

## Smart Stethoscope Zeros in on Lung Sounds



Time isn't the only thing doctors may be up against when diagnosing a child with pneumonia. Noise, like crying, can make it difficult to hear a baby's congested lungs through a stethoscope. It can be worse in places where soundproofed exam rooms don't exist. A team of Johns Hopkins researchers is working to change this by developing a smart, low-cost stethoscope that lets doctors zero in on sounds in the lungs.

With acute lower respiratory infections being a leading cause of childhood death worldwide, the stethoscope could make a big difference in diagnosing pneumonia.

"If a child is misdiagnosed, that child goes home and could die," says pulmonologist William Checkley.

Unlike traditional, nonelectric stethoscopes, five low-frequency microphones inside the programmable stethoscope's head will make it easier to pick up lung sounds, even if it isn't ideally placed on the body. A sixth microphone facing outward will collect noise from the environment; an algorithm on the stethoscope's microprocessor will strip that ambient noise from the lung sounds heard by the physician.

"It's a very tricky balance with removing the noise," says Mounya Elhilali, the electrical and computer

engineer who developed the algorithm. "If you end up canceling out a sound that actually speaks to what is wrong with their lungs, then you might actually miss the whole diagnosis."

The team is also developing software to alert users when the stethoscope detects a lung sound—like the crackly noise of pneumonia—that warrants a visit to a health care facility for further evaluation, as well as an option to hear sounds as they would be heard on a traditional stethoscope.

A prototype is being made by Baltimore-based Harbor Designs and Manufacturing. The work is being supported by a \$2.5 million, four-year grant from the National Institutes of Health.

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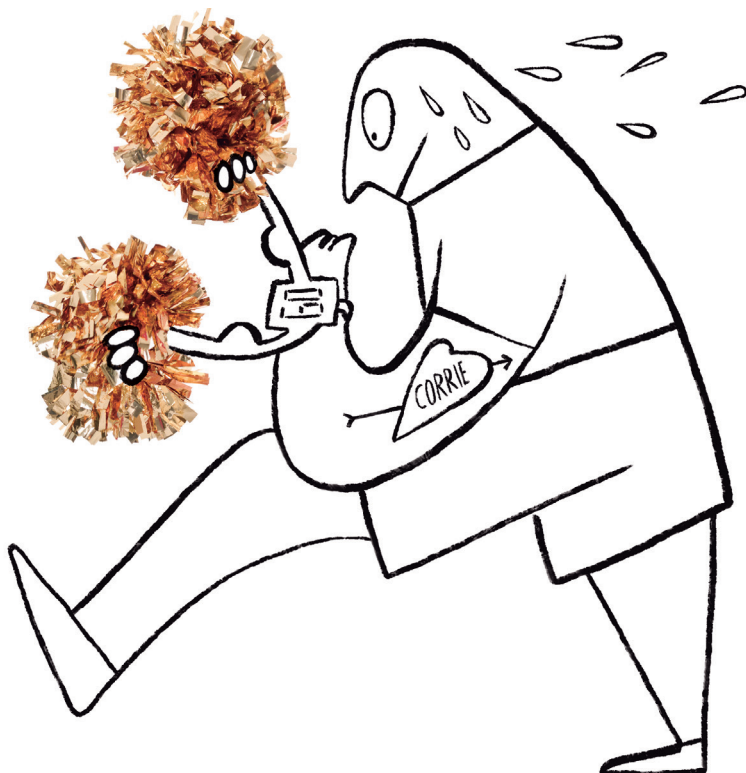


JASU HU / MARLENA AGENCY

## Mobile App Could Help with Heart Attack Recovery



Nationwide, one in five cardiac patients is readmitted to the hospital within 30 days, says Francoise Marvel, a third-year internal medical resident and soon-to-be chief resident. "They leave without the guidance, information and skill-building they need to get a healthy start," she says.



MARTA SEVILLA / MARLENA AGENCY

Marvel is leading a team of Johns Hopkins physicians, nurses, designers and engineers who are collaborating with Apple on an app designed to empower heart attack patients in their recovery.

The app, called Corrie ("Cor" is Latin for heart), works with Apple Watch and would be the first cardiology app in CareKit, Apple's new framework for medical applications.

Corrie monitors a patient's heartbeat, blood pressure and exercise, creating a record for patients and their doctors. It also alerts users when it's time to take medications, and it pings if they have been sitting a long time and would benefit from a walk. Through Corrie, users can also schedule follow-up appointments and learn about heart health through animated videos.

"It's like a digital health buddy to keep

patients on track," says Marvel.

She began developing the app in 2014 with support from Johns Hopkins Technology Ventures and grants. The project gained momentum in 2016, when Marvel teamed with preventive cardiologist and mobile health expert Seth Martin, and with Whiting School of Engineering students Matthias Lee and Gavi Rawson.

For a pilot study, Apple donated 200 Corrie-equipped smartwatches to The Johns Hopkins Hospital and Johns Hopkins Bayview Medical Center. Cardiac patients at those hospitals now receive the watches the day after they are admitted and keep them for 30 days after discharge. If the pilot shows Corrie can help those patients improve their health and prevent readmissions, the app could be available to cardiac patients at other hospitals within the next year.



A look at innovative developments outside the halls of Johns Hopkins Medicine

## Medication Innovations

**An app from UnitedHealthcare provides prices for prescription medications, takes insurance and discount plans into consideration, and suggests less expensive options.** The goal is to initiate a conversation between patients and physicians before the patient leaves the office, avoiding future back-and-forth conversations if a patient needs to change a prescription based on cost. Called ScriptHub Plus, the app is being piloted at a 300-doctor multispecialty group in New York.

**Using the right mix of chemicals, a portable device invented by MIT researchers can manufacture Benadryl, lidocaine, Valium and Prozac on demand.** Capable of making 1,000 doses of medication in 24 hours, the system could be used during an unexpected disease outbreak, a drug shortage or a manufacturing plant shutdown. It could also make small amounts of drugs for clinical trials or for the treatment of rare diseases.

**A contact lens developed by Harvard Medical School researchers effectively provides glaucoma medication in a controlled, gradual manner.** A polymer film on the periphery houses the drug and releases it slowly, while the center of the lens remains clear and allows for normal visual acuity, breathability and hydration. A small study by the researchers showed that a lens delivering a low dose of the drug provided the same therapeutic effect as liquid eyedrops. Researchers hope the innovation will ensure patients receive their glaucoma medicine.

## Johns Hopkins-Derived App Helping Patients Stick to Drug Regimens



Sticking to a drug regimen is about to get a lot easier for people with tuberculosis in California and Washington state. Emocha, a company that makes applications based off licensed Johns Hopkins technology, has secured contracts with a string of health departments to use miDOT, a medication adherence app.

Direct observation is the accepted standard of care when treating TB patients. Traditionally, that has meant a health care worker watching a patient take her medicine—in person. Emocha's miDOT app saves time and money by letting patients record themselves taking their medication and securely submit the video to their care provider.

MiDOT lets providers watch patients' videos to confirm their medication adherence and learn of any side effects. It also helps manage large video files and provides customizable analytics, like triaging patients by risk group.

Fresno, Merced and Contra Costa counties in California, and Seattle in Washington, all signed on to use miDOT in the past four months. Emocha is now working with more than a dozen cities, counties and states to ensure TB patients are taking their meds.

The company is adapting miDOT to manage other illnesses, including opioid addiction. It's also participating in a two-year, eight-city study that will use miDOT to track adherence in hepatitis C patients. David Thomas, director of the Division of Infectious Diseases, and epidemiologist Shruti Mehta are heading the Baltimore segment of the study.

Emocha is headquartered at the Johns Hopkins FastForward East business accelerator. CEO Sebastian Seiguer is a former Johns Hopkins Carey Business School student, and several Johns Hopkins faculty members sit on Emocha's advisory board.

"It's hard to get medical expertise into software," says Seiguer. "I think we've come up with a way to do it, mostly because of our partnership with Hopkins and being in the Hopkins environment."



## Device to Detect the Risk of Blindness in People with Diabetes



Vision loss is a serious concern for those with diabetes. By the time symptoms surface, it can be too late to halt the loss of sight. Alums of Johns Hopkins' biomedical engineering graduate program are developing technology to detect this vision loss—called diabetic retinopathy—before patients notice any changes in their vision.

Initially developed by Abhishek Rege while completing a Ph.D. and postdoctoral work, the device takes a series of back-of-the-

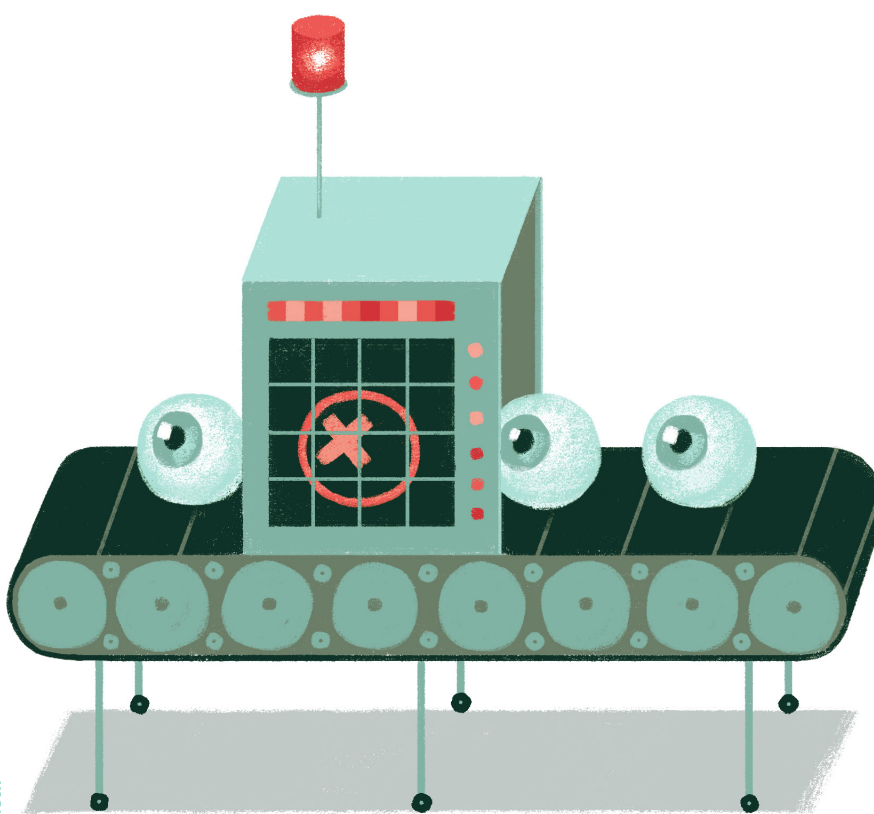
eye photographs in less than a second to check for changes in blood vessels, which can be brought on by diabetes and lead to

blindness. A software algorithm then interprets the photos to measure blood flow. If it detects a reduction in blood flow between an initial photo and one obtained during a later appointment, the patient can be referred to an ophthalmologist.

Though doctors encourage patients with diabetes to have their eyes examined annually, only about half follow through. For this reason, Rege and fellow alum M. Jason Brooke are designing the technology for point-of-care locations, like endocrinology clinics, pharmacies and emergency rooms—places where eye care isn't normally given but where people with diabetes may go. When someone visiting one of these locations indicates that he or she has diabetes, a clinician can suggest that his or her eyes be checked.

Brooke says the imaging technology and software algorithms could eventually be adapted for other clinical applications, such as wound care and blood flow monitoring during surgery.

In 2012, Rege and Brooke co-founded Vasoptic Medical Inc. to commercialize the innovation. Since then, Johns Hopkins Technology Ventures has helped the duo patent their technology, raise funds to continue their work and test the technology. Rege and Brooke aim to obtain FDA market clearance by 2018.



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