# Undergrads invent cell phone screener to combat anemia in developing world

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Could a low-cost screening device connected to a cell phone save thousands of women and children from anemia-related deaths and disabilities?

That's the goal of Johns Hopkins biomedical engineering undergraduates who've developed a noninvasive way to identify women with this dangerous blood disorder in developing nations. The device, HemoGlobe, is designed to convert the existing cell phones of health workers into a "prick-free" system for detecting and reporting anemia at the community level.

The device's sensor, placed on a patient's fingertip, shines different wavelengths of light through the skin to measure the hemoglobin level in the blood. On a phone's screen, a community health worker quickly sees a color-coded test result, indicating cases of anemia, from mild to moderate and severe.

If anemia is detected, a patient would be encouraged to follow a course of treatment, ranging from taking iron supplements to visiting a clinic or hospital for potentially lifesaving measures. After each test, the phone would send an automated text message with a summary of the results to a central server, which would produce a real-time map showing where anemia is prevalent. This information could facilitate follow-up care and help health officials to allocate resources where the need is most urgent.

Soumyadipta Acharya, an assistant research professor in Johns Hopkins' Department of Biomedical Engineering and the project's faculty advisor and principal investigator, said the device could be important in reducing anemia-related deaths in developing countries. International health experts estimate that anemia contributes to 100,000 maternal deaths and 600,000 newborn deaths annually.

"This device has the potential to be a game-changer," Acharya said. "It will equip millions of health care workers across the globe to quickly and safely detect and report this debilitating condition in pregnant women and newborns."

The HemoGlobe student inventors have estimated their cell phone-based systems could be produced for $10 to $20 each. At the recent Saving Lives at Birth: A Grand Challenge for Development competition, the potential public health benefits of this device won over the judges, who awarded a $250,000 seed grant to the Johns Hopkins students' project. The event, which attracted more than 500 entrants from 60 countries, was sponsored by prominent global health organizations, including the U.S. Agency for International Development and the Bill & Melinda Gates Foundation. Only 12 entrants received seed grants.

"When we thought about the big-name corporations and nonprofit groups we were competing against, we were amazed and surprised to find out that our team had won," said George Chen, 19, of Hacienda Heights, Calif., a sophomore majoring in biomedical engineering. Chen attended the July 14 announcement in Seattle, along with Acharya and team members Noah Greenbaum and Justin Rubin.

For a biomedical engineering design team class assignment, the students spent a year brainstorming and building a prototype. The seed grant will allow the team to refine its technology and support field testing next year in Kenya by Jhpiego, a Johns Hopkins affiliate that provides global health training and services for women and their families. Jhpiego sponsored the HemoGlobe project through a partnership with the university's Center for Bioengineering Innovation and Design.

Team member Greenbaum, 21, of Watchung, N.J, a senior majoring in biomedical and electrical engineering, has continued working on the anemia system this summer.

"The first year we just focused on proving that the technology worked," he said. "Now, we have a greater challenge: to prove that it can have a real impact by detecting anemia and making sure the mothers get the care they need."

The student inventors were looking for a new way to curb a stubborn health problem in developing nations. Anemia occurs when a person has too few healthy red blood cells, which carry critical oxygen throughout the body. This is often due to a lack of iron, and therefore a lack of hemoglobin, the iron-based protein that helps red blood cells store and release oxygen. Anemic mothers face many complications before and during birth, including death from blood loss associated with the delivery. In addition, a baby that survives a birth from an anemic mother may face serious health problems.

Health officials in developing countries have tried to respond by making iron supplements widely available. According to Acharya, however, the problem of anemia remains intractable. "So we looked at it from a different angle," he said.

In places where medical care is easily accessible, doctors routinely test pregnant women for anemia and prescribe treatment, including routine iron supplementation. But in developing regions where medical help is not always nearby, the condition may go undetected. Community health workers with limited training do, however, serve these areas.

"The team members realized that every community health worker already carries a powerful computer in their pocket -- their cell phone," Acharya said. "So we didn't have to build a computer for our screening device, and we didn't have to build a display. Our low-cost device will use the existing cell phones of health workers to estimate and report hemoglobin levels."

A provisional patent covering the invention has been obtained through the Johns Hopkins Technology Transfer office.

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In addition to Chen, Greenbaum and Rubin, other Whiting School of Engineering students who have participated on the team are Guilherme Barros, William Chen, Judy Doong, Phillip Oh and David Yin.

Color graphics of the invention are available; contact Phil Sneiderman.

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