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Team finds novel way to monitor serious blood disorder using a smart phone

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A researcher from Florida Atlantic University has come up with a unique way to monitor sickle cell disease—a serious blood disorder—using a smart phone. With a $166,935 grant from the National Science Foundation, E. (Sarah) Du, Ph.D., assistant professor in the Department of Ocean and Mechanical Engineering in FAU's College of Engineering and Computer Science, and principal investigator, will develop a portable smart sensor and a phone application for patients to analyze and store the results of their blood tests on a smart phone. This technology will enable them to keep a close watch on any abnormal activities in their blood cells and take important steps to manage this disease with early intervention.

Sickle cell disease is a hereditary blood disorder that affects red blood cells, distorting their natural disc shape into a crescent moon or "sickle" shape. Normal red blood cells move freely through small vessels throughout the body to deliver oxygen. With sickle cell disease, the misshapen red blood cells become hard and sticky, making it difficult for them to move through blood vessels. They eventually block the flow and break apart. This process results in a number of problems including severe chronic pain, stroke, organ damage, spleen dysfunction, heart failure and even death.

"A major challenge in the management of sickle cell disease is the tremendous pain that patients endure from chronic and acute pain episodes called pain crisis," said Du. "Unfortunately, these pain episodes are unpredictable and patients never know when or where these episodes

will take place."

Integrating microfluidics with communication technologies like a smart phone, Du and her collaborators will create a disposable testing platform much like a glucometer that is used by patients who have diabetes. There are currently no such field sensors available for patients with sickle cell disease.

By monitoring the activity of their red blood cells, patients will have a potential risk indicator of a pain crisis and therefore take the appropriate steps for early intervention. They will be able to better manage the disease by making sure they are appropriately hydrated and have sufficient oxygen.

"We will only need to use a very small drop of blood from a finger stick that will then be loaded into a microscale channel that is biochemically modified," said Du. "Then, the embedded microprobes inside the channel together with the microprocessor will transmit the signals of blood cells to a patient's cell phone revealing the results of their blood test."

With further development, this sensor technology could be used as an important part of a smart and connected health system for sickle cell disease management. Based on these sensor measurements, patients could potentially receive intervention strategies, feedback and even prescription medications from health care providers.

"This National Science Foundation grant will help Dr. Du advance her important work on sickle cell disease and provide a tool with great clinical utility that will help patients around the world afflicted by this debilitating disease," said Javad Hashemi, Ph.D., chair and professor in FAU's Department of Ocean and Mechanical Engineering.

Sickle cell disease affects millions of people of many nationalities throughout the world, including both children and adults. In the U.S., it disproportionately affects people of African descent as well as Hispanics and those of Middle Eastern descent. Approximately two million Americans carry this genetic mutation, which affects about 100,000 individuals in the U.S.

The most common and serious problems caused by sickle cell disease are anemia, pain and organ failure, and stroke affects about 10 out of 100 children who have this disease. Currently, the life expectancy for patients with sickle cell disease can reach up to 50 years, a dramatic improvement since 1973, when the average lifespan for the disease was only 14 years.

Current treatment options for sickle cell disease include hydroxyurea, blood transfusions, antibiotics, and pain killers.

When the two-year NSF project is completed, Du plans on collaborating with health partners to collect longitudinal cell sickling data from individual patients. These measurements will be compared to patients' clinical outcomes to establish criteria for prediction of pain crises.

Provided by Florida Atlantic University