



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 important 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 to rapidly 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 is worth discussing with specialist units where pulse oximeters are used 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 absorbed from a source in the probe (of two separate wavelengths) when put onto a digit (finger / toe). This produces 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 arterial pulsed flow to do this. An SpO₂ of greater than 95% is considered normal.

Use and training

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

Many of the available pulse oximeters can be used in slightly different ways and it is important that a clinician using a pulse oximeter is aware of how to use the equipment and obtain accurate readings. 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 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 failureThis usually results in the machine not providing a reading.
- Carbon monoxide poisoning
Carboxyhaemoglobin (haemoglobin combined with carbon monoxide) is

registered as 90% oxygenated haemoglobin and 10% desaturated – therefore the oximeter will overestimate the saturation in this situation and may be falsely reassuring.

- Shivering
Can cause problems with many oximeters having problems identifying an adequate signal.
- 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 jaundiced²/anaemic³ remains debatable (however skin colour does not produce abnormal readings).
- Pulse oximetry in patients with arrhythmias need to be interpreted with some caution. Pulse oximetry is reliant on a steady pulse signal, therefore conditions such as slow atrial fibrillation will affect the result.^{4,5}
- 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)⁶
- 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 (including community acquired pneumonia and influenza)

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

In older people, and those with COPD, the normal oxygen saturation levels may be lower than 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.^{7,8}

One of the key considerations for hospital admission would be an oxygen saturation below 92% in a previously healthy individual, who is not receiving oxygen therapy, especially if other clinical features that indicate severity are evident. One of the commonest used measures in community acquired pneumonia is CRB65 – see details below.⁹⁻¹¹

Any features that are present increase the risk of death from community acquired pneumonia. Patients compromised by the severity of influenza illness¹² 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.¹³

Asthma

In addition to the usual assessments considered appropriate in asthma (history, examination, pulse, respiratory rate, peak expiratory flow rate) 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.

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%

COPD

In the chronic, non urgent situation, a patient with moderate – severe COPD should be considered for screening pulse oximetry. A figure of 92% or less should trigger referral for more comprehensive oxygen assessment.¹⁵

Hypoxic drive¹³

For a small number of patients with chronic severe lung disease their respiration is driven by oxygen rather than carbon dioxide. These patients are not always predictable but they often have severe disease and may already be on long term oxygen therapy. It is important that the oxygen given to this group of patients is controlled, since oxygen can suppress respiration and increase hypercapnia.

The earliest signs of hypercapnia are often difficult to establish (flushing, tachycardia and muscle twitching), however, as the hypercapnia progresses the patient can become rapidly disorientated and anxious. This is associated with increased respiratory rate, convulsions and unconsciousness. It is recommended that for this group of patients oxygen, if given, should be monitored to ensure that the SpO₂ range is between 88-92%.

Those who are known to be at risk should be warned and provided with appropriate alerts to warn other health care professionals.

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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