

Opinion

Pulse Oximetry in Primary Care

Not an infallible test – use clinical judgement!

Whilst pulse oximetry is deemed to be a simple non-invasive monitoring system and has been described as the greatest advance in monitoring since the invention of the electrocardiogram,¹ it is not to be used in isolation.

It should support a comprehensive patient assessment and physical examination and aid the decision making process. Pulse oximetry has the ability rapidly to detect changes in oxygen saturation enabling practitioners to identify problems before the patient is compromised. The measurement of oxygen (O₂) saturation is endorsed in numerous guidelines to aid the assessment process and therefore, oximeters should be widely available in primary care.

Purchasing a pulse oximeter

Pulse oximeters are available, highly portable and increasingly less costly to purchase. In purchasing equipment it is worth considering what factors are important. Within primary care – especially when carried in diagnostic bags the equipment needs to be:

- Reliable
- Reproducible
- Safe
- Accurate
- Robust
- Portable
- Cost effective
- Simple to use

If considering buying pulse oximeters for a practice / community setting it may be worth discussing with colleagues using pulse oximeters regularly (especially if they use pulse oximeters in a community setting - for example respiratory nurse specialists).

How does pulse oximetry work?

The pulse oximeter calculates the amount of light of two separate wavelengths absorbed from a source in the probe when put onto a finger or toe. This reflects the red colour of arterial blood, thus producing an estimate of

oxygen saturation / desaturation in the body. This is referred to as % SpO₂.

The oximeter is designed to pick up arterial pulsed flow rather than venous flow in its estimations, and needs an arterial pulse to do this. A saturation of greater than 95% is considered normal. Indeed, oxygen saturations in the normal healthy individual are often more than 98%. In an acute situation when oxygen saturations are decreased below 92%; oxygen is given to maintain the level between 94-98%, and one should consider hospital admission. If a healthy individual during an acute episode has saturations of 93-94% this may, depending on the total clinical picture, warrant admission or earlier review.²

Use and training

Like any equipment it is important that clinicians using a pulse oximeter are able to use the equipment correctly, know when to use the equipment and know its limitations and how to interpret test results.

Most available pulse oximeters are accurate between oxygen saturations of 70–100% with a range of +/- 2%. The oximeters are calibrated during manufacture and most have an internal check system to ensure that calibration remains valid.

Limitations

There are many factors that can affect the readings displayed. It is essential practitioners are aware of the potential limitations to ensure effective management of the patient. Most errors are the result of factors that affect light transmission, perfusion or pulse detection.

There are several situations where the pulse oximeter readings may not be accurate:

- Low perfusion state which reduces peripheral pulsatile blood flow (cold digits):
 - Hypotension
 - Hypovolaemic shock
 - Cold weather / house
 - Cardiac failure

This usually results in the machine not providing a reading.

- Carbon monoxide poisoning. Carboxyhaemoglobin (haemoglobin combined with carbon monoxide) is bright red in colour therefore the oximeter will overestimate the saturation in this situation and may be falsely reassuring.
- Shivering. The background movement causes problems for oximeters which may be unable to differentiate an adequate signal from arterial pulsation.
- Nail varnish or dirt may cause falsely low readings. If a patient has nail varnish on, this should be removed (or use of appropriate digits – eg toes) where the varnish is absent.
- The evidence for change of oxygen saturation in a patient who is jaundiced³ or anaemic⁴ remains debatable (however skin colour does not produce affect readings).
- Pulse oximetry in patients with arrhythmias need to be interpreted with some caution. Pulse oximetry relies on a steady pulse signal, therefore conditions such as slow atrial fibrillation will affect the result.^{5,6}
- If patients are being assessed in an area with a high level of artificial light this can falsely reduce the readings (eg. Operating theatre fluorescent lighting)⁷
- This article is written for UK based practice however it should be remembered that at altitude oxygen saturations can drop causing altitude sickness; use of pulse oximetry at high altitude is not within the scope of this article.

Uses of pulse oximetry in respiratory problems

This section will look at the use of pulse oximetry in three areas; it is appropriate to refer to recognised national or international guidance for more comprehensive details on the individual conditions.

- Acute respiratory infection (includ-

ing community acquired pneumonia and influenza)

2. Asthma
3. Chronic Obstructive Pulmonary Disease (COPD)

Whatever the clinical circumstances, it is essential to record whether the patient was breathing room air, or receiving oxygen at the time the oxygen saturation was measured.

Pulse oximetry is equally useful in the management of children as it is in adults, and the same ranges are applicable. Many of the "adult" pulse oximeters can be used in children over the age of 2 years. Below the age of 2 years more specialised oximeters are generally preferred. There are two particular challenges with measuring oxygen saturation in young children. Firstly, they may be difficult to examine and not want to stay still whilst the oximeter reading is taken. Secondly, small digits (fingers) are more likely to have poor perfusion (see above) and a reading may not be obtainable.

In older people, and those with COPD, the normal oxygen saturation levels may be lower than in younger people.

Acute respiratory infections (including influenza and community acquired pneumonia (CAP))

The British Thoracic Society guidance on emergency oxygen suggest that pulse oximetry is the "fifth vital sign" (along with temperature, pulse, blood pressure and respiratory rate) in assessing the acutely breathless patient and it should be considered in primary care for all those with acute breathlessness.^{8,9}

One of the key considerations for hospital admission is an oxygen saturation below 92% in a previously healthy individual, especially if other clinical features that indicate severity are evident. One of the most commonly used measures in community acquired pneumonia is CRB65 – see Box 1.¹⁰⁻¹² These features enable an estimation of the risk of death from community acquired pneumonia. Patients compromised by severe influenza illness¹³ show similar features to those described in CAP.

If emergency oxygen is given it should be aimed at achieving 94–98% saturations until further assessment is available within a more specialist setting where arterial blood gases can be measured.²

Box 1. Clinical features indicating severity of condition and requirement for admission to hospital

- Pulse oximetry
- CRB65
 - Confusion (new onset)
 - Respiratory rate >30 / minute
 - Blood pressure systolic <90mmHg, diastolic <60mmHg
 - 65 years of age or older
- Score one point for each of the CRB65 components. Patients with a score of 1 or 2 may need hospital admission and those with scores of 3 or 4 need urgent hospital admission, especially if SpO₂<92%

Asthma

In addition to the usual assessments considered appropriate in asthma (history, examination, pulse, respiratory rate, peak expiratory flow rate compared to patients' best) it is important to measure oxygen saturation in an acute asthma attack or if an acute episode is suspected. If the oxygen saturation, before treatment with bronchodilators, is below 92% the patient should be considered for acute admission to hospital.¹⁴

If emergency oxygen is given, aim to keep SpO₂ levels between 94–98%, until further assessment is available within a secondary care setting.

COPD

In a routine review, a patient with moderate – severe COPD should be considered for screening pulse oximetry. A figure of 92% or less, especially if repeated on more than one occasion, should trigger referral for more comprehensive oxygen assessment.¹⁵

It is recognized that some people with hypercapnic respiratory failure will deteriorate if given high dose oxygen. In the acute situation pulse oximetry should be used to ensure that oxygen saturations are maintained between 88-92% if at risk. These patients usually have a history of significant respiratory problems and some will have an alert warning card.²

Other situations

Pulse oximetry should be used if considering oxygen administration in acute stroke and myocardial infarction – as high flow oxygen has been shown to produce vasospasm and potentially

worsen outcomes. It would appear appropriate from the guidelines to ensure that oxygen is only given if the patient is hypoxic and levels should be maintained at 94–98%.

Conclusions

Pulse oximetry is a useful non-invasive investigation that is easily performed and is reproducible in primary care.

Research findings in other settings may be applicable in primary care. The evidence for benefit is clear and it is difficult to justify failure to use pulse oximetry with the current evidence-based guidelines in influenza, community acquired pneumonia, asthma and COPD.

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