STANDARD GUIDELINES FOR OXYGEN ADMINISTRATION AND MONITORING

Contents

Appendices

1. ADMINISTRATION

Oxygen should be regarded as a drug. It is prescribed to increase alveolar oxygen tension and so prevent/treat hypoxaemia. The concentration of oxygen prescribed depends on the condition being treated; an inappropriate concentration may have serious or even lethal effects (BNF, 2005). It must therefore be administered by prescription only. However, a Patient Group Direction (PGD) may be formulated to facilitate nursing staff to commence or alter prescribed oxygen therapy.

In an emergency situation e.g. cardiac or respiratory arrest, oxygen may be commenced before a written prescription has been made. Any acutely hypoxic patient should have emergency oxygen administered whilst awaiting the arrival of a doctor. Such patients must be continuously monitored until a formal medical review has been undertaken.

2. ASSESSMENT OF NEED FOR OXYGEN THERAPY

In acutely ill patients oxygen delivery relies on maintaining a patent airway. Airway patency should always be checked prior to delivering oxygen therapy (Bateman & Leach, 1998).

The concentration of oxygen required must be prescribed. For further information see **'Guidelines for the Selection of Equipment'** (Appendix 1). Copies of these charts should be displayed at every oxygen point and on all oxygen cylinders.

The principal clinical indicators for initiating, monitoring and adjusting oxygen therapy are: arterial (PaO_2) and oxygen saturation (SpO_2/SaO_2). Patient colour and respiratory rate and work MUST also be observed.

Oxygen therapy is given to treat / prevent hypoxia and hypoxaemia. A full list of indications can be found in Appendix 4.

3. NURSING RESPONSIBILITIES

It is the registered nurse's responsibility to ensure the prescribed dose of oxygen is delivered to the patient and this, and the patient's condition, are regularly monitored. These facts and any changes **MUST** be documented in the patient's nursing notes.

Best Practice
For general administration of oxygen in non-specialized areas, a standard aerosol mask with a Venturi device should be used. This will ensure that oxygen can be "controlled to give inspired levels of 24-60%" (Bateman and Leach, 1998).

4. GUIDELINES FOR SELECTION OF EQUIPMENT

The QMC has now standardised on the products for oxygen delivery, see **'Guidelines for the selection of equipment'** (Appendix 1**).**
Some specialist areas have different equipment. Where so, please refer to local policies.

Nasal Cannulae/Catheters.

Effective for delivering low concentrations of oxygen, between 24 and 35%. Maximum 4 litres a minute

Best Practice
Some patients may have difficulty tolerating oxygen masks. In such cases, nasal cannulae/catheters may be a better alternative (Porter-Jones, 2002).

Non Re-Breathing Oxygen Masks.

For high percentage of oxygen 60% - 90% when patients are not at risk of retaining carbon dioxide (CO_2) or losing their hypoxic drive.

Best Practice
Non re-breathing masks should only be used for short-term treatment due to
possibility of oxygen toxicity (See section 6).
When used, the flow rate must be sufficient to keep the reservoir bag at least a
third to half full at all times (Jevon, 2000).

Best Practice
For patients who have a tracheostomy or larygectomy, an appropriate mask must be used that fits securely around the stoma. A face mask is not effective

5. HUMIDIFICATION.

Oxygen therapy can dry the mucous membrane of the upper respiratory tract causing soreness. It can also cause pulmonary secretions to become stickier making them more difficult to expectorate (Porter-Jones, 2002). Therefore consideration should be given to humidification of oxygen for patients requiring concentrations greater than 35% (See appendix 7).

Best Practice
Use a single use, sterile water bottle, available from pharmacy.

6. HAZARDS - CLINICAL

• Loss Of Hypoxic Drive.

Elevated arterial carbon dioxide ($PaCO_2$) and reduced blood pH are both strong stimulants to respiration. However, patients with chronic lung disease (often considered to be Type II respiratory failure), who have experienced carbon dioxide retention for some time, have respiratory centres in the brain that are stimulated by reduced arterial oxygen levels (PaO_2).
Administration of an inspired oxygen concentration above 24% in this type of patient may abolish the hypoxic drive and lead to further carbon dioxide retention and respiratory arrest. However, not all patients with chronic lung disease fall into this category, and the only way to determine this is to measure arterial blood gases (Porter-Jones, 2002). In an emergency situation, when a patient is hypoxic, administration of oxygen is the priority as hypoxia will kill whereas apnoea caused by loss of hypoxic drive can be managed by mechanical ventilation. The nurse must remain with the patient, observing vital signs and conscious level, after increasing oxygen.

• Oxygen Toxicity And Alveolar Damage.

Oxygen may be toxic, especially in high concentrations. Concentrations greater than 60% may damage the alveolar membrane when inhaled for more than 48 hours (Bateman and Leach, 1998), or result in atelectasis. Oxygen toxicity is more likely to occur when using a non-rebreathing mask (see Appendix 6).

7. HAZARDS - HEALTH & SAFETY

• All staff should be aware that oxygen supports combustion (Ashurst, 1995) and patients be advised of the risks.

• Oxygen does not, in itself, explode or burn, but it does enhance the flammable properties of other materials such as grease and oils. (Porter-Jones, 2002) It is therefore important to turn off gas flow to unused devices as soon as possible.

• Oxygen cylinders must be stored in a designated room, their numbers should be kept to a minimum, and they must be secured in a suitable cylinder holder. Appropriate signs should be displayed when a compressed gas cylinder is in use on the ward or where cylinders are stored. (Signs can be obtained from Estates Dept). Advice on transportation of oxygen cylinders can be obtained from Estates Dept.

• There is also a small risk of fire if dirt, oil, grease or hand creams contaminate connections between medical devices and gas cylinders (Medical Devices Agency, 2000).

8. PROCEDURE

ACTION	RATIONALE
1. Assess patient's need for mask or nasal cannulae.	To ensure effective delivery of oxygen. To promote patient comfort. To ensure cost effectiveness
2. The patient should be in the position most appropriate for him/her, preferably sitting upright.	To promote patient comfort, and aid chest expansion.
3. Attach humidification device if required.	To reduce the risk of side effects associated with dry gas administration. To promote patient comfort.
4. Complete the administration system by attaching tubing either small bore or wide bore corrugated (elephant tubing) as appropriate. Connect to oxygen flow meter and turn on to the required flow rate. It is the nurse's responsibility to maintain the correct flow rate, to deliver the prescribed concentration. Oxygen must be prescribed in percentage for mask and venturi barrel, or flow rate if using trauma mask / nasal cannulae.	Oxygen is safely delivered as prescribed.

ACTION	RATIONALE
5. Position mask and adjust if necessary. It is important that the patient feels comfortable wearing the mask/device. Single nasal cannulae may be moistened with a water based lubricating gel/water to ease insertion into nostril, it may be secured by tape to the face if necessary. Double nasal cannulae are placed in nostrils, over the ears and can be secured under the chin or behind head. Replace with a new one if they fall to the floor or become contaminated	To ensure patient compliance and comfort
6. Assess and record respiratory rate. Observe for signs of respiratory distress e.g. increasing respiratory rate, wheezing, panting and use of accessory muscles. Routinely check tubing for water collection and empty as necessary.	To obtain baseline (initial) values and observe for changes in a patient's condition. **An increased respiratory rate is a primary indication that a patient is becoming acutely ill.** Slow and shallow respirations may indicate respiratory depression. Collection of water in the tubing can partially or completely occlude the flow of oxygen.

ACTION	RATIONALE
7. Observe patient's color, looking at nail beds and lips to detect worsening or improving cyanosis or as the patient's condition dictates.	As a patient becomes more hypoxic their saturation will fall, their color will deteriorate.
Monitor patient's oxygen saturation levels. If it drops below 90% check position of probe. If still recording levels below 90% **CALL 911**	Saturation probes if not correctly fitted to the finger/ear lobe can give a false reading.
See guidelines/principles for oxygen saturation monitoring (see appendix 5).	
8. Assess and record pulse rate.	To obtain a baseline value and observe for any change in heart rate. Patients in respiratory distress often become tachycardic.
9. Observe for clinical signs of deterioration i.e. conscious level decreases, patients often become restless, confused or drowsy and there may be a drop in saturation. **CALL 911**	To detect changes in patients' Condition **The conscious level of patients is one of the best indicators of deterioration in their condition.**
10. Patients who require oxygen or are in respiratory failure should be encouraged to take regular deep breaths.	To clear bronchial secretions and to maximise the effect of the oxygen therapy

ACTION	RATIONALE
11. Offer mouth care as described in the procedure 'Care of the mouth' (NNPDG, 2002). Oral hygiene and an adequate fluid intake should be encouraged. If mask becomes grossly contaminated with secretions it should be cleaned/replaced.	Minimize dryness and soreness to mouth. Discomfort and sputum tenacity are minimized (Ashurst, 1995). Maintain hydration. Only water-based creams should be used for dry lips because of the potential inflammatory properties of petroleum jelly
12. If lips or nose become dry or sore a water-based cream can be used. Observe for elastic strap causing tissue damage around the ears. Adjust straps and pad if necessary.	To keep the skin, lips, nose from drying and cracking.
13. Ensure all appliances carry hazard warning and safety instructions.	To comply with Health and Safety regulations. Staff are aware of the risks.
14. Ensure all staff and patients are aware of the fire precautions. No-smoking signs should be displayed in the vicinity of the oxygen appliances.	Oxygen supports combustion therefore fire regulations should be adhered to.
15. All nurses should know the location of the central oxygen turn off point, in the area they are working and the course of action required in the event of fire.	So that staff can identify the location of the central oxygen turn off point to the fire department or estates personnel
16. No grease is to be used on oxygen appliances.	The use of grease on apparatus must be avoided as this increases the fire risk.

9. REFERENCES

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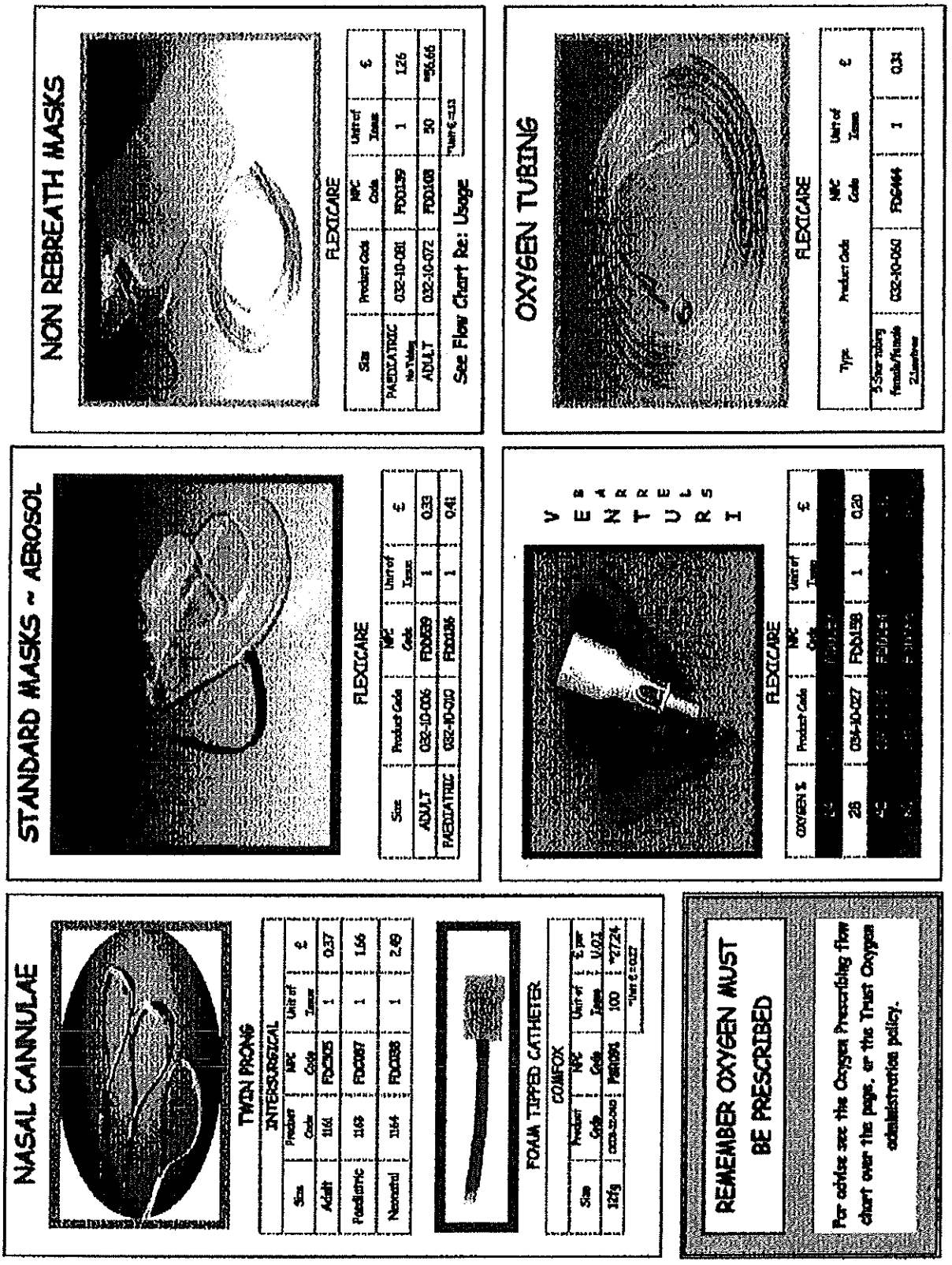
11. ELEMENTS FOR ASSESSMENT OF CLINICAL COMPETENCE

Knowledge
Anatomy and physiology of the respiratory system
Pathophysiology (need for intervention and effect of intervention on pathophysiology)
Assessment of need for oxygen
Medicines Code of Practice (2003)
BOC oxygen guidelines

Skills
Assesses patient's condition and identifies appropriate equipment for administration of
Selection of equipment
Correct assembly
Safe, effective completion of procedure
Adaptation to changing circumstances

Attitudes
Communication with patient is effective
Explanations of practice are appropriate

Appendix 1 Guidelines for Selection of Equipment



Appendix 2

NORMAL ARTERIAL BLOOD GAS VALUES

Oxygen saturation (SpO_2) 95% to 100% (SpO_2) falls with age and in chronic respiratory disease

- pH 7.35-7.45
- PO_2 12-15 kPa (slightly less in older people)
- PCO_2 4.50-6.10kPa
- HCO_3 22-26 mmol/l
- Base excess –2 +2

Deviation from these values should be reported immediately to the medical staff so that appropriate action can be taken.

Appendix 3
DEFINITION OF TERMS

ABG Arterial blood gas.
Atelectasis Failure of part of the lung to expand.
CPAP Continuous positive airway pressure.
FiO_2 The % of oxygen the patient is breathing in.
HCO_3 Bicarbonate.
Hypercarbia High $PaCO_2$.
Hypoxemia Deficiency of oxygen in the blood - PO_2 less than 8kPa.
Hypoxia Deficiency of oxygen at the tissues - PaO_2 less than 8kPa.
$PaCO_2$ Partial pressure of carbon dioxide in arterial blood.
PaO_2 Partial pressure of oxygen. Dalton's law indicates each gas exerts a partial pressure relative to the concentration in the mixture. A 'P' before the gas symbol denotes partial pressure, the 'a' denotes arterial.
SpO_2 Oxygen saturation as measured by pulse oximeter
Type I Respiratory failure
"The PaO_2 is low the $PaCO_2$ is normal or low" (Field 1997) e.g. asthma, pulmonary oedema, pulmonary embolism, lung fibrosis.
Type II Respiratory failure
"The PaO_2 is low and the PCO_2 is high" (Field 1997) e.g.; chronic obstructive pulmonary disease (COPD), lack of neuromuscular control of ventilation e.g. overdose of respiratory depressive drugs i.e. opioids, myopathy

Appendix 4
INDICATIONS FOR OXYGEN THERAPY
Hypoventilation
This can be due to:

• Weak muscles	e.g. Guillain Barré Syndrome, Motor Neuron Disease.
• Chest wall abnormalities	Inability to inflate lungs properly e.g. scoliosis, previous thoracic surgery, kyphosis, ankylosing spondylitis.
• Neurological Disorders	e.g. Spinal cord injuries, phrenic nerve palsy (paralyzed diaphragm), head injury, stroke.
• Others	e.g. Depression of respiratory drive by opioid drugs, pain, traumatic injury Upper airway obstruction, e.g. sleep apnoea. Lower airway obstruction, e.g. asthma, Chronic Obstructive Pulmonary Diseases.

Impaired Diffusion of Oxygen into the Blood

This can be due to:

• Obstruction to diffusion e.g. Pulmonary oedema in heart failure.

• Fibrosing alveolitis

• Chronic Obstructive Pulmonary Disease (COPD), a slow progressive disorder which might include:
  Chronic bronchitis
  Emphysema
  Chronic airflow limitation
  Some cases of chronic asthma

Anemia

Although patient's SpO_2 / SaO_2 may be normal their PaO_2 may be abnormal e.g. chronic renal failure and post surgery.

Smoke Inhalation
Carbon monoxide poisoning, where carbon monoxide instead of oxygen combines with the haemoglobin reducing the oxygen carrying capacity of the blood.

Ventilation / Perfusion 'Mismatch'
In the normal lung, the lung is equally ventilated and perfused. In some disease states there is a 'mismatch'. Large areas are ventilated but not perfused e.g. pulmonary embolism, or large areas are perfused but not ventilated e.g. pneumonia. Another example is "shunting" when blood partially bypasses the lungs eg. in cardiac defects.

Cardio/Respiratory Arrest

Reduced Oxygen Concentration
This can happen at altitude. Atmospheric air has a normal oxygen concentration of 21%. However, at altitude, this concentration is markedly reduced.

Appendix 5

MONITORING
The monitoring of the effectiveness of the prescribed oxygen therapy can be carried out using pulse oximetry and/or blood gas analysis.

Pulse Oximetry

A pulse oximeter measures haemoglobin oxygen saturation (SpO_2) which is a close estimate of the arterial oxygen saturation. It does not indicate partial pressure of oxygen PaO_2 and should not be compared to saturation indicated by a blood gas analyser (SaO_2). It measures SpO_2 via a sensor that is usually clipped to the patient's earlobe or finger (Lowton, 1999).

Pulse oximetry also detects hypoxaemia in a patient before it becomes obvious by sight i.e. cyanosis. However, it is not a measurement of adequacy of ventilation or a determination of carbon dioxide levels.
Accuracy of pulse oximeters is reduced at saturations of below 85% and is also dependent on the patient's peripheral perfusion.

Why Is It Performed?
To evaluate effectiveness of oxygen therapy.
To assess the safety of a diagnostic procedure.
To alert healthcare professional to early stages of hypoxemia.

When Is It Used?
Continuous monitoring, intermittent monitoring, during patient transfer and sleep apnea studies.

What is the best site?
The site with the best pulsatile bed, that is, the finger, toe and earlobe – finger probes generally tend to have better performance.

What can affect the readings?
The following can affect the readings:
• Poor perfusion
• Nail varnish or synthetic nails – these may need to be removed
• Anaemia
• Jaundice
• Positional / artefact (interference)
• Nitrate or lignocaine therapy

Nursing Responsibilities
• All nursing staff that record oxygen saturation must have had appropriate training on how to use the saturation monitor and where to record results.
• The site must be rotated every 4 hours to prevent ischaemia when continuous monitoring (MDA, 2001).
• All nursing staff must be familiar with the oxygen policy.
• Nurse in charge / team leader should review all patients requiring saturation monitoring daily. This to be communicated to the nurse looking after the patient and documented in the care plan and discussed with doctors re. discontinuing saturation monitoring on patients identified.
• Identify with medical staff those patients that require continuous saturation monitoring.
• Report any low readings i.e.; below 90% to the nurse in charge as soon as possible. It is the nurse's responsibility to act on the information appropriately by informing the medical staff, assessing and reviewing the patient.
• If a patient's normal saturation is less than 90%, nursing staff must obtain parameters from the medical staff that are acceptable for that particular patient. This must be documented in the nursing notes.
• Appropriate high / low alarms must be set.
• Do not tape probes on fingers.
• Review need for continuous monitoring each shift.

Medical Staff Responsibilities
• Medical staff to discuss with nursing staff and identify patients that require continuous saturation monitoring. This must be recorded in the medical / nursing notes.
• Medical staff to give parameters for individual patients whose normal saturations are below 90%

Best Practice
Some patients e.g. those with COPD, normally have a low saturation e.g. between 80 – 90%.
Some patients breathing supplementary oxygen may have life-threatening hypoventilation with normal saturations so:
LOOK AT THE PATIENT AS WELL AS THE MONITOR
As with every monitoring device, all results must be interpreted in the light of the clinical situation.
Pulse oximetry does not replace but compliments the monitoring of vital signs

Cleaning

Please refer to individual manufacturers' guidelines for advice on cleaning. The external portion of the monitor should be cleaned according to manufacturers' recommendations whenever the device remains in a patient's room for prolonged periods, when soiled, or when it has come in contact with potentially transmissible organisms.

Maintenance

Calibration and regular servicing of equipment should be accordance with manufacturers' guidelines

Blood Gas Analysis

This provides accurate information on pH, PaO_2, $PaCO_2$, HCO_3 and base excess, either from an arterial stab (performed by medical staff and other staff that have successfully completed a role expansion package and have been judged competent), from an arterial line (by competent staff in specialist units) or from an ear lobe sample (performed by the lung function technicians).
Arterial and oxygen saturation SaO_2 and PaO_2 remain the principal clinical indicators for initiating, monitoring and adjusting oxygen therapy

Appendix 6
DELIVERY DEVICES
Venturi Devices
The venturi mask contains a venturi situated at the base of the mask and uses a principle of jet mixing [Bernoulli effect]. Thus when oxygen passes through the narrow orifice it produces a high velocity stream that draws a constant proportion (up to 40 litres) of room air through the base of the mask. Air entrainment depends on the velocity of the jet, size of the orifice and oxygen flow rate. Each diameter of venturi gives a different final oxygen concentration and are available to give oxygen concentration of 24 –60%.

• **Benefits**
Venturi barrels can be changed to vary oxygen concentrations.
Reduced rebreathing of exhaled air.
Is independent of oxygen flow and patient breathing factors (Ashurst, 1995).

• **Disadvantages**
May be noisy, claustrophobic / interferes with eating and drinking.
Oxygen cannot be humidified.

• **Recommendation for Use**
Can be used for type II Respiratory failure. See definition of terms *(appendix3).*

Nasal Cannulae
Simple and easy to use. They are available as single or double cannulae. The concentration of oxygen is given dependant on the flow rate 1 – 4 litres per minute. Patients should be assessed whether they require nasal cannulae or mask.

• **Advantages**
Nasal prongs prevent rebreathing of exhaled CO_2 and can be comfortable for long periods. Patients are also able to hold a conversation and eat without removing them. (Bateman and Leach, 1998).
They are safe, simple and have low cost. Effective for delivering low concentrations of oxygen approx between 24% & 35%.

• **Disadvantages**
Occasionally there may be local irritation or dermatitis if high flow rates are used.
Cannot be used for medium / high oxygen concentrations (> 4 litres).
Not suitable for patients with nasal obstruction i.e. polyps, mucosal oedema.
May cause headaches or dry mucous membranes if flow exceeds 4 Litres.
Inspired oxygen concentrations are variables dependent on flow settings and patient respiratory pattern e.g. patients who are mouth breathing such as those with dyspnoea (Ashurst 1995). For accurate concentrations a Venturi mask is preferable.

• **Recommendation for Use**
Can be used on patients with type I and type II respiratory failure.

Appendix 7

HUMIDIFICATION

Inspired gas is normally heated and humidified by the nose and upper airways. This normal physiological system maybe bypassed, i.e. in the patient with a tracheostomy, or overwhelmed i.e. with supplemental dry gases (Jackson, 1996).

Oxygen delivered via nasal cannulae does not need to be humidified.

Humidification is generally not required if oxygen therapy is likely to be required for less than 24 hours.

After 24 hours of oxygen therapy, humidification should be considered:

• Delivering more than 35% oxygen via a venturi system

• Delivering more than 5 litres of oxygen per minute via a fixed percentage mask

Patients who are likely to require high concentrations of oxygen for several days or more can be started on humidification immediately