

Pulse oximetry in primary care:

primary care diagnostic technology update

Clinical Questions

- In patients with chronic obstructive pulmonary disease, is pulse oximetry effective in assessing the need for long-term oxygen therapy, compared to arterial blood gas?
- In patients with asthma, is oxygen saturation monitoring by pulse oximetry an objective measure of acute asthma severity compared to peak expiratory flow rate?
- In patients with community-acquired pneumonia does pulse oximetry accurately stratify patients requiring hospital admission compared to signs and symptoms alone?

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Submitted: 30 June 2010; **final acceptance:** 23 August 2010.

©British Journal of General Practice 2011; 61: 358–359.

DOI: 10.3399/bjgp11X572553

ADVANTAGES OVER EXISTING TECHNOLOGY

Pulse oximeters give non-invasive estimation of the arterial haemoglobin oxygen saturation. The gold standard for measurement of oxygen saturation remains arterial blood gas (ABG) analysis. However, this is invasive, painful, time consuming, costly, provides only intermittent information on patient status, and is impractical in most primary care settings.

DETAILS OF TECHNOLOGY

The pulse oximeter is a probe attached to the patient's finger that measures the differential absorption of infrared light by oxygenated and deoxygenated haemoglobin in capillaries. The display unit indicates the percentage of haemoglobin saturated with oxygen (SpO₂) together with an audible or visual signal for each pulse beat, a calculated heart rate and in some models, a graphical display of the blood flow past the probe.¹ Pulse oximeters are calibrated empirically by observations on normal volunteers. The instruments are accurate to a 2% error at oxyhaemoglobin saturations of 70–99%.² Correlation coefficients between pulse oximetry and direct blood oxygen saturation measurements are excellent, ranging from 0.77–0.99 when oxygen saturation is >60%.

PATIENT GROUP AND USE

- Managing chronic obstructive pulmonary disease (COPD) — acute exacerbations and need for long-term oxygen therapy.
- Grading the severity of an asthma attack.
- Assessing severity and oxygen requirements for patients with community-acquired pneumonia (CAP).
- Acute paediatric assessment for accurate measurement of heart rate as well as respiratory status.

IMPORTANCE

The National Institute for Health and Clinical

Excellence (NICE) COPD guideline estimates there are approximately 1.5 million patients in the UK with COPD and on average a GP's list will contain 200 patients with COPD. Asthma UK reports 5.4 million people are currently receiving treatment for asthma: 1 in 11 children (1.1 million) and 1 in 12 adults (4.3 million). CAP occurs in 5–12% of all cases of adult lower respiratory tract infection managed by GPs in the community.

Breathing difficulty is one of the common reasons for paediatric visits to primary care, out of hours, and emergency departments. Acute infections, including respiratory illness, are one of the common reasons for paediatric admission to hospital.

PREVIOUS RESEARCH

Pulse oximeters are used widely in emergency departments, anaesthesiology, and critical care.³ However, data on the role of pulse oximeters in general practice is limited. A recent survey of GPs revealed a minority (9%) reported they used a pulse oximeter to measure pulse rate, or to assess respiratory status (20%).⁴ In clinical examination, a traditional sign of hypoxia is central cyanosis. However, studies have shown clinicians have difficulty in reliably detecting hypoxaemia until the saturation is <80%.²

In terms of COPD, studies suggest that pulse oximetry is not a reliable method alone for diagnosis. COPD is currently diagnosed based on clinical features along with spirometry, where a ratio of forced expiratory volume in 1 second (FEV₁) to forced vital capacity (FVC) of less than 0.7 indicates airway obstruction. Oxygen saturations are not useful for diagnosis of COPD; saturations of <98% had sensitivity of 79%, but specificity of only 37%.⁵ However, pulse oximetry could have a valuable role in determining long-term oxygen therapy criteria in patients with COPD, and in indicating the need for referral to hospital in acute exacerbations.⁶

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What this technology adds

- This technology is relevant to the forthcoming National Clinical Strategy for COPD, improving management of acute exacerbations, and need for long-term oxygen therapy.
- Pulse oximetry could also improve assessment of severity of asthma exacerbations, and severity of CAP in adults.
- Pulse oximetry may have a role in the acute assessment of children, but its added value to existing clinical assessment is still unclear.

The 2008 British Thoracic Society (BTS) guideline on the management of asthma and the Scottish Intercollegiate Guidelines Network recommend SpO₂ monitoring by pulse oximetry as an objective measure of acute asthma severity, particularly in children, in both primary and secondary care. In children who require oxygen, pulse oximetry is recommended to determine the adequacy of oxygen therapy and the need for ABG analysis. According to these guidelines, a SpO₂ <92% is considered life threatening and these patients require an ABG measurement. What is less clear is how useful SpO₂ is compared to other measures of asthma severity in primary care, such as peak flow or clinical assessment.

Studies into the diagnosis of CAP have indicated the identification of arterial hypoxaemia has direct treatment implications, including the delivery of supplemental oxygen and hospitalisation, for more intensive clinical observation. The routine use of pulse oximetry in patients suspected of having CAP would detect clinically unrecognised hypoxaemia, thereby identifying patients requiring hospitalisation.^{7,8} A 2004 update of the BTS guideline for the management of CAP in adults recommended pulse oximetry, with appropriate training, should become increasingly available to GPs responsible for the assessment of patients in the out-of-hours setting, for assessment of severity and oxygen requirement for patients with CAP and other acute respiratory illnesses.

The extent to which SpO₂ sats provide diagnostic information that complements clinical assessment of children by GPs is not known. NICE lists SpO₂ <95% as an amber flag feature in assessing children with acute febrile illness. This guideline also recommends measuring heart rate in children with acute illness. Accurate measurement of heart rate in children is difficult using non-electronic methods; however, its added value as a vital sign in children is still unclear in primary care.

The NICE Centre for Evidence Based Purchasing recently published an evidence review, market review, and buyers' guide for pulse oximeters, providing a list of pulse oximeters with evidence of accuracy and performance.⁹

Relevant Guidelines

1. NICE clinical guideline. *Management of chronic obstructive pulmonary disease in adults in primary and secondary care*. <http://guidance.nice.org.uk/CG101> [accessed 30 Mar 2011].
2. *British Guideline on the Management of Asthma*. May 2008 (revised June 2009). *Guideline No. 10*. www.sign.ac.uk/guidelines/fulltext/101/index.html [accessed 30 Mar 2011].
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Funding

The Centre for Monitoring and Diagnosis Oxford (MaDOx) is funded by the National Institute for Health Research, UK programme grant 'Development and implementation of new diagnostic processes and technologies in primary care'.

Competing interests

The authors have declared no competing interests.

Acknowledgements

The authors would like to thank Richard Stevens and Nia Roberts for helpful discussions.

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