Badrinath Jagannath is a doctoral candidate in the Department of Bioengineering at The University of Texas at Dallas. He completed his Bachelors in Electronics and Instrumentation Engineering in India and obtained Master of Science degree in Biomedical Engineering from Arizona State University in 2015 before joining Dr. Shalini Prasad’s lab at UT Dallas. His research interests include developing wearable and point-of-care devices for precision health. His current research focuses on developing wearable sensors for real-time monitoring of upper respiratory infections and inflammatory bowel disease non-invasively from sweat. Badri currently has 17 peer-reviewed publications among which two of the publications have been recognized as one of the Top 10 articles in Nature Scientific Reports and Inflammatory Bowel Diseases journals. He has received several awards and fellowships for his research work. Badri has given podium presentations at various conferences and has also been an invited Plenary speaker for his work on wearable diagnostics. His research work on infection monitoring wearable sensor has received a lot of recognition and was recently featured at the ACS conference 2021.

The developed SWEATSENSE device comprises of a disposable sensor strip attached to a portable electronic reader. The strip, which contains electrodes, is coated with antibodies to capture specific cytokines. When the device is worn on the wrist, sweat diffuses from the skin onto the sensor strip. Binding of cytokines to their antibodies results in a change in electrical current flowing through the reader. The reader then wirelessly transfers the data to a smartphone app converting electrical signal to an accurate cytokine level. The device can continuously measure the cytokine biomarkers from very low volume (almost 1/10th drop) of naturally expressed sweat. The device is extremely sensitive and can measure four cytokines (tumor necrosis factor-α, interleukin-6, interleukin-8 and interleukin-10) simultaneously. In this pilot study, we were able to differentiate 5 patients with respiratory infections from 10 healthy subjects. These results are significant as this is the first study to report the detection of infection non-invasively from sweat. The findings reported in this work opens new avenues of wearable devices for providing feedback on health status to the user in real-time.

This work was a collaboration between ‘Biomedical Microdevices and Nanotechnology Laboratory’ at The University of Texas at Dallas and EnLiSense LLC. The findings from this work were published in Bioengineering and Translational Medicine.

How would you explain your paper’s key results to the non-scientific community?

Typically, when a person gets an infection, immune response is triggered releasing certain molecules called ‘cytokines’ as a part of the body’s defense mechanism. Sometimes this defense mechanism leads to excessive or uncontrolled release of multiple cytokines creating a storm-like effect. The impending cytokine storm has rippling effects on the body causing organ damage and ultimately death. Cytokine storms are one of the major causes for complications in COVID-19 and other respiratory infections. There is often a time delay between when cytokine levels get elevated to when the symptoms of infection are experienced. Therefore, it is imperative to capture abnormalities in cytokine levels during onset of infection to prevent any deleterious effects. However, current technologies use blood-based testing methods. They are not suitable for real-time, continuous monitoring, and often take large processing times. These blood tests are typically done only after symptoms appear which can prove fatal due to delay in detection. Therefore, early detection through continuous monitoring can aid in rapid and real-time reporting of any abnormalities in cytokine levels. To overcome current technological shortcomings, a wristwatch like device called ‘SWEATSENSE Dx’, commercialized by EnLiSense LLC, was used to report cytokine levels in real-time from naturally perspired sweat.

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What are the possible consequences of these findings for your research area?
The ‘SWEATSENSER’ wearable device can be paradigm-shifting in the use of wearable technologies for precision health. The results presented in the study demonstrate a way to track infections non-invasively. Additionally, continuous monitoring of physiological parameters presented in the study can empower users by providing active feedback for self-monitoring. Such wearable systems can be invaluable in providing users with real-time feedback on health status and help physicians make informed decisions on patient treatment strategies.

What was the exciting moment (eureka moment) during your research?
There are quite a few interesting findings from this study. Current methods use chemical stimulation to induce sweat. However, this causes discomfort and is not a suitable method for quantifying levels of inflammatory molecules. A critical finding was that such external stimulation methods result in under-expression of the actual level of biomarker and do not represent the true level of that in circulation (blood). Further, we were able to quantify the levels of inflammatory cytokines in passive sweat i.e. naturally perspired sweat without any chemical stimulation or exercise. But the “icing on the cake” has been that we were able to detect people with upper respiratory infections through real-time monitoring of biomarkers in sweat. This is the first-of-a-kind demonstration of technological viability to detect infections non-invasively. Such a result shows a lot of promise and provides hope for rapid and early detection during pandemics and epidemics.

What do you hope to do next?
We are collaborating with hospitals to validate the clinical performance of the device. We would like to further expand our studies by testing on large patient population with various upper respiratory infections.

Where do you seek scientific inspiration?
Inspiration to me comes from learning and observing the world around me. I get motivated while reading some innovative research articles and discussions with my peers helps me think out of the box. When I come across certain unique experiments from research papers, it gives me a lot of enthusiasm. But importantly, my failures motivate me the most. They keep me determined, humbled and perseverant in pushing my limits to achieve my goals.

How do you intend to help Indian science improve?
One of the holistic ways for progress in science is by collaboration. Industry collaborations help in translation of research from an academic lab to the market for which this work is an excellent example. I believe Indian science would benefit greatly with such academic-industry partnerships. I would like to contribute in whatever capacity I can by exchange of information with academic researchers in India on my experience of collaboration with industry for translation of research from an academic setting.

Reference

Website: https://www.utdbmnl.com/