Smartphone photos can be used to detect anemia

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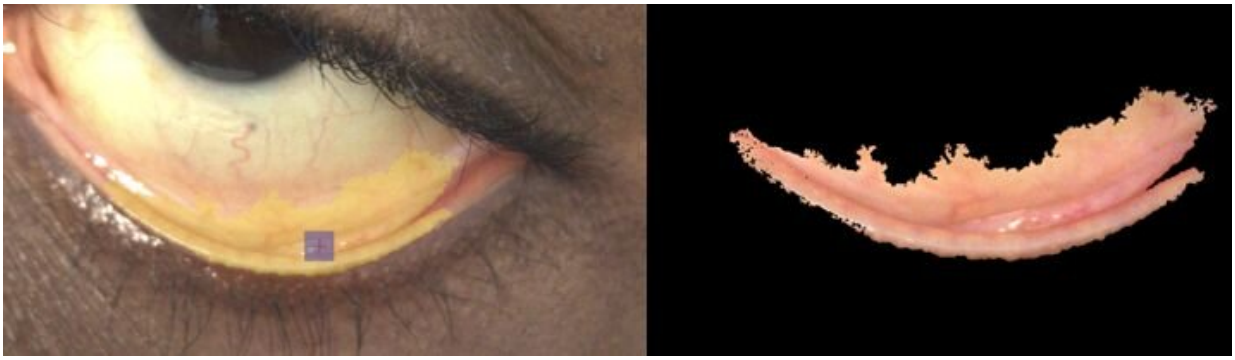

Image capture and region of interest selection.(A) Participant's left eye in the MATLAB application for selection of conjunctiva region to be used in analysis. The gray square outlines the selected pixel representing best conjunctiva color. (B) Region of interest (ROI) of the patient's palpebral conjunctiva that was selected by the ROI algorithm. Credit: Suner et al, 2021, PLOS ONE (CC-BY 4.0, creativecommons.org/licenses/by/4.0/)

A picture of a person's inner eyelid taken with a standard smartphone camera can be used to screen for anemia, according to a new study published this week in the open-access journal *PLOS ONE* by Selim Suner of Brown University and Rhode Island Hospital, U.S., and colleagues.

Anemia, a low blood hemoglobin concentration, affects an estimated 5.6% of Americans and more than 25% of the global population. Severe

anemia is a significant risk factor for morbidity and mortality, especially in children, the elderly and the chronically ill. There is an unmet need for inexpensive, accessible and non-invasive point-of-care tools to screen for and diagnose anemia.

Previous studies have shown that the inside of a person's lower eyelid—called the palpebral conjunctiva—appears paler with anemia. In the new study, researchers obtained smartphone images of the palpebral conjunctiva from 142 patients with a wide range of hemoglobin levels. They zoomed into a small region of the conjunctiva in each photo and developed a new algorithm optimizing color resolution as well as a prediction model linking conjunctiva color, compared to the surrounding skin and whites of the eyes, to hemoglobin levels. Then, the team tested the new algorithms on photos collected from 202 new patients.

When analyzing the new set of photographs, the model was 72.6% accurate (CI 71.4-73.8), 72.8% sensitive (71-74.6), and 72.5% specific (70.8-74.1) at predicting anemia. Accuracy for transfusion thresholds was higher, at 94.4% accurate (93.7-95.0) for a low transfusion threshold and 86% accurate (85.0-86.9) for a higher threshold. Skin tone did not change results, but image quality had some effect. The results suggest that a smartphone app could be used to screen for anemia in a telehealth or remote setting where the infrastructure for blood tests is not available.

The authors add: "Images of the lower eyelid's vascular surface obtained by a smartphone camera can be utilized to estimate blood hemoglobin concentration and predict anemia which is a serious health condition afflicting billions of people world-wide with a disproportionate effect in developing countries. Utilization of non-invasive techniques to detect anemia opens the door to widespread screening, early diagnosis and treatment, particularly in low resource settings where access to healthcare is sparce."

More information: Suner S, Rayner J, Ozturan IU, Hogan G, Meehan CP, Chambers AB, et al. (2021) Prediction of anemia and estimation of hemoglobin concentration using a smartphone camera. *PLoS ONE* 16(7): e0253495. doi.org/10.1371/journal.pone.0253495