UC San Diego
UC San Diego News Center

October 22, 2012 | By Doug Ramsey

Bringing Power of Prevention, Diagnosis to the People

Mozambique uses a tablet-based ultrasound developed 2 Digital Health Lab to analyze a patient.

"A Mercedes Benz isn't designed to function in the Sahara Desert," notes Dr. Eliah Aronoff-Spencer of the University of California, San Diego. "So why are we designing medical equipment for developing countries the same way we do for developed ones?"

It's a question researchers at the new Distributed Health Laboratory in the California Institute for Telecommunications and Information Technology (Calit2) at UC San Diego aim to address, and eventually, to render moot. In collaboration with the UC San Diego School of Medicine and the Universidade Eduardo Mondlane (UEM) in Maputo, Mozambique, Calit2's DH Lab is designing low-cost medical devices such as microscopes and wireless sensing devices that can be used by virtually anyone anywhere in the world to prevent and even diagnose illness.

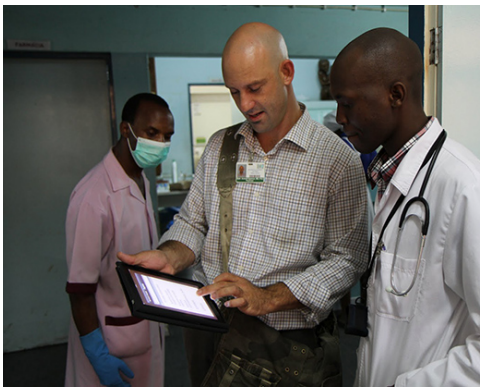
The members of the lab envision this suite of tools as eventually comprising (to use a term from "Star Trek") a global "Tricorder" –an "open-health stack" of medical devices, apps and cloud-infrastructure that will support medical providers and give individuals increasing autonomy over their own health.

"We see this stack as rebalancing the global health equation," says Dr. Aronoff-Spencer, a physician scientist in UCSD's infectious disease department and co-director of the DH Lab. "It's a set of interlocking and open tools that anyone can use alone, connect, replicate or evolve. People do not exist in a vacuum—their environment is a crucial factor in how they go about their lives. We need to consider and measure both to understand ourselves."

The DH Lab has a core design rule, says Dr. Aronoff-Spencer: "Let's build what people will actually use." For that to happen, he says, "technologies have to be simple, effective and inexpensive. We also have to design for openness and transparency in such a way that the most natural thing to do is the right one."

Dr. Eliah Aronoff-Spencer discusses new DH Lab-develope

Adds DH Lab Co-Director Albert Yu-Min Lin: “It might also mean that a new era of low-cost networked medical technologies connect patients to doctors virtually, since doctors aren’t always available to patients living in rural, undeveloped areas of the world.”



technologies with a doctor at Mozambique’s Universidade Mondlane.

Lin notes that while health care often focuses on the individual, “I think there is a lot to be learned from our human networks.” He notes that the team’s OASIS project is, for example, “a low-cost—we’re talking sub-dollar—water-quality measurement device that can quantify the amount of toxins, heavy metals, and pollutants in drinking water. The concept here is to create sensing instruments so we can implement them at a community level, taking advantage of cell phone networks to create a distributed web of sensing.”

Using OASIS, individuals who need to know if their water source is safe to drink on a given day can collect the data locally and then, through the network, populate a digital map with the data, thereby providing the information to their community of other users, “and giving insight into the constantly changing state of health of the larger water system,” explains Lin.

The team plans to deploy the OASIS devices in the Gobi Region of Mongolia, which has become increasingly polluted as a result of mining activities in the area. Lin himself is intimately familiar with this region of the world: his primary research project is a collaboration with the National Geographic Society and the Calit2-based Center of Interdisciplinary Science for Art, Architecture and Archaeology (CISA3) to use high-tech, noninvasive technologies in a search for the lost tomb of Genghis Khan.

Eventually, the team hopes to deploy their devices and apps over a wide range of health applications, as they did recently in Mozambique during a three-week trial of the DH Lab’s $3,000 tablet-based ultrasound. The ultrasound is part of the Lab’s SENSE network—a toolkit of wearable sensors and a generic “lab-in-a-box” device that lowers the barrier to disease diagnosis for those living in areas of the world with limited medical resources.

Director Albert Yu-Min Lin

During the trial, local physicians were able to use the devices “with nearly no training and all noted they were superior in usability and portability to other ultrasounds in use at UEM, some of which cost upwards of $25,000,” says Dr. Aronoff-Spencer, who conducted the trial. “The current plan is to deploy and test the new devices in January in an international clinical trial between UC San Diego and UEM.”

Another DH Lab-developed tool, the DOKNOSIS, is an online database of medical concepts and relations that allows doctors to formulate a list of likely diseases based on patients' symptoms. Rather than giving sets of likely diseases for a set of findings, a patient version would act like an "algorithmic genie," providing a possible diagnosis directly to the patient by asking a series of questions.

The team previously developed a low-cost, multifunction microscope run by a laptop or iPad that enables clinicians to render spectroscopy, fluorescence and brightfield imaging and share the data immediately. The price point for their technology? $500. A similar microscope can cost upwards of $50,000.

Lin notes that the DH Lab team—which includes designers, engineers, scientists and clinicians—is part of a larger mobile health initiative at Calit2 that aims to help people become more aware of their health, through data-sharing and crowd-sourcing.

Other members of the DH Lab include Professor of Nanoengineering Joseph Wang; Associate Professor of Visual Arts Benjamin Bratton, Assistant Adjunct Professors of Medicine Sanjay Mehta and Staal Vinterbo; Matthew Strain, an assistant professor in Infectious Diseases; Calit2 Project Scientist Rich Stoner, DH Lab engineer Sean Patno and Ph.D. student Andrew Huynh.

The researchers even foresee some social implications as their devices and systems become more ubiquitous. Their "Pulse" platform, for example—which they developed for a "hack-a-thon" sponsored by Qualcomm—uses a webcam and custom software to take a person's pulse in real-time and map their location.

"Ultimately, we're trying to take the semantic Web and use it to create a 'global pulse' that's always on," explains Lin. "We can see this being used to take the global pulse during key moments in history —say during Carnival in Rio, or during the revolution in Libya." Or adds Dr. Aronoff-Spencer, the app could be used to track outbreaks of diseases such as SARS and influenza.

"The more people use it, the more data we have, the smarter we are" he adds. "These are just the first steps toward open and secure platforms that integrate a patient's data to create a rich and interactive health-timeline."

The lab is partially funded by the United States President's Emergency Plan for AIDS Relief (PEPFAR), the National Institutes for Health Medical Education Partnership Initiative (MEPI), the National Science Foundation and the Calit2 Strategic Research Opportunities grant.

UC San Diego's Studio Ten 300 offers radio and television connections for media interviews with our faculty, which can be coordinated via studio@ucsd.edu. To connect with a UC San Diego faculty expert on relevant issues and trending news stories, visit https://ucsdnews.ucsd.edu/media-resources/faculty-experts.