

Seeing the Future With Telemedicine

WITH DARIUS M. MOSHFEGHI, MD

With recent news about former Apple CEO John Sculley backing MDLive, Google Helpouts getting regulatory approval as fully HIPAA-compliant, and InTouch Health already in 15% of all US hospitals, it is difficult to recall the high level of mistrust that formerly burdened telemedicine. But that was exactly the climate that surrounded the Stanford University Network for Diagnosis of Retinopathy of Prematurity (SUNDROP) telemedicine initiative when it started in 2005. Today, telemedicine for eye screening is growing worldwide, and the challenges for telemedicine have moved from gaining acceptance to solving technological and financial issues.

Retina Today recently spoke with Darius M. Moshfeghi, MD, director of the SUNDROP program, to get an update on the program's progress.

Retina Today: Please provide an update on the SUNDROP program, the number of patients served, and its success in diagnosing retinopathy of prematurity (ROP).

Dr. Moshfeghi: Over the past 8.5 years, SUNDROP has established ROP screening in 5 neonatal intensive care units in and around the San Francisco Bay Area. In screening more than 600 babies, the program has obtained nearly 30 000 images. Although the latest data are still being processed for publication, the 5-year results of the program that were recently published offer a good forecast of what the latest data are likely to reveal.¹ From December 1, 2005, to November 30, 2010, 511 infants (1022 eyes) presented that met guidelines for ROP screening and were photographed with the RetCam widefield digital imaging system (Clarity Medical Systems). The images were then sent to me for evaluation.

Of all the infants screened, 15 had treatment-worthy ROP and underwent laser photocoagulation. No patient progressed to adverse anatomic outcomes, and no cases of treatment-worthy ROP were missed. Our methods had 100% sensitivity, 99.8% specificity, 93.8% positive predictive value, and 100% negative predictive value for

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detection of treatment-worthy ROP. One baby recommended for referral did not need treatment.

RT: What adaptations have you made to your process of screening and diagnosing babies via images compared with an in-person infant examination?

Dr. Moshfeghi: I am very conservative in my application of the joint statement screening guidelines on babies that are labeled as having immature pathology. The ROP diagnoses that require treatment are zone 1, zone 2, stage 3, and plus disease. Although the camera captures all of this, it does not reliably indicate zone 3 disease. And, although screening guidelines recommend follow-up in 2 weeks for infants diagnosed with immature zone 2 ROP, the cameras are not reliable enough to provide images that we can use to diagnose pathology in zone 3, which may potentially develop into plus disease. To cover against the possibility of disease that the camera cannot see, I screen these children again after only 1 week. As the number of babies that have gone through the program grows each year, all of the data seem to support telemedicine as a very effective screening mechanism of ROP.

RT: How have advances in technology impacted the SUNDROP program?

Dr. Moshfeghi: Following the official acceptance of widefield digital imaging for the diagnosis of ROP in 2013,² the greatest technical advance since the incep-

tion of SUNDROP has been the development of synchronization software, called RetCam Review Software. Previously, nurses had to download the images from the camera to a computer, attach them to a secured email, and, depending on the file sizes, send multiple emails. I then had to upload them to my server and verify with the sender what I had received. It was a time-consuming process prone to errors, such as sending only 1 eye of a patient, sending the same patient multiple times, and not sending other patients.

The addition of the RetCam Review Software enables files to be automatically uploaded to a shared server once the camera is plugged into the network. The software also allows side-by-side image comparison and optional patient demographics. I can efficiently evaluate the images directly on the server, make my report, and send it. This new system is faster and reduces the risk of user error.

Babies who go blind due to ROP sometimes lose vision because of technical difficulties or institutional disorganization. Any automation of the screening process helps reduce human error and gives these patients a higher likelihood of successful treatment results.

RT: Who takes the images, and how are these people trained?

Dr. Moshfeghi: I was very conservative during the early days of the SUNDROP program. For 6 months after the nurses received training and began imaging the infants, I would see each individual infant using binocular indirect ophthalmoscopy, let the nurses photograph them, and go to my office to interpret the images. I continued this pattern until I became convinced that we were not missing any treatment-warranted disease using this technique. Afterward, I would show them my technique for imaging, and then check in with them on an annual basis for training updates. Today, we identify nurses at each of the sites, the NICU purchases a camera, and the manufacturer does all of the training. Not only do they come to the site to install the camera and instruct the users, they also provide the needed mannequins, help photographers progress to their first live babies, and have online training modules for follow-up. I generally follow up with a visit to evaluate how they are doing and show them any additional tips I use to get the best images.

RT: What are the next steps for SUNDROP?

Dr. Moshfeghi: The next evolution in the SUNDROP program involves automating the recommended action.

We are developing an algorithm that will assess the diagnosis and automatically generate a recommended action report per the Early Treatment of Retinopathy of Prematurity guidelines. For example, if the specialist indicates zone 1, stage 3 without plus disease, the report will automatically generate a notice saying that treatment is required. As the only person currently reviewing all sites, I do this by myself. With the approval of the camera as a means of diagnosis for ROP by the joint statement screening guidelines, the program is now poised to expand to more locations. As multiple screeners and readers are added, automation of treatment recommendations adds a fail-safe mechanism. We have initiated a training program here at Stanford using the SUNDROP and have 6 qualified screeners.

RT: Are there plans to become a universal eye-screening program?

Dr. Moshfeghi: Following the success of specifically screening for ROP, we are investigating the usefulness of universal eye screening of babies. An unexplained 1% to 5% rate of vision loss exists in children due to amblyopia. Often, children are not screened until they enter kindergarten, by which time the opportunity to intervene and have a positive outcome has been missed. We have initiated the Newborn Eye Screen Test (NEST) to study the hypothesis that, with sufficiently early diagnosis, we can identify neonates with treatable pathology, make appropriate referrals, initiate treatment, and end with a positive outcome. We offer parents of newborns the opportunity to have their child screened and connected with a specialist if any questionable pathology is identified. So far, we have screened approximately 150 babies and are tracking their outcomes. The study is still in an early stage and babies are still being enrolled, but there are a lot of opportunities here.

RT: How will you determine success for the NEST program?

Dr. Moshfeghi: The goal for this program is to determine if a program like NEST, which seeks to diagnose and treat curable diseases, operates under an effective financial model. Generally, a 2% hit rate on pathology is necessary for a screening test to be economically feasible. If 1000 babies must be screened to catch 1 disease, the screening program is considered economically unfeasible.

RT: What is the Global Universal Eye Screen Testing (GUEST) program?

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Dr. Moshfeghi: We know that ROP screening works, and inclusive newborn eye screening programs similar to the NEST program at Stanford are being implemented in many nations, including China, Russia, Spain, and Brazil. We look forward to the data from all of these studies, and we hope we can use that information to find the best means of preventing childhood blindness due to ROP. To validate the technique and to identify the lowest level of training a screener requires to reliably identify eyes with pathology from normal eyes, we have initiated at Stanford the GUEST program. We have introduced into a database data on more than 10 000 babies from China and Brazil. All of these babies have been anonymized. We are evaluating cohorts of 4 screeners representing various levels of education and training to identify which cohorts can achieve an agreement rate of 98% or more at classifying eyes as normal or abnormal. Ideally, such a task can be performed by an allied health care professional, with secondary review and diagnosis performed by quaternary care experts.

RT: Do you see advantages to telemedicine other than accessibility?

Dr. Moshfeghi: I do believe that babies should be screened with a camera to provide quality control for the work of the readers. Readers need specialized training and must be up to date on all the nuances, treatments, and strategies for ROP.

It is always possible to review an image multiple times, and it is generally not feasible to examine a patient multiple times, so telemedicine gives doctors the opportunity to easily review cases as necessary. Doctors connected to the telemedicine network can forward photographs to 1 or 100 colleagues, with the world's top experts commenting in a matter of hours. Telemedicine enables every baby to have access to this quality of expertise, which increases the likelihood for the most accurate diagnoses. ■

Darius M. Moshfeghi, MD, is an Associate Professor of Ophthalmology at Stanford University and Founder and Director of SUNDROP. He states that he has an equity interest in Visunex Medical Systems.

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