Irish Guidelines on the Administration of Oxygen Therapy in the Acute Clinical Setting in Adults 2017

Irish Thoracic Society

IRISH SOCIETY OF CHARTERED PHYSIOTHERAPISTS

ANÁIL Respiratory Nurses Association of Ireland

The Acute Oxygen Guideline Working Group wishes thanks the following organisations for their submissions in relation to the development of this Guideline:

- Anáil (Respiratory Nurses Association of Ireland) members
- Irish Society of Chartered Physiotherapists (ISCP)
- Irish Thoracic Society members (ITS)
- British Thoracic Society (BTS)
- BOC Healthcare member of the Linde Group

The membership of the Acute Oxygen Working Group included:

Tara Cahill (co-ordinator) Respiratory Physiotherapist, Galway University Hospital.

Dr Marcus Butler, Consultant Respiratory Physician, St Vincent's Hospital, Dublin.

Ursula Clarke, Respiratory Clinical Nurse Specialist, Sligo University Hospital.

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No member of the Working Group received any gratuities or time for their involvement in the generation of this Guideline. No conflicts of interest were declared.

Revision number	1	Document approved by	Anáil, Irish Thoracic Society & ISCP
Approval date	13/11/15	Responsibility for implementation	All Health sector employees involved in the delivery of Oxygen Therapy in the acute care setting
Next Revision date	November 2019	Responsibility for review and audit	Tara Cahill

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1.0 Guideline Statement

Oxygen is probably the commonest drug used in the care of patients who present with medical emergencies[1]. It had been identified that there was a lack of clear Guidelines in Ireland and as a result a Working Group comprising representatives from the Respiratory Nurses Association of Ireland (Anáil) and the Irish Society of Chartered Physiotherapists (ISCP) in conjunction with the Irish Thoracic Society (ITS) was established to address this gap.

These Guidelines provide concise evidence based recommendations for the assessment, prescription, monitoring and weaning where appropriate of oxygen in the acute care setting. Details on the delivery modalities are also included.

2.0 Purpose

The purpose of this Guideline is to offer a standardised framework that can be adopted in all areas where oxygen is provided in the acute setting. They include the most recent evidence from the British Thoracic Society (BTS) which serve to:

- Promote best practice.
- Provide clarity in clinically complex situations i.e. differing clinical presentations
- Standardise service delivery and care of patients requiring emergency Oxygen Therapy.
- Reduce inappropriate prescribing
- Act as a basis for audit and evaluation of current service provision.
- Encourage improved interaction between healthcare professionals to ensure continuity of care for this patient group.

3.0 Scope

This Guideline is intended for use by all healthcare professionals who may be involved in oxygen use in the hospital setting. This will include doctors, nurses, midwives, physiotherapists, pharmacists and all other healthcare professionals who may deal with ill or breathless patients.

The Guideline addresses the use of oxygen in adult patients in the acute hospital setting including:

- Critically ill patients.
- Patients with hypoxaemia or at risk of hypoxaemia.
- Non-hypoxaemic patients who may benefit from oxygen (e.g., carbon monoxide poisoning).

Areas not covered by this Guideline:

- Oxygen use in paediatrics: the present Guideline applies only to patients aged 16 years and older
- Oxygen use for high altitude activities.
- Oxygen use during air travel.
- Underwater diving and diving accidents.
- Oxygen use in animal experiments.
- Oxygen use in HDUs.
- Oxygen use in ICUs.
- Inter-hospital Level 3 transfers.

- Hyperbaric oxygen.
- Respiratory support techniques including tracheal intubation, invasive ventilation and NIV (CPAP is included).
- Self-initiated use of oxygen by patients who have home oxygen for any reason.
- Ongoing care of hypoxaemic patients at home.
- This Guideline is based on the best available evidence concerning oxygen therapy. However, a Guideline can never be a substitute for clinical judgement in individual cases.

4.0 Glossary of Terms and Definitions

4.1 Abbreviations

ABG	Arterial Blood Gases
Anáil	Respiratory Nurses Association of Ireland
ARF	Acute Respiratory Failure
BNF	British National Formulary
Bpm	Breaths Per Minute
BTS	British Thoracic Society
CF	Cystic Fibrosis
CO_2	Carbon Dioxide
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CPR	Cardio-pulmonary Resuscitation
FiO_2	Fraction of inspired oxygen (e.g., 21% oxygen=FiO_2 0.21)
GCS	Glasgow Coma Scale
[H+]	Hydrogen ion concentration. Normal range 35–45 nmol/L (pH 7.35–7.45): lower levels are alkalotic, higher levels are acidotic
HDU	High Dependency Unit
HME	Heat and moisture exchangers
HSE	Health Service Executive

ICU	Intensive Care Unit
IMV	Invasive Mechanical Ventilation
ITS	Irish Thoracic Society
ISCP	Irish Society of Chartered Physiotherapists
kPa	Kilopascal, unit of pressure measurement (multiply by 7.5 to convert from kPa to mm Hg; 1 kPa=7.5 mm Hg)
L/min	Litres per minute
MDT	Multidisciplinary Team
Mmol/L	Millimoles per litre
mm Hg	Millimetres of mercury (unit of measurement for pressures)
NEWS	National Early Warning Score (NEWS)
NICE	National Institute for Health and Care Excellence
NIV	Non-invasive ventilation
O_2	Oxygen
$PaCO_2$	Arterial Carbon Dioxide tension (partial pressure). Normal range is 4.5–6.0 kPa (34–45 mm Hg)
PaO_2	Oxygen tension (partial pressure), in blood (arterial or arterialised; multiply by 7.5 to convert from kPa to mm Hg)
pH	Unit of measurement for acidity of blood. Normal range 7.35–7.45 ([H+] from 35 to 45 nmol/L): lower levels are acidotic, higher levels are alkalotic
PPPG	Policy, Procedure, Protocol and Guideline
PRN	Pro Re Nata meaning "as needed"
SaO_2	Arterial Oxygen Saturation
SpO_2	Arterial oxygen saturation measured by pulse oximetry
Symbols	> Greater than, for example, $PaCO_2$>6.0 kPa < Less than, for example, PaO_2<8.0 kPa ≥ Greater than or equal to, for example, age≥70 ≤ Less than or equal to, for example, pH≤7.35

4.2 Guideline

Is defined as a principle or criterion that guides or directs action [2]. Guideline development emphasises using clear evidence from the existing literature, rather than expert opinion alone, as the basis for advisor materials [3].

4.3 Scope

This includes both the target users and the target population (only refers to a target population if the Policy, Procedure, Protocol and Guideline (PPPG) is referring to specific groups for example all service users aged 16 years and over) of the PPPG. It identifies to whom the PPPG applies.

4.4 Clinical Governance

Clinical governance is described as the system through which healthcare teams are accountable for the quality, safety and experience of patients in the care they have delivered. For health care staff this means specifying the clinical standards you are going to deliver and showing everyone the measurements you have made to demonstrate that you have done what you set out to do.[4]

4.5 Definitions

Oxygen Therapy: is the administration of oxygen at concentrations greater than that in the ambient air with the intent of treating or preventing hypoxia. It is a prescribed medication, and should be regarded in the same way as any other therapeutic medicine (Guidance on oxygen prescription is given in the British National Formulary, BNF, 2017[4]).
As there is a fixed amount of haemoglobin circulating in the blood, the amount of oxygen carried in the blood is often expressed in terms of how saturated with oxygen the circulating haemoglobin is. This is what is meant by 'oxygen saturation level'. If this is measured directly from an arterial blood sample, it is termed SaO_2. If it is measured from a pulse oximeter it is termed SpO_2. Alternatively, one can measure the PaO_2 of the blood, known as the 'partial pressure of oxygen' in the blood. This measurement can be expressed in kilopascals (kPa; normal range 12.0 -14.0 kPa)

Hypoxia: Hypoxia occurs when oxygen supply is insufficient to meet oxygen demand in a particular compartment (e.g. alveolar or tissue hypoxia). Tissue hypoxia may be subdivided into four main causes: hypoxaemia, anaemic, stagnant or histotoxic. Oxygen Therapy may only correct hypoxia due to hypoxaemia, other ways to improve oxygen delivery to the tissues need to be considered.

Hypoxaemia: refers to low PaO_2 in the blood. For practical reasons, hypoxaemia can also be measured in relation to oxyhaemoglobin saturation. Most authors who have studied this area have defined hypoxaemia as PaO_2<8kPa or SpO2<90%[1].

Hypercapnia: is when the $PaCO_2$ is above the normal range of 4.5–6.0kPa. Patients with hypercapnia are said to have type 2 respiratory failure even if the oxygen saturation is within the normal range.
CAUTION should be taken when administering oxygen to patients with chronically raised levels of carbon dioxide due to their chronic lung condition (NICE, 2010).

Acute Respiratory Failure (ARF) Type 1: is defined by a PaO_2<8ka with a normal or low $PaCO_2$.

Acute Respiratory Failure Type 2: is defined by a high $PaCO_2$ (> 6.0kPa) with or without reduced pH (acidosis). Patients with hypercapnia are said to be in type 2 respiratory failure even if the oxygen saturation is within normal range. This may be acute, acute on chronic or chronic.

Oxygen: should be prescribed to achieve a target saturation of 94%-98% for most acutely ill patients or 88%- 92% for those at risk of hypercapnic respiratory failure or an underlying known respiratory disease e.g. COPD patients.

Acidosis: acidosis is defined as a pH < 7.35 and alkalosis is defined as a pH > 7.45. Acidosis can be caused by respiratory or metabolic disorders. The normal pH range in human blood is between 7.35-7.45 units.

Respiratory acidosis: occurs if the pH of the blood falls below 7.35 ([H+]>45 nmol/L) in the presence of a raised CO_2 level.

Metabolic acidosis: In all forms of metabolic acidosis, there is a low blood bicarbonate level, either due to loss of bicarbonate or due to buffering of excess acid by bicarbonate which is excreted as CO_2.

5.0 Roles and Responsibilities

This Guideline applies to all clinical staff and clinical areas in the acute hospital setting responsible for patients receiving oxygen therapy.

5.1 Roles

- It is the role of all health professionals involved in prescribing oxygen in the acute setting to do so in accordance with recognised Guidelines.
- Oxygen is a drug and as such practitioners should be familiar with how it is to be delivered to the patient and to ensure that every patient is made aware of the implications of this treatment [4].
- Only after careful assessment as described herein has been carried out in conjunction with the patient's consent where possible, should oxygen be prescribed.
- All staff involved in the care of patients requiring acute Oxygen Therapy should utilise this Guideline.
- Audit and review of current practices involving this patient group should be carried out to ensure best practice is taking place.

5.2 Responsibility

- All health professionals involved in the prescribing of acute Oxygen Therapy are accountable for their own practice. This means being answerable for decisions they

make and being prepared to make explicit the rationale for those decisions and justify them in the context of legislation, case law, professional standards and guidelines, evidence based practice, professional and ethical conduct.

- It is the responsibility of all staff to ensure patients who smoke have access at every opportunity to smoking cessation support.

- It should be recognised that this Guideline represents a statement reflecting an expected standard of care and could be introduced in law as evidence of the standard of care expected. There may be occasions when it is acceptable to deviate from the Guidelines but clinical judgement in such a decision must be clearly documented.

- The public may request access to guidelines and public bodies may be called on to publish such documents under Freedom of Information Act (2014)[5] and appropriate legislation.

5.3 Individual responsibility

5.3.1 Hospital Management:

- To ensure all staff are aware of the Guideline.

- To provide support and resources for the Guideline to be implemented to the maximum extent possible.

- To provide all necessary equipment for the safe delivery of Oxygen Therapy.

- To ensure staff are trained and competent in medical gas handling and safety.

- To provide staff with appropriate education and training at a local or national level.

- Line Managers should ensure that all staff who report to them are familiar with and adhere to these Guidelines.

5.3.2 Medical Practitioner:

Oxygen should be prescribed by a doctor in the patient's drug kardex to ensure safe and effective delivery of oxygen therapy to the patient. See Appendix A for quick-guide.

The prescription should cover;

- Oxygen percentage and flow rate
- Target saturation
- Delivery system
- Duration period/ Review Date

5.3.3 Clinical Nurse Specialist- Respiratory:

- Advise and educate relevant Multidisciplinary Team (MDT) members.

- Co-ordinate with the multidisciplinary team in caring for the patient on Oxygen Therapy.

- Offer ongoing support and information for patients with respiratory disease and their families.

- Co-ordinate the in-service education programme, in conjunction with the Senior Respiratory Physiotherapist, for members of the medical team, Registered Nurses and Chartered Physiotherapists.

5.3.4 Registered Nurse:

- Set up and initiate prescribed Oxygen Therapy according to target saturations.

- Nurses should ensure that all oxygen is prescribed for patients requiring oxygen therapy.

- Nursing staff play a pivotal role in providing continuity of care for the patient. It is important that the Nurse is competent to care for patients receiving Oxygen Therapy.

- Nursing staff should inform a member of the medical team immediately if the patient's condition deteriorates significantly using the National Early Warning Score (NEWS)[6].

5.3.5 Specialist Physiotherapist in Respiratory Care:

- Respiratory Physiotherapists are extensively involved in the care of patients with respiratory disease. They have a role not only in the traditional airway clearance and exercise, but also in assessment and monitoring of the patient as well as education.

- Set up and initiate Oxygen Therapy and according to prescription.

- Lead the Physiotherapy Department's involvement in the Oxygen Therapy service.

- Supervise and contribute to the development and training of Physiotherapists in Oxygen Therapy.

- Advise and educate relevant MDT members.

- Co-ordinate the in-service education programmes, in conjunction with the Clinical Nurse Specialist, for members of the medical team, registered nurses and Chartered Physiotherapists.

5.3.6 Staff Grade Physiotherapist:

- To undergo training in Oxygen Therapy, with regular educational updates at in-service training sessions.

- Having assessed the patient and made a clinical decision that Oxygen Therapy may be required; the Physiotherapist (in the absence of a Physiotherapist specialist in

Respiratory Care) will liaise with the appropriate medical team to arrange a review of the patient's need for Oxygen Therapy.

5.3.7 Portering Staff:

- Need to be familiar with the requirements for handling, transporting and storing Oxygen cylinders including the following;
- Cylinders can be heavy and bulky and should therefore be handled with care in order to comply with current manual handling regulations [7].
- Cylinders should not be placed loose on beds or wheelchairs during transportation.
- Cylinders should be placed in an appropriate holder, designed for purpose.

5.3.8 Maintenance Staff:

- To ensure there is a contract with the Oxygen supplier for annual maintenance[8].
- To ensure the supplier undertakes the annual maintenance check
- To undertake the following checks;
    - Quarterly checks of oxygen outlets for functionality, flow rate, gas specificity and pressure [8].
    - Oxygen flow meters and regulators to be serviced yearly and replaced every five years.[8]
    - All alarm signals should be reported to maintenance.[8]

6.0 Procedure

The following process shall be adhered to in the prescription of oxygen in the acute setting.

6.1 Prescribing Oxygen Therapy (See Appendices A and C)

Medical oxygen is a drug and therefore must be prescribed. An oxygen prescription should be written in the patient's drug kardex or similar document [1].

N.B. Oxygen should never be withheld from a patient in an emergency situation if no prescription available. The prescription can be sought retrospectively once the patient is stable [1].

The prescription should include the following important information:

- Patients Name and Hospital Number. Target Oxygen Saturations, flow rate, oxygen delivery device and instructions if the Oxygen Therapy is continuous or as required (PRN) (See Appendix C)[1].
- The Nurse signs for the Oxygen Therapy at each drug round like any other drug. The Nurse's signature is confirming the patient is receiving the correct flow rate via correct

delivery device. The oxygen tubing should also be checked for kinks or accidental disconnection of tubing from the wall flow meter.

- It is not necessary to measure the patient's SpO_2 at each drug round. The latest value in patients NEWS can be used.

6.2 Initiating Oxygen Therapy

- Acutely breathless patients not at risk of Carbon Dioxide retention who have SpO_2 of <85% should be started with a reservoir mask at 15L/min until stable. The oxygen concentration can be reduced thereafter using alternative oxygen devices to maintain the prescribed target SpO_2. (See Appendix D).

- Patients should have their target SpO_2 documented in their medial notes accompanied by the oxygen prescription.

- Patients starting Oxygen Therapy should have their SpO_2 monitored for 5 minutes.

- Pulse oximetry monitoring should be continuous in the seriously ill or critical patient.

- Health Care professionals need to stipulate the amount of oxygen the patient is receiving and delivery device when documenting in observation sheets, patients' notes or drug kardex.

- Ensure Oxygen Therapy does not become interrupted during patient transfers for diagnostic procedures or to other departments. If the patient is seriously ill continuous monitoring of SpO_2 is required.

- Oxygen should continue during nebulised treatments, do not allow hypoxaemia to occur during nebuliser therapy. Use the patient's target SpO_2 as your guide.

- If the patient has Asthma use oxygen as the driving force ≥6L/min.

- When nebulised bronchodilators are given to patients with hypercapnia, they should be given using an ultrasonic nebuliser or else a jet nebuliser driven by compressed air and, if necessary, supplementary oxygen should be given concurrently by nasal cannulae to maintain an oxygen saturation of 88–92%.

- If a patient is being transferred within the hospital Oxygen Therapy should remain in place at the prescribed dose via a portable cylinder.

6.3 Direct patient monitoring

6.3.1 Pulse oximetry

- Pulse oximetry should be available to all healthcare staff managing patients receiving oxygen therapy.
- Pulse oximetry is dependent on pulsatile flow. Readings may be affected by cold hands, Raynaud's disease, shock, skin pigmentation and nail varnish.

- Care is needed with interpretation in patients with low haemoglobin levels. All measurements of oxygen saturation should be recorded in the patients NEWS document/observation sheet.

6.3.2 Arterial blood gases

- Blood gases should be measured as soon as possible in most emergency situations where the patient displays evidence of hypoxaemia.

- Arterial blood gases should be measured and the inspired oxygen concentration noted in the medical record and on the ABG print out for patients requiring emergency Oxygen Therapy.

- If any changes are made to the patient's oxygen requirements, an ABG should be carried out, ideally within 30mins or sooner if patient's GCS indicates.

- An ABG should be considered in patients with a target SpO_2 of 88-92%, this is to ensure their CO_2 level is not rising from their baseline.

- If at any stage a change occurs in a patient's clinical condition evident by their NEWS, a medical review is sought and an ABG should be considered.

6.3.3 Physiological monitoring

- NEWS is the national standard for monitoring patients. Refer to local hospital policy on using NEWS.

6.4 Adjusting Oxygen Therapy

- If the oxygen saturations are below the target SpO_2 range, consider increasing the oxygen flow rate or changing the delivery device to achieve the target SpO_2.

- If the target SpO_2 is 88-92% an ABG should be taken ideally 30-60mins after increase.

- If target SpO_2 remain low after oxygen adjustments first check all connections, delivery devices and pulse oximeter for any faults.

- If SpO_2 remain low after 5-10mins seek a medical review +/- ABG.

- If the oxygen saturations are above the target SpO_2 range and the patient is stable, the flow rate or delivery device should be modified to return the SpO_2 within the target range.

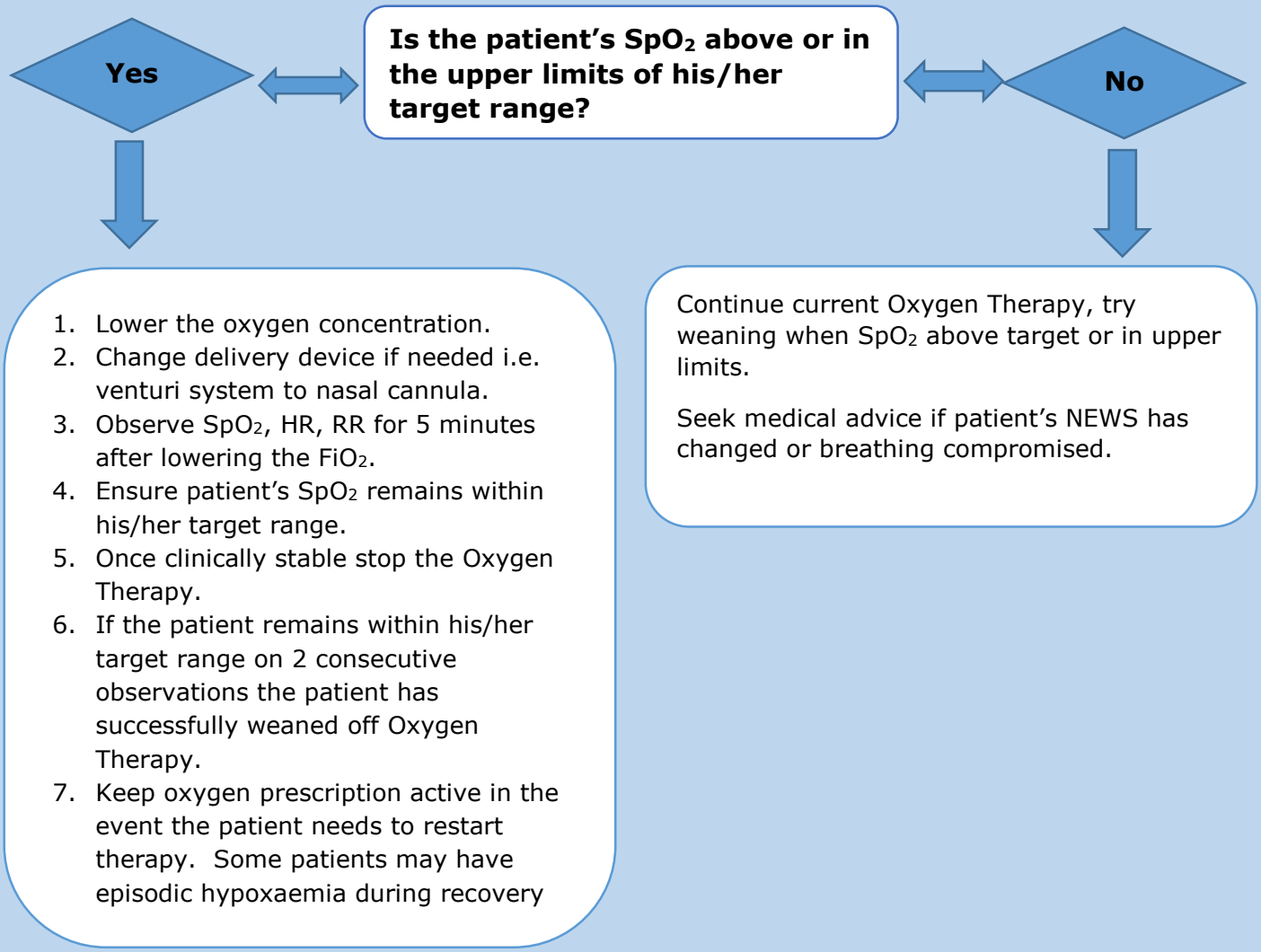
- An ABG is not required for any decrease or cessation of Oxygen Therapy if the patient is maintaining his/her target SpO_2.

- If the patient requires any adjustment to their oxygen therapy it is recommended that his/her SpO_2 would be observed for at least 5 minutes.

- Once the patient is clinically stable Oxygen Therapy should be gradually decreased and discontinued.

- Refer to Appendix B for Algorithm

6.4.1 Weaning and discontinuation of Oxygen Therapy



6.5 Oxygen Delivery Devices (See Appendix D) BTS, (2017)

<table>
<tr><th>Controlled /fixed oxygen delivery devices</th><th>Uncontrolled /variable oxygen delivery devices</th></tr>
<tr><td>Venturi Cone/Valve
Connected to face or tracheostomy mask
Can deliver up to 15L/min oxygen
Colour coded venturi adaptors
Blue 24% FiO_2 set flow rate @ 2L/min
White 28% FiO_2 set flow rate @ 4L/min
Yellow 35% FiO_2 set flow rate @ 8L/min
Red 40% FiO_2 set flow rate @ 10L/min
Green 60% FiO_2 set flow rate @ 15L/min
Do not humidify.
Venturi do not have to correspond directly to their appropriate flow rates.
The flow rate is the minimum flow rate required to give the percentage.
If giving above the flow rate you are not increasing the percentage rate, but you may be helping to meet the patients respiratory demand especially patients with RR>30bpm.</td><td>Nasal Cannula low flow
1-6L/min
Recommend not exceeding 4L/min this is to ensure patient comfort and prevent nasal dryness.
Nasal Cannula high flow
Deliver 5L/min-15L/min
Non Invasive Ventilation home machine
Supplemental oxygen can be added to a patient's domestic NIV machine i.e. BIPAP/CPAP this is delivered in an uncontrolled manor.
In the acute situation it is recommended that a patient revert to the hospital NIV machine until stable. This ensures an accurate FiO_2 is administered and monitored.
Some hospital NIV machines deliver uncontrolled FiO_2
Please refer to your local hospital policy on NIV in the acute situation.</td></tr>
<tr><td>High –flow humidified oxygen via nasal cannula (HFNC) or face/tracheostomy mask e.g. AIRVO
HFNC is a humidifier with integrated flow generator that delivers high flow heated and humidified respiratory gases to spontaneously breathing patients through a variety of patient interfaces.
HFNC is for the treatment of spontaneously breathing patients who would benefit from receiving high flow heated and humidified respiratory gases. This includes patients who have had upper airways bypassed.
The air flow may be from 2 – 60L/min depending on the patient interface. HFNC is for patients in hospitals and long-term care facilities
It can deliver concentrations of oxygen up to 100%
HFNC should be considered as a treatment for acute type 1 respiratory failure.[9,10]</td><td>High concentration reservoir (Non Re-Breathe Mask)
This type of mask delivers oxygen at concentrations between 60%-90% when used with a flow rate of 15L/min.
The concentration of oxygen is not accurate and depends on the flow rate and patients breathing pattern.
These masks are most suited to the emergency situation where carbon dioxide retention is unlikely.
Tracheostomy
Oxygen can be delivered via a Heat and Moisture Exchanger (HME) or a speaking valve attached to tracheotomy tube.
Seek expert advice for tracheostomy care.
Oxymask
Delivers concentrations between 24% – 90% dependant on flow rate of oxygen and the patients breathing pattern.</td></tr>
</table>

6.5.1 Humidification

- Humidification is not required for the delivery of low-flow oxygen (<4 L/min) (mask or nasal cannulae) or for the short-term use of high-flow oxygen.

- It is reasonable to use humidified oxygen for patients who require high-flow oxygen systems for more than 24 hours or who report upper airway discomfort due to dryness.

- In the emergency situation, humidified oxygen use can be confined to patients with tracheostomy or an artificial airway although these patients can be managed without humidification for short periods of time.

- Humidification may also be of benefit to patients with viscous secretions causing difficulty with expectoration.

- Bubble bottles which allow a stream of oxygen to bubble through a container of water should not be used because there is no evidence of a clinically significant benefit but there is a risk of infection[1].

- Consider use of a large volume oxygen humidifier device for patients requiring high-flow rates or longer term oxygen, especially if sputum retention is a clinical problem. (See Appendix F).

- High-flow nasal oxygen should be considered as an alternative to reservoir mask treatment in patients with acute respiratory failure without hypercapnia. (See Appendix G)[1]

6.6 Which patients need oxygen therapy?

Supplemental Oxygen Therapy is recommended for all patients with acute hypoxaemia and for many who are at risk of hypoxaemia, including patients with major trauma and shock. Many patients with acute breathlessness will require supplemental Oxygen Therapy, but there are some situations such as acute hyperventilation or diabetic ketoacidosis where an apparently breathless patient will not benefit from Oxygen Therapy.
Oxygen saturation should be measured in all breathless and acutely ill patients. All patients with shock, major trauma, sepsis or other critical illness should be managed initially with high-concentration Oxygen Therapy from a reservoir mask. Targeted Oxygen Therapy can be initiated once there is spontaneous circulation and oximetry can be measured reliably[1].

6.6.1 Which patients require blood gas measurements?

Blood gases should be measured as soon as possible in most emergency situations involving hypoxaemic patients [11] and are essential in patients who may develop hypercapnic respiratory failure. Blood gases should also be checked (and the clinical situation should be reviewed) if the oxygen saturation should fall by more than three percentage points, even if the saturation remains within the target range. If oximetry shows a patient to be hypoxaemic, the initiation of Oxygen Therapy should not be delayed while awaiting the results of blood gas measurements.
Please refer to local guidelines to determine if arterial or venous blood gases are indicated.

Blood gases should be checked in the following situations:

- All critically ill patients.
- Unexpected or inappropriate fall in SpO_2 below 94% in patients breathing air or oxygen or any patient requiring oxygen to achieve the above target range. (Allowance should be made for transient dips in saturation to 90% or less in normal participants during sleep.)
- Deteriorating oxygen saturation (fall of ≥3%) or increasing breathlessness in a patient with previously stable chronic hypoxaemia (e.g. severe COPD).
- Most previously stable patients who deteriorate clinically and require increased FiO_2 to maintain a constant oxygen saturation.
- Any patient with risk factors for hypercapnic respiratory failure who develops acute breathlessness, deteriorating oxygen saturation, drowsiness or other features of carbon dioxide retention.
- Patients with breathlessness who are thought to be at risk of metabolic conditions such as diabetic ketoacidosis or metabolic acidosis due to renal failure.
- Any other evidence from the patient's medical condition that would indicate that blood gas results would be useful in the patient's management (e.g. an unexpected change in 'track and trigger' systems such as a sudden rise of several units in the NEWS or an unexpected fall in oxygen saturation of 3% or more, even if within the target range)[1].

6.6.2 Recommended Oxygen Therapy for major medical emergencies and critical illness

The initial Oxygen Therapy is a reservoir mask at 15 L/min pending the availability of reliable oximetry readings. For patients with spontaneous circulation and a reliable oximetry reading, it may quickly become possible to reduce the oxygen dose while maintaining a target saturation range of 94–98%. If oximetry is unavailable, continue to use a reservoir mask until definitive treatment is available. Patients with COPD and other risk factors for hypercapnia who develop critical illness should have the same initial target saturations as other critically ill patients pending the results of blood gas results after which these patients may need controlled Oxygen Therapy with target range 88–92% or supported ventilation if there is severe hypoxaemia and/or hypercapnia with respiratory acidosis.

Cardiac arrest or resuscitation	Refer to resuscitation Guidelines for choice of delivery device during active resuscitation. Give highest possible inspired oxygen concentration during CPR until spontaneous circulation has been restored.
Shock, sepsis, major trauma, drowning, anaphylaxis, major pulmonary haemorrhage, status epilepticus	Also give specific treatment for the underlying condition
Major head injury	Early tracheal intubation and ventilation if comatose
Carbon Monoxide poisoning	Give as much oxygen as possible using a bag-valve mask or reservoir mask. Check carboxyhaemoglobin levels. A normal or high oximetry reading should be disregarded because saturation monitors cannot differentiate between carboxyhaemoglobin and oxyhaemoglobin, owing to their similar absorbances. The blood gas PaO_2 will also be normal in these cases (despite the presence of tissue hypoxia).

6.6.3 Serious illnesses requiring moderate levels of supplemental oxygen if the patient is hypoxaemic

The initial Oxygen Therapy is nasal cannulae at 2–6 L/min (preferably) unless stated otherwise. For patients not at risk of hypercapnic respiratory failure who have saturation below 85%, treatment should be started with a reservoir mask at 15 L/min and the recommended initial oxygen saturation target range is 94–98%. If oximetry is not available, give oxygen as above, until oximetry or blood gas results are available. Change to reservoir mask if the desired saturation range cannot be maintained with nasal cannulae (and ensure that the patient is assessed by senior medical staff).

If these patients have coexisting COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88–92% pending blood gas results but adjust to 94–98% if the $PaCO_2$ is normal (unless there is a history of previous hypercapnic respiratory failure requiring NIV or IMV) and recheck blood gases after 30–60 min.

Acute hypoxaemia (cause not yet diagnosed)	Reservoir mask at 15 L/min if initial SpO_2 below 85%, otherwise nasal cannulae. Patients requiring reservoir mask therapy need urgent clinical assessment by senior staff.
Acute asthma, pneumonia, lung cancer. Deterioration of lung fibrosis or other interstitial lung disease	Reservoir mask at 15 L/min if initial SpO_2 below 85%, otherwise nasal cannulae.
Pneumothorax	Needs aspiration or drainage if the patient is hypoxaemic. Although most patients with pneumothorax are not hypoxaemic, supplemental oxygen should be administered to facilitate accelerated resorption of the pleural air. Use a reservoir mask at 15 L/min if admitted for observation. Aim at 100% saturation, while exercising caution if at risk for hypercapnia (e.g. pneumothorax secondary to moderate/severe COPD)
Pleural effusions	Most patients with pleural effusions are not hypoxaemic. If hypoxaemic, treat by draining the effusion as well as giving Oxygen Therapy
Pulmonary embolism	Most patients with minor pulmonary embolism are not hypoxaemic and do not require Oxygen Therapy.
Acute heart failure	Consider CPAP or NIV in cases of pulmonary oedema
Severe anaemia	The main issue is to correct the anaemia. Most patients with anaemia do not require Oxygen Therapy
Postoperative breathlessness	Management depends on the underlying cause

6.6.4 Conditions for which patients should be monitored closely but Oxygen Therapy is not required unless the patient is hypoxaemic.

If hypoxaemic, the initial Oxygen Therapy is nasal cannulae at 2–6 L/min unless saturation is below 85% (use reservoir mask) or if at risk from hypercapnia (see below). The recommended initial target saturation range, unless stated otherwise, is 94–98%. If oximetry is not available, give oxygen as above until oximetry or blood gas results are available. If patients have COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88–92% pending blood gas results but adjust to 94–98% if the $PaCO_2$ is normal (unless there is a history of respiratory failure requiring NIV or IMV) and recheck blood gases after 30–60 min.

Myocardial infarction and acute coronary syndromes	Most patients with acute coronary artery syndromes are not hypoxaemic and the benefits/ harms of Oxygen Therapy are unknown in such cases. Unnecessary use of high concentration oxygen may increase infarct size.
Stroke	Most patients with stroke are not hypoxaemic. Oxygen Therapy may be harmful for non-hypoxaemic patients with mild–moderate strokes.
Hyperventilation or dysfunctional breathing	Exclude organic illness. Patients with pure hyperventilation due to anxiety or panic attacks are unlikely to require Oxygen Therapy. Rebreathing from a paper bag may cause hypoxaemia and is not recommended.
Most poisonings and drug overdoses	Hypoxaemia is more likely with respiratory depressant drugs; give the antidote if available, for example, naloxone for opiate poisoning. Check blood gases to exclude hypercapnia if a respiratory depressant drug has been taken. Avoid high blood oxygen levels in cases of acid aspiration as there is theoretical evidence that oxygen may be harmful in this condition. Monitor all potentially serious cases of poisoning in a level 2 or 3 environment (HDU or ICU).
Poisoning with Paraquat or bleomycin	Patients with Paraquat poisoning or bleomycin lung injury may be harmed by supplemental oxygen. Avoid oxygen unless the patient is hypoxaemic. Target saturation is 85–88%.
Metabolic and renal disorders	Most do not need oxygen (tachypnoea may be due to acidosis in these patients)
Acute and subacute neurological and muscular conditions producing muscle weakness	These patients may require ventilatory support and they need careful monitoring which includes spirometry. If the oxygen level falls below the target saturation, patients need urgent blood gas measurements and are likely to need ventilatory support.
Pregnancy and obstetric emergencies	Oxygen Therapy may be harmful to the foetus if the mother is not hypoxaemic.

6.6.5 Recommended Oxygen Therapy for patients who may be vulnerable to medium or high concentration of oxygen

Prior to availability of blood gases, use a 24% FiO_2 Venturi valve at 2–3 L/min or 28% FiO_2 Venturi valve at 4 L/min or nasal cannulae at 1–2 L/min and aim for an oxygen saturation of 88–92% for patients with risk factors for hypercapnia but no prior history of respiratory acidosis. Adjust target range to 94–98% if the PaCO2 is normal (unless there is a history of previous NIV or IMV) and recheck blood gases after 30–60 min.

COPD and other conditions causing fixed airflow obstruction (e.g., bronchiectasis)	May need lower range if acidotic or if known to be very sensitive to Oxygen Therapy. Ideally use 'alert cards' to guide therapy based on previous blood gas results. Increase Venturi mask flow by up to 50% if respiratory rate is above 30 breaths/min.
Exacerbation of CF	Admit to regional CF centre if possible, if not discuss with regional centre or manage according to protocol agreed with regional CF centre. Ideally use 'alert cards' to guide therapy. Increase Venturi mask flow by up to 50% if respiratory rate is above 30 breaths/ min.
Neuromuscular disease, neurological condition and chest wall deformity Morbid obesity	May require ventilatory support. Risk of hypercapnic respiratory failure

7.0 Storage of equipment

This section is specific to each hospital. This section should contain the location at which the oxygen cylinders are stored and detail the supply and size of cylinders on each ward.

All piped oxygen flow meters should be switched off when not in use. Piped oxygen is available in all clinical environments.

7.1 Guidelines for storage of medical oxygen cylinders[12]

- Oxygen cylinders should be stored in a secure dry place with an oxygen key available to turn on/off oxygen required. All persons using oxygen cylinders should check the labelling and fill levels.

- Medical gas cylinders shall be stored in a purpose built medical cylinders store to ensure patients or healthcare workers are not subject to undue risk in the event of any cylinder storage incident.

- To ensure that excessive numbers of cylinders are not held stocks of medical oxygen cylinders shall be maintained at an optimum level, commensurate with the hospital's requirements. It is important to maintain stocks at an appropriate level as excessive

cylinder stocks can lead to poor stock rotation and increase the potential of any incident that may occur on site.

7.2 Purpose built medical cylinders stores in clinics and hospitals should be:

- under cover, preferably inside and not subjected to extremes of heat.
- kept dry, clean and well ventilated, with ventilation grilles preferably at both high and low level.
- large enough to allow for segregation of full and empty cylinders and permit separation of the different gases within the store, with the different storage areas being well signed.
- laid out to enable strict stock rotation of full cylinders to enable cylinders with the earliest expiry date to be used first.
- separate from any non-medical gas storage areas.
- sited to have good access for the delivery vehicle to enable cylinders to be off loaded safely onto a reasonably level floor.
- located away from any sources of heat or ignition and storage tanks containing highly flammable materials and other combustible materials.
- provided with suitable pens for the storage of large cylinders in the upright position and racking for the storage of small cylinders.
- designed to prevent unauthorised entry to protect cylinders from theft.
- provided with warning notices prohibiting smoking and naked lights within the vicinity of the store.
- Where cylinders are stored in remote 'in use' cylinder storage areas nearer the point of use (adjacent to patient ward areas), the same cylinder storage conditions should be applied.

8.0 Health and Safety[12]

No smoking in the vicinity of oxygen cylinders. Irish Hospitals are smoke free environments.

There are a number of precautions that must be adhered to with medical oxygen irrespective of the method of supply. General hazards when using medical oxygen include the following:

- Materials that burn in air will burn much more vigorously in oxygen and burn at a higher temperature in an oxygen or oxygen-enriched atmosphere. Most serious incidents involving the use of medical oxygen are caused by the patient smoking. Instructions shall be given to the patient to:

- Never smoke whilst using their medical oxygen equipment.
- Never allow any other person to smoke in the vicinity of the patient using their medical oxygen.
- Keep sources of ignition away from areas where medical oxygen is used or stored.
- Avoid ignition sources, including cigarettes, electrical toys or equipment when in potentially high oxygen-enriched atmospheres.

- Oils, grease and alcohol burn in an oxygen-enriched environment with explosive violence. Ignitions may occur with oxygen equipment if it has been contaminated with oil or grease. Only handle or operate medical oxygen equipment with clean hands and tools and keep the oxygen equipment clean and free from any oils or grease.

- Absorbent materials, such as clothing or bedding, when saturated with oxygen, will readily ignite. These materials remain oxygen-enriched for some time after removal from the oxygen source.

- Ventilate any clothing or bedding, where it is suspected that it has become saturated with oxygen, to ensure that any oxygen enrichment is cleared. It may take at least 15 minutes to adequately ventilate clothing or 30 minutes to ventilate bedding before it is safe to approach with a source of ignition. Never cover medical oxygen equipment with any material or store it adjacent to curtains as they may become oxygen enriched.

- Oxygen systems must be turned off when not in use to prevent any unnecessary enrichment of the air

- Only trained persons shall be allowed to operate the medical oxygen equipment. Special care needs to be taken to ensure that children do not tamper with the equipment.

- The total length of flexible unsupported tubing, from supply source to the connection to the nasal cannula or mask shall be kept to a minimum, but in any case not longer than 15 meters. In addition, care is needed to prevent the kinking of the tube to prevent restrictions in the flow.

- Oxygen supplier must provide medical gas safety training. This is available for all staff that utilise oxygen.

8.1 Hazards with compressed oxygen

Instructions concerning the handling and use of compressed oxygen systems shall include:

- Compressed oxygen supplied in cylinders is filled to a high pressure and care is needed to ensure that cylinder valves are kept closed when not in use to prevent leakage. It is important that cylinders storage areas are kept well ventilated to prevent any build-up of oxygen concentration if a leak occurs.

- The stored energy in a compressed oxygen cylinder under pressure is very high and care is needed to store cylinders correctly. As the pressure in a cylinder increases as the cylinder gets hotter (with a corresponding increase in stored energy) it is important that cylinders are stored away from sources of heat.

- As the compressed oxygen is at a high pressure in the cylinder, care is needed to ensure that the regulator, where required, is fitted correctly and set at zero/minimum flow before opening the cylinder valve.

- Instructions shall always be given to open the cylinder valve slowly, to prevent adiabatic compression of the oxygen, which could lead to an ignition.

- Care is needed when storing or using compressed oxygen cylinders to ensure that they are suitably restrained to prevent them from falling so as to avoid the cylinder, cylinder valve or regulator being damaged.

8.2 Hazards with oxygen concentrators

There are specific precautions concerning the electrical supplies to the concentrator that need to be followed and instructions concerning the handling and use of medical oxygen concentrator systems shall include:

- When operating oxygen concentrators, care is needed to connect the equipment to a suitable electrical supply and to avoid any possibility of electrical shock.

- Always switch off the machine and isolate it from the mains electrical supply when maintaining the medical oxygen concentrator or refilling the humidifier.

- Never operate the concentrator in a bathroom.

8.3 Medical oxygen incidents

Having installed the medical oxygen supply system, it is important that the patient or healthcare facility representative is informed of the actions that should be taken in the event of an incident with their oxygen supply. The type of incident could include the loss of supply, malfunction of the unit, adverse reaction by the patient to the gas or the involvement of the equipment in a fire (whether caused by the equipment or not). Provided that the equipment is installed correctly and the user adequately trained and warned about the potential hazards of using medical oxygen, the likelihood of an incident is very remote. Where incidents do occur, they are often caused by external events that impact on the medical oxygen supply system. The patient/user shall be instructed to contact their Medical Oxygen Healthcare Service Provider immediately if they have any doubt about the safety of any situation[13]. Most serious incidents involving the use of medical oxygen are caused by the patient smoking.

Where the medical oxygen supply system is involved in a fire, the patient / user shall be instructed to[14]:

- Initially contact the fire brigade, ensuring they are informed that medical oxygen is in use.
- If there is any doubt about the safety of the situation, not to touch the equipment and to leave the property immediately.

- To isolate the oxygen supply only when it is safe to do so, before following any other instructions.

Where there is a major leak of gas either from a medical oxygen cylinder caused by the cylinder falling over and the attached pressure regulator sheering off or a large leak developing between the cylinder valve and the regulator or where a liquid oxygen vessel develops a major gas or liquid leak the patient / user shall be instructed to:

- Close the cylinder or liquid vessel valve only if it is safe to do so.
- Ensure that external windows and doors are opened to ventilate the area.
- Inform the Medical Oxygen Healthcare Service Provider immediately to obtain advice.

In the event of a cylinder or liquid vessel falling over, where there is no other apparent damage, the Medical Oxygen Healthcare Service Provider should still be notified immediately to obtain advice as to the appropriate actions to be taken.

If there is any evidence of the medical oxygen concentrators running hotter than usual, the patient / user shall be advised to isolate the equipment at the mains supply and inform the Medical Oxygen Healthcare Service Provider immediately. Where it is essential for the patient to receive Oxygen they should be instructed to use their back-up cylinder supply. In all cases the patient / user shall be advised to contact the Medical Oxygen Healthcare Service Provider whenever they are concerned that any unusual event may have occurred that they believe could lead to a failure of the medical oxygen supply.

8.4 Maintenance of equipment

- Inspection of oxygen equipment is performed routinely by the Maintenance Department.
- All flow meters should be serviced yearly and changed every 5 years as per manufactures recommendations.
- The maintenance and servicing of the equipment will be provided by the Biomedical Engineering section in the hospital.

8.5 Cleaning equipment and consumables

- All hospital staff must adhere to standard infection control precautions when handling the patients requiring oxygen.
- This Guideline must be read in conjunction with local Infection Control Guideline.
- Hand hygiene is the most effective means of reducing the risk of cross infection.
- All non-sharp disposable equipment must be disposed of safely in health-care non-risk waste as per local Waste Management Policy.
- Prior to use masks can be stored at the bedside but must be labelled and stored in a clear plastic bag.
- Masks and tubing are disposable after single patient use or visibly dirty.
- Nursing staff should ensure that all the non-disposable equipment is decontaminated after patient use to reduce the risk of cross infection.
- Manufacturer's Guidelines should be available with all equipment.

9.0 Education & training

Each hospital must take responsibility to provide local induction and education for all healthcare professionals involved in the use of Oxygen Therapy.[1]

10.0 References

1. O Driscoll R, Howard L, Earis J et al. BTS Guideline for oxygen use in adults in healthcare and emergency settings. Thorax 2017; 72 (Suppl 1).
2. The Concise Oxford Dictionary of Current English 9th Edition (1995)
3. The Conceptual Framework for the International Classification for Patient Safety (WHO, 2009). www.who.int/**patientsafety**/taxonomy/icps_full_report.pdf
4. British National Formulary (BNF) 2017. 73rd ed. UK: BNF Publishing Group
5. Freedom of Information Act (2014) Houses of the Oireachtas https://www.oireachtas.ie/documents/bills28/**acts**/**2014**/a3014.pdf
6. http://health.gov.ie/wp-content/uploads/2015/01/NEWSFull-ReportAugust2014.pdf
7. BOC: Living Healthcare (2010) Medical Gas Safety: Learners Guide HTM 02-01
8. www.**bochealthcare**.co.uk/.../**gas-safety**.../**gas-safety**-training.html BOC (2017)
9. Gotera C, Diaz Lobato S, Pinto T, Winck J (2013), Clinical evidence on high flow oxygen therapy and active humidification in adults.
10. Lowery, F (2011) High Flow Oxygen cuts need for intubation in Acute Respiratory Syndrome, Society of Critical Care Medicine, Abstract 381.
11. Raffin TA. Indications for arterial blood gas analysis. Ann Intern Med 1986;105:390–8
12. http://www.bochealthcare.ie/en/quality-and-safety/safety-and-technical-data/storage-and-handling-medical-gas-cylinders/storage-and-handling.html
13. http://www.bochealthcare.ie/en/quality-and-safety/safety-and-technical-data/cylinder-complaints/cylinder-complaints.html
14. http://www.bochealthcare.ie/en/quality-and-safety/safety-and-technical-data/fire-procedure/fire-procedure.html

Appendices

Appendix A Oxygen prescription for acutely hypoxemic patients

Appendix B Flow chart for oxygen administration in acute setting

Appendix C Oxygen prescription kardex example

Appendix D Equipment used to deliver oxygen

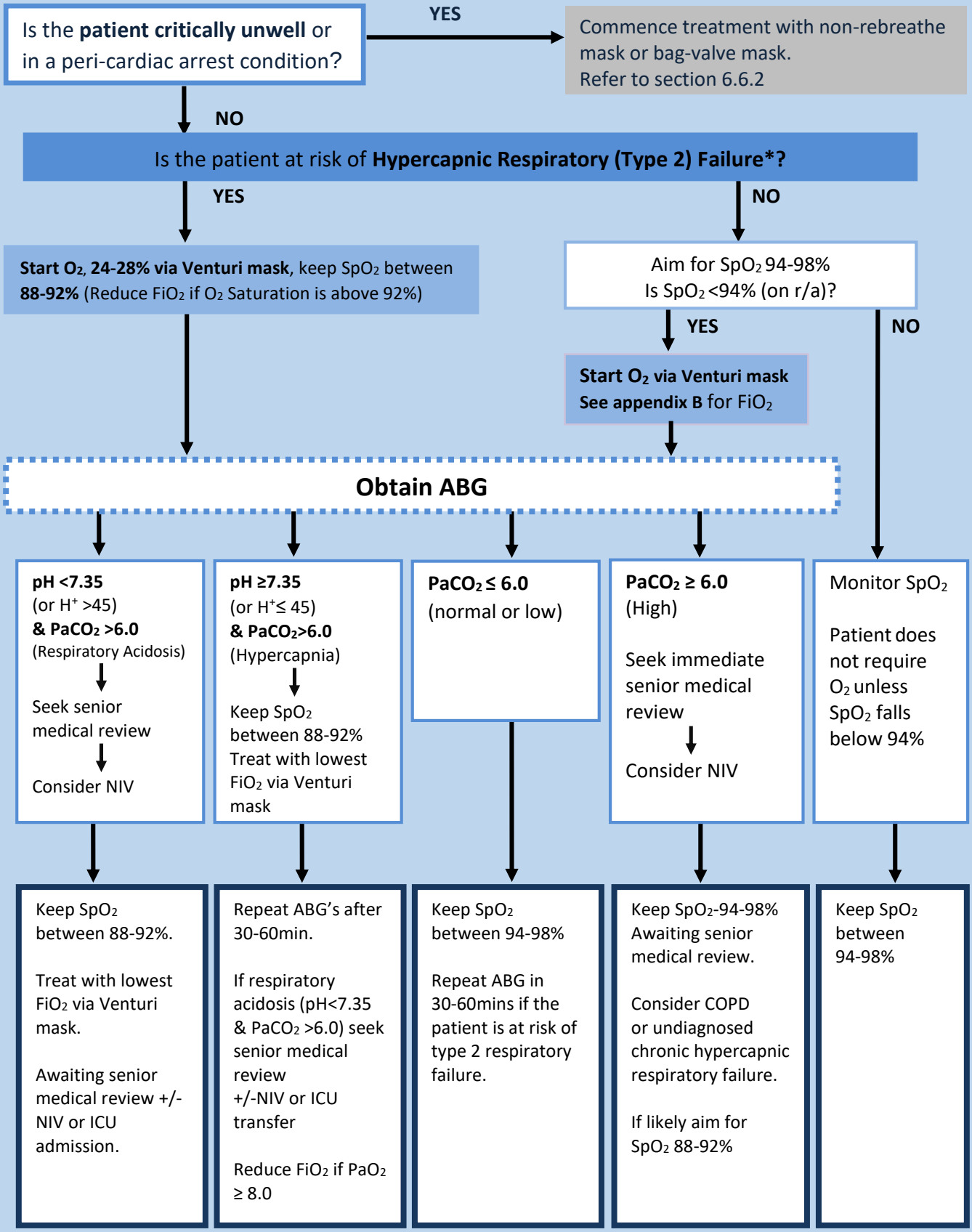
- Nasal cannula
- Venturi mask
- Re-breather mask with reservoir bag
- Optiflow nasal cannula
- Tracheostomy mask
- Optiflow tracheostomy mask

Appendix E Oxygen flow metre

Appendix F Cold Humidification

Appendix G Humidified Nasal High Flow (Airvo)

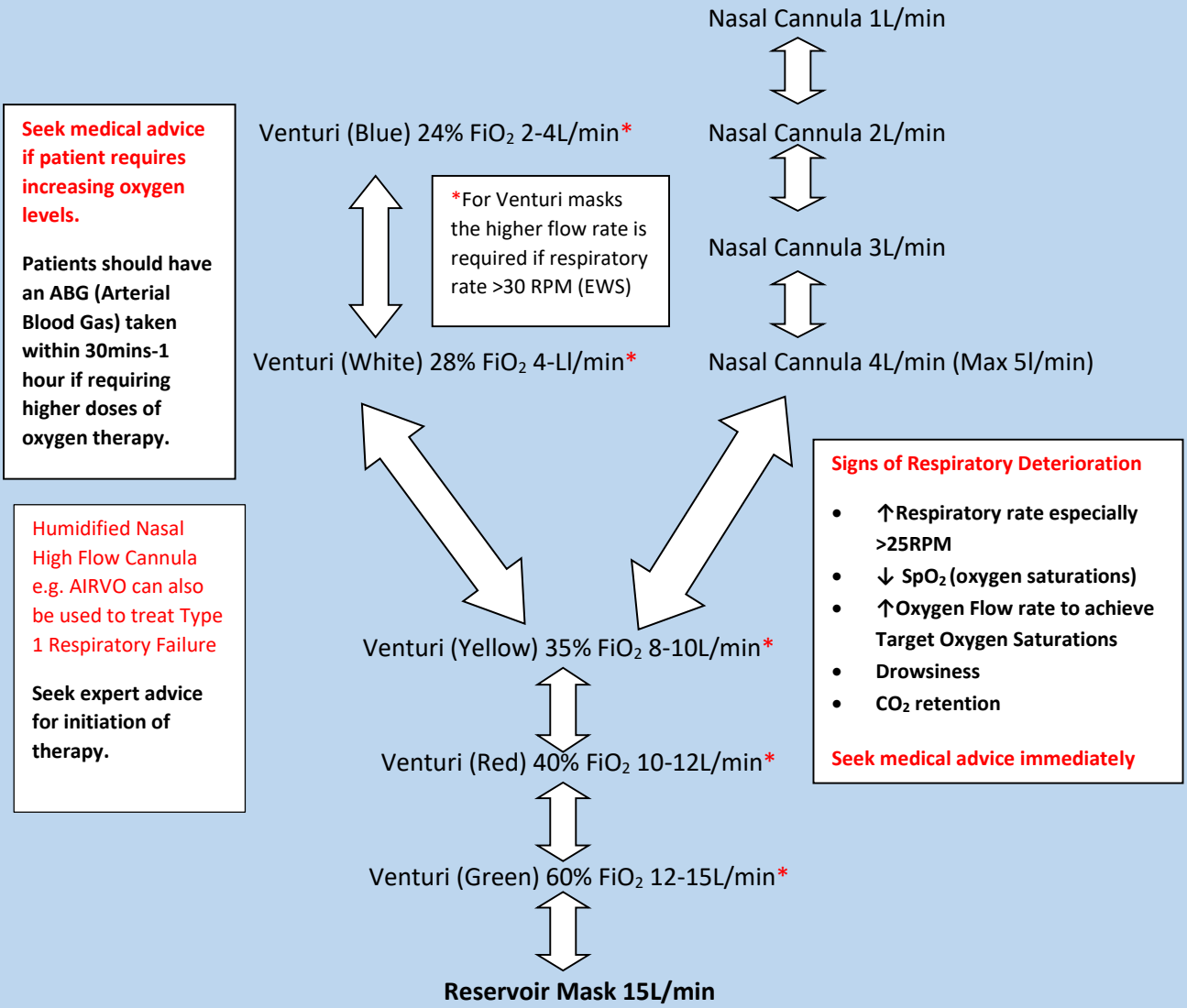
Appendix A Oxygen prescription for acutely hypoxemic patients



*Hypercapnic (Type 2) Respiratory Failure- the main risk factor is moderate to severe COPD, especially those with previous respiratory failure or those on long-term O_2. Other patients include those with severe chest wall or spinal disease, neuro-muscular disease, severe obesity, CF, Bronchiectasis.

Appendix B Flow Chart for oxygen administration in acute setting

- Check patient's oxygen prescription and target oxygen saturations (88-92% for patients at risk of retaining carbon dioxide (CO_2) & 94-98% for all other patients)
- Choose the most suitable oxygen delivery system and oxygen flow rate
- Titrate oxygen flow rate to achieve & maintain target oxygen saturations
- The table below shows the available options for stepping up or down Oxygen Therapy
- Allow 5 minutes at each flow rate before titrating oxygen flow rate up or down (except in the emergency situation)
- Once your patient is stable and maintaining target oxygen saturations consider weaning oxygen therapy further with a view to discontinuation
- **NB: The chart does not imply any equivalence between the Venturi mask and the nasal cannula**



Patients in a peri-arrest situation or critically ill should be given maximum flow rate of oxygen therapy via a reservoir bag while immediate medical help is arriving (except for COPD patients known to have a sensitivity to Oxygen Therapy keep their SpO_2 88-92% until medical help arrives)

Appendix C Oxygen prescription kardex example

Patient Name:	Date of Birth:	Chart No. (MRN):

Prescriber: For most acutely ill patients, oxygen should be prescribed to achieve a target saturation of 94-98% (or 88-92% for those at risk of hypercapnic respiratory failure i.e. CO_2 retainers)

Is the patient a known CO_2 retainer or at risk of retaining CO_2?
(e.g. severe or moderate COPD, patients with severe chest wall, spinal or neuromuscular diseases, severe obesity, Cystic Fibrosis, bronchiectasis or previously unrecognised COPD) **Yes ☐ No ☐**

On Home Oxygen Pre-Admission Yes ☐ No ☐

Prescription:
OXYGEN

Continuous Oxygen Therapy ☐ **OR**
'When required PRN' oxygen therapy ☐

Target oxygen Saturation ☐ 88-92% ☐ 94-98%

Other saturation range: _____

Tick here ☐ if saturation not indicated and state reason e.g. end of life care

_____

Starting Device	Flow Rate	Start Date

Prescriber Sig.:

MCN No.: Bleep No.:

Stop Date: _____

Reason: _____

Prescriber Sig. : _____

Bleep No.: _____

Administration: Check and record flow rate (FR) at each medicine round or others times specified. **Only record device (D) if it differs from that originally prescribed**

Day and month: → / Other times: ↓																
0800																
FR/D																
1000																
FR/D																
1200																
FR/D																
1400																
FR/D																
1800																
FR/D																
2200																
FR/D																

Device Codes:

Room Air (**RA**)
Venturi Devices % (**V24/V28/V35/V40/V60**)
Tracheostomy mask (**TM**)
Ventilation (**NIV**)
Other e.g. humidified % (**H28/H35/H40/H60**)
Nasal Cannula (**N**)
Reservoir mask (**RM**)
Continuous Positive Airway Pressure (**CP**) Non Invasive
Nasal High Flow % (**NHF**)

- The prescriber must state the initial flow rate and concentration of oxygen. This is then adjusted by the nurse administering the oxygen in order to attain the target oxygen range prescribed.
- Oxygen saturations should be recorded on the patient's observation chart.
- If target saturations are 88-92%, nebulised drugs should be driven by the nebuliser machine. If the nebuliser is driven via wall O_2 the rate must be set at 6 – 8 litres per minute for approximately 10 minutes.
- Where the target oxygen range is not stated the flow rate/concentration of oxygen will be prescribed as a fixed dose and therefore can only be adjusted if represcribed.
- All patients must have ABG or earlobe blood gases checked within 1 hour of requiring increased oxygen dose. Hypercapnia or acidosis may not be detected by oxygen saturation and arterial blood gases may need to be measured.
- Seek medical advice if the patient appears to need increasing oxygen therapy or if there is a rise in the Early Warning Score.
- Discontinue or wean oxygen if target oxygen saturations are met and the patient is clinically stable.
- Avoid the use of paraffin based emollients e.g. petroleum jelly on patients receiving oxygen.
- **Failure to wean off Oxygen Therapy - ALERT medical team.**

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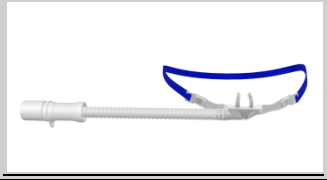
Appendix D Equipment used to deliver oxygen

Oxygen Delivery Device	**Nasal Cannula**  1L/min = 24% 2L/min = 28% 3L/min = 32% 4L/min = 36% The formula is FiO_2= 20% + (4 x O_2 litre flow) ***N.B. Approx. values only never assume percentage of oxygen***
Description	• Consist of a pair of tubes that fit into the nasal passages. • They are approximately 2cm long. • The tubing is placed behind both ears and secured under the chin. • They are self-retaining provided fitted correctly. • Usual flow rate 1-6L/min ***(Flow rate above 4L/min is considered uncomfortable, if a flow rate of >4L/min is required reassess patient and consider alternative delivery device).***
Controlled or Uncontrolled	Uncontrolled delivery device Influenced by the patient's rate and depth of breathing.
Pros	Allows for low flow delivery of Oxygen Therapy. Does not interfere with eating and drinking. Not as inconvenient during coughing and sneezing compared to facemask.
Cons	Can cause drying of the nasal passages Do not use petroleum jelly if nasal dryness occurs. Use water base lubricant if necessary. Can cause pressure sores behind the patients ears.
Patient Care	Ensure patient's oxygen is prescribed with a target SpO_2 Position tips of the nasal cannula comfortably into the patient's nostrils. It should not extend further than 1.5cm. Adjust flow rate of oxygen to achieve the target SpO_2. Check behind patients ears for pressure sores regularly.
Infection Control	Ensure patients oxygen is prescribed with a target SpO_2 Gently place mask over the patient's airway. Position the strap behind the head then carefully pull both ends until secure. Use neck ties with caution post head and neck surgery
Humidification	Not required for low flow oxygen. Cold bubble humidification should not be used and is an infection control risk. Consider AIRVO Therapy,

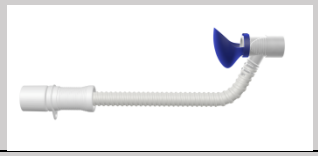
Oxygen Delivery Device	**<u>Venturi Cones & Facemask</u>** Aersol Mask & O_2 Tubing   2L/min Delivers 24% O_2  4L/min Delivers 28% O_2  8L/min Delivers 35% O_2  10L/min Delivers 40% O_2  15L/min Delivers 60% O_2
Description	• A Venturi mask mixes oxygen with room air, creating high flow enriched oxygen at fixed concentrations. • It provides an accurate and constant FiO_2. • Oxygen is forced out through a small hole causing a Venturi effect which enables air to mix with oxygen. • Typical FiO_2 delivery settings are 24%, 28%, 35%, 40% and 60% - All colour coded.
Controlled or Uncontrolled	Controlled oxygen delivery system The concentration does not change with the patient's rate and depth of breathing.
Pros	Allows for delivery of high flow oxygen therapy of know percentage oxygen values. Often employed if concerns arise over CO_2 retention.
Cons	Interferes with eating and drinking. Noisy.
Patient Care	Ensure patient's oxygen is prescribed with a target SpO_2 Connect the mask to the appropriate Venturi barrel attached firmly into the mask inlet. Secure oxygen tubing onto the Venturi cone. Attach tubing to the oxygen flow meter and set the corresponding oxygen as indicated on the Venturi cone. The flow can be increased by 1-2l/min if the patient has a respiratory rate above 25 per minute. This does not affect the concentration of oxygen but allows the gas flow rate to match the patient's RR.
Infection Control	Ensure patient's oxygen is prescribed with a target SpO_2 Gently place mask over the patient's airway. Position the strap behind the head then carefully pull both ends until secure. Use neck ties with caution post head and neck surgery
Humidification	Humidification is not required.

Oxygen Delivery Device	<u>Re-breather mask with reservoir bag</u>  N:B Flow Rate 15l/min **NOT to be used for CO_2 retaining patients except in life-threatening emergencies such as cardiac arrest or major trauma.**
Description	• Mask has a soft plastic face piece with flap-valve exhalation ports which may be removed for emergency air-intake. • There is also a one-way valve between the face mask and reservoir bag • In non-re-breathing systems the oxygen may be stored in the reservoir bag during exhalation by means of a one-way valve. • High concentrations of oxygen 60-80% can be achieved at relatively low flow rates. • In disposable reservoir, oxygen flows directly into the mask during inspiration and into the reservoir bag during exhalation. All exhaled air is vented through a port in the mask and a one-way valve between the bag and mask, which prevents re-breathing.
Controlled or Uncontrolled	Uncontrolled oxygen delivery device
Pros	Allows for high concentrations of Oxygen Therapy in the emergency situation
Cons	Use cautiously in patients suspected of CO_2 retention.
Patient Care	Ensure the reservoir bag is inflated before placing mask on patient, this can be maintained by using 15 litres of oxygen per min. A prescription for oxygen can be sought after the event and patient is stable.
Infection Control	Adhere to hand hygiene at all times. It is a single patient use device. Adhere to your local hospital policy. Dispose equipment if it becomes contaminated.
Humidification	Humidification is not required.

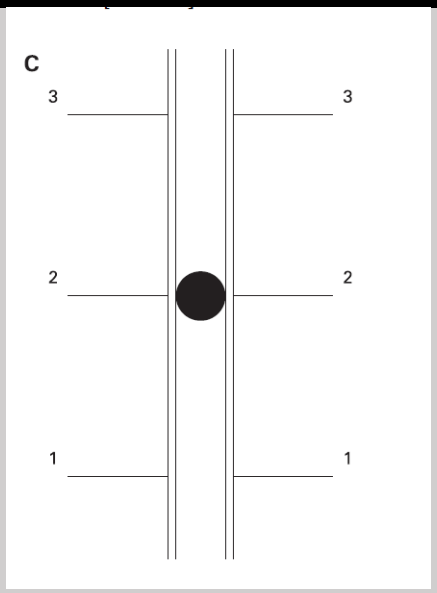
Oxygen Delivery Device	**Optiflow Nasal Cannula (for use with AIRVO)** 
Description	• The Optiflow nasal cannula is made of softer material than standard PVC nasal cannulas. • There are three sizes (Small, Medium, Large) for different sizes of nares. The aim is to leave a gap around the prongs in the nostril (aim for 50%). • The tubing material is made of Evaqua material, which means that any condensate in the tubing evaporates.
Controlled or Uncontrolled	Controlled (the flow delivered by the Airvo generally exceeds the patient's peak inspiratory demand, so O_2 and flow remain constant).
Pros	Allows for wide range of oxygen levels to be delivered (21-95%) Allows eating, drinking, talking etc. (according to patient's condition)
Cons	Use cautiously in patients suspected of CO_2 retention.
Patient Care	
Infection Control	Adhere to hand hygiene at all times. It is a single patient use device. Adhere to your local hospital policy. Dispose equipment if it becomes contaminated.
Humidification	Humidification required through AIRVO.

Oxygen Delivery Device	**Tracheostomy Mask** Use for patients with: • tracheostomy • laryngectomy Adjust flow rate according to the target SpO_2. 
Description	• Mask designed for "neck breathing patients". • Fits comfortably over tracheostomy or tracheotomy exhalation port on front of mask.
Controlled or Uncontrolled	Controlled delivery device when used with Venturi cone.
Pros	Comfortable light weight mask
Cons	Use cautiously in patients suspected of CO_2 retention.
Patient Care	Ensure patient's oxygen is prescribed with a target SpO_2 Gently place mask over the patient's airway. Position the strap behind the head then carefully pull both ends until secure. Use neck ties with caution post head and neck surgery
Infection Control	Adhere to hand hygiene at all times. It is a single patient use device. Adhere to your local hospital policy. Dispose equipment if it becomes contaminated.
Humidification	Required: A tracheostomy bypasses the upper airway therefore humidification of oxygen therapy is required

Oxygen Delivery Device	**Oxymask** 
Description	Open mask design capable of delivering a broad range of oxygen concentrations from 24 to 90%, at flows ranging from 1 to 15+ litres per minute
Controlled or Uncontrolled	Uncontrolled
Pros	Comfortable light weight mask. Can provide high concentrations of oxygen. Decreased rebreathing of CO.
Cons	
Patient Care	Ensure patient's oxygen is prescribed with a target SpO_2 Gently place mask over the patient's face Position the strap behind the head then carefully pull both ends until secure.
Infection Control	Ensure patient's oxygen is prescribed with a target SpO_2 Gently place mask over the patient's airway. Position the strap behind the head then carefully pull both ends until secure. Use neck ties with caution post head and neck surgery
Humidification	N/A

Oxygen Delivery Device	**Optiflow Tracheostomy Direct Connection (for use with AIRVO)** Use for patients with: • tracheostomy 
Description	Designed to fit on to a standard 15 mm tracheostomy connector.
Controlled or Uncontrolled	Controlled (the flow delivered by the Airvo generally exceeds the patient's peak inspiratory demand, so O_2 and flow remain constant).
Pros	Delivers humidity at body temperature and humidity. Lightweight.
Cons	
Patient Care	
Infection Control	Ensure patient's oxygen is prescribed with a target SpO_2 Gently place mask over the patient's airway. Position the strap behind the head then carefully pull both ends until secure. Use neck ties with caution post head and neck surgery
Humidification	

Appendix E Oxygen flow metre

Oxygen Flow Meter	  The example shown on the above indicates the correct setting to deliver 2 l/min.
Description	The oxygen flow metre is a device that delivers a flow of oxygen to the patient between 1-15 litres per minute. It may be wall mounted or on a cylinder. Oxygen tubing is needed to connect flow meters and regulators to the patient delivery device. It is important to ensure that all tubing is connected correctly at both ends. Most oxygen flow meters use a floating ball to indicate the flow rate. The centre of the ball should be aligned with the appropriate flow rate marking.
Cautions	Compressed air outlets are often used to drive nebulisers. However, the flow meter looks very similar to an oxygen flow meter and is often mounted beside an oxygen flow meter so it is very important to ensure that air flow meters are clearly labelled. Air flow meters are never required in an emergency and should be removed from wall sockets or covered by a designated ‘‘hood’’ when not in use.

Appendix F Cold Humidification

Humidification	**Large Volume Nebulisation-base Humidifier** 
Description	Newer humidification systems are really "giant nebulisers" with a 1Litre reservoir of saline or sterile water and an adjustable venture device (see picture left). This system is attached directly to the oxygen flow meter and connected to an aerosol mask via flex tube. They allow delivery of precise oxygen concentrations of 28%, 35%, 40% and 60% oxygen via their Venturi nozzle on the device. It is possible to deliver 24% oxygen using a special adaptor. The main indication for use is to assist with expectoration of viscous sputum.
Cautions	The main reason for using humidification, especially with high-flow oxygen, is that it may reduce the sensation of dryness in the upper airways that oxygen can cause. However, in the non-intubated population there appears to be little scientific evidence of any benefit from humidified oxygen except that single doses of nebulised isotonic saline have been shown to assist sputum clearance and reduce breathlessness in patients with COPD[1] There is also evidence that humidification, when combined with physiotherapy, can increase sputum clearance in bronchiectasis. In the emergency situation, humidified oxygen use can be confined to patients with tracheostomy or an artificial airway although these patients can be managed without humidification for short periods of time (e.g. ambulance journeys).

Appendix G Humidified Nasal High Flow (Airvo)

Humidification	**AIRVO heated pass-over humidifier (Nasal High Flow)** 
Description	The AIRVO is a humidifier with integrated flow generator delivering NHF. It takes in room air plus wall oxygen, warms and humidifies the mixture, then delivers it to the patient through a heated breathing tube and Optiflow nasal cannula or tracheostomy direct connection (see Appendix E) The AIRVO contains an integrated oxygen analyser, allowing precise delivery of oxygen. O_2 % delivery range 21% - 100% In addition, the humidity helps with mucocilliary clearance and secretion management.
Cautions	Nasal High Flow therapy can generate several centimetres of positive airway pressure in patients using the nasal interfaces, so care must be exercised in patients for whom CPAP is contraindicated.

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