater element should never be permitted to run dry of water with the heater left on

- Rates of acquired pneumonia between patients in whom circuitry is changed weekly versus 3rd daily are comparable

Special Considerations

Pregnancy

- All women with hypoxaemia who are more than 20 weeks pregnant should be managed with left lateral tilt to improve cardiac output and oxygen therapy to maintain an oxygen saturation of 94-98%¹.

Poisoning

- In patients with carbon monoxide poisoning, measurement of blood carboxyhaemoglobin level is required.
- The half-life of carboxyhaemoglobin is decreased by high concentrations of oxygen so such patients should be treated with high oxygen concentrations.
- This can be achieved with high flow oxygen via a reservoir mask in spontaneously breathing patients and with endotracheal intubation and mechanical ventilation with 100% oxygen in comatose patients or those with severe impairment of consciousness¹.

Posture

Oxygenation is reduced in the supine position so fully conscious patients should be nursed in the most upright posture possible (special consideration should be given to patients with spinal cord injury about the sustainability of upright positioning for respiratory function) unless¹:

- It causes significant discomfort that is distressing to the patient and cannot be managed (e.g. pain relief post-surgery)
- Immobilisation is required for suspected or actual skeletal or spinal trauma
- Patient is hypotensive
- Post seizure recover period

Domiciliary Oxygen

Advice for those rural and remote General Practitioners who are required to prescribe home oxygen to adults in the absence of a specialist Respiratory Physician opinion is provided by WA Health.

Domiciliary Oxygen information via the [WA Health Respiratory Health Network](#) internet page is provided. A Western Australian Domiciliary Oxygen Referral Form is available as a resource (the form includes a referral form; information sheet covering indications, contraindications for domiciliary oxygen therapy; and a sample proforma letter for residential aged care facilities). A WACHS referral contact list for regional contacts responsible for supplying oxygen in is also available.

Refer also to the WACHS Provision of Domiciliary Oxygen for Travel in WA Guideline for flexible support in the supply of oxygen therapy for patients when travelling for prolonged periods away from their usual place of permanent residence.

Oxygen concentrators^{19,20,21}

For those rural patients where oxygen bottles/piped oxygen is not easily accessed, oxygen concentrators may be an option if suitable for the patient's needs. Health funds may provide rebates for concentrators and electricity companies may also offer rebates. Oxygen concentrators are often classified as life-support equipment that can be prioritised when restoring power during outages – registration is needed to link to this service (contact local electricity provider).



Figure 1: Examples of oxygen concentrators

Home concentrators: are usually about the size of a bedside table that concentrates oxygen by filtering the nitrogen out of the air. They require electricity to operate. Placement of the concentrator is important as they may be difficult to move around – long tubing is used with them and those in the environment need to be mindful so as not to trip and try to not have more tubing than needed as this can get in the way.

It is recommended to read the product user guide for specific instructions related to concentrator set up, care and ongoing use. Concentrators need plenty of air circulating around them. Locate them in a well-ventilated area away from sources of ignition, avoid cupboards or confined spaces. If placing a concentrator near a window, make sure curtains do not stop the concentrator from drawing in the air it needs. Concentrators should not be placed in bathrooms or in any area that liquid could be spilled on them. Use an extension tubing when accessing wet areas. They should be located at least 15cm from the wall. Open a window for ventilation if possible. The concentrator should be plugged directly into a power point. Do not use extension cords, double adapters or power boards.

A home oxygen concentrator is transportable (although heavy) and can normally be taken away when travelling. It is important to talk to the supplier about how to transport it safely. Generally, they are carried upright. They may be damaged if transported lying flat or on their side. If travelling by car, put the concentrator in the boot if possible, or on the back seat restrained by a seatbelt. Check with airline or travel provider to make sure they will allow the concentrator on board as luggage and ask about the extra cost. It may be cheaper and easier to hire one and have it delivered to where the accommodation is.

Portable concentrator: are smaller concentrators designed to be taken out of the home. Many are so light they can be carried in a bag or wheeled. They also contain their own power supply. These concentrators can be fairly costly and normally require private funding. Most deliver oxygen in a pulsed dose, which means receiving oxygen then breathing in, but not when breathing out. This is done to make the machine lighter, and also to preserve battery life.

Some portable oxygen concentrators are easy to use on board planes and other modes of transport and can then be used during stop-overs as well. It is wise, however, to check that travel companies will allow a concentrator on board. It may be necessary to book a seat near an appropriate power source, so the concentrator

batteries can continue to charge in transit. This is especially important for long journeys where the concentrator may need to operate for many hours. The plug should be checked to ensure it is compatible with the electrical outlet being used.

Care and maintenance:

- before each use - inspect the cannula and tubing for deterioration. If they show signs of damage discard and replace immediately. Suggest always keep a spare handy
- keep free from dust with regular cleaning with a damp cloth
- wash filters regularly and replace yearly
- some suppliers may offer a service where they will check or service the equipment on a regular basis.

Safety precautions when using a concentrator:

- Never leave the oxygen equipment unattended if it is switched on and not in use
- Refrain from placing towels or fabric on top or below the device. This may cause overheating
- While the oxygen is on, do not cover/smooth the cannula or tubing with sheets, blankets or cushions
- Oxygen can make material flammable
- Allow enough slack on the power cord to prevent accidental unplugging
- To prevent accidents and risk of falls, drape long lengths of tubing over hooks positioned above floor level
- Do not allow children or visitors to tamper with the concentrator or flow rate settings
- No smoking - never smoke or use e-cigarettes (or let someone else smoke) near the oxygen equipment at any time.

Appendix 2: Uncontrolled Oxygen Delivery Devices

Nasal Cannulae (Simple)

- Nasal cannulae can be used to deliver low and medium dose oxygen concentrations.
- Delivers approximate FiO₂ between 0.24 - 0.4.
- **Not indicated** if the patient’s clinical state is **unstable**.
- Unsuitable for concentrations greater than 40%.
- Mouth breathing does not appear to reduce the efficacy of nasal cannulae¹.

Generally preferred by patients over face masks and have the advantages of improved comfort, less claustrophobia, ability to eat and speak freely, less easily dislodged, less inspiratory resistance and no risk of (carbon dioxide) CO₂ rebreathing.



Figure 2 Nasal cannula¹

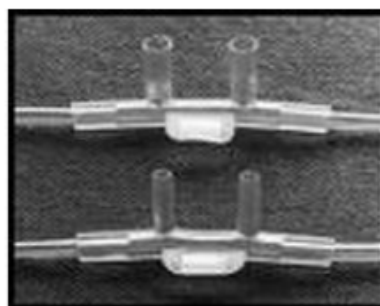


Figure 3 Nasal cannula¹

Disadvantages are that flow above 4L/min tends to cause nasal dryness and discomfort if maintained for several hours and may not be effective in patients with severe nasal obstruction ¹. Should not be used in patients who have nasal trauma, nasal injury including epistaxis (+/- packing), and nasal blockages.


	Oxygen Flow per min	Approximate FiO ₂
	1 litre	0.24
	2 litres	0.28
	3 litres	0.32
	4 litres	0.36

Figure 4 Nasal cannulae flow rate and approximate FiO₂

Application of nasal cannulae

- Insert nasal cannulae into the opening of nares
- Secure the tubing behind the ears ensuring that it is not too tight to cause trauma
- Gently secure under the chin using sliding adjustment piece
- Turn oxygen flow meter on to the prescribed flow rate
- Titrate the flow rate according to saturation level in relation to the medical prescription. Select minimum flow rate to achieve target saturation level

High Flow Nasal Prongs / Cannulae (Humidified) Airvo2™

High Flow Nasal Prongs (HFNP) can be used as an alternative to CPAP in maintaining patients without the need for intubation and mechanical ventilation.

The HFNP system uses a sterile water reservoir, heater system, filter, oxygen and air mixer, and nasal cannulae.

The system can deliver up to 50L/min of warm and humidified oxygen and can deliver oxygen up to FiO₂ 1.0.



Figure 5 High flow nasal prongs¹



Figure 6 High flow nasal prongs/humidifier¹

Indications:

- Hypoxia
- When reduced oxygen therapy and reduced dose of positive end respiratory pressure (PEEP) is considered advantageous
- To achieve optimal humidification

Contraindications:

- Untreated pneumothorax
- Penetrating lung injury
- Hypercapnic respiratory failure (exception, palliation) – HFNP should not replace NIV/CPAP

Humidification prevents the nasal mucosa from drying. HFNP delivery systems can be used in clinical areas that have both piped medical air and oxygen outlets.

Key points:

- Initiating and maintaining treatment depends on underlying pathology
- Commence therapy using settings of FiO₂ and 50 L/min as per medical officers' instructions
- Titrate treatments according to arterial blood gas results in consultation with medical officer and/ or pulse oximeter readings
- Flow rates can be adjusted as clinically indicated but should not exceed 50 L/min

- FiO₂ can be adjusted as clinically indicated but if greater than 0.6 then escalate care and consider critical care review as appropriate
- Decision and regime for weaning HFNP is based on clinical judgement which takes into consideration patients underlying pathology, respiratory function assessment, arterial blood gas (ABG) trends and vital signs

Airvo2™

Treatment commonly starts at FiO₂ 0.4 and flow of 40 litres with the intention to wean down titrating to prescribed oxygen saturations. If FiO₂ requirement is >0.4, flow is >40L/min or there is an increasing oxygen demand Medical review is necessary.

Consider Goals of Patient Care or Not for Resuscitation orders and treatment parameters in determining interventions and level of observations, e.g. depending on level of treatment - no ABG may be recommended.

AIRVO 2 AND ACCESSORIES

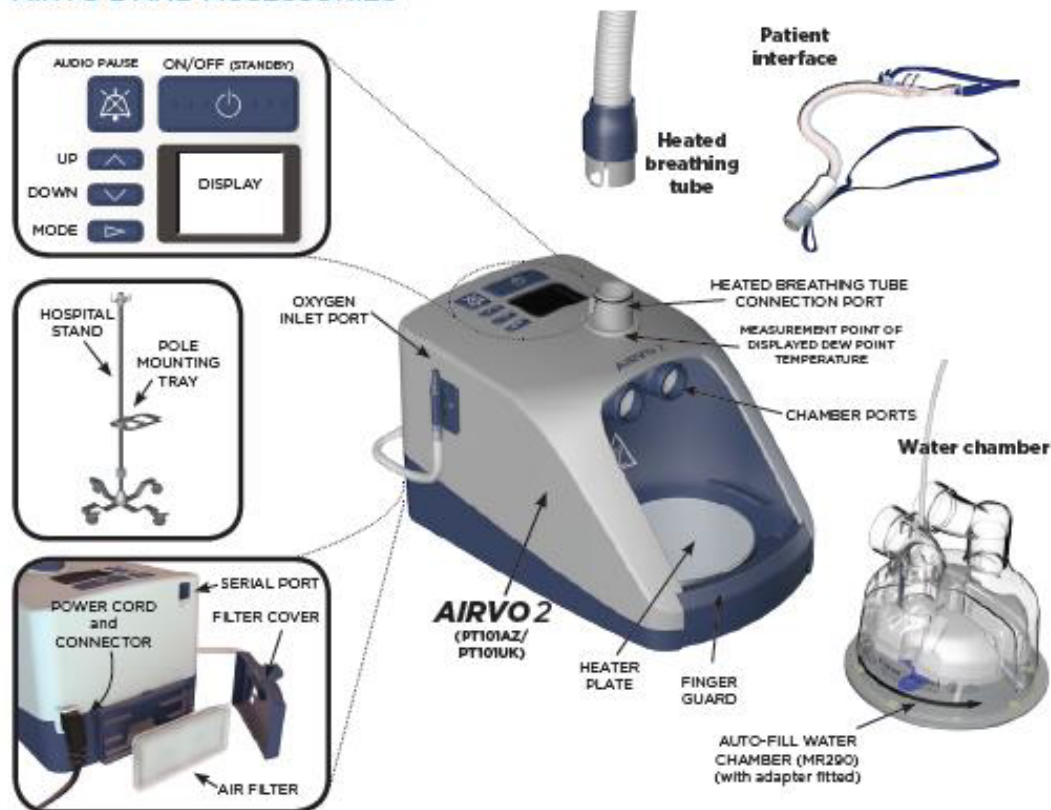


Figure 7 Airvo2™ humidifier¹

- Is used for both adult and paediatric patients in many sites in WACHS, areas include general wards, ICU/HDU, paediatric ward areas and emergency departments.
- Delivers humidified high flow oxygen but **does not** require medical air¹
- Is a humidifier with an integrated flow generator that delivers high flow warmed and humidified respiratory gases to assist spontaneously breathing patients with their oxygen requirements.
- Contains an oxygen analyser to help determine the oxygen fraction being delivered to the patient.
- Can adjust the level of oxygen from the oxygen source, until the desired oxygen fraction is displayed on screen. It may take the reading several minutes to settle.
- HFNP allows high concentration of oxygen to be tolerated and provides a degree of PEEP. This is a supportive measure for type 1 respiratory failure. Precautions to remain the same as for conventional oxygen therapy i.e. CO₂ retention, hypoxia despite therapy.
- Resources available include:
 - quick user guides, user manual and other resources – available from the equipment manufacturer representatives
 - education resources (videos, Airvo™2 simulator app and product resources/user instructions) via [Fisher & Paykel® Healthcare website](#).

Weaning HFNP

The decision and regimen for weaning HFNP is based upon clinical judgement considering:

- Patient's underlying pathology
- Assessment of patient's respiratory function
- ABG trends and vital signs

Weaning HFNP treatment must involve consultation with the Medical Officer.

Simple Face Masks

- Simple face masks deliver oxygen concentrations between FiO_2 of 0.40 - 0.60.
- Flow must be at least 5 litres per minute to prevent the patient re-breathing CO_2 .
- The mask is suitable for patients with hypoxaemic (Type I) respiratory failure but not for patients with hypercapnic (Type II) respiratory failure¹.



Figure 8 Hudson™

A Hudson™ face mask is a simple facemask with open side ports that allows room air to enter the mask and dilute the oxygen as well as allowing exhaled carbon dioxide to leave the containment space.

Application of simple mask

- Apply simple mask to patient
- Set flow rate to minimum of 5L/min¹
- Do not occlude side ports
- Titrate the oxygen flow rate to the minimum prescribed flow rate, to achieve the target saturation


	Oxygen flow per min	Approximate FiO ₂
	5- 6 litres	0.40
	6- 7 litres	0.50
	7-10 litres	0.5-0.6

Figure 9 Hudson™ mask flow rate and approximate FiO₂

Non Rebreather Mask and Bag

- Non rebreather (reservoir) masks are most suitable in an emergency where CO₂ retention is less relevant^{1, 2}.
- They achieve close to 100% oxygenation at 10-15 litres per minute by minimising room air entrapment.
- They deliver the highest concentration of oxygen without a sealed system (i.e. CPAP, NIV).
- They have multiple one way valves in the side ports and a reservoir bag attached.



Figure 10 Non rebreather mask and bag¹

The valves:

- prevent air being drawn into the mask
- enables CO₂ to leave the mask thus preventing risk of rebreathing.

The reservoir bag:

- fills with a greater concentration of oxygen available for the patient to inspire
- has a one way valve preventing exhaled air from being rebreathed.

Application of non-rebreather mask and bag

- Apply facemask to patient
- Set flow rate to a minimum of 10L/min
- Ensure that the reservoir is inflated at the end of inspiration at all times. If not, check tubing connections and oxygen. If still not inflated, increase flow rate and escalate care. Deflation suggests a leak or inadequate oxygen flow and may be a sign of deterioration¹
- Titrate the oxygen flow to the minimum prescribed flow rate, to achieve the target saturation. Escalate care if patients condition deteriorates or patient is requiring increasing oxygen requirements to maintain prescribed saturation levels

Tracheostomy Oxygen Devices

Tracheostomy Mask

- Used to deliver humidified oxygen/ nebulised medication to the patient via a tracheostomy tube. It is generally used when oxygen flow rates are greater than 4L/min or if the patient has thick pulmonary secretions.



Figure 11 Tracheostomy mask

Tracheolife™

- A Heat Moisture exchange (HME) is a single use device, complete with oxygen port positioned to allow heating and humidification of all inspired gases for the administration of oxygen to a patient with a tracheostomy.
- The central port allows suctioning and sampling to be performed without removing the humidifier.
- An additional piece of oxygen tubing is required when connecting oxygen to the humidifier.



Figure 12 Tracheolife II HME™ humidifier with oxygen vent¹ (example of

Thermovent O2™

- An HME with oxygen port is a convenient and comfortable method of supplying humidified, oxygen enriched air.
- The device clips over a heat moisture exchanger (HME). It is supplied with 150cm connecting tube and coned mount for immediate connection to the oxygen source.
- There is an even distribution of gas flow.



Figure 13 Thermovent O2™ with integrated oxygen connecting

Key Points before commencement of oxygen:

- The patient's airway is checked for secretions and tracheal suction completed
- HME is attached to the end of the tracheostomy tube.
- Oxygen tubing is connected to the tracheostomy tube by attaching the oxygen tubing to the Tracheolife™ or clipping on the integrated Thermovent™.
- Commence the oxygen therapy at 1- 2L/min. Target oxygen flow rate to achieve the target range oxygen saturation.

Appendix 3: Controlled Oxygen Delivery Devices

Venturi Mask

- Venturi masks provide a more portable oxygen concentration to the patient.
- They are suitable for all patients needing a known concentration of oxygen.
- The oxygen flow required to achieve the appropriate concentration is defined on the colour coded nozzles (air entrainment regulators). See Figure 16 below.



Figure 14 Venturi Mask¹

Note: The colour may vary at each site. Staff are to note FiO₂% on each regulator prior to use



Entrainment Device	O ₂ Flow per minute	Precise FiO ₂
Blue	4 litres	0.24
Yellow	4 litres	0.28
White	6 litres	0.31
Green	8 litres	0.35
Pink	8 litres	0.40
Orange	8 litres	0.50

Figure 16 Venturi mask flow rate and precise FiO₂ according to entrainment device

Key Points

- Apply facemask with appropriate nozzle to patient. Ensure hood insitu at all times and adjust elastic strap to ensure adequate fit obtained.
- Ensure that nozzle vent is not obstructed and that the protector hood is in the correct place protecting the vent at all times.
- Set flow rate as specified on bottom of nozzle air entrainment regulator (as prescribed).
- Refer to specifics of manufactures' product information for each area as may vary.

Appendix 4: Replacement and Disposal of Oxygen Delivery System¹⁷

- Check oxygen delivery device at least once per shift when device is in current use.
- Ensure oxygen device is labelled with patient identification (single patient use device).
- Replace respiratory device as required when:
 - Soiled or contaminated due to secretions or inadequate storage
 - Tubing is damaged
 - Reservoir bag is damaged
 Example: When dropped on the floor or contaminated with sputum
- Dispose of mask device in the general waste when:
 - Patient is discharged/deceased
 - Mask is replaced
- Note: If a pack of multiple air entrainment regulators is opened, do not discard the remaining regulators until the patient has been discharged.
- Transfer with patient if relocated.

Appendix 5: Nebulisation

Nebulisers used by patients carrying an airborne infectious disease agent pose a risk of transmission to others in their immediate environment and additional precautions are required.

Aerosol generating procedures are those that stimulate coughing and promote the generation of fine airborne particles (aerosols) resulting in the risk of airborne transmission. Refer to the WACHS Infection Prevention and Control Policy.

COVID-19 guidelines state that Nebulisers are not recommended for use and should be replaced by dedicated single patient use spacers where possible (source: [COVID-19 Infection Prevention and Control in WA Healthcare Facilities](#) [version 8, 31 August 2020] Appendix 3 Aerosol generating procedures)

- Nebulisers are a delivery system for inhaled medications or suspensions.
- The aim of nebulisation is to deliver a therapeutic dose of appropriate respirable size suitable for patient inhalation to the lower respiratory tract.

Types of Nebulisers⁸

Type	Description
Jet	<ul style="list-style-type: none"> • Jet nebulisers are the most common types used. • They are operated by compressed air or oxygen in order to aerosolise liquid medications. • They deliver compressed air through a jet, causing a region of negative pressure. • The solution to be aerosolised is entrained into the gas stream and is sheared into the liquid film. This film is unstable and breaks into droplets due to surface tension forces.

	<ul style="list-style-type: none"> • A baffle in the aerosol stream produces smaller particles.
Ultrasonic	<ul style="list-style-type: none"> • Ultrasonic nebulisers convert electrical energy to high frequency vibrations using a transducer. These vibrations are transferred to the surface of the solution, creating a standing waves that generates aerosol.
Mesh	<ul style="list-style-type: none"> • Mesh nebulisers use electricity to vibrate a transducer (piezo) that moves liquid formulations through a fine mesh to generate aerosol.

Safety and Precautions

Significant facial and eye deposition of aerosol can occur when a face mask is used. Eye deposition is of particular concern when aerolised anticholinergic agents are administered and may result in blurred vision, pupil dilation and worsening of narrow angle glaucoma⁶

- For patients with severe chronic lung disease and other conditions at risk of hypercapnic respiratory failure- the nebuliser is best driven by compressed air with oxygen therapy given concurrently by nasal cannulae (without altering the current rate) to maintain an oxygen saturation of 88-92%. If compressed air is not available, the nebuliser can be driven by oxygen at a flow rate of 6-10 L/min for 3-4 minutes
- Some nebulisers may be delivered at a lower rate (e.g. chest physio/ induced sputum procedure) and can take up to 30 minutes
- Care providers and bystanders have the risk of exposure to inhaled medications during routine monitoring and care of patients
- Label nebuliser set with patient’s identification label and date first used
- Consider Personal Protective Equipment (PPE) and/ or isolation room if appropriate

Clinical Considerations

- Nebuliser medications must be drawn up and administered separately to intravenous medications
- Prescribed nebulised bronchodilator therapy should be assessed at least daily to confirm nebulisation is indicated
- Nebuliser pots are for single patient use only and must be washed thoroughly or disinfected after every use as per manufacturer’s instructions
- If medication is to be diluted, a new ampoule of sodium chloride 0.9% (or sterile water for injection as indicated) must be used each time

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- Each solution (if not using whole nebule) must be drawn up with a new needle and syringe and labelled accordingly
- T-piece device is the preferred administration method. Instruct the patient to maintain a tight seal with their teeth and lips around the mouthpiece. Instruct patient to breathe through the mouth as this increases medication delivery to the lungs
- When using a face mask ensure a secure mask fit is maintained and adjust the metal support over the bridge of the nose
- Hold device in an upright position during administration
- If non-invasive ventilation therapy is in progress, a nebuliser can be administered if the patient can tolerate an interruption to positive pressure therapy during block care (i.e. combined nursing care). If interruption cannot be tolerated, contact site specific senior nursing staff or Physiotherapy staff for adapter
- If patient is receiving oxygen via nasal prongs, remove these for the duration of nebuliser with T piece unless otherwise instructed by medical officer
- If two hourly nebulisers are prescribed, consider second nebuliser set to ensure one is always dry prior to use
- Check the volume fill capacity of each nebuliser set before adding prescribed medication/ solution to reduce the risk of under filling or overfilling the reservoir
- Nebuliser chambers have a residual volume in which a small amount of liquid will remain after the treatment is finished
- Discard and replace the 'single patient use' nebuliser, oxygen tubing and kidney dish if visibly soiled or as per manufacturer's instructions
- Provision of ongoing education and review of correct nebuliser use will help ensure the effectiveness of prescribed therapies

Equipment

- Nebuliser set
- Compressed air or oxygen as prescribed
- Connecting Tubing
- T-piece nebuliser mouthpiece or mask (including tracheostomy mask if applicable)
- Prescribed solution for inhalation
- Diluent solution (if required for inhalation product)
- Blunt drawing up needle (if required)
- Sterile syringe
- PPE

Procedure

- Explain procedure to patient and educate patient, family and/or carer as able.
- Gain verbal consent as per the OD0657/16 WA Health Consent to Treatment Policy.
- Position patient upright, as clinically indicated to optimise lung deposition.
- Ensure correct assembly of nebuliser set.
- Add prescribed solution/ squeeze contents of ampoule for inhalation into reservoir of nebuliser set.

- Add prescribed diluent ensuring the total volume does not exceed the recommended maximum fill volume. Consider dosages to be administered as two treatments if required.
- Discard remaining solution of diluent.
- Secure the nebuliser cap to jar (including the baffle).
- Secure connecting tube to nipple of oxygen or air supply (whichever is prescribed).
- Turn on oxygen or air supply (whichever is prescribed) to an adequate flow rate (may vary according to nebuliser set specifications but is usually 6-8 litres per minute).
- Sit patient upright and apply T-piece/ mask to mouth/ face instructing the patient to breath steadily interspersed with occasional deep breaths. If T-piece used, instruct patient to maintain a good seal around the mouthpiece and breathe through the mouth. Ensure there is a mist from the T-piece or mask.
- Nebuliser is finished when it begins to splutter (5-15 minute timeframe depending on volume and flow rate). There may be some residual volume left in the jar.
- Dismantle components of the nebuliser set after use and wash the reservoir, baffle and cap with warm water. (Warm soapy water may be used according to manufacturer's instructions. Rinse with clean water). Allow to air dry on a clean surface.

Hypertonic Saline Nebulisation

Administration of a hypertonic saline (3% to 14%) may be used to increase mucociliary clearance by influencing ciliary function, increasing the osmotic drive, altering the visco-elasticity of sputum and reducing viscosity. It can be used for clearing tenacious secretions in patients with cystic fibrosis and patients post lung transplantation.

Safety and Precautions

- Ensure bronchodilator reliever therapy is readily available
- A nebulised 3% hypertonic saline challenge is recommended for first dose to assess possible reactivity.
- Patient to be monitored during administration and observed for any adverse reactions such as chest tightness, wheeze and difficulty in breathing. Cease nebulisation should these occur and initiate escalation of care process specific to the site, setting and area

Equipment and Procedure

- Use a 3% or 6% sodium chloride (where appropriate) sachet/nebule
- Draw up 5mL of the solution
- Add to nebuliser reservoir
- Discard remaining solution
- Administer to patient. (Refer to previous page for equipment and procedure)

Induced Sputum Procedure

Nebulisation may also be used for an induced sputum procedure which assists in the diagnoses of:

- Pneumocystitis jiroveci (PJP), previously known as Pneumocystitis carinii (PCP)
- Pulmonary Mycobacterium Tuberculosis
- Pulmonary Mycobacterium Avium Complex (MAC)

May also be requested for cytology in suspected cases of lung cancer if unable to produce a sputum specimen and bronchoscopy is not considered a viable alternative.

Contraindications

- Pulmonary oedema
- Pulmonary embolism
- Oxygenation saturations below 90%
- Severe shortness of breath or bronchospasm
- Poor conscious level or co-operation
- Pneumothorax

Clinical Considerations

- Perform in an isolated single room. A negative pressure room is required for suspected Pulmonary Mycobacterium Tuberculosis (TB) or MAC
- Performed at the request of a medical officer and requires a laboratory request form to be completed
- Infection control respiratory precautions should be adhered to including the use of PPE (with appropriate mask)
- Hypertonic saline solution is administered using an Iso-Neb filtered nebuliser system
- Inhalation of hypertonic saline solution may cause bronchoconstriction/bronchospasm in some patients. Ensure bronchodilator reliever is available for use as required. Patients at risk may require bronchodilator pre procedure
- The procedure may take up to 30 minutes to complete
- Sputum produced may be quite watery and appear like saliva only but should still be sent to pathology
- Monitor patient post procedure for any adverse events and when necessary, initiate escalation of care process specific to the site, setting and area

Filtered Nebuliser System

Used for the administration of medications (antibiotics or antifungal) via a nebuliser with a filter in the exhalation port. This aids in the prevention of exposure of staff and others to the nebulised medications.

May be used for the following medications:

- Pentamidine (see safety alert below)
- Taurolidine
- Colistin
- Amphotericin
- Iloprost
- Adrenaline
- Gentamicin

- Tobramycin
- Acetylcysteine (Mucomyst™)
- Dornase Alfa (Pulmozyme™)

Safety and Precautions

Pentamidine

- Is administered in negative pressure room
 - Staff who are pregnant or attempting to conceive should avoid exposure to Pentamidine.
-
- A suitable well fitted one way nebuliser system should be used to reduce leakage.
 - Filter systems (either filter or tubing) should be fitted to the expiratory port to prevent environmental exposure to staff and others.
 - The nebuliser system and filter system should be used with a compatible compressor system producing an adequate flow rate and nebulisation should take no longer than 10- 15 minutes in order to ensure maximum compliance.
 - Expiratory filters must be replaced as per manufacturers specifications.
 - Ensure all procedures for nebulisation follow infection control recommendations.
 - Equipment should be cleaned and maintained according to manufacturer's recommendations.

Clinical Considerations

- A Respiratory Physician or Infectious Disease Physician should assess whether nebulised antibiotics are indicated.
- A test dose assessment should be undertaken in hospital to identify possible adverse reactions.
- Perform procedure in a well-ventilated single room or isolated area whilst wearing PPE to reduce the risk of exposure to medications and droplet infection
- A negative pressure room is required for administration of Pentamidine. If unavailable, consider the need for transfer to an appropriate site.
- Administration through a T-piece mouthpiece is the preferred method to optimise medication delivery to the airways and reduce systemic absorption.
- Patient education that includes correct assembly, safe use of nebuliser and potential side effects is essential to maximise therapeutic effect.

Nebulisation via Tracheostomy Tube

Nebulisation with sodium chloride 0.9% may be prescribed as indicated for patients with tracheostomy tube insitu. This should be considered in all patients using a Heat Moisture Exchange Filter (HME)⁷. It is indicated when secretions are tenacious, making removal by coughing or suctioning difficult.

Equipment

- Nebuliser set
- Tubing
- Sodium Chloride 0.9% ampoule
- Oxygen or air supply as prescribed
- PPE

Procedure

- Explain procedure to patient and educate patient, family and/or carer as able
- Gain verbal consent
- Ensure patient privacy
- Don PPE and perform hand hygiene
- Place 5mL sodium chloride 0.9% into bowl of nebuliser
- Attach bowl to mask and tubing
- Connect to oxygen/air supply (as prescribed)
- Remove garments or attachments from tracheostomy tube
- Secure the mask around the patient's neck and attach to the oxygen or air source at a setting of 8-10 L/minute until nebuliser bowl is empty. Some residual volume may remain in bowl
- Visualise the patient throughout the nebuliser administration
- Document in patient's health record

Appendix 6: Inhaler Devices

Inhaler devices are used to deliver a variety of inhaled medications, such as beta-agonists, anticholinergics and glucocorticoids. Each device has a specific formulation and dose of drug. There are a large variety of inhaler designs and examples. The National Asthma Council Australia provides information for health professionals:

- [Asthma and COPD Medication](#)
- [Inhaler technique checklists](#)

Lung deposition varies according to inhaler device, drug particle size, inhaler technique and pattern of inspiratory flow. Each inhaler device has different mechanisms of operation, performance characteristics and requirements for proper use⁸.

Patient age, physical and cognitive ability should guide the selection of an inhaler device⁸. From infants to adults, changes in airway size, respiratory rate, inspiratory flow, breathing pattern and lung volume impact the ability to use various devices and impacts drug delivery to the lungs. Physical ability, coordination (dexterity and timing) and patient preference should be considered when choosing appropriate device⁸.

Providing verbal, written and/or physical demonstration of correct technique is essential during patient education. Correct technique should be regularly reinforced whenever necessary.

Main types of inhaler devices available⁶:

- Pressurised metered dose inhaler (MDI)
- Dry powder inhaler (DPI)
- Soft Mist Inhalation (SMI)

Pressurised Metered Dose Inhaler (MDI)

- MDIs allow low doses of medication to be delivered directly to the site of action in the airways, significantly reducing systemic side effects⁹.
- There are two (2) types of MDIs:
 - conventional- press and breath design
 - breath- actuated- mechanism is triggered by inhalation through a breath-actuated nozzle.
- Spacers and valved holding chambers are accessory devices that reduce oropharyngeal deposition of MDI delivered drug and improve distal delivery⁶.

Clinical Considerations

- Consider the use of a volumatic spacer device (holding chamber) with MDI administration of medication to improve efficiency by providing more reliable delivery, especially for patients who lack of coordination with actuation and inhalation¹⁰
- Medication should be administered by single actuation of the MDI followed immediately by inhalation, repeating actuation and inhalation per doses prescribed
- Consider aids that are available to enable patients with altered manual dexterity to self-administer MDIs and MDIs with spacers e.g. Haleraid™
- The patient's knowledge base and technique in using MDIs must be assessed and the required education provided. Incorrect use of inhalers reduces any potential benefit of the medication¹¹

Procedure

Instruct the patient:

1. Prime the MDI as per manufacturer's instructions.
2. Hold MDI upright and shake well for 5-10 seconds⁶.
3. Breathe out gently and slowly.
4. Remove dusk cap and place device mouth piece in mouth.
5. Seal lips around the mouthpiece to create a seal.
6. Begin to breathe in slowly and deeply whilst activating the canister once only.
7. Continue slow, deep inspiration.
8. Remove inhaler from mouth and hold breath for as long as comfortable.
9. If a second dose is prescribed repeat the process, waiting at least 10 seconds between puffs.
10. If required, rinse mouth post MDI administration as per medication instructions.

For use with a spacer

1. Assemble the spacer as per manufacturer's guidelines.
2. Hold MDI upright and shake well for 5-10 seconds⁶.
3. Connect the MDI to the spacer and prime if necessary.
4. Breathe out gently and slowly.
5. Place lips around the mouthpiece on the spacer to create a seal.
6. Begin to breathe in slowly and deeply whilst activating the canister.
7. Take a long slow deep breath through the mouth and hold for as long as able (approx. 5-10 seconds) then breath out slowly.

OR if the patient is short of breath then instruct them to use the tidal technique

- Breathe slowly and evenly in and out for 4 breaths (tidal breathing).
- If a second dose is prescribed, repeat the process, waiting at least 10 seconds between puffs.

Clean as per manufacturer's instructions.

Dry Powder Inhaler (DPI)

- Administration of certain medications will require the use of a dry powder inhaler in which device specific inspiratory flow is needed to disperse the dry particles and to draw the medication from the DPI to the lung⁸.
- Inspiratory flow rates of 30 to 60 L/min are required to disaggregate and aerosolise medication when using a DPI¹¹.
- They are breath-actuated devices that deliver micronized drug particles with a mass median aerodynamic diameter of less than 5µm.
- Drug is delivered to the airways by the inhalation of air over a punctured capsule or blister⁶.

There are two main types:

- Multiple dose devices which contain up to 200 doses and the method for moving the medication containing powder into the holding chamber is either depressing a lever or twisting part of the canister e.g. Turbohaler[®] and Accuhaler[®]
- Single dose devices which require placement of a capsule in the device immediately before each treatment e.g. HandiHaler[®], Breezhaler[®] and Aerolizer[®]

Clinical Considerations

- Patients require instructions for and demonstration of the correct use of DPIs. Key points to emphasise are storing the device at room temperature in a dry place, inhaling the medication forcefully and deeply, and not exhaling into the canister⁶
- DPIs should not be washed with soap and water as it causes the medication to clump
- Patients should be instructed not to swallow the capsules
- Adequate inspiratory effort is important to disaggregate the powder into fine particles and improve lung delivery
- Young children and patients with acute airflow obstruction or chronic obstructive pulmonary disease (COPD) or the elderly should be evaluated for the ability to generate a minimal inspiratory flow⁵
- Consider manual dexterity devices if needed e.g. Turbogrip[™]

Technique

Refer to manufacturer's instructions for each DPI device technique. The patient should be instructed to:

- Read and follow the instructions for proper assembly
- Make sure to keep the DPI clean and dry
- Keep the DPI in proper orientation during the treatment
- Be sure to puncture the capsule or blister pack once only
- Do not exhale into the DPI
- Make sure to generate adequate inspiratory flow
- Track the devices remaining doses left in the DPI
- Clean as per manufacturer's instructions.

Common errors

- Failure to detect when inhaler is empty
- Poor maintenance of device and/or spacer
- Inspiring too fast or too slow
- Failure to exhaling to functional residual capacity before inhaling or actuating at total lung capacity
- Exhaling into mouthpiece of dry powdered medications
- Tilting head excessively forward or backward
- Cold Freon effect especially without spacer use (cold blast of propellants causes patients either to stop inhaling or inhale via the nose)
- Blocking the vents e.g. Turbuhaler
- Holding mouthpiece to load instead of device e.g. Turbohaler
- Not checking expiry dates
- Not priming as per manufacturers guidelines
- Poor coordination with actuation and inspiration
- Putting wrong end of inhaler in mouth
- Swallowing capsules instead of putting in device
- Not shaking or tilting before use
- Inhaling through nose during actuation instead of mouth
- Exhaling during actuation
- Not removing cap off mouthpiece
- Floating the device in water to check if empty

Soft Mist Inhaler (SMI)⁶

- SMIs are aerosol delivery devices that have been formulated to aerosolise solutions through microelectronic dosimetric systems
- The SMI aerosol has a high fine particle fraction, a low velocity, and more sustained duration than a MDI
- The device has a dose indicator. Once the dose indicator reaches the red zone it alerts the patient that approximately 30 doses remain in the device. The device locks after all the doses have been actuated.
- The inhaler should be cleaned once a week. This is done by wiping the inside and outside of the mouthpiece with a clean, damp cloth.

Procedure⁶

- **Insertion of cartridge**

Before using the inhaler, the cartridge needs to be inserted.

To do this:

1. Press the safety catch on the side of the inhaler. This releases the clear plastic base.
2. Remove the base
3. Push the narrow end of the cartridge into the inhaler until it clicks
4. Push on the cartridge to make sure it is in all the way. You can press it against a table top or other hard surface to do this.
5. Put the clear plastic base back on, and press until you hear a click
6. Once the cartridge is in the inhaler, do not remove it or the base again.

Note: before using the soft mist inhaler for the first time, you need to prime it (for it to release the right dose of medicine).

- **Priming the inhaler**

To prime the inhaler:

1. Hold the inhaler upright with the cap closed
2. Twist the clear base to the right until it clicks
3. Open the cap and point the inhaler at the floor, away from your face
4. Press the button on the side until you see a mist come out
5. Repeat these steps 3 more times

Note:

- If the inhaler has not been used for more than **3 days**, do a "priming cycle" before using it. That means following the first 4 steps above to release one spray of medicine
- If the inhaler has not been used for more than **3 weeks**, do all the steps above. That means going through the priming cycle and repeating it for a total of 4 sprays of medicine

- **Using the soft mist inhaler**

Each inhaler comes with its own directions.

1. Hold the inhaler upright with one hand, with the cap closed.
2. Use the other hand to turn the clear base to the right until it clicks.
3. Open the cap.
4. Breathe out slowly and completely.
5. Put the mouthpiece in mouth, holding the inhaler horizontally. This means it should be pointing toward the back of the throat.
6. Close lips around the mouthpiece, making sure not to cover the air vents (holes) on the sides.
7. Take a slow deep breath in. When starting to inhale, press the button on the side of the inhaler.
8. When the lungs are full, hold breath for 10 seconds to keep the medicine in the lungs.
9. Take the inhaler out of the mouth and breathe out slowly.
10. Put the cap back on the mouthpiece.

The inhaler does not need to be shaken.

Appendix 7: Spirometer

Definition

A spirometer is a device that can accurately and reproductively measure how quickly and how much air can be moved in and out of the lungs.

Indications

Use as an aid for preliminary diagnoses of lung disease, and also as a guide to therapy and longer term monitoring.



Figure 17 Example of a Spirometer

Safety and Precautions ¹⁰

- Should only be performed by clinical staff who have had relevant education as inadequate training will result in poor quality spirometry
- Mouthpieces are single use
- Spirometry requires maximal effort which may cause:
 - Transient breathlessness
 - Syncope
 - Cough
 - Short term oxygen desaturation
 - Chest pain
- May also induce bronchospasm in patients with poorly controlled asthma.
- Ensure a reliever medication is readily available during spirometry.
- Consider avoiding or delaying in the following circumstances:
 - Known or suspected respiratory infection
 - Haemoptysis of unknown origin
 - Pneumothorax
 - Myocardial infarction within 1 week
 - Uncontrolled hypertension or pulmonary embolism
 - History of hemorrhagic cerebrovascular event
 - Recent thoracic, abdominal or eye surgery
 - Nausea, vomiting or pain
 - Cognitive impairment
 - Recent middle ear infection¹⁴

Clinical Considerations

- Should only be carried out by staff trained in the technique.
- Current best practice recommends operators wear a face mask during the procedure
- Maximum patient effort is required in performing spirometry to avoid underestimation of values.
- Good technique is essential to ensure optimal results.¹⁴
- Document spirometry testing results. Some devices may have electronic print out.
- Devices that need calibration should be done according to manufacturer's instructions.

- Procedure should be repeated until 3 acceptable and reproducible results have been obtained with a variation in FEV1 and FVC within 150mL¹⁴ Maximum number of attempts is generally accepted as being eight (8).

Appendix 8: Peak Flow Meter

Definition

A peak flow meter is used to measure peak expiratory flow (PEF) or peak flow. This is defined as the maximum flow achieved during expiration with optimal force from maximal lung inflation.

Use spirometry whenever possible.

Record date/ time and highest peak flow in healthcare records.



Figure 18 Example of Peak Flow

Indications

May be used:

- as a guide to the severity of airway obstruction or airway disease for a given patient at a particular time, and ongoing monitoring and initial diagnoses¹⁶
- to monitor trend, progress or deterioration of respiratory function. Use for trending purposes only in patients who have either been diagnosed with asthma and for whom spirometry testing is not available for whatever reason
- to monitor response to a new treatment or change in medication and/ or dose
- can be used to trend the increase or decline in respiratory muscle power in patients who have problems such as Guillain-Barre or Myasthenia Gravis

Safety and Precautions

- Inhalation or exhalation effort may stimulate the cough reflex which may affect the reading¹⁶
- Peak flow meters are single patient use only
- Clean device according to manufacturer's instructions

Clinical Considerations

- Good technique is paramount for the accurate assessment of response to treatments. Understanding correct technique is important to ensure accurate readings as peak flow measurements are effort and volume dependent¹⁶
- Sustained effort is not necessary as peak flow is measured in the first 10 milliseconds
- Peak flow measurement should not be used for diagnostic purposes. A high peak flow does not mean the absence of lung disease
- Always try to use the same meter on a given patient to maintain consistency
- Remember to document when the patient last used any bronchodilator therapy

- Where possible, peak flow measurements should be performed at the same time of the day on the patient in the same position as previous measurements¹⁶
- Obtain three measurements and record the highest result as the final recorded measurement¹⁶.
- Perform peak flow both before and after inhaled medication if indicated, twice daily at least 10- 15 minutes after completion of any prescribed nebulised medication

Technique

- Either sit patient upright with shoulders back or patient to stand if possible
- Prepare device as per manufacturer's instructions
- Ensure pointer on peak flow meter is set at zero
- Patient to hold device horizontally and avoid obstructing pointer with fingers
- Patient to take a deep breath through the mouth to full inspiration, placing lips and teeth around mouthpiece and ensuring a good seal
- Patient to blow out hard and fast in a single blow
- Note and document the number indicated by the pointer
- Reset pointer and repeat this procedure twice more unless peak flows are not within 40L/min. 30 second interval should be given between blows

Documentation

A Peak flow chart is available for use from the [National Asthma Council Australia website](#). This can be used in its current format until a WACHS version has been developed.

The chart is used to record the highest reading of the three taken. It is graphed all on the same chart so that the trend can be observed. It is recommended for patients with severe asthma, a history of frequent flare-ups, or poor perception of airflow limitation.²²

No modifications are to be made to the chart as it is copyright. If the chart is used for admitted patients in the hospital or community it is filed at the back of the current admission as it does not have an MR number.

A full patient identification (ID) label is required for the front page of the chart and the subsequent pages can have a smaller patient ID label. Patient identification labels must be on all pages utilised (to comply with the WACHS [Health Record Management Policy](#)).

The chart can also be used for clients in the community who are self-monitoring at home (accessed directly from the website).