Pulse oximetry and the pandemic

Widespread use highlights the need for formal training in pulse oximetry

Paul Silverston, 1 Marco Ferrari, 2 Valentina Quaresima 2

At the height of the covid-19 pandemic large numbers of patients with acute respiratory symptoms needed to be assessed, triaged, and monitored to identify those requiring admission to hospital and those who could be managed with medical supervision at home. Presence of hypoxaemia is one of the criteria used during this decision making process.

The ability of pulse oximeters to detect and quantify hypoxaemia led to pulse oximetry featuring prominently in guidelines for the assessment and management of patients with covid-19, especially after reports that some patients develop "silent" hypoxaemia. 2 However, the increased use of pulse oximetry in clinical decision making reawakened longstanding concerns about its role in clinical assessment. In response to these concerns, the UK’s Medicines and Healthcare Products Regulatory Agency (MHRA) and the US Food and Drug Administration (FDA) issued patient safety alerts on the accuracy of pulse oximeters, the limitations of pulse oximetry, and the interpretation of oxygen saturation readings. 3 4

The accuracy of a pulse oximeter is determined by comparing its reading (SpO2) with the arterial blood gas value (SaO2). Pulse oximeters certified for medical use are required to be accurate to within 2-3% (FDA) or 4% (MHRA) of the SaO2 value, across a range of readings between 70% and 100%. However, it is important to be aware that testing is performed under laboratory, not clinical, conditions and that 66% of readings are within 2-3% and 95% within 4-6% of the SaO2. 4 This led the FDA to state that, for a SpO2 reading of 90%, the SaO2 will generally be between 86 and 94%. 4 Both the MHRA and FDA have advised that SpO2 readings should be regarded as an “estimate” of the SaO2, adding that clinical decisions should be based on trends in readings rather than on individual readings. Accuracy is important because inaccurate readings create the potential for hypoxaemia to be missed or underestimated. Furthermore, it emphasises the need to understand pulse oximetry, in terms of the physiological difference between pulse oximeter and arterial blood gas readings and the potential pitfalls in using pulse oximetry for spot assessment rather than for continuous monitoring.

Clinical interpretation

Accuracy can be affected by technical, physiological, and pathological factors, including the quality of hardware and software used in pulse oximeters, the sampling technique, the quantity and quality of the person’s circulating haemoglobin, their peripheral perfusion, and skin colour. 5 10 Accuracy is highest for readings of 90-100% but decreases as readings approach 90%—the point at which many critical clinical decisions are made. Clinicians should be aware of these factors when interpreting SpO2 readings.

Pulse oximeters identify hypoxaemia not its cause. Correct identification of the cause requires clinicians to interpret readings within the context of a patient’s symptoms and other clinical findings. 11 For example, a fall in SpO2 from 98% to 95% in someone with covid-19 could be due to the infection (requiring no further action) or to a pulmonary embolus or a secondary bacterial chest infection, both of which require urgent intervention. Additional clinical information is essential to avoid potentially harmful misinterpretation of oximetry readings. 12 Correct interpretation also requires clinicians to account for factors such as smoking or longstanding respiratory disease that could influence the accuracy of pulse oximetry readings. 13 14

The FDA summarised the situation as follows: “Pulse oximeters have limitations and a risk of inaccuracy under certain circumstances. In many cases, the level of inaccuracy may be small and not clinically meaningful; however, there is a risk that an inaccurate measurement may result in unrecognised low oxygen saturation levels. Therefore, it is important to understand the limitations of pulse oximetry and how accuracy is calculated and interpreted.” 14

Evidence suggests, however, that many clinicians have received little, if any, formal training in pulse oximetry and may therefore be unaware of the many factors that affect accuracy and interpretation of readings. 15 16 Given the increasing use of pulse oximetry by both clinicians and patients, we need further studies to determine clinicians’ understanding of pulse oximetry. 10

Training in pulse oximetry is as important as training in electrocardiography, so it should be included in undergraduate and postgraduate curriculums. In addition, the NHS should commission an online training programme that all clinicians can access through e-learning platforms. The pandemic is a further reminder that, when using pulse oximetry, patient safety depends on clinicians being able to interpret SpO2 readings correctly.

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1 Faculty of Health, Education, Medicine and Social Care, Anglia Ruskin University, Cambridge, UK
2 Department of Life, Health and Environmental Science, University of L’Aquila, L’Aquila, Italy

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