The Royal Bournemouth and Christchurch Hospitals
NHS Foundation Trust

MEDICAL GASES LEARNING PACKAGE

Approval Committee	Version	Issue Date	Review Date	Document Author
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Communicate - Say it, hear it, do it! Improve - Change it! Teamwork - Share it! Pride - Show it!

GLOSSARY AND USEFUL TERMS:

BOC UK – healthcare company providing medical gases

CD cylinder – portable Oxygen cylinder, most commonly used on transfers

Compressor – a machine used to drive nebulisers

CO_2 - Carbon dioxide - the waste product of metabolism and is expelled from the body during exhalation. Can also cross the blood-brain barrier

CO_2 retainers – individuals who have hypercapnia

COPD – Chronic Obstructive Pulmonary Disease

DPG - diphosphoglycerate – a salt in red blood cells that plays a role in liberating oxygen from haemoglobin in the peripheral circulation.

e-Observations – electronic track and trigger system used in many wards and departments of RBCH

Functional residual capacity - the volume of air present in the lungs at the end of passive expiration

Hypercapnia - Hypercapnia develops when an increased level of carbon dioxide is present in the bloodstream and leads to CO_2 retention. PaCo2 is greater than 6.1kPa

Hypoxia – reduction of oxygen levels at tissue level

Hypoxaemia – reduced oxygen concentration within the blood/low partial pressure of oxygen

kPa – Kilopascal – a unit of measurement used in blood gases

MGPS - Medical gas Pipeline System

NEWS2 – National Early Warning Score (version 2)

O_2 - Oxygen

Oxygen saturation – 'saturations/sats' -how saturated with oxygen the circulating haemoglobin is

$PaCO_2$ - partial pressure of Carbon Dioxide. Normal range on blood gas is 4.5-6.0 kPa

PaO_2 – partial pressure of oxygen. Normal range on blood gas is 11.5-13.5 kPa

pH - a figure expressing the acidity or alkalinity of a solution on a logarithmic scale. It is the concentration of hydrogen ions in a solution. Normal pH within the human blood is 7.35-7.45

Respiratory acidosis- when the blood becomes acidic due to concentration of hydrogen ions (excess CO_2 causes more bicarbonate and hydrogen ions to be released when combined with water).

Tidal Volume - the amount of gas expired per breath - typically 500ml at rest in a young, healthy adult

TMS – Task Management System

Type 1 respiratory failure – also called hypoxic respiratory failure, hypoxia without hypercapnia. Pa02 less than 8kPa.

Type 2 respiratory failure – also called hypercapnic respiratory failure, hypoxia with hypercapnia

Venturi effect - the reduction in fluid pressure that results when a fluid flows through a constricted section of a pipe. In Oxygen administration, due to the pressure drop at the point of the narrowing in the Venturi nozzle, room air is entrained in, thus diluting the oxygen to the calibrated value set by the coloured nozzle. The different colour nozzles have a varying aperture open to room air that sets the entrainment ratio and hence the inspired concentration given to the patient.

Symbols in the Learning Package

You will see this sign throughout the learning package to reinforce important points or where caution is highlighted

You will see this sign throughout the learning package when an incident that has happened here at the Trust is referred to.

INTRODUCTION

This learning package is designed for registered staff, including nurses and allied health professionals, to understand the principles of safe use and administration of medical gases.

Despite the NHS Improvement Patient Safety Alerts regarding medical gases, there continues to be a number of reported incidents , including never events, related to the use of medical gases both nationally and here at Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust (RBCH/the Trust). This therefore highlights the need for further training for all registered professionals using medical gases to ensure the safety of our patients, staff and visitors. Throughout this learning package, there will be reference to incidents related to medical gases which have occurred here at The Trust with the associated learning and measures to have been implemented as a result. The key themes for this learning package have therefore been driven by these incidents. Learning from what goes wrong in healthcare is crucial to preventing future harm (NHS Improvement,2018). Guidance has been taken from a variety of sources (see references at the end) including the British Thoracic Society (BTS), NHS Improvement Patient Safety Alerts and Trust policy.

The aims of this learning package are:

- to give practical information on the use of medical gases to ensure the safety of our patients, staff and visitors
- for staff to gain a good understanding of medical gases to ensure effective use

- To ensure staff are working within policy in the use of medical gases

The fundamentals of safe medical gas general use and administration will be covered. It is expected that additional training will be undertaken within specialist areas as needed.

Oxygen administration via the tracheostomy route is also not covered in this learning package as further specialist training is required for the management of patients with a tracheostomy.

You are also required to read the latest versions of the following related Trust policies and SOP's:

- Policy For The Prescription And Administration Of Oxygen In Adults
- Standard Operating Procedure for Pressure relieving devices for patients receiving oxygen therapy

MEDICAL GASES – WHAT DOES THIS MEAN?

Medical gases are those specifically manufactured for the treatment of and administration to patients. They are usually supplied to patients for administration through the Medical gas Pipeline System (MGPS) or via a cylinder.

Medical gases most commonly used at RBCH

- **OXYGEN** - O_2 – widely used in clinical practice across the Trust
- **MEDICAL AIR** – 21% Oxygen, 79% Nitrogen – used in anaesthesia, for ventilators and can be used to nebulise drugs.
- **ENTENOX** - 50% oxygen 50% nitrous oxide - most commonly used in midwifery but can be used in other areas of the hospital for effective short term pain relief such as in trauma, changing of wound dressings. Rapid onset of action and quickly eliminated by the body.
- **NITROUS OXIDE** - N_2O - used predominantly in anaesthetics
- **CARBON DIOXIDE** - CO_2 – used to insufflate into the abdominal cavity to distend it to allow investigation and treatment of intra-abdominal disease and for laparoscopic surgery.
- **HELIUM –** used as the inflating gas in equipment such as Intra-aortic Balloon Pumps.

FROM THIS POINT, THE LEARNING PACKAGE WILL FOCUS ON THE USE OF OXYGEN AND MEDICAL AIR.

All of the other gases mentioned above, and others that may be used in the Trust, will require additional training as they are for use only by those appropriately trained, some by medical personnel only.

Equipment

Let's refresh ourselves on the equipment that is required for the correct set up of medical gases and the terminology used.

Oxygen related equipment = WHITE
Medical Air related equipment = BLACK

If you identify that there is not the correct equipment for the safe use and storage of medical gases within your area, please report this to your line manager immediately. Any parts that are needed (such as nipples, terminal unit plugs and air guards) can be ordered through the SISO system.

TERMINAL UNITS

- Terminal units are ports in the wall for the appropriate flow meter to be plugged into.
- They follow the same colour coding
- White = Oxygen
- Black and white = medical air
- (Yellow is for suction)

FLOW METER

- Inserted into the terminal unit
- A flow measurement device used to regulate the flow of the medical gas
- A flow meter with a WHITE control knob is used for Oxygen
- A flow meter with a BLACK control knob is used for Medical Air

ENSURE THAT THE CORRECT FLOW METER IS INSERTED INTO THE CORRECT TERMINAL UNIT!

NIPPLE

- The nipple fits into the base of the flow meter to allow tubing to be attached
- **IT IS NOT ACCEPTABLE TO USE ANY COLOUR NIPPLE AS THIS COULD LEAD TO ACCIDENTAL CONNECTION TO THE WRONG MEDICAL GAS**
- **ENSURE THAT CORRECT NIPPLE IS INSERTED INTO THE CORRECT FLOW METER**

Oxygen = WHITE nipple
Medical Air = BLACK nipple

Please note some of the nipples that are available for Oxygen may appear to be pale grey rather than pure white.

MEDICAL AIR GUARD

- Must be fitted to the Medical Air flow meter when in situ in the Terminal Unit.
- Lift the air guard to attach the tubing to the Medical Air nipple when Medical Air is indicated.

STOP AND THINK! SHOULD YOU BE CONNECTING YOUR PATIENT TO MEDICAL AIR?

CHECK YOU ARE CORRECT BEFORE YOU CONNECT!

How should the oxygen and medical air flow meters look?

This is the standard layout when only oxygen is being used. It is fitted with a white nipple.

When the medical air flow meter is not in use, it must have a terminal unit plug fitted

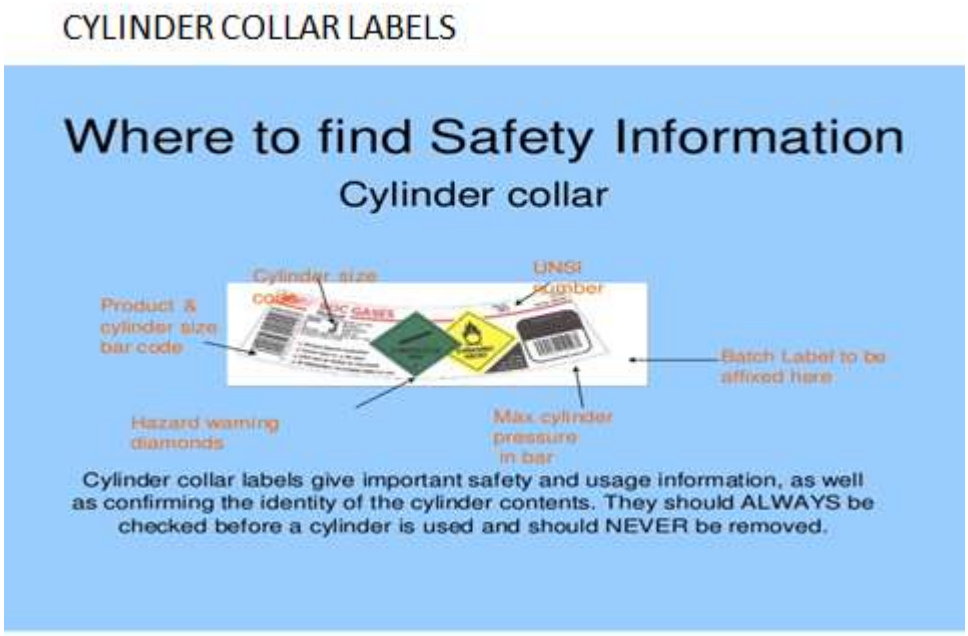
This is the standard layout when medical air is being used. It is fitted with a black nipple and an air guard.

Identification of Medical Gas Cylinders

The medical gas contained in a cylinder can be identified by the colour on the top of the gas cylinder, the “shoulders”.

Oxygen cylinders have WHITE shoulders
Medical Air cylinders have BLACK AND WHITE shoulders

Did you know that cylinders have an expiry date on them? This must be checked before use as with any other medication. You can find this on the batch label on the cylinder collar as shown below. The cylinder collar will display information about the gas.



QUESTION - WHY IS IT SO IMPORTANT TO KNOW WHAT THE EQUIPMENT IS AND TO ENSURE THAT MEDICAL GASES ARE SET UP CORRECTLY?

ANSWER – TO ENSURE SAFE USE AND ADMINISTRATION AND TO PREVENT A NEVER EVENT OCCURRING!

Unless you are familiar with the equipment and ensure that the set-up is correct, there is a clear risk of connecting your patient to the wrong Medical Gas. Air and oxygen flow meters can be difficult to tell apart and as they both have universal outlets, oxygen tubing can be attached to both. (NHS Improvement Patient Safety Alert, 2016).

UNINTENTIONAL CONNECTION OF A PATIENT REQUIRING OXYGEN TO AN AIR FLOW METER IS A NEVER EVENT.

Never events are defined as:

patient safety incidents that are wholly preventable where guidance or safety recommendations that provide strong systemic protective barriers are available at a national level and have been implemented by healthcare providers (NHS Improvement, 2018)

Severe harm or death can occur if Medical Air is accidentally administered to patients instead of Oxygen (NHS Improvement Patient Safety Alert, 2016).

It is therefore essential that you check thoroughly that you are attaching the tubing to the correct flow meter - ask a colleague to double check if you can, particularly in an emergency situation. Air flow meters are never required in an emergency situation.

There have been 8 never events of this nature reported in the Trust since 2004, seven of those have been since 2011. Following the correct procedures and having the correct equipment available will prevent this from happening. Check your ward or department today!

CHECK YOU ARE CORRECT BEFORE YOU CONNECT!

Use of Medical Gas Cylinders

Ensure correct moving and handling techniques are followed when moving medical gas cylinders.

Safe Storage of Cylinders

What are the risks?

- Risk of injury to patients, staff and visitors due to falling cylinders
- Risk of damage to property due to falling cylinders
- Risk of theft

Risk of injury to patients, staff and visitors

Cylinders must be stored safely in the recommended way. Cylinders must never be left freestanding on the floor, this has led to incidents of injury here within the Trust. Staff must not put cylinders out onto the hospital street as there is no safe storage in this location.

- **If you have cylinders requiring collection, please request collection by the Porters via TMS**
- **Review the cylinder storage in your area, if it is not adequate, speak with your Clinical Leader to request further storage through Docket Line**

A member of RBCH staff was injured by an oxygen cylinder, which was not safely stored, being knocked over onto her foot. This led to a significant foot injury resulting in lengthy time off work, on-going pain and distress for the individual concerned.

Correct Cylinder Storage

Theft

There have been a number of reported incidents of theft of medical gas cylinders here within the Trust. The most common items to be stolen are Nitrous Oxide and Entenox cylinders.

Be vigilant and report anything suspicious.

Actions to Reduce the Risks:

- Reduce the number of cylinders in use
- Consider moving a patient to a bed space with piped gas supply rather than using a cylinder at a bed space without a piped supply
- Where possible, replace Medical Air Cylinders used for drug nebulisation with compressors (nebuliser machines)
- Ensure safe storage

If a cylinder is found to be faulty it must be removed from use immediately, labelled as faulty and that it has been reported to the Porters via TMS.

Use of Portable Cylinders

There have been incidents reported within the Trust where staff thought that a patient had been receiving oxygen via a portable cylinder as the flow selector dial was turned on. However the patient was in fact not receiving Oxygen as the valve (the hand wheel) on the cylinder itself had not been turned to open.

An NHS Patient Safety Alert was also released in 2018 about this issue.

It is vitally important the style of cylinders below are turned on correctly to ensure that oxygen is being delivered to the patient. Follow the steps below from BOC UK, How to Use your Oxygen Cylinder:

STEP 1

Ensure you have the correct medical gas by checking the label and the expiry date on the batch label.

STEP 2

Make sure the contents gauge is in the green zone. This indicates that the cylinder is FULL.

STEP 3

Remove the tamper evident handwheel cover by pulling the tear ring

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STEP 4

Remove the valve outlet cover

STEP 5

Ensure the flow selector on top of the cylinder is set to zero and the hand wheel is turned off before connecting the equipment.

STEP 6

Attach tubing from the mask or nasal canuula to the valve outlet. Ensure the tubing is pushed on securely

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STEP 7

Slowly turn on the cylinder by rotating the hand wheel anticlockwise until it comes to a complete stop

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STEP 8

Set the prescribed flow by rotating the dial flow selector. Ensure that the correct flow rate number is clearly visible in the flow selector window.

CHECK YOU ARE CORRECT BEFORE YOU CONNECT!

OXYGEN

It is stipulated by the British Thoracic Society (BTS, 2017) that Oxygen should be administered by staff that are trained in oxygen administration.

Oxygen is widely used in clinical practice to prevent cellular hypoxia, caused by hypoxaemia (low concentration of oxygen in the blood/low PaO_2), therefore preventing potentially irreversible damage to vital organs.

Anatomy and Physiology

To aid understanding of Oxygen administration, here is a refresher of some principles of anatomy and physiology associated with respiration. It is assumed that as a registered professional you have a certain level of understanding of the respiratory system. If you need to refresh this, it is recommended that you do your own self-directed learning prior to continuing with the remainder of this learning package.

Breathing

- Breathing is the physical process of inhaling oxygen (O_2) and exhaling carbon dioxide (CO_2).
- The process of breathing is a delicate balance of neurological control, chemical control and muscular control.
- Sometimes referred to as ventilation.

Control of Breathing

- Neurological Control
    - Breathing is controlled by the medulla and the pons within the brain, signals are sent to the respiratory centre, which in turn sends signals to the nerves supplying the respiratory muscles.
    - The respiratory muscles are innervated by the phrenic nerve (controls diaphragm), the vagus nerve (diaphragm, larynx, pharynx and parasympathetic control of heart and digestive system), and the posterior thoracic nerve (intercostal nerves)

- Chemical Control

    - There are also chemoreceptors within the respiratory muscles, which detect changes in pH levels, caused by carbon dioxide levels within the blood. This allows the breathing rate to increase or lower accordingly.
    - Chemoreceptors are also stimulated by a fall in the partial pressure of oxygen (PaO2), which can increase our rate of ventilation by increasing our respiratory rate or the depth of breathing.

- Muscular Control
    - Muscles are attached to the ribs. We have a set of inspiratory muscles which contract when there is neurological instruction to inhale: diaphragm and external intercostals. Exhalation is mainly passive; however a few muscles may help with forced expiration: internal intercostals, subcostals and the abdominals.

Respiration

- External respiration is the exchange of oxygen and carbon dioxide between a living body and the environment.
- Internal respiration includes the exchange of gases between single cells and the extracellular fluids. It is the transport of oxygen to the cells within the tissues and is used to create energy. Carbon dioxide is the waste product of this chemical reaction.
- There are several components of respiration:
  - Oxygen transport: transported in haemoglobin, affected by temperature, pH levels and diphosphoglycerate (DPG) – a salt in red blood cells that plays a role in liberating oxygen from haemoglobin in the peripheral circulation.
  - Gas exchange: delivery of oxygen to the tissues and removal of CO_2
  - Carbon dioxide transport: dissolved in plasma, bound to haemoglobin, or as bicarbonate ions (which alter Ph levels in the body)
- Additional considerations:
  - Oxygen delivery: not only do the lungs oxygenate our blood, but if the oxygen carrying capacity of the blood is low, other organs may join in to ensure adequate delivery. Eg. Kidneys produce erythropoietin to stimulate red blood cell production, or the heart will increase its cardiac output.
  - Carbon monoxide presence will block oxygen binding to haemoglobin despite having a normal level of oxygen in the blood
  - Carbon dioxide is a waste product cleared from the body by being transferred from the blood steam, into the alveoli in the lungs, then exhaled.
  - Increased levels of carbon dioxide will stimulate ventilation in most people. This is called the hypercapnic drive where a high arterial level of CO_2 stimulates an increase in the rate and depth of respiration.

Physiology of Oxygen Therapy

- Oxygen is breathed into the lungs and is transferred into the bloodstream, to supply the organs, tissues and cells, via the alveoli.
- Oxygen therapy increases PaO_2, and is only effective when alveolar capillary units have some functional ventilation
- It is ineffective if there is a pure shunt (where normal gas exchange does not occur)
- There may be diffusion limitations due to fibrotic lung tissue

Oxygen Therapy Indications and Cautions

- Oxygen is a life-saving drug for hypoxaemic patients
- Giving too much Oxygen is unnecessary as it cannot be stored in the body

 **There are some patients who may be harmed by too much Oxygen.**

This includes:

- Those at risk of CO_2 retention such as patients with COPD (see next section)
- Patients with Myocardial Infarction with no associated hypoxaemia – unnecessary use of high concentration Oxygen may increase infarct size
- Stroke without associated hypoxaemia

Common indications for Oxygen therapy include:

- Acute hypoxaemia (for example pneumonia, shock, asthma, heart failure, pulmonary embolus)
- Ischaemia (for example Myocardial Infarction, but **ONLY** if associated with hypoxaemia
- Abnormalities in quality or type of haemoglobin (for example acute GI blood loss or carbon monoxide poisoning).
- Pneumothorax – Oxygen may increase the rate of resolution of pneumothorax in patients for whom a chest drain is not indicated.
- Post operative state (general anaesthesia can lead to a decrease in functional residual capacity within the lungs - especially following thoracic or abdominal surgery) resulting in hypoxaemia. There is some evidence to suggest a decreased incidence of post operative wound infections with short- term oxygen therapy following bowel surgery.

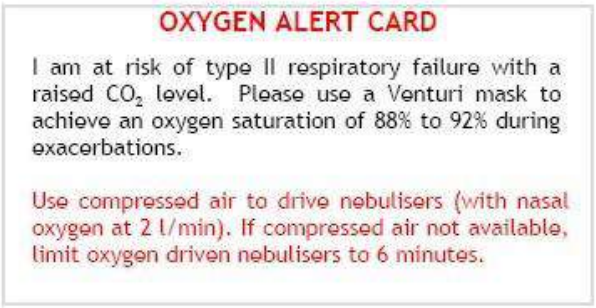
Oxygen Administration in Patients With COPD or Those Others at Risk of CO_2 Retention

- In some patients, such as those with COPD, neuromuscular skeletal disorders or obesity-hypoventilation, there can be a loss of the hypercapnic drive, which leads to CO_2 retention.
- COPD patients (and some other patients who are prone to CO_2 retention – "CO_2 retainers") may be harmed by too much oxygen as this may cause further increases in CO_2 and respiratory acidosis
- The disease process of COPD can lead to chronically high arterial levels of carbon dioxide and low levels of oxygen. Over time, the central chemoreceptors become less sensitive to these changes. The stimulus for ventilation is then managed by the peripheral chemoreceptors in the carotid bodies and the aortic arch. These receptors are stimulated by low arterial levels of oxygen, transmitting messages to the respiratory centre in the medulla. This leads to an increased respiratory rate and depth, with a low arterial oxygen level, and a reduced depth and rate with a high arterial oxygen level.
- The target Oxygen prescription therefore for those at risk of hypercapnia is 88-92% in patients with CO_2 retention as giving too much Oxygen may increase O_2 levels from what may be normal for that individual. This may result in a reduction in the rate and depth of respirations which will increase the arterial level of CO_2. This is CO_2 retention, otherwise known as hypercapnia.

Clinical symptoms and signs of carbon dioxide retention include:

- headache
- poor appetite
- vasodilation producing flushing and warm peripheries with dilated blood vessels (including retinal veins)
- bounding pulse
- drowsiness
- flapping tremor (tremor of the hand when the wrist is extended, resembles a bird flapping it's wings)
- confusion
- coma

- Those known to be CO_2 retainers should have an Oxygen Alert Card with them, detailing their saturation/ oxygen requirements



Other Hazards of Oxygen Therapy include:

- Fire hazard - Oxygen supports combustion therefore is a fire hazard as the environment can become saturated. Ensure oxygen not running at higher doses than necessary and switched off when not in use.
- Inappropriate actions around medical gas outlets - inform patients and relatives not to smoke or charge electrical devices (eg. Mobile phones as these chargers are at risk of overheating and catching fire) near medical gas outlets.
- Drying of nasal and pharyngeal mucosa – humidification with "Misty-ox" can be considered flow rates above 28% that is not short term

<u>Prescribing of Oxygen</u>

Oxygen should be regarded as a drug (BNF 2019) and therefore requires prescribing in all but emergency situations (RBCH Policy for the prescription and administration of oxygen in adults, 2019, BTS 2017).

Oxygen should be prescribed on the designated section of the drug chart. It must be prescribed according to a target saturation range.

 **Note – target saturations may not be indicated for all patients, eg. those on the care pathway for the last days of life. This should be recorded in the notes.**

Target oxygen prescription

- Prescribed to achieve 94-98% for most acutely ill patients or 88-92% in those at risk of hypercapnia
- Prescribe target range at time of admission in case of clinical deterioration
- Written on drug chart

Normal oxygen saturation ranges:

- In adults less than 70 years of age, at rest, at sea level 96-98% when awake
- Aged 70 and above at rest at sea level- 94-98% when awake
- All patients may drop periodically to 84% when asleep

Oxygen Administration and Delivery

 **Those who administer oxygen therapy must monitor the patient and keep them within the target saturation range.**

- Oxygen must be prescribed and signed for on each drug round
- Ensure all patients have oxygen saturations checked for at least 5 minutes following starting on oxygen therapy
- Oxygen saturation and delivery system should be recorded on NEWS2/observation chart
- Delivery devices and flow rates should be adjusted to keep within target range
- Titrate Oxygen up or down to maintain the target oxygen saturation
- If needed, please refer to the Trust Policy For The Prescription And Administration Of Oxygen In Adults, 2019 for more details on Oxygen administration on general wards in hospitals and options for stepping Oxygen up or down

The Oxygen Flow Meter

The flow meter controls how fast oxygen is released from the oxygen in litres per minute (LPM)
Before using the flow meter check there are no signs of damage to it.

 **Ensure the flow meter is in an upright vertical position for it to work properly and to measure the flow correctly.**

To set the flow, turn the control knob anti-clockwise until the ball rises to the flow rate prescribed. Wait for 3-4 seconds to ensure the flow rate has been maintained.
The ball should sit in the **centre** of the line of the required litres per minute (see picture overleaf)
When not in use the flow of the oxygen must be turned off by turning the control knob in a clockwise direction. The ball should fall to the bottom of the flowmeter.

Flow meters must only be operated by registered staff

- Photo showing the correct position of the ball in the flow meter to deliver 2 litres per minute.

<u>Oxygen Delivery Devices</u>

Nasal Cannulae – uncontrolled Oxygen therapy

- Nasal cannulae are preferred by most patients who require low to medium flow oxygen
- They do not interfere with talking, eating, drinking or coughing
- Commonly used for 2-4 litres per minute (but can be used between 1-6 litres in some circumstances)

Simple Face Mask – uncontrolled Oxygen therapy

- May be used instead of nasal cannulae due to patient preference or if the nose is blocked
- Variable performance due to flow rate, leakage between the mask and face, the patient's tidal volume and breathing rate
- Flow rate must not be below 5 litres per minute as this does not give enough flow of oxygen to prevent rebreathing of carbon dioxide.

NOT TO BE USED FOR CO_2 RETAINING PATIENTS

Venturi – controlled oxygen therapy

- A mask incorporating a device to enable a fixed concentration of oxygen
- Delivered independent of patient factors or fit to the face or flow rate
- Oxygen is forced out through a small hole causing a Venturi effect which enables air to mix with oxygen.
- Blue = 24%
- White = 28%
- Yellow = 35%
- Red = 40%
- Green = 60%

Monitoring oxygen saturations

During the administration of oxygen and when indicated by the clinical condition, monitoring of oxygen saturations is needed. All patients on Oxygen therapy should have regular pulse oximetry measurements, the frequency will depend on the condition being treated and the stability of the patient. In order to do this, it is essential that the correct equipment is used. A sudden reduction of 3% or more in a patient's oxygen saturation within the target saturation range should prompt fuller assessment of the patient because this may be the first evidence of an acute illness (BTS, 2017).

However, in the last days of life, care is comfort-focussed and the patient should be assessed by whether they are comfortable rather than necessarily needing Oxygen saturation or PaO_2 monitoring.

Finger probes must only be used on fingers and must never be attached to ear lobes. This can lead to incorrect monitoring, potential tissue damage and discomfort for the patient. There are specific saturation probes for use on ear lobes.

Incorrect use of saturation finger probe

- Picture shows pressure damage sustained to an ear after incorrect use of a finger probe on a patient's ear

Correct use of finger probe

Correct use of ear probe

Pressure reducing products

- intended to distribute pressure while protecting and padding bony prominences.
- EZ wraps are designed to be used in conjunction with nasal cannula tubing.
- These products help to prevent the early formation of tissue damage.
- Refer to the Trust SOP 27 Pressure relieving devices for patients receiving oxygen therapy for more guidance

USE OF OXYGEN IN THE EMERGENCY SITUATION

- As per BTS (2017) guidance and RBCH Trust Policy, Oxygen prescription is **NOT** required in the emergency situation before Oxygen is administered. It must however be documented later.
- All peri-arrest and critically ill patients should be given high flow Oxygen in the form of 15 litres per minute via a non-rebreathe mask
- Call for immediate medical review
- All patients in cardiac or respiratory arrest should have high flow oxygen provided alongside basic and advanced life support techniques

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 **Only registered health professionals can commence oxygen therapy in an emergency situation**

 **COPD patients, and those at risk of CO_2 retention, who are critically ill should also have 15 litres per minute of Oxygen administered through a non-rebreather mask until blood gases have been obtained. Following this they may then need controlled oxygen therapy, non-invasive ventilation or invasive ventilation. Remember, hypoxia will cause death quicker than the build-up of CO_2.**

 **CHECK YOU ARE CORRECT BEFORE YOU CONNECT! DON'T MISTAKE MEDICAL AIR FOR OXYGEN IN THE EMERGENCY SITUATION!**

Aims of Emergency Oxygen Therapy

- To correct potentially harmful hypoxaemia
- To alleviate breathlessness only if caused by hypoxaemia
    - Oxygen has not been proven to have any consistent effect on the sensation of breathlessness in non-hypoxaemic patients

Assessing Your Patient

- Acutely unwell patients should be assessed using an A-E approach
- Respiratory rate and Oxygen saturation levels are included in B for Breathing where the administration of emergency Oxygen therapy may be indicated
- Oxygen saturations must be checked by pulse oximetry in breathless and acutely ill patients and the inspired oxygen concentration should be recorded on e-observations/ observations chart
- Supplemental oxygen is given to improve oxygenation but it does not treat the underlying causes of hypoxaemia which must be diagnosed and treated as a matter of urgency
- Critically ill patients outside high dependent areas should be monitored using e-Observations/NEWS2 chart

If saturations are lower than target specified:

- Check all elements of oxygen delivery for faults or errors
- Set up oxygen as per protocols & consider re-assessment as per NEWS2

Clinical features of hypoxaemia:

- Altered mental state
- Dyspnoea
- Cyanosis
- Tachypnoea
- Arrhythmias
- Coma - Loss of consciousness occurs with a PaO_2 of 4.3kPa (Saturations less than 56%)
- Death – PaO_2 of 2.7kPa

Weaning and Discontinuation

- When considering weaning from oxygen, we should follow the BTS (2017) guidance

- Saturations higher than target specified or greater than 98% for an extended period of time
    - If O_2 stable and observations within target range on 2 consecutive readings, you can consider weaning O_2 (usually 4-8 hours)
    - Step down oxygen therapy
    - Consider discontinuation
    - Saturations should be monitored for 5 minutes following weaning oxygen
    - If the saturation falls below the patient's target range on stopping oxygen therapy, restart the lowest concentration that maintained the patient in the target range and monitor for 5 minutes.
    - If saturations restored into the target range, continue oxygen therapy at this level and attempt discontinuation of oxygen therapy again at a later date provided the patient remains clinically stable

– If saturations not restored or if the patient is not clinically stable then Medical review must be requested

Nebuliser Therapy in Patients Requiring Oxygen

Some patients may need supplementary Oxygen while using their nebulisers. Ensure frequent monitoring of the patient is performed including oxygen saturations.

Where possible, consider the use of a compressor box to drive the nebuliser. Where this is not available, piped air through the air flow meter can be used.

As per hospital policy, the routine use of oxygen as a driving gas is to be avoided. However also as per policy, patients requiring 35% Oxygen or greater should have their nebuliser driven by Oxygen at a flow of greater than 6 litres per minute.

The patient must have their usual Oxygen delivery device set at their usual rate replaced when nebuliser therapy is complete.

A Physiotherapist noticed as they walked by, that a patient who was receiving a nebuliser driven by Medical Air had considerably dropped their oxygen saturations. Pre-nebuliser, the patient was receiving 40% Oxygen which had been removed. 40% Oxygen was recommenced, the patient was monitored closely and they improved with saturation levels returning to target range

Transferring patients on Oxygen

As per hospital policy, patients requiring Oxygen therapy whilst being transferred should be accompanied by a trained member of the nursing staff wherever possible. If this is not possible then clear instructions must be provided for the personnel involved in the transfer. This must include delivery device and flow rate.

- Be vigilant for inadvertent disconnection
- Reconnect as prescribed. This must be done by a registered professional only.
- Check that there is enough Oxygen within the cylinder to last for the duration of the transfer
- The approximate consumption rate of a full CD cylinder at 5L per min is 1.5hrs
- Handover to the receiving ward or department must include the details of the Oxygen administration and requirements of the patient

There have been several reported incidents in the Trust where during transfer or following transfer, the patient has not been receiving the correct dose of Oxygen to maintain their target saturation range. On occasions, transfer has also resulted in the patient being connected to Medical Air instead of Oxygen.

Documentation

It is essential to document the care of your patient in relation to their Oxygen therapy, accurately and clearly.

Drug chart

The registered nurse must sign the drug chart for the administration of oxygen. Signing the drug chart confirms that:

- The oxygen is prescribed
- The patient is receiving the correct range of oxygen to maintain their target saturation range
- The oxygen is set up appropriately
- Weaning and/or discontinuation has been considered

NEWS2/observation chart

- Oxygen dose
- Method of delivery/delivery device
- Oxygen saturations

Patient's notes

Any assessment, planning, implementation and evaluation of the patient's care relevant to oxygen administration, weaning and discontinuation must be documented in the patient's notes.

MEDICAL AIR

Common uses for Medical Air in the hospital setting:

- in anaesthesia as a carrier gas for volatile anaesthetic agents
- as a power source for pneumatic equipment
- in ventilators and incubators to provide uncontaminated and controlled air flows
- To drive nebulisers

Use of Medical Air

- If your patient requires Medical Air, where possible they should be moved to a bed space with a piped supply.
- Air flow meters must only be in situ at the bed spaces of those patients where medical air is currently being used (eg. to drive nebulisers). Ensure that the black air nipple and a medical air guard are in place at all times.

When Medical Air is not in use

- As soon as medical air is no longer needed for that patient, the air flow meter must be removed from the wall and a Medical Air plug must be inserted into the medical air terminal unit.
- When turning around a bed space between patients, please check that there is no longer an air flow meter in place and that the Medical Air plug is in situ.
- Note the plug has a chain attached to it to ensure that there is always one available.

STOP AND THINK! MEDICAL AIR – SHOULD THAT BE THERE?

If your patient no longer requires Medical Air, remove it immediately as per the steps above.

NOTE – OXYGEN FLOW METERS MUST ALWAYS REMAIN IN PLACE IN CASE OF EMERGENCY

- Most wards have medical air flow meter storage areas
- If this is missing from your clinical area, speak to your Clinical Leader to arrange an instillation through Docket line

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Flow meter racks can be ordered through Powergate.

Summary of key learning points

- **Ensure correct equipment and set up**
- **Oxygen = white, Medical Air = black**
- **Ensure safe storage of cylinders**
- **Portable cylinders must be turned on correctly in order to administer Oxygen**
- **Oxygen should be administered to maintain target oxygen saturations as prescribed and the patient must be monitored**
- **Oxygen is a drug therefore needs prescribing and signing for except in an emergency situation when it can be documented later**
- **Oxygen may be harmful to some patients and those known to have Type 2 respiratory failure with CO_2 retention should carry an Oxygen Alert card**
- **All patients, including COPD patients and those at risk of CO_2 retention, who are critically ill should have 15 litres per minute of Oxygen administered through a non-rebreather mask followed by urgent medical review**
- **Air flow meters must not be in place at bed spaces for patients where it is not being used**
- **On removal of an air flow meter, a Medical Air plug must be fitted into the terminal unit**
- **Assess to see if your patient requires supplementary Oxygen while having a nebuliser**
- **Above all…**

CHECK YOU ARE CORRECT BEFORE YOU CONNECT!

QUIZ

1. **WHAT COLOUR IS THE EQUIPMENT RELATED TO OXYGEN?**
   A) black
   B) white
   C) blue
   D) red

2. **WHAT COLOUR IS THE EQUIPMENT RELATED TO MEDICAL AIR?**
   A) black
   B) white
   C) blue
   D) red

3. **HOW MUST MEDICAL GAS CYLINDERS BE STORED WHEN THEY ARE NOT IN USE?**
   A) loose on the floor
   B) safely and securely in trolleys or chained to the wall
   C) lying on the patient's bed
   D) in the patient's bedside locker

4. **WHAT MUST YOU REMEMBER TO DO BEFORE CONNECTING A PATIENT TO A PORTABLE OXYGEN CYLINDER?**
   A) go for your tea break
   B) let the Porter sort it out
   C) check you have the correct gas, check that the cylinder is in date with a good supply remaining, attach the tubing, turn the cylinder on with the hand wheel and set the correct flow rate
   D) nothing

5. **WHAT IS THE TARGET OXYGEN SATURATION RANGE ON THE PRESCRIPTION FOR PATIENTS WHO ARE NOT CO2 RETAINERS?**
   A) 94-98%
   B) 90-95%
   C) 88-92%
   D) There isn't one

6. **WHAT IS THE TARGET OXYGEN SATURATION RANGE ON THE PRESCRIPTION FOR PATIENTS WHO ARE CO2 RETAINERS?**
   A) 94-98%
   B) 90-95%
   C) 88-92%
   D) There isn't one

7. WHO CAN ADMINISTER OXYGEN?

A) All registered nurses, midwives and health care support workers
B) Porters
C) Any registered professional who has been trained in the use of medical gases following a prescription or without a prescription in the event of an emergency
D) Doctors only

8. WHAT IS THE RECOMMENDED OXYGEN ADMINISTRATION IN THE EMERGENCY SITUATION FOR ALL PATIENTS?

A) 10 litres/minute via a non-rebreathe mask
B) 15 litres/minute via a non-rebreathe mask once it has been prescribed
C) 15 litres/minute via a non-rebreathe mask which may be initiated without a prescription
D) 2 litres/minute via nasal cannula

9. WHAT STEPS SHOULD YOU TAKE IF YOUR PATIENT NO LONGER NEEDS MEDICAL AIR?

A) Leave it there just in case of emergency
B) Remove the medical air flow meter
C) Remove the tubing and medical air nipple but leave the flow meter in place
D) Remove the medical air flow meter and place a medical air plug into the medical air terminal unit so that this is not used inadvertently

10. WHICH PICTURE SHOWS THE CORRECT MEDICAL GAS SET UP ON A WARD FOR A PATIENT REQUIRING OXYGEN AND JUST ABOUT TO USE MEDICAL AIR?

A)

B)

C)

D)

ON COMPLETION OF THE QUIZ, CHECK YOUR ANSWERS AGAINST THE ANSWERS BELOW. IF YOU DID NOT GET A QUESTION RIGHT, PLEASE REVISIT THE LEARNING PACKAGE TO REVISE THAT SECTION TO ENSURE THAT YOU ARE CLEAR ON THE CORRECT INFORMATION.

1) **B**
2) **A**
3) **B**
4) **C**
5) **A**
6) **C**
7) **C**
8) **C**
9) **D**
10) **C**

The Royal Bournemouth and Christchurch Hospitals
NHS Foundation Trust

MEDICAL GASES LEARNING PACKAGE COMPLETION NOTICE

On completion of this learning package, please complete the following declaration, scan and send a copy of this page to clinical.skills@rbch.nhs.uk so that this can be assigned to your ESR record. Please retain a copy for your own records.

I CONFIRM THAT:

- I HAVE COMPLETED THE MEDICAL GASES LEARNING PACKAGE INCLUDING THE QUIZ
- I HAVE READ THE LATEST POLICY ON THE INTRANET FOR THE PRESCRIPTION AND ADMINISTRATION OF OXYGEN IN ADULTS AND THE STANDARD OPERATING PROCEDURE FOR PRESSURE RELIEVING DEVICES FOR PATIENTS RECEIVING OXYGEN THERAPY
- FOLLOWING THIS TRAINING I FEEL COMPETENT TO SAFELY ADMINISTER OXYGEN AND MEDICAL AIR AND WILL PRACTISE WITHIN MY SCOPE OF PRACTICE

  OR:

- FOLLOWING THIS TRAINING I DO NOT FEEL FULLY COMPETENT TO ADMINISTER OXYGEN AND MEDICAL AIR AND REQUIRE FURTHER TRAINING (delete as appropriate)

LEARNER'S NAME (PRINT) _____

CLINICAL AREA _____

BAND _____

SIGNATURE _____

DATE _____

REFERENCES:

- BOC Medical Gas Data Sheet Medical Air
https://www.bochealthcare.co.uk/en/images/Safety-data-sheet-Synthetic-Medical-Air_tcm409-520828.pdf

- BOC Medical Gas Data Sheet Compressed Medical Oxygen
https://www.bochealthcare.co.uk/en/images/507770 - Healthcare%20Oxygen%20MGDS%20Rev4%20%28Nov%202016%29%20web_tcm409-54070.pdf

- http://www.bochomeoxygen.co.uk/en/patients/ourhomeoxygenequipment/oxygencylinders/HowtouseyourOxygenCylinder/How_to_use_your_Oxygen_Cylinder.html

- Black, J. and Kalowes, P. 2016. Medical –devices related pressure ulcers. Chronic Wound Care Management and Research. Vol 3, p 91-99.

- British National Formulary 2019

- British Thoracic Society Guideline For Oxygen Use In Healthcare And Emergency Settings, Thorax, 2017

- Brown, J. 2016, 'Understanding COPD and the hypoxic drive to breathe' Ausmed 22 September

- Hough, 2001, Physiotherapy in Respiratory Care, Nelson Thornes, Gloucester

- NHS Improvement Patient Safety Alert, 2016

- NHS Improvement Never Event Policy and Framework 2018

- Physiopedia, 2019, 'Muscles of Respiration'
https://www.physiopedia.com/Muscles_of_Respiration

- RBCH Trust Policy for the Prescription and Administration of Oxygen in Adults, 2019

- RBCH Trust Policy for Medical Gases Pipeline Systems (MGPS) Policy, RBCH, 2019

- RBCH Pressure Ulcer Prevention and Management Policy, 2018

- RBCH Standard Operating Procedure for Pressure relieving devices for patients receiving oxygen therapy (2016)