Inventors Aim To Increase Availability Of Eye Screening For Diabetics

Oak Ridge National Laboratory
University of Tennessee Research Foundation

Pressing public health problems rarely have easy and affordable solutions. In the case of diabetic retinopathy — a complication of diabetes mellitus that can lead to blindness — myriad factors, from too many patients and too few health care providers to the cost and accessibility of routine care, keep millions of diabetics from getting an annual eye exam to screen for the disease.

"There are 25 million diabetics in America today and fewer than half of them get the recommended eye exam each year," says Edward Chaum, M.D., Ph.D., professor of ophthalmology at the University of Tennessee Hamilton Eye Institute inMemphis. "We're not even managing the number of diabetics we have now, and we certainly won't be able to manage the growing numbers of diabetics. We're trying to funnel a huge number of patients through a narrow number of providers."

Chaum and co-inventor Kenneth W. Tobin, Ph.D., hope automating the screening process for diabetic retinopathy with an advanced computer technique will make the simple and vision-saving test affordable and accessible to millions of diabetics.

About Diabetic Retinopathy

According to the American Diabetes Association, more than 25 million people in the United States have diabetes, a chronic, lifelong disease marked by high levels of sugar in the blood. That number is expected to rise to 115 million by 2050.

Diabetic retinopathy, a deterioration of the retina, or the light-sensitive membrane that receives and transmits visual images to the brain, occurs in a high percentage of those who live with the disease for more than 10 years. Although diabetic retinopathy can be treated in its early stages with laser therapy, many patients are unaware they have the disease until it's too late.

"The reality is patients go blind from diabetes because they don't get seen in a timely fashion," says Chaum. "Their vision gets worse and worse, and there's only so much I can do to bring back their sight or preserve what's left. To prevent blindness, we need to seek out individuals at risk and intervene early."

Diabetic retinopathy has historically been detected through an eye exam in which the retina is imaged and analyzed by an ophthalmologist, a physician who specializes in medical and surgical eye problems. As a result of a shortage of ophthalmologists in some parts of the country — as well as the inconvenience of the screening test — far too many diabetics lose their vision each year.

Connecting the Dots

Chaum had been invited to hear Tobin, division director and corporate research fellow at Oak Ridge National Laboratory (ORNL), speak on his automated method of analyzing computer chips for defects when he had an "aha" moment.

Tobin was describing how a semiconductor manufacturer used his content-based image retrieval (CBIR) system as an automatic inspection tool to assist in quality control and engineering. The system included a database of hundreds of thousands of images of semiconductor wafers and a set of algorithms that could match an image of a newly manufactured wafer to those in the library, providing engineers with invaluable information with which to identify and correct defects.

"What Ken had taught computers to do in the manufacturing process matched what I do clinically with the retina," says Chaum. "I saw the opportunity to apply Ken's technology to a different library of images. We could search for features of disease states in the eye using patient images that we have acquired over the years."

Michael J. Paulus, Ph.D., director of technology transfer at ORNL, calls Chaum a brilliant dot-connector for seeing a medical application in Tobin's work.

"We have wonderful toolmakers at Oak Ridge and at the University of Tennessee, there are physicians looking for tools," says Paulus. "The marriage of the two turns out to be a great place for invention."

Matching Images

Within weeks, Chaum and Tobin applied for funding from ORNL and won $125,000 in seed money to build a CBIR

database of retinal images and develop algorithms to recognize disease patterns within them.

"What we're doing is teaching computers to diagnose eye disease," says Chaum. "The way to manage millions of patients is by doing it in a fully automated way. My goal is to change the paradigm by bringing screening to a societal scale."

Results of the ORNL funding laid the groundwork for grants from the U.S. Army Biomedical Information Technology Network in the amount of $830,000 and a National Eye Institute R01 grant of $1.63 million (renewed three years later for $3.16 million), which helped this collaborative effort to refine the CBIR technology and develop software to transmit patient images over the Internet.

From Invention to Startup

In 2008, Chaum and Tobin met with their respective technology transfer officers, Paulus and Richard Magid, vice president, University of Tennessee Research Foundation, to begin the patenting process for the CBIR system. Two years later, Chaum and Tobin licensed the technology and established a startup company called Hubble Telemedical Inc. Additional funding from MB Venture Partners LLC and the Small Business Innovation Research program enabled the pair to bring CEO Chuck Witkowski on board at the beginning of 2012.

Later that year, while awaiting approval for its computerized screening system from the U.S. Food and Drug Administration, the company began laying the groundwork for a rapid expansion by marketing its Real-Time Remote Retinal Exam service. The service consists of a commercially available retinal camera and the company's computer software that connects the camera to a telemedical platform called the TRIAD network.

> *In 2010, the TRIAD Network was awarded the prestigious R&D100 Award as one of the top life sciences breakthroughs and the following year, Hubble Telemedical won the American Telemedicine Association Innovation Award.*

It takes less than an hour to install the retinal camera and TRIAD network in a doctor's office or clinic and only 30 minutes to train staff on imaging the retina and uploading images for analysis via the Internet. For now, the images are sent online to Chaum and a team of ophthalmologists, who analyze the retinal images and send a report back to the physician's office.

"Staff love it, they think it's cool," says Witkowski. "They want to help their patients and they immediately understand the benefit. The system is extremely easy to use."

The service, which is being sold to health care professionals, insurance providers and employers throughout the country, has already provided remote retinal exams for several thousand patients.

Increasing Patient Compliance

The company's research has shown that simply increasing the availability of diabetic retinopathy screening in primary care offices can have a dramatic affect on diabetic eye care. In a study of 1,002 diabetic patients screened over 12 months in a primary care clinic at the University of North Carolina, the percentage of diabetics in the practice receiving screening increased from 32 percent to 71 percent.

"With our TRIAD network, recommended annual eye exam compliance rates among diabetics more than doubled. Most importantly, we identified dozens of individuals with disease they didn't know they had," says Witkowski.

In the meantime, the company is conducting a blinded prospective clinical trial to compare the accuracy and consistency of the CBIR system with ophthalmologists' analyses of retinal screening images — data the company hopes will not only validate the reliability of the automated screening, but also pave the way for the quick-and-easy eye exam to become widespread.

"We hope that someday soon, when you walk into Walmart, you will see a camera and our CBIR system next to the blood pressure cuff, ready to identify potential eye pathology and save someone from blindness," says Tobin.

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