

# More health inequality: Black people are 3 times more likely to experience pulse oximeter errors

18 January 2021, by Thomas Valley, Michael Sjoding and Susan Dorr Goold



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During the COVID-19 pandemic, many people have purchased small devices called [pulse oximeters](#) for use in their home—based on well-intentioned recommendations from health care providers and the media. Pulse oximeters are devices, usually placed on a person's finger, used to noninvasively measure oxygen levels in the blood. Clinics and hospitals, for example, use them regularly to screen newborns for heart defects after birth.

Yet pulse oximeter measurements are imperfect, particularly for Black patients. Our recent paper demonstrated that Black patients were [three times more likely](#) than white patients to have low [oxygen levels](#) that were missed by pulse oximeters. That could translate into as many as 1 in 10 inaccurate readings among Blacks.

We are [ICU physicians](#) and [internists](#) with expertise in health care research and policy. Our findings were guided by our [personal experiences](#) engaging with communities of color during the pandemic and seeing firsthand how easy it is for racial bias to affect health care.

## Of oxygen and oximetry

Low blood [oxygen](#) levels are harmful to patients and can indicate that they are seriously ill. Clinicians frequently use pulse oximetry measurements to decide whether a patient should receive oxygen therapy and how much oxygen a patient should receive. Health care workers may also use this information when deciding what type of care a patient needs, such as admission to a hospital, transfer to an intensive care unit or need for a ventilator.

Pulse oximeters came on the market in the late 1970s and seemed to meet the need for an accurate measure of oxygen levels.

[Pulse oximeters](#) use light that passes through the skin to measure oxygen levels. Blood with higher oxygen levels absorbs light differently than blood with lower oxygen levels. However, anything that slows the passage of this light, like nail polish or skin tone, can cause inaccuracies. Early in the COVID-19 pandemic we started to recognize that these measurements seemed to be inaccurate for Black patients. Our study confirmed those suspicions, for example finding that sometimes when a pulse oximeter read 94%, the actual blood level of oxygen was much lower.

A normal oxygen saturation is above 92%. Oxygen therapy is typically started when oxygen levels are consistently below 89%. In our study, we identified patients who had normal oxygen levels by pulse

oximetry (between 92% and 96%) but low oxygen levels by blood oxygen testing (less than 89%).

If [low oxygen levels](#) in Black patients are missed because of inaccurate pulse oximeter readings, Black patients may be less likely to receive appropriate oxygen therapy or other [medical care](#) when they need it. Some people with COVID-19 infection were encouraged to purchase pulse oximeters to monitor their oxygen levels at home as a tool to decide whether hospitalization was needed. These inexpensive home pulse oximeters [may be even less accurate](#) than the hospital pulse oximeters used in our study.

The extent to which biased pulse oximeters [may have delayed appropriate treatment](#) for Black patients is unknown. It is also unclear just how these inaccuracies might affect other [medical conditions](#) where [racial disparities in medical care](#) have been previously identified.

### **The importance of accurate oxygen measurements**

The [first pulse oximeter](#) was developed in 1974. However, because early designers did not use a diverse group of test subjects, sources of error, like skin tone, were underrecognized. Today's pulse oximeters might be better than the ones from the 1970s—the FDA requires all medical technology to be tested on a diverse population of patients, based on age, gender and skin tone. However, the agency defines skin tone diversity by having [at least two "darkly pigmented" individuals](#) in the entire testing sample. Our study shows today's pulse oximeters are still not good enough and that the agency's guidelines for diverse testing remain insufficient.

A study from [the late 1980s](#) began to show that pulse oximeters might be inaccurate based on skin tone, and a [series of publications](#) in the 1990s seemed to confirm these findings. Yet 40 years later, these findings have not been widely publicized, were not thoroughly investigated with additional clinical studies and are not routinely a part of medical school curricula at this time.

### **How to close the gap**

Pulse oximetry will remain an important tool for clinicians, and our findings highlight the need to consider pulse oximetry data in the context of other information related to the patient.

However, there are no other straightforward and noninvasive ways to estimate oxygen levels. Feeling short of breath [poorly correlates](#) with oxygen levels; skin findings, such as [cyanosis](#), may be more difficult to identify in individuals with darker skin tones; and using other locations of the body to measure oxygen levels noninvasively ([like the ear](#)) may not produce more accurate results than the finger.

An alternative strategy might be to perform more invasive measurements of oxygen level, such as sampling arterial blood. However, arterial blood draws are painful and [can lead to complications](#). They are also inconvenient and require specialized training. Requiring arterial blood for accurate measurements in Black patients but not white patients simply propagates a different form of racial bias.

Medical technology developers should increase the number and diversity of test subjects, with device performance compared across groups to ensure the equity of their accuracy. In addition, prior testing was conducted only among healthy subjects, and our study suggests inaccuracies may be more prominent as oxygen levels decrease. Diversity, in this case, should include a range of patients, based on age, gender, [skin tone](#), and disability.

Our recent conversations with device manufacturers suggest that engineering solutions may already be available. However, once new technologies are available, replacing legacy pulse oximeters with more accurate devices will be difficult, given the ubiquity of existing [pulse oximeters](#) and the expense associated with purchasing new devices. Health care providers and patient advocacy groups will need to demand updated technology when it becomes available. Recognizing this now may lead to improvements in [medical technology](#), better medical care for Black patients, and greater recognition of [structural racism within medicine](#).

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