

Press Release

News from: Light and Health Research Center
Icahn School of Medicine at Mount Sinai

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Scientists Reveal Cause of Skin-Color Bias in Pulse Oximetry

Light and Health Research Center scientists have discovered that the recently identified melanin bias in pulse oximetry can be explained by the spectral properties of the LED light sources used in commercial pulse oximeters. The results of this research have just been published in the [*British Journal of Anaesthesia*](#), an editorially independent journal affiliated with The Royal College of Anaesthetists, The College of Anaesthesiologists of Ireland, and The Hong Kong College of Anaesthesiologists.

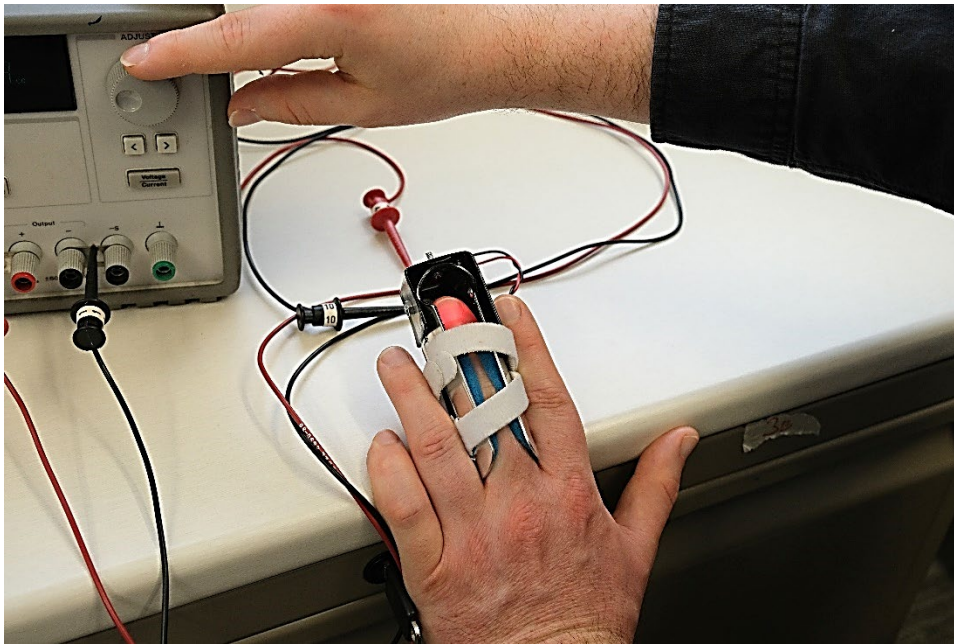
In pulse oximetry, one or more light sources are directed at living vascular tissue to detect the ratio of oxygenated to deoxygenated hemoglobin in arterial blood flow. Under a condition of low blood oxygen levels known as hypoxemia, which can accompany serious medical conditions (like COVID-19) and serves as a criterion for clinical intervention, the relative concentrations of oxygenated hemoglobin decrease and deoxygenated hemoglobin increase. Fingertip pulse oximeters are known to systematically overestimate oxygen saturation among individuals with dark skin compared to those with light skin. In clinical terms, this can mean that patients with dark skin are less likely to be diagnosed with hypoxemia and therefore less likely to receive treatment for compromised respiratory function.

In a controlled laboratory experiment, 33 subjects (14 self-identifying as White, 14 as Black, and 5 as neither Black nor White) were connected to a reduced oxygen breathing device that was programmed to step the subject through a series of progressively lower concentrations of oxygen in the air supplied through a mask. The subject's oxygen saturation levels were measured using the breathing device's pulse oximetry probe on the subject's right index finger and a custom-built probe designed by the researchers on the subject's right middle finger. The new pulse oximetry method developed for the study, called *spectrally resolved photoplethysmography*, was used to examine how a light source's spectral bandwidth affects the transmission of polychromatic light through the human fingertip across the cardiac cycle.

The cause of pulse oximetry's skin-color bias had not been conclusively resolved prior to this study, and prevailing clinical opinion held that faulty device calibration methods employed by manufacturers and regulators lay behind the bias. Light and Health Research Center scientists concluded that the culprit is the light sources employed in the devices themselves, and that changing calibration protocols would only shift the bias, not solve the problem.

“In short,” primary author Mark S. Rea noted, “the skin pigmentation bias can only be eliminated by narrowing the spectral bandwidth of the light sources used in pulse oximetry.”

[Mark S. Rea, PhD](#), Professor in the Department of Population Health Science and Policy at the Icahn School of Medicine, led the research effort with funding provided by the National Institute for Occupational Safety and Health (5R01EB033799).



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