

LETTER TO THE EDITOR

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# Pulse oximetry, racial bias and statistical bias: further improvements of pulse oximetry are necessary

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We read with great interest the review by Tobin and Jubran [1]. We strongly agree about the urgent need to correct racial bias due to the negative impact of dark skin pigmentation on the accuracy of pulse oximetry, and the necessity to introduce new international medical standards. In contrast to pulse oximetry, the influence of melanin absorption in the epidermal layer is already corrected in transcutaneous bilirubinometry, a widely used screening method, based on multi-wavelength optical spectroscopy, employed to diagnose of neonatal hyperbilirubinemia [2]. Unfortunately, pulse oximetry devices without melanin correction, and having additional technical limitations, are widely in use in many countries during the current COVID-19 pandemic [3, 4]. Therefore, there is an urgent need that manufacturers would replace conventional two-wavelengths finger pulse oximeters with multi-wavelength systems implemented for melanin absorption correction. High-cost multi-wavelength finger pulse oximeters, named pulse CO-oximeters, capable of estimating blood levels of carboxyhemoglobin and methemoglobin, are already commercially available. The significance of methemoglobinemia has been reported for COVID-19 patients [5]. The introduction of low-cost multi-wavelength finger pulse oximeters with melanin correction is urgently necessary. Furthermore, manufacturers of pulse oximeters should be forced to release

the calibration algorithm and calibration data employed in their instruments so that the public and the medical community using these devices are aware of the possible bias introduced by calibration algorithm and data.

#### Acknowledgements

Not applicable.

#### Authors' contributions

All authors contributed equally to the drafting of the manuscript and provided critical revision for important intellectual content. All authors read and approved the final manuscript.

#### Funding

None.

#### Availability of data and materials

Not applicable.

#### Declarations

#### Ethics approval and consent to participate

Not applicable.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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Received: 7 January 2022 Accepted: 7 February 2022

Published online: 22 February 2022

This comment refers to the article available online at <https://doi.org/10.1186/s13613-021-00974-7>.

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## References

1. Tobin MJ, Jubran A. Pulse oximetry, racial bias and statistical bias. *Ann Intensive Care*. 2022;12(1):2. <https://doi.org/10.1186/s13613-021-00974-7>.
2. Dam-Vervloet AJ, van Erk MD, Doorn N, Lip SGJ, Timmermans NA, Vanwinzen L, de Boer FA, van Straaten HLM, Bosschaart N. Inter-device reproducibility of transcutaneous bilirubin meters. *Pediatr Res*. 2020;89(4):770–5.
3. Luks AM, Swenson ER. Pulse oximetry for monitoring patients with COVID-19 at home. Potential pitfalls and practical guidance. *Ann Am Thorac Soc*. 2020;17(9):1040–6.
4. Tobin MJ, Laghi F, Jubran A. Why COVID-19 silent hypoxemia is baffling to physicians. *Am J Respir Crit Care Med*. 2020;202(3):356–60.
5. Scholkmann F, Restin T, Ferrari M, Quaresima V. The role of methemoglobin and carboxyhemoglobin in COVID-19: a review. *J Clin Med*. 2021;10(1):50.

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