Providing best practice oxygen therapy in the community

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In the course of their work, community nurses may often come across patients being treated with oxygen therapy for long-term conditions. This article examines the knowledge that community nurses need to provide effective evidence-based care, particularly referencing the British Thoracic Society (BTS) guidelines as well as how referral to specialist respiratory/oxygen teams can sometimes be the best option. The author also considers the potential benefits of providing community teams with pulse oximeters and how this would support them in assessing patients who might require oxygen therapy, identify at-risk patients and support clinical decision-making, particularly with referrals into specialist services.

KEYWORDS:
Oxygen  ▪  Pulse oximetry  ▪  Specialist referral

The potential value of oxygen for patients with respiratory conditions was recognised shortly after its discovery in an 18th century laboratory. In 1798, Beddoes and Watt worked together to generate oxygen in the Pneumatic Institute in Bristol, using oxygen and nitrous oxide to treat asthma and congestive heart failure. Later, the 20th century brought the dawn of the clinical use of oxygen in medicine and better understanding of the physiological effects and technological advances that support its use in practice (Heffner, 2013).

Oxygen is a commonly used drug in modern-day medicine, particularly in emergency care and the long-term management of hypoxaemia (an abnormally low concentration of oxygen in the blood), but also in a wide range of other conditions such as long-term respiratory illnesses, cardiac failure, cancer, end-stage cardiorespiratory disease, terminal illnesses, and cluster headaches.

The majority of evidence around oxygen therapy comes from its use in patients with chronic obstructive pulmonary disease (COPD), while the British Thoracic Society (BTS) (2015) provided evidence-based guidelines on the use of oxygen and these now act as a framework to support practitioners.

OXYGEN IN THE COMMUNITY

In the community, the most common conditions requiring oxygen therapy are COPD and palliative care. This article refers in the main to these groups of patients, however, the general principles discussed can be applied to all community patients.

In 2010, around 85,000 people received home oxygen therapy in England at a cost of about £110 million. The demand for oxygen therapy is increasing and it is a key service where quality, efficiency, and value for money are important factors, alongside outcomes and patient experience (Department of Health [DH], 2010).

ASSESSMENT

Oxygen should be regarded as a drug. It is prescribed for patients with hypoxaemia (abnormally low concentration of oxygen in the blood and a common feature of COPD and patients at the end of life) to increase alveolar oxygen tension and decrease the physical exertion involved in breathing. The concentration of oxygen prescribed depends on the condition being treated and inappropriate concentrations can have serious or even fatal consequences (Joint Formulary Committee, 2016).

Patients who experience breathlessness are not necessarily short of oxygen, even though many patients ask for oxygen therapy due to this misconception. Supplemental oxygen in a patient who is not hypoxaemic is costly and of no clinical benefit (BTS, 2015).

The clinical features of hypoxaemia are non-specific. Acute patients with hypoxaemia can experience an increased respiratory rate, tachycardia, confusion, irritability, lethargy and cyanosis, which is a late sign (Resuscitation Council, 2012). However, in chronic disease hypoxaemia is a more insidious process, with patients showing signs when respiratory failure with cyanosis and pulmonary heart disease (sometimes known as cor pulmonale) has become apparent.

Therefore, regular measurement of SpO₂ (saturation of peripheral oxygen) at annual reviews is useful in detecting patients who may be affected. Patients with COPD should be reviewed at least once a year, or more frequently if indicated, and the review should cover oxygen therapy. Palliative care patients are likely to be seen much more frequently by community nurses and as such they would be best placed to assess dyspnoea and hypoxia as part of a
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A comprehensive assessment is required if oxygen is to be provided safely and appropriately. Pulse oximeters are now widely available in the community and are a cost-effective, non-invasive means of measuring oxygen saturation.

Pulse oximetry
Oximeters work by the principles of spectrophotometry, which compares how much red and infrared light is absorbed by oxygenated and deoxygenated haemoglobin, thereby monitoring the percentage of oxygen-saturated haemoglobin. A normal oxygen saturation reading would be 94–98% (Hinkelbein et al, 2007), whereas a patient with an SpO2 of under 94% would be classed as hypoxaemic (BTS, 2015).

The oximetry probes are positioned on translucent sites that have good blood flow, e.g. fingertips, and time should be allowed to achieve a steady reading, taking into account temperature (i.e. cold hands), poor perfusion, irregular pulse, and motion artefact (the reliability of the pulse oximeter can be reduced when the person moves or when movements are involuntary, such as shivering or tremors). Nail polish should be removed if possible, as it may cause false readings.

Blood gas assessment
COPD patients with oxygen saturation levels of 92% or less should be referred onto a specialist respiratory service for a blood gas assessment. The oxygen saturation level for referral is 94% or under for those patients who already have:

- Clinical evidence of pulmonary heart disease
- Peripheral oedema
- Polycythaemia: a condition where there is an increased proportion (55% or over) of red blood cells in the overall blood volume as measured by haematocrit (test of the blood’s viscosity)
- Pulmonary hypertension identified on echocardiogram: these patients are already showing signs of right-sided heart strain caused by pulmonary vasoconstriction due to hypoxia.

Patients should be assessed for long-term oxygen therapy during a period of clinical stability; where possible at least eight weeks since their last exacerbation (BTS, 2015).

In specialist services, patients will be optimised pharmacologically (involving the use of inhalers, combination therapy and mucolytics to assist with sputum clearance) and a blood gas analysis performed. In the community setting, a capillary blood gas (CBG) is obtained from the patient’s earlobe as opposed to the radial artery used in acute settings.

The CBG is non invasive and not usually painful, involving piercing the skin, usually an earlobe, with a lancet and collecting the blood in a capillary tube. The blood gas measurement will reveal the partial pressures (the contribution of one individual gas within a gas mixture) of oxygen and carbon dioxide (PO2 and PCO2). Patients with a PO2 over 7.3 kilopascals (kpa) or less than 8kpa with existing cor pulmonale (assessed during a period of clinical stability) will be offered long-term oxygen therapy (see below).

Respiratory failure
There are two levels of respiratory failure, types 1 and 2.

Type 1 respiratory failure
Type 1 respiratory failure is defined as a low PO2 with normal or low PCO2 and implies defective oxygenation despite adequate ventilation. Some of the common causes are pneumonia, pulmonary embolism, acute asthma, pulmonary oedema and pulmonary fibrosis (Hennessey and Japp, 2012).

Type 2 respiratory failure
Conversely, some patients will present with a low PO2, and a raised PCO2 (hypercapnia, or abnormally elevated carbon dioxide in the blood); this is known as type 2 respiratory failure due to inadequate ventilation. Type 2 respiratory failure is not unique to COPD and may also occur in obesity-related hypoventilation and neuromuscular disorders. Type 1 respiratory impairment may lead to type 2 if the patient becomes exhausted.

Accurate assessment of type 2 respiratory impairment requires blood gas testing as SpO2 tests (such as pulse oximetry) only provide data on oxygen saturation and not acid base balance or PCO2. Patients at risk of carbon dioxide retention/hypercapnia are managed carefully to prevent acidosis. This involves the careful titration of oxygen therapy to target levels — usually 88–92%. There is a lower threshold for admitting these patients during an acute exacerbation, as they may tire with the extra work of breathing, hypoventilating and build up harmful CO2. Care should also be taken to ensure these patients are not overmedicated with opioids or sedatives, which may affect their breathing.

The common symptoms of COPD include increasing breathlessness, persistent cough with phlegm and frequent chest infections. The main cause is smoking, which irritates and inflames the lungs.

Source: NHS Choices, www.nhs.uk

Chronic obstructive pulmonary disease (COPD) is the name given to a collection of lung diseases including chronic bronchitis, emphysema and chronic obstructive airways disease. People with COPD will experience difficulties in breathing because of a narrowing of their airways (referred to as airflow obstruction).
The target oxygen saturation range for type 2 respiratory patients is 88–92% and they must be informed that it is not safe for them to increase their oxygen concentrations without specialist advice. If COPD patients were to turn up their oxygen therapy, this could result in depressed ventilation and, in turn, acid accumulation. The clinical signs of hypercapnia are confusion, drowsiness, headache, ‘bounding’ pulse, warm extremities and a ‘flapping’ tremor (tremor of the hand when the wrist is extended), which is a late sign (Hennessey and Japp, 2012).

Non-invasive ventilation
Some patients will need referral for non-invasive ventilation assessment before commencing oxygen therapy. This is delivered via a tight-fitting mask placed over the nose and mouth and connected to a ventilating machine, which delivers additional tidal volume under positive pressure after being triggered by the patient’s breathing. This helps return the patient’s acid base to normal over time. It is most-often used in the acute setting, however, some patients with chronic hypercapnic respiratory failure now have these machines in their own homes (Bourke and Burns, 2011).

Acute exacerbation of COPD
Patients at risk of type 2 respiratory failure who are chronically hypercapnic may be able to compensate homeostatically when in a stable condition, but may not be able to do so when experiencing an acute exacerbation of COPD (AECOPD).

These patients should be issued with a venturi mask (an oxygen mask that delivers a defined oxygen concentration to patients, in this case 28%), and an oxygen alert card to be used in case of transfer to hospital (the alert card warns medical staff that the patient is at risk of type 2 respiratory failure and should be managed with targeted oxygen therapy to maintain saturations at between 88–92%). This is because patients with chronically high partial carbon dioxide levels rely on receptors in the brainstem to detect these carbon dioxide levels and measure ventilation. For some, however, low oxygen levels rather than raised carbon dioxide becomes the main ventilatory stimulus; therefore supplemental oxygen administered at high levels could depress ventilation and lead to catastrophic rises in carbon dioxide and subsequent acidosis (Hennessey and Japp, 2012).

LONG-TERM OXYGEN THERAPY
Long-term oxygen therapy is delivered by an oxygen concentrator in the patient’s home; these are powered by electricity and have a filter that enables the oxygen to be separated from other gases and delivered to the patient in a defined amount (litres per minute [L/pm]) via nasal cannulae. The patient is reimbursed by the oxygen supplier for the electricity used by the concentrator and a backup cylinder is provided in case of temporary power failure.

Oxygen is prescribed on a home oxygen order form known as a HOOF and patients provide consent using a home oxygen consent form (HOCF). In England and Wales, this order is faxed to the supplier who is responsible for delivery, installation, and maintenance of the equipment. The engineers will also train the patient on use of the equipment. Patients with oxygen therapy are also offered a home visit assessment by the fire service during which any risks are discussed and smoke alarms fitted. Patients are encouraged to inform their landlord and/or home insurance companies that oxygen is being provided.

Oxygen can also be piped into the home enabling the patient to move around freely with a suitable length of tubing; this means they can use the oxygen for the prescribed period of at least 15 hours per day, or more if required. Long-term oxygen therapy is usually started at 1–2 L/pm and blood gases will be repeated during the therapy, with the oxygen levels titrated up at 20 minute intervals until a target of over 8kpa is achieved.

A venturi mask allows an accurate percentage of oxygen to be delivered, usually at 24–28%, whereas nasal cannulae offer variable percentages of oxygen depending on the patient’s respiratory rate. The majority of patients on long-term oxygen therapy use nasal cannulae, whereas masks are commonly used in the acute setting and, as mentioned above, during transfer to hospital if the person becomes acutely unwell.

In the early 1980s, two major studies, the NOTT trial and the MRC trial, showed that the administration of oxygen for at least 15 hours per day, but preferably longer, improved survival in COPD patients with a partial oxygen level of less than 7.3kpa (Nocturnal Oxygen Therapy Trial Group, 1980; Medical Research Council Working Party, 1981). While oxygen does not have any impact on the progressive decline of lung function, it does help to alleviate the right heart strain caused by pulmonary vasoconstriction (BTS, 2015).

Patient education
It is important that patients are taught that oxygen therapy is prescribed to improve their long-term prognosis rather than for symptom management. Overnight use accounts for around eight hours of the daily amount and patients are encouraged to continue their normal activities during the day with oxygen in situ. Patients undergoing long-term oxygen therapy can travel freely within the UK, while the provider will supply a holiday order following the provision of travel details. Patients undergoing oxygen therapy should seek the advice of the respiratory specialist before travelling by air.

Ambulatory oxygen
Ambulatory oxygen is delivered by portable cylinders and is appropriate for patients on long-term oxygen therapy with exercise-induced desaturation (defined as a drop in SpO2 of 4% or over to below 90%). To assess the patient’s suitability for ambulatory oxygen, a six-minute walk test is carried out, during which the patient is assessed for desaturation with the most appropriate device and setting chosen to correct this. There are certain considerations to be aware of during the assessment for ambulatory oxygen, such as whether the patient can manage the weight of the cylinders and the suitability of the cylinders and the suitability of

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Oxygen can also be piped into the home enabling the patient to move around freely with a suitable length of tubing; this means they can use the oxygen for the prescribed period of at least 15 hours in any 24-hour period. Long-term oxygen therapy is usually started at 1–2 L/pm and blood gases will be repeated during the therapy, with the oxygen levels titrated up at 20 minute intervals until a target of over 8kpa is achieved.

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KEY POINTS

- In the course of their work, community nurses may often come across patients being treated with oxygen therapy for long-term conditions.

- This article examines the knowledge that community nurses need to provide effective evidence-based care, particularly referencing the British Thoracic Society (BTS) guidelines as well as how referral to specialist respiratory/oxygen teams can sometimes be the best option.

- The article considers the provision of pulse oximeters to community teams and how this would support them in assessing patients that may require oxygen therapy.

- Pulse oximeters also help to identify at-risk patients and support clinical decision-making, particularly with regards to referrals into specialist services.

- A portable oxygen concentrator with a conserving device, which increases the longevity of the ambulatory cylinder (these only last approximately three-and-a-half hours on a 2 L/pm continuous flow). A conserving device delivers a pulsed dose on inspiration rather than a continuous flow; however, they are not suitable for all patients and should be assessed while being used to ensure that the patient’s depth of inspiration will trigger the device. Patients are also issued with a diary to make sure they are concordant with the oxygen prescription and to help ensure cost-effectiveness.

- Ambulatory oxygen cylinders are also used for patients with severe hypoxaemia who are unable to leave home to attend appointments without supplemental oxygen; this cohort of patients are not subjected to a six-minute walk test.

Palliative care

Short-burst oxygen therapy from larger or smaller portable cylinders and delivered via nasal cannulae or a venturi mask is sometimes used in palliative care to aid the patient’s recovery from intractable breathlessness and where all other palliative measures have been tried. There is no evidence to support the widespread use of this, however.

- Dyspnoea (laboured breathing) is common in patients with advanced life-limiting illness and nurses will frequently have to discuss breathlessness with them. The BTS (2015) offer advice on managing palliative patients including ensuring psychosocial factors have been assessed and addressed.

- Patients may be offered non-pharmacological measures including breathing techniques, relaxation, and life-modifying strategies (such as reducing unnecessary activity to conserve energy), which can be delivered by physiotherapists or occupational therapists and it is recommended that the patient tries a hand-held fan before oxygen therapy is considered. The use of opioids is also well-established in breathlessness, although their positive effect is not completely understood (Jennings et al, 2001).

- Palliative oxygen therapy should only be used by specialist teams where all reversible causes have been addressed and the patient’s SpO₂ has been checked using pulse oximetry at rest and/or after exertion. The mode of delivery — nasal cannulae or oxygen mask — and prescription will be down to the individual assessment. Stated optimal flow rates for symptom relief in palliative care range from 2–5L/pm; therefore oxygen flow rates in palliative oxygen therapy should be determined by an individual’s symptoms, rather than relying on an SpO₂ reading (BTS, 2015).

RISK ASSESSMENT

There is increasing recognition of the significant risk of fire and injury associated with smoking and the use of home oxygen therapy, with approximately 0.1% of patients experiencing a serious adverse event involving fire while using home oxygen in the UK (Cooper, 2015). It is the responsibility of nurses to advise patients about the risks of naked flames and smoking around oxygen cylinders and equipment, and nurses should do all they can to assist smokers to quit before they start home oxygen.

- Trips and falls are another potential hazard associated with oxygen therapy because of the tubing involved and a risk assessment of patients and anyone else sharing the home should be undertaken before oxygen is recommended (BTS, 2015; Cooper, 2015).

- Patients should be provided with written information on the risks involved and oxygen suppliers issue a useful booklet and publish a quarterly magazine, which has important advice and tips on the safe use of oxygen therapy.

- The use of oxygen can also have a drying effect on the nasal mucosa but the oil-based emollients and petroleum jelly used to soothe this can contribute to combustion in the presence of oxygen. Patients should be made aware that only water-based lubricants should be used on the hands and face or inside the nose while using oxygen (BTS, 2015). The cannulae used to deliver oxygen therapy can cause pressure damage...
to the skin on the ears and protectors are usually available from the oxygen supplier.

**CONCLUSION**

Community nurses are often the first point of contact for patients being treated with oxygen therapy for long-term conditions. It is essential they ensure that their knowledge is updated to provide evidence-based care and alongside specialist respiratory teams, the BTS (2015) guidelines are a useful resource. Oxygen providers also have nurse advisors who can advise nurses and patients. The provision of pulse oximeters to community teams should be a core requirement so that nurses are better able to identify and assess patients who are suitable for oxygen therapy, monitor at-risk patients, and support clinical decision-making and referrals into specialist services.

**REFERENCES**


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