A novel 'man and machine' decision support system makes malaria diagnostics more effective

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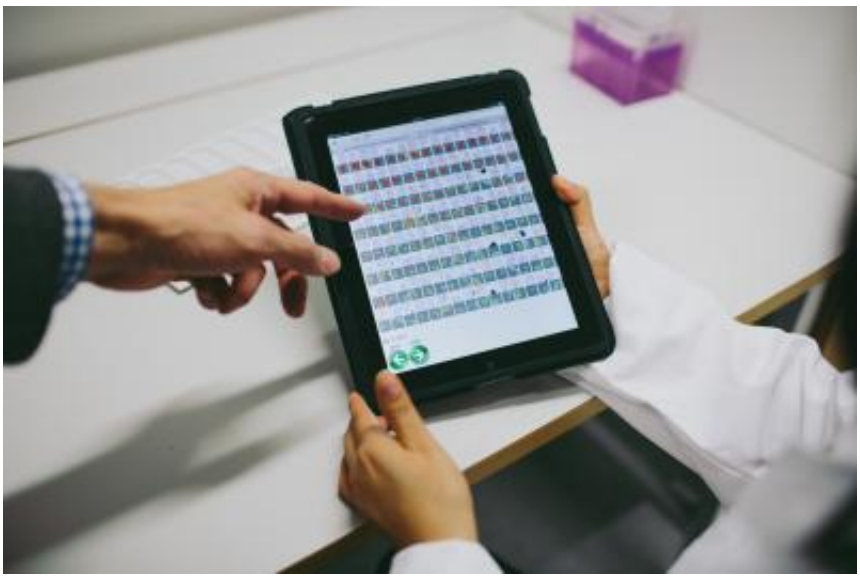

The method is based on computer vision algorithms similar to those used in facial recognition systems combined with visualization of only the diagnostically most relevant areas. Tablet computers can be utilized in viewing the images. Credit: Photo: Ari Hallami / FIMM

A Finnish-Swedish research group at the Institute for Molecular Medicine Finland (FIMM), University of Helsinki, and Karolinska institutet, Stockholm, has developed a novel "man and machine" decision support system for diagnosing malaria infection. This innovative diagnostic aid was described in *PLOS One* scientific journal today, 21

August. The method is based on computer vision algorithms similar to those used in facial recognition systems combined with visualization of only the diagnostically most relevant areas. Tablet computers can be utilized in viewing the images.

In this newly developed method, a thin layer of blood smeared on a microscope slide is first digitized. The algorithm analyzes more than 50,000 red blood cells per sample and ranks them according to the probability of infection. Then the program creates a panel containing images of more than a hundred most likely infected cells and presents that panel to the user. The final diagnosis is done by a health-care professional based on the visualized images.

By utilizing a set of existing, already diagnosed samples, the researchers were able to show that the accuracy of this method was comparable to the quality criteria defined by the World Health Organization. In the test setting, more than 90% of the infected samples were accurately diagnosed based on the panel. The few problematic samples were of low quality and in a true diagnostic setting would have led to further analyses.

"We are not suggesting that the whole malaria diagnostic process could or should be automated. Rather, our aim is to develop methods that are significantly less labor intensive than the traditional ones and have a potential to considerably increase the throughput in malaria diagnostics", said Research Director Johan Lundin (MD, PhD) from the Institute for Molecular Medicine Finland, FIMM.

"The equipment needed for digitization of the samples is a challenge in developed countries. In the next phase of our project we will test the system in combination with inexpensive mobile microscopy devices that our group has also developed", told the shared first author of the article Nina Linder (MD, PhD) from FIMM.

The developed support system can be applied in various other fields of medicine. In addition to other infectious diseases such as tuberculosis, the research group is planning to test the system fro cancer diagnostics in tissue samples.

"There is also a strong need for fast and accurate methods for measuring the malaria parasite load in a sample. Various malaria drug screening programs are underway and the parasite load in a large number of samples needs to be quantified for determining the efficacy of potential drugs. We are further developing the computer algorithms used in this study to meet this need as well", Dr. Linder continued.

There are more than 200 million new malaria cases yearly. High-quality microscopy is still the most accurate method for detection of malaria infection. However, microscopy requires well-trained personnel and can be very time-consuming when performed according to the recommendations. In 2012, less than half of the suspected malaria cases in Sub-Saharan Africa received a diagnostic test. The workload of the health-care personnel is excessive thus contributing to the demonstrably low accuracy of microscopy.

"The new method of imaging and analysis can revolutionise the point of care diagnostics of not only malaria but also several diseases where diagnosis depends on microscopy. The action may lead to 'market rupture' in the field of disease diagnostics", says Professor Vinod Diwan from Karolinska Institutet.

More information: Linder N., Turkki R., Walliander M. ym. A malaria diagnostic tool based on computer vision screening and visualization of Plasmodium falciparum candidate areas in digitized blood smears. *PLOS ONE* dx.plos.org/10.1371/journal.pone.0104855