



## Rapid summary: Oximetry to guide COVID-19 management

Rapid summaries are designed to provide evidence-based answers to a question about a health technology. They may also highlight gaps and uncertainties in the existing evidence. They aim to provide a balanced overview of the evidence base, but are not underpinned by exhaustive literature searches due to the short timescales in which they are produced.

Question:	What is the effectiveness of home monitoring using oximetry in people with COVID-19 symptoms to guide future management, and what guidelines exist on its use?
Summary of findings:	<p>Recently published UK and international guidance recommends the use of oximetry to help manage COVID-19, including in the home setting. NHS England guidance provides principles for the monitoring of patients with COVID-19 at home using oximetry to identify 'silent hypoxia' and rapid patient deterioration. In addition, it details the subsequent management which should be considered at different O<sub>2</sub> saturation thresholds.</p> <p>Several systematic reviews and other reviews identify that there is a paucity of evidence for home oximetry for people with confirmed or suspected COVID-19. Some systematic reviews conclude that smartphone applications should not be used as oximeters due to a lack of evidence on their effectiveness.</p> <p>While there are no primary studies on the clinical effectiveness of home oximetry to monitor people with confirmed or suspected COVID-19, there are four directly applicable ongoing studies. One study was completed on 22<sup>nd</sup> April 2020, while a second was completed on 18th May 2020. The remaining two studies have estimated dates of completion of April and December 2020.</p>
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## The health problem/intervention

### Introduction

During the novel coronavirus (COVID-19) pandemic, pathways have emerged for managing patients at home or in the community, with an aim of limiting the spread of the virus and prioritising health care resources (Greenhalgh & Choon Huat Koh 2020). While people experiencing acute respiratory failure generally have an increased respiratory rate, in some hypoxic people with COVID-19 a normal respiratory rate has been observed, which has been termed 'silent hypoxia' (Jouffroy et al 2020). Silent hypoxia may contribute to delays in people seeking appropriate care. Pulse oximetry to monitor people with COVID-19 in the home and community settings may be effective in detecting people with silent hypoxia earlier, and guiding subsequent management such as hospital admission or palliative care (Jouffroy et al 2020). A pulse oximeter is a non-invasive device which uses the absorbance of different wavelengths of light to measure peripheral oxygen saturation of haemoglobin in the blood, expressed as a percentage (SpO<sub>2</sub>).

### Scope of report

Health Technology Wales researchers searched for guidelines and evidence on the use of oximetry in the home and community settings to determine subsequent management of people with suspected or confirmed COVID-19. As we were interested in the use of oximetry to monitor people with COVID-19 in the community, studies in the hospital and intensive care settings were not considered. In addition, studies describing the association between physiological parameters (SpO<sub>2</sub>) and outcomes such as mortality and length of stay were not considered.

## Evidence overview

### 1. Secondary evidence

#### Published UK guidance

The NICE COVID-19 rapid guideline on managing symptoms (including at the end of life) in the community, published on 30<sup>th</sup> April 2020, considers that people with severe symptoms may deteriorate rapidly and need urgent hospital admission. It also cross-refers to the NICE COVID-19 rapid guideline on managing suspected or confirmed pneumonia in adults in the community. This guideline recommends that where pulse oximetry is available, oxygen saturation levels below 92% (below 88% in people with COPD) on room air at rest should be used to identify people with serious illness.

The NHS England guidance on the use of pulse oximetry to detect early deterioration of patients with COVID-19 in primary and community care settings (published 11<sup>th</sup> June 2020; updated 15<sup>th</sup> June 2020) sets out principles to support the remote monitoring, using pulse oximetry, of patients with confirmed or possible COVID-19. The guidance states that "Patients most at risk of poor outcomes are best identified by oxygen levels. The use of oximetry to monitor and identify 'silent hypoxia' and rapid patient deterioration at home is recommended for this group." When an assessment using pulse oximetry is planned, at the discretion of a clinician, ambulatory patients should be assessed on site or pulse oximeters should be delivered to patients who are housebound or shielding. The patient should then supply their oxygen saturation readings, with the frequency of follow-up (and use of a diary) at the discretion of the clinician.

The Adult primary care COVID-19 assessment pathway within the NHS England guidance states that a clinician decides during telephone/video triage if and when oximetry would be helpful. The assessment pathway also suggests the following clinical criteria for determining subsequent management at different O<sub>2</sub> saturations:

- O<sub>2</sub> 92%\* or lower (or ≤84% if baseline saturation is 83%): Face to face or virtual assessments should be conducted and urgent admission should be considered
- O<sub>2</sub> 93%-94% (or 84-85% if baseline saturation is 83%): Hospital admission/assessment should be considered
- O<sub>2</sub> 95% or higher (or 86% if baseline saturation is 88%): Continued monitoring should be considered

National Supporting Guidance for Scottish General Practice, published 17<sup>th</sup> March 2020, advises that during telephone and 'NHS Near Me' consultations, general practitioners (GPs) should remember that some patients have blood pressure machines and pulse oximeters at home and to ask patients what is normal for them. The guidance does not provide a threshold for SpO<sub>2</sub> at which there would be change in patient management, such as hospitalisation.

The British Geriatrics Society published guidance on the management of COVID-19 in care homes for older people on 30<sup>th</sup> March 2020. The guidance states that "where possible, care home staff should be trained to measure... pulse oximetry... this will enable external healthcare practitioners to triage and prioritise support of residents according to need". The guidance describes pulse oximetry as a useful adjunct in this setting and that care homes without the required equipment should be provided with or consider purchasing equipment, at an approximate cost of £75-£100.

The British Medical Journal published an article which provides 'guiding principles' on the remote assessment of COVID-19 in primary care, though the article states that remote triage is not covered. The article notes that on rare occasions, patients may own home oximeters, and cautions that if recording a reading made by a patient, GPs should note their confidence in the accuracy of the reading especially if it does not align with the wider assessment.

### **Published international guidance**

The World Health Organization (WHO) published interim guidance on the clinical management of severe acute respiratory infection when COVID-19 disease is suspected on 13<sup>th</sup> March 2020. The guidance does not refer to oximetry, but states that patients cared for outside hospital (at home or in non-traditional settings) should be instructed to manage themselves appropriately... and return to a designated COVID-19 hospital if they get worse. The COVID-19 adaptation of the WHO toolkit for the clinical care for severe acute respiratory infection (intended for low- and middle-income countries) states that "pulse oximetry is essential at all health facilities to assess patients at first point of contact, to conduct triage and inform referral". The toolkit does not mention oximetry in the home setting.

ECRI published an 'ECRI Exclusive Hazard Report (High Priority)' which includes recommendations on consumer-grade pulse oximeters for home use in people with COVID-19 on 4<sup>th</sup> June 2020. ECRI reference that the American Lung Association and the American Thoracic Association are advising that otherwise healthy people should not buy a pulse oximeter. ECRI therefore recommends to 'consider whether the patient truly needs a home pulse oximeter device'. If prescribing the use of such a device, ECRI recommends that appropriate directions should be given to patients on how and when they should use the device and at what SpO<sub>2</sub> threshold to contact the physician, as defined by the facility or care team. Further details are

supplied on how to get the best readings, such as proper attachment of the sensor. ECRI provides detailed recommends for facilities or patients considering purchasing an oximeter, such as 'consider whether the pulse oximeter complies with ISO 80601-261:2011 or equivalent standard'.

The Centre for Evidence-Based Practice at the Penn Medicine Centre produced rapid guidance summaries on hospitalisation triage during the COVID-19 pandemic. The policy in a Cleveland hospital is that patients should be transferred to the emergency department if the patient has abnormal vital signs (e.g. pulse oximetry < 93%). A second rapid guidance summary gives an overview of professional society and public health agency guidelines on discharge criteria. The rapid guidance summary includes the American College of Emergency Physicians COVID-19 Field Guide (April 2020), which states that patients may be safe to discharge if oxygen saturation measured using pulse oximetry does not fall more than 3% between walking and resting. Further, it states that people with COVID-19 may be discharged with a pulse oximeter and instructed to perform a daily walking test and return to the hospital if the 'walking' measurement falls more than 3% below resting level. The field guide notes that the discharge criteria were based on an interview with an Italian emergency physician and should be applied with clinical judgement, taking the capacity of the health care system into consideration.

Guidance on the management of Ambulatory Heart Failure Patients from the Canadian Cardiovascular Society COVID-19 rapid response team notes that "Home-based blood pressure and heart rate monitors including oximetry from personal devices cannot reliably differentiate between COVID-19 and HF."

The American College of Obstetricians and Gynecologists published guidance for the outpatient assessment and management of pregnant women with suspected or confirmed COVID-19. The guidance stipulates that when someone is assessed as moderate risk following assessment of severity of symptoms and clinical and social risk, the patient should be seen as soon as possible in an ambulatory setting where tests such as pulse oximetry should be conducted.

### **Systematic reviews and reviews**

The Oxford COVID-19 Evidence Service has produced several relevant rapid evidence reviews. Their rapid evidence review on smartphone apps used as oximeters concludes that "there is no evidence that any smartphone technology is accurate for the measurement of blood oxygen saturation for clinical use. Furthermore, the scientific basis of such technologies is questionable. Oxygen saturation levels obtained from such technologies should not be trusted in the clinical assessment of patients". Healthcare Improvement Scotland and SIGN conducted an evidence review on the assessment of COVID-19 in primary care. The review also concluded that smartphone apps should not be used as oximeters.

The Oxford COVID-19 Evidence Service rapid evidence reviews on the rapid diagnosis of community acquired pneumonia for clinicians and the rapid management of pneumonia in older people during a pandemic each note that pulse oximeters are a key piece of equipment.

A further rapid review by the Oxford COVID-19 Evidence Service on the evidence base for assessing dyspnoea breathlessness by telephone or video notes that oximetry devices supplied to patients have not yet been evaluated in a primary care setting, but have been commonly applied in respiratory medicine.

One review from the National Institute of Health Research (NIHR) and the University of Bristol considered the accuracy of self-monitoring of heart rate, respiratory rate and oxygen saturation in people with suspected COVID-19. The review found two studies, (n=101, n=15) which assessed

oxygen saturation measurement using smartphone apps. The studies were not in the COVID-19 population, but reported good correlation between smartphone apps and arterial blood gas devices for the measurement of oxygen saturation. The first study reported a correlation of 0.97 (95% confidence interval 0.95 to 0.98) for the Samsung Health application on the Samsung Galaxy S8 smartphone, and a worse performance in people with hypoxia. The second study considered the Kenek O<sub>2</sub> oximeter and found that measurements were valid at rest in people with chronic lung disease but not during exercise. The NIHR review referenced the conclusion of the rapid review by the Oxford COVID-19 Evidence Service on smartphone apps as oximeters, that the scientific basis of the use of smartphone apps for measuring oxygen saturation is questionable.

A COVID-19 rapid review by GoMainpro, Alberta College of Family Physicians, considered whether there are techniques available to supplement a typical history when assessing dyspnoea/pneumonia over the phone or via video. The review included a study which compared the ROTH score with pulse oximetry. However, the review found that no studies have evaluated dyspnoea assessment in COVID-19 patients.

One review (Couzin-Frankel, 2020) discusses COVID-19 and 'silent hypoxia'. It notes that there are no studies on whether early detection of hypoxia improves patient outcomes.

One review (Luks & Swenson, 2020) considered different types of pulse oximetry devices for monitoring people with COVID-19, accuracy data for the devices and the possible disadvantages. The review found that "data on the accuracy of inexpensive pulse oximeters is limited for both stand-alone finger (i.e. "pocket") oximeters and the phone-based products". The review did not identify any studies in people with COVID-19.

## **2. Primary studies**

Salisbury (2020) describes the introduction of a system in a GP practice to proactively contact patients at 24 hour or 48 hour intervals, and an attempt to source more oximeters which might then be given to patients for home monitoring. Salisbury notes that questions remain regarding decontamination.

A case report by Wilkerson et al, 2020 denotes how a patient died after presenting to the emergency department with minimal symptoms, but with low oxygen saturation. The authors discuss how self-monitoring of pulse oximetry by patients discharged from the emergency department might identify patients needing to return.

### **Gaps in the evidence**

We did not identify any primary studies which considered the effectiveness of pulse oximetry in the home setting for people with confirmed or suspected COVID-19.

### **Ongoing trials**

We identified four ongoing studies:

- [NCT04373161](#) Home Pulse Oximeter Use in Patients with COVID-19. This single arm study will investigate monitoring (three times daily, for seven days) with a portable, fingertip pulse oximeter to take home. Patients with non-severe COVID-19 who are discharged to home from an emergency department or outpatient testing centre will be instructed to return to the emergency department for sustained oxygen <92% or for worsening symptoms. The primary outcome of the study is the relative risk of hospitalisation. The study was completed on 22<sup>nd</sup> April, 2020.
- [NCT04350476](#) COVID-19 Remote Monitoring. This single arm study will assess remote cardiac and vital sign monitoring using the VitalConnect Vital Sign Patch in people with COVID-19 in the outpatient setting. The patch provides continuous real-time monitoring of cardiac telemetry, heart rate, respiratory rate and oxygen saturation. The study population includes those previously evaluated at Mount Sinai



Hospital/Mount Sinai Health System (MSHS) and affiliated hospitals deemed appropriate for home monitoring. Patients will be monitored remotely in the outpatient setting for 1-3 weeks following diagnosis and/or treatment for COVID-19. The estimated date for completion of the study was April 2020.

- [NCT04423289](#) Telematic Monitoring Through a Mobile Application of Patients with COVID-19. This open-label randomized clinical trial will compare the effect of telematic monitoring through a mobile app with the regular primary care setting (monitoring with phone calls) on the need for re-consultation after discharge in people with COVID-19. The mobile application is the Farmalarm app. The application's software offers modifiable parameters so was adapted for COVID-19 monitoring. Patients are provided with 'SMART PULSE OXIMETER OL-750' and are instructed to take measurements at least twice per day (over a two-week follow-up period). The study was completed on 18<sup>th</sup> May 2020.
- [NCT04383457](#) COVID-19 Triage Using Camera-Based AI. This prospective cohort study aims to evaluate a new method for rapid camera-based non-contact measurement of five vital signs; body temperature, heart rate, blood oxygen saturation, respiratory rate, and blood pressure. In the study, the results from the new camera-based measurement of vital sign and the outcome of the AIs risk prediction will not determine the care received by the patient. The estimated date for completion of the study is December 2020.

## Key references and resources

### Introduction

- Jouffroy, R, Jost, D, Prunet, B, 8 June 2020. Prehospital Pulse Oximetry: A Red Flag for Early Detection of Silent Hypoxemia in COVID-19 Patients. Crit Care. 2020 Jun 8;24(1):313. doi: 10.1186/s13054-020-03036-9.

### Guidelines and guidance

- National Institute of Health and Care Excellence, 2020. COVID-19 rapid guideline: managing symptoms (including at the end of life) in the community. NICE guideline [NG163] Published date: 03 April 2020. Last updated: 30 April 2020. <https://www.nice.org.uk/guidance/ng163>
- National Institute of Health and Care Excellence, 2020. COVID-19 rapid guideline: managing suspected or confirmed pneumonia in adults in the community. NICE guideline [NG165] Published date: 3 April 2020. Last updated 23 April 2020. <https://www.nice.org.uk/guidance/ng165>
- National Institute of Health and Care Excellence, 2020. Pulse oximetry to detect early deterioration of patients with COVID-19 in primary and community care settings. Version 1. Published date: 11 June 2020 <https://www.england.nhs.uk/coronavirus/publication/pulse-oximetry-to-detect-early-deterioration-of-patients-with-covid-19-in-primary-and-community-care-settings/>
- The Scottish Government, Community Health & Social Care Directorate Primary Care Division, 2020. Covid-19: National supporting guidance for Scottish General Practice. Covid-19 Ad hoc guidelines. <https://www.rcgp.org.uk/-/media/Files/Policy/A-Z->

[policy/2020/covid19/RCGP-national-covid-19-supporting-guidance-for-scottish-general-practice-march-2020.ashx?la=en%20](https://www.rcgp.org.uk/policy/2020/covid19/RCGP-national-covid-19-supporting-guidance-for-scottish-general-practice-march-2020.ashx?la=en%20)

- British Geriatrics Society, 30 March 2020 (updated 02 June 2020). COVID-19: Managing the COVID-19 pandemic in care homes for older people. <https://www.bgs.org.uk/resources/covid-19-managing-the-covid-19-pandemic-in-care-homes>
- Greenhalgh, T and Choon Huat Koh, G, 25 March 2020. Covid-19: a remote assessment in primary care. British Medical Journal. <https://www.bmj.com/content/368/bmj.m1182>
- World Health Organization, 13 March 2020. Clinical management of severe acute respiratory infection when COVID-19 is suspected. Interim Guidance. WHO Coronavirus disease (COVID-19) Pandemic. <https://apps.who.int/iris/rest/bitstreams/1272156/retrieve>
- World Health Organization, 2020. Clinical care for severe acute respiratory infection: toolkit. COVID-19 adaptation. Geneva: World Health Organization; 2020 (WHO/2019-nCoV/SARI\_toolkit/2020.1). Licence: CC BY-NC-SA 3.0 IGO. <https://apps.who.int/iris/rest/bitstreams/1274629/retrieve>
- ECRI, 05 June 2020. [High Priority ] - H0619: [COVID-19] Home-Use SpO2: Considerations before Prescribing or Using Consumer-Grade Pulse Oximeters in the Home Care Environment [ECRI Exclusive Hazard Report] Medical Device Hazard Report. Printed from Health Devices Alerts on Friday, June 5, 2020 Page 1 [https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-19\\_Alert\\_Home-Use-SpO2.pdf](https://assets.ecri.org/PDF/COVID-19-Resource-Center/COVID-19-Clinical-Care/COVID-19_Alert_Home-Use-SpO2.pdf)
- Penn Medicine Center for Evidence-based Practice, 29 March 2020. COVID-19: SURGE TRIAGE FOR SUSPECTED INFLUENZA-LIKE ILLNESS [http://www.uphs.upenn.edu/cep/COVID/ILI%20clinic%20guidance%20329%20\(1\).pdf](http://www.uphs.upenn.edu/cep/COVID/ILI%20clinic%20guidance%20329%20(1).pdf)
- Penn Medicine Center for Evidence-based Practice, 15 April 2020. COVID-19: CRITERIA FOR DISCHARGING PATIENTS FROM INPATIENT CARE <http://www.uphs.upenn.edu/cep/COVID/Inpatient%20discharge%20criteria%20update%20415.pdf>
- Canadian Cardiovascular Society COVID-19 Rapid Response Team, 2020. Is it COVID-19 or Is it Heart Failure? Management of Ambulatory Heart Failure Patients. [http://www.ccs.ca/images/Images\\_2020/COVID\\_or\\_HF\\_RRT\\_doc\\_01Apr.pdf](http://www.ccs.ca/images/Images_2020/COVID_or_HF_RRT_doc_01Apr.pdf)
- The American College of Obstetricians and Gynecologists, 2020. Outpatient Assessment and Management for Pregnant Women With Suspected or Confirmed Novel Coronavirus (COVID-19) <https://www.acog.org/-/media/project/acog/acogorg/files/pdfs/clinical-guidance/practice-advisory/covid-19-algorithm.pdf>

#### Systematic reviews/reviews

- Oxford COVID-19 Evidence Service, 2020. Should smartphone apps be used as oximeters? Answer: No. <https://www.cebm.net/covid-19/question-should-smartphone-apps-be-used-as-oximeters-answer-no/>
- Healthcare Improvement Scotland and SIGN, 07 May 2020. Evidence Review: Assessment of COVID-19 in primary care: the identification of symptoms, signs, characteristics, comorbidities and clinical signs in adults which may indicate a higher risk of progression to severe disease. [https://www.sign.ac.uk/assets/covid19\\_assessment\\_of\\_covid19\\_in\\_primary\\_care.pdf](https://www.sign.ac.uk/assets/covid19_assessment_of_covid19_in_primary_care.pdf)
- Oxford COVID-19 Evidence Service, 2020. Rapid diagnosis strategy of community-acquired pneumonia for clinicians <https://www.cebm.net/covid-19/rapid-diagnosis-of-community-acquired-pneumonia-for-clinicians/>

- Oxford COVID-19 Evidence Service, 2020. COVID-19: Rapidly managing pneumonia in older people during a pandemic. <https://www.cebm.net/covid-19/rapidly-managing-pneumonia-in-older-people-during-a-pandemic/>
- Oxford COVID-19 Evidence Service, 2020. COVID-19: Are there any evidence-based ways of assessing dyspnoea (breathlessness) by telephone or video? <https://www.cebm.net/covid-19/are-there-any-evidence-based-ways-of-assessing-dyspnoea-breathlessness-by-telephone-or-video/>
- Whiting, P and Elwenspoek, M (NIHR and University of Bristol), 2 April 2020. Accuracy of self-monitoring heart rate, respiratory rate and oxygen saturation in patients with symptoms suggestive of COVID infection. [https://arc-w.nihr.ac.uk/WordPress/wp-content/uploads/2020/04/BNSSG-COV.10-COVID-19-report-1\\_4\\_2020\\_-1-1.pdf](https://arc-w.nihr.ac.uk/WordPress/wp-content/uploads/2020/04/BNSSG-COV.10-COVID-19-report-1_4_2020_-1-1.pdf)
- GoMainPro Alberta College of Family Physicians (ACFP), 2020. Are there tools to help assess dyspnea virtually? [https://gomainpro.ca/wp-content/uploads/tools-for-practice/1588106260\\_tfp260-covidadvrevised.pdf](https://gomainpro.ca/wp-content/uploads/tools-for-practice/1588106260_tfp260-covidadvrevised.pdf)
- Couzin-Frankel, J, 2020. The mystery of the pandemic's 'happy hypoxia'. Science; Volume 368; Issue 6490; 455-456
- Luks A M and Swenson, E R, 10 June 2020. Pulse Oximetry for Monitoring Patients With COVID-19 at Home: Potential Pitfalls and Practical Guidance Ann Am Thorac Soc. doi: 10.1513/AnnalsATS.202005-418FR. Online ahead of print.

#### Primary studies

- Salisbury, H, 2020. Planning for the peak. British Medical Journal. Volume 369; Issue 1408; ISSN 0959-8146 1756-1833; DOI <http://dx.doi.org/10.1136/bmj.m1408>;
- Wilkerson, R. G. Adler, J. D. Shah, N. G. Brown, R., 2020. Silent hypoxia: A harbinger of clinical deterioration in patients with COVID-19. American Journal of Emergency Medicine. Volume 22. 22. ISSN 1532-8171. DOI <https://dx.doi.org/10.1016/j.ajem.2020.05.044>

#### Ongoing studies

- [NCT04373161](#) Home Pulse Oximeter Use in Patients with COVID-19.
- [NCT04350476](#) COVID-19 Remote Monitoring.
- [NCT04423289](#) Telematic Monitoring Through a Mobile Application of Patients with COVID-19.
- [NCT04383457](#) COVID-19 Triage Using Camera-Based AI.

*For any non-medicine technology where more detailed guidance is needed on clinical and cost effectiveness, HTW can consider this for fuller assessment underpinned by a rapid health technology assessment. Requests for technologies on which such guidance would be useful can be submitted to HTW here: <https://www.healthtechnology.wales/suggest-a-topic/>*