THE USE OF PULSE OXIMETRY IN PRIMARY CARE

Pulse oximetry is now in common use in all healthcare settings. Until recently regarded as a secondary care device, the pulse oximeter is now routinely used in primary care, both in the general practice surgery and in the community. It can be useful in initial assessment, ongoing monitoring, and in both acute and chronic clinical situations. This article examines the how, when, what and why of pulse oximetry.

The pulse oximeter is a device that transcutaneously monitors the amount of oxygen ($O_2$) being carried on the haemoglobin (Hb) molecules in the blood. It does this by shining two types of light through a capillary bed and measuring how much of the light is absorbed by the $O_2$ in the blood. This gives an indication of the amount of $O_2$ being delivered to the tissues. This non-invasive, convenient technique displays the readings as a percentage of haemoglobin saturated with oxygen which is also called the peripheral oxygen saturation or $SpO_2$.

HOW DO YOU USE A PULSE OXIMETER?

A sensory electrode is placed over a finger or attached to an ear lobe to give a continuous or intermittent recording of the patient’s peripheral oxygen saturation and pulse rate. Like any new test, patients unfamiliar with pulse oximetry may be anxious about the procedure. The nurse should explain what is being measured and why, and answer any questions. Placing the probe on your own finger can reassure the patient that it is not painful.

Perhaps then, pulse oximetry should be used in all cases of initial respiratory assessment and diagnosis, and be deemed as good clinical practice.

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HOW SHOULD RESULTS BE INTERPRETED?
Normal oxygen saturation is 94–98%. Abnormal pulse oximetry readings, like all investigation results, should be considered in the context of the patient’s presenting clinical condition. It is important then to consider that oxygen delivery also depends on adequate ventilation, gas exchange and circulation, and any impairment of these mechanisms must be initially addressed to ensure optimal delivery of oxygen to the cells.

WHEN SHOULD IT BE USED IN PRIMARY CARE?
The NICE guidelines on the management of chronic obstructive pulmonary disease (COPD) advocate the use of pulse oximetry as a screening tool in the management of chronic stable disease. This will enable identification of all patients eligible for assessment for long-term oxygen therapy (LTOT); these are patients with oxygen saturations <92% when breathing room air. This screening should also include all patients with FEV₁ (forced expiratory volume in one second) <50% predicted, or those with cyanosis or signs of cor pulmonale.

In patients with severe disease (FEV₁ <30%) NICE recommends that SpO₂ is assessed at least twice yearly; however, there is no recommendation for routine screening with pulse oximetry in patients with mild or moderate disease. The Quality Outcomes Framework does not currently feature pulse oximetry as an outcome indicator. It may, however, prove useful not only in screening but also to suggest a differential diagnosis when hypoxaemia is detected in patients with mild chronic respiratory disease. Perhaps then, pulse oximetry should be used in all cases of initial respiratory assessment and diagnosis, and be deemed as good clinical practice.

Pulse oximetry is also valuable when assessing patients with acute respiratory clinical features, and can determine the need for supplemental oxygen therapy and/or the need for hospital treatment. In emergency situations the British Thoracic Society guidelines for emergency oxygen use in adult patients state that pulse oximetry should be checked in all breathless and acutely ill patients, and should be regarded as “the fifth vital sign”. The guideline goes on to recommend that pulse oximetry should be available in all locations where emergency oxygen is used; this of course includes primary care.

When supplemental oxygen is given for an acute presentation of breathlessness (eg acute exacerbation of asthma) it should aim to achieve a target saturation of 94–98% for patients aged <70 and 92–98% for those aged 70 and above. The reason for lower levels in the elderly reflects the fact that the normal range gradually declines with age. However, for some patients with, or at risk of developing type II respiratory failure (eg COPD, see box), receiving an inappropriate high concentration of oxygen can have serious or even fatal consequences. In these situations, it is recommended that a target oxygen saturation of 88–92% is achieved for patients treated with oxygen prior to the availability of blood gas analysis (Table 1).²

| Table 1: Guidance for target oxygen saturations when administering oxygen therapy |
|----------------------------------|-------------|
| Patient group                  | Target saturations |
| Age <70 years                  | 94–98%       |
| Age ≥70 years                  | 92–98%       |
| Type II respiratory failure (at risk) | 88–92%     |

Definition of respiratory failure
Respiratory failure is defined as failure of the respiratory system to function as an area of gas exchange and as a pump for effective ventilation. There are two types of respiratory failure and definitions are according to blood gas analysis:

- **Type I** - Low oxygen level in arterial blood (<8kPa) seen in patients with acute asthma, pneumonia.
- **Type II** - Low oxygen and high carbon dioxide levels in arterial blood (O₂ <8kPa; CO₂ >6 kPa) seen in patients with severe or moderate COPD, chest wall disease, neuro-muscular disease, severe obesity.

Despite these obvious advantages pulse oximetry is still under-used. One study conducted in primary care found that only 1.8% of all primary care referrals to A&E with an acute exacerbation of asthma had documented pulse oximetry. The study, a questionnaire survey of 103 general practices and 8 out-of-hours co-operatives found that pulse oximetry was available in only 3.9% of practices and 37.5% of out-of-hours services. The researchers studied 721 referrals from primary care of children over 12 months of age with wheeze.
and/or asthma, and identified that SpO₂ monitoring was not widely available in primary care and when available it was frequently not used for assessment of asthma. The authors recommended that SpO₂ recording could result in more targeted referrals to hospital for patients exacerbating with asthma.⁴

WHAT ARE ITS LIMITATIONS?
The pulse oximeter can be inaccurate under certain conditions (see box). A pulse oximetry reading cannot accurately predict oxygen delivery on its own. The result should be considered in the context of the background diagnosis, presenting symptoms and other investigations; in particular, the Hb and peripheral perfusion need to be considered. SpO₂ may be normal in a patient with low oxygen content due to anaemia. Cold or poorly perfused peripheries will give false readings, as will poorly positioned or dirty probes. Additionally, it is important to remember that the presence of a normal SpO₂ can occur in a patient with abnormal blood pH or CO₂ levels, as may occur in patients with Type II respiratory failure; in these situations arterial or capillary blood gas sampling and analysis are needed.

Pulse oximetry can be inaccurate in patients with:
- Poor peripheral circulation
- Excessive sweating
- The presence of carbon monoxide (may occur in smokers)
- Nail varnish/synthetic nails
- Light interference
- Motion artefact
- Abnormal haemoglobin
- Dark or jaundiced skin.

To reduce the likelihood of inaccurate readings in patients undergoing pulse oximetry, healthcare professionals should always ensure that:
- A patient’s nail varnish is removed
- A patient’s hand is warmed if cold on presentation
- The probe is correctly positioned
- The probe is clean.

EQUIPMENT AND TRAINING
All staff who use pulse oximeters must be fully trained and made aware of the limitations of oximetry. Those using the machine are responsible for ensuring that it is in good working order, stored correctly (according to manufacturers’ recommendations) and regularly serviced. Probes should be appropriate for the site of monitoring, eg finger or ear sensor, cleaned regularly and checked for obvious faults such as loose connections or loose wires. Probes are an infection control risk and it is important that cleaning procedures, according to manufacturers’ recommendations, are performed between patients. Dirty probes can also reduce the accuracy of results, because the light will not be effectively transmitted. Other risks associated with pulse oximetry include burns and pressure ulcers but this is due to prolonged use at one site and would rarely be an issue in primary care.

There are many models available for purchase currently from numerous manufacturers. Prices can vary from around £50 to £300. Sizes also vary from small pocket-sized models to bench-top displays; and a practical word of advice - smaller versions may be more likely to be ‘mislaid’! Consider the likely areas of use when choosing an instrument, with the emphasis on size, battery capability and robustness.

Documentation of the pulse oximetry test, as with all clinical procedures, is essential. This should detail the actual reading, any activity (at rest or walking), whether the patient was breathing room air or oxygen (if so what flow rate and percentage) and any other factors that may have influenced the reading (eg tremor, cold hands).

CONCLUSION
The use of pulse oximeters is becoming increasingly common in primary care settings. It has a vital role to play in the initial diagnosis, assessment and ongoing monitoring of respiratory patients with various presenting conditions, and should be considered as an objective addition to the clinical assessment. It is a useful screening tool and could potentially avoid inappropriate referrals to secondary care for assessment for LTOT. Pulse oximeters should be available in all clinical areas where acutely ill patients are managed and oxygen is given. Treatment should be based on achieving target arterial oxygen tensions and saturations rather than on giving predetermined concentrations or flow rates of inspired oxygen.

As with all equipment used in clinical areas it is essential that all healthcare staff using the device are fully trained in its use and aware of its limitations.

more information