

# ROP Screening Using Telemedicine

The history of the Stanford University Network for Diagnosis of Retinopathy of Prematurity.

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Screening for retinopathy of prematurity (ROP) is one of the most important activities that occur in the neonatal intensive care unit (NICU). ROP is the leading cause of blindness in children in the United States, and timely treatment usually results in prevention of blindness.

Prevention programs across medicine, in general, receive less attention than surgical treatments, and the same is true for ROP. The guidelines are clear in stipulating that ROP screening be performed for at-risk infants by ophthalmologists experienced in ROP screening using binocular indirect ophthalmoscopy (BIO). Additionally, the screening guidelines were updated in 2006 to include a larger cohort of infants, effectively raising the number of eligible infants for ROP screening by 33% (from 60,000 to approximately 80,000). At the same time, the American Academy of Ophthalmology issued a 2006 survey of its members who screened for ROP and found that nearly 25% of them would be discontinuing screening for ROP, largely because of financial considerations including low reimbursement for services, complexity of scheduling examinations, lack of hospital support, and, of course, the medicolegal risks associated with ROP.

## A SHORTAGE OF SCREENING SERVICES

In late 2005, I was experiencing all of these problems simultaneously, acutely, and from multiple institutions. Several screeners in the San Francisco Bay Area who had been providing services to NICUs had decided to end their screening services for a variety of reasons. It was a gradual process that had been building since my arrival at Stanford University in 2002, and I was recruited to “help out” until a longer-term solution could be imple-

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mented. It turns out that I was, unwittingly, the longer-term solution. As with all situations such as this, you never realize the depths of the waters until you are alone and can no longer see the shore.

I had started helping out at a county NICU, and I assumed full-time screening services when their ROP screener moved out of the area. In short order, three smaller regional NICUs with affiliations with Lucile Packard Children’s Hospital (LPCH) at Stanford all were requesting services, infrequently at first, but gradually increasing in demand. In the beginning, it was not a problem, more of an inconvenience—I would drive over the mountains to Santa Cruz and see one baby each week for 3 weeks, then no one for 3 months. Or I would drive across the bay to Fremont and see a pair of twins weekly for 1 month, then no one for a few months. The volume began to increase, and soon, in addition to my contractual obligations at the county NICU, my “helping out” was beginning to eat up 2 days of my schedule. The babies were getting smaller, there were more of them, and I was being required to see some of them more than once a week—not to mention that I had a 4.5 day full-time vitreoretinal practice to attend to during the rest of the week. My life was hectic, my schedule was out of control, I was spending an inordinate amount of driving time to see a few babies, and I was doing it frequently.

## FINDING A WORKING SOLUTION

Since my ocular oncology fellowship, I had been fascinated with the potential of using the RetCam (Clarity Medical Systems, Pleasanton, CA) for screening of ROP. In retinoblastoma, the technology had been truly paradigm-shifting, allowing physicians to photographically document the size and location of tumors throughout the fundus, as well as the patient's response to treatment, as opposed to extended ophthalmoscopy drawings. In fact, during my ocular oncology fellowship, I had worked with Steve Charles, MD, and his fellows to utilize the RetCam for documentation of ROP and had even come up with preliminary plans to utilize photographic screening for ROP. My fellowship ended, however, and as I headed off to learn about the retina for 2 years, I largely forgot about the RetCam. Now, however, my own screening problem was acute, and I was being forced to reconsider how much "helping out" I could afford to provide to these NICUs. I had some discussions with the LPCH leadership at the time, explained the problem from the NICUs' perspective regulatory requirement to screen and my own—(not having enough time to screen and perform my other clinical duties). From these initial discussions and my description of the use of the camera as a potential physician extender, the concept of the SUNDROP network was born.

## INITIAL IMPLEMENTATION

SUNDROP is an acronym for the Stanford University Network for Diagnosis of Retinopathy of Prematurity. LPCH agreed that the affiliated NICUs needed to have uninterrupted screening services and recognized that it was untenable for me to provide these services because of the unpredictability of the volume and intensity of the risk for these infants. They purchased four cameras and made them available for the NICUs. I had extensive discussions with the personnel at a small level-2 NICU and found them receptive to the idea of using photographic screening and identifying their own nursing personnel to take the actual photographs. Additionally, I contacted Clarity Medical Systems, and they arranged to have a certified ophthalmic photographer train the nurses in the use of a camera for premature infants. Initially, I requested five photographic fields in each eye: optic nerve centered, up, down, nasal, and temporal. When the PHOTO-ROP protocol was made available, I included an external photograph of the iris in each eye.

In the beginning, I really did not know what to expect. My own bias was that if I was taking the photographs and then sending them to myself for review, it would probably work, even without a bedside BIO examination. Whether a nurse with a short training period could deliver photographs of sufficient quality for me to render an opinion

whether treatment or bedside BIO was warranted or not remained an open question in my mind. So I compromised and performed bedside BIO on each patient at the NICU for several weeks immediately preceding the photographic documentation. I was pleasantly surprised; with this NICU team, I was satisfied that I was receiving photographs with sufficient information to make informed clinical decisions, so we proceeded with a camera-first strategy.

## TESTING SUNDROP ON A LARGER SCALE

Our initial successes with SUNDROP caused the county hospital to be interested in trying it. This level-3 NICU had a significantly higher volume; in a slow year they had 4,000 deliveries, and at any given time there were several babies weighing less than 800 g and of less than 25 weeks gestation. After they purchased a RetCam and the nursing personnel were trained, progress was slow. Initially, the nurses photographed new infants only on their first examination, while I continued screening as usual with BIO. Then we added the bigger babies—1000 grams and larger, always with accompanying BIO examinations. Shortly thereafter, we started adding the babies who were less than 1000 grams with accompanying BIO examinations. Each time, I was satisfied that the photographs were providing me with the relevant information to make clinically sound decisions with respect to ROP management. After nearly 6 months of evaluating the screening technique vis-à-vis BIO in this level-3 NICU, I stopped the confirmatory contemporaneous BIO examinations and proceeded with telemedicine as my primary method of screening at the county hospital. As with the level-2 NICU, I was satisfied that with careful supervision by me for nearly 6 months, appropriate clinical decisions regarding ROP management could be performed with the camera being used by the personnel at this level-3 NICU.

## THE CURRENT SUNDROP NETWORK

Using this stepwise approach, SUNDROP now includes four NICUs, all located in the San Francisco Bay area. Each time a NICU is added, a similar process of iterative training with a certified ophthalmic photographer, my oversight, and regular discussions with NICU personnel take place to ensure that we will have a smooth transition.

One common misconception is that SUNDROP is a study, and this may be propagated by the publications regarding our safety outcomes. In fact, SUNDROP is a community-based clinical outreach program to provide ROP screening services to underserved NICUs. In some cases, they are underserved because they are small and located away from population centers without access to experienced ROP screeners, and in other cases they are underserved because there are no willing, experienced

ROP screeners to provide services. In either situation, SUNDROP serves as a physician extender—in this case, an extender of a pediatric vitreoretinal surgeon. The goal remains the same: to identify at-risk infants for ROP who will need either confirmatory BIO examination or treatment. In those circumstances, the baby is then seen in person with bedside BIO by myself, either locally at the NICU or following transfer to LPCH.

As a screening program, the goal is not to identify all ROP in the eye, but rather to identify those babies who require further evaluation. The inherent limitations of photographic screening include lack of 3D visualization and reliance upon the photographer to provide adequate images. With respect to the former, this limitation is more than offset by the ability to digitally enhance the images and also to provide longitudinal comparison over several time points. In my experience, lack of adequate images is usually a learning curve problem that can be overcome with encouragement, oversight, and hands-on training.

#### FOLLOW-UP CRUCIAL TO SUCCESSFUL SCREENING

The final piece of the actual screening puzzle is to ensure that there is adequate follow-up upon discharge from the NICU. Termination is a two-part problem—the

first is to ensure that an adequate patient tracking plan is in place, and the second is to ensure that BIO examination actually occurs. This is crucially important because none of the four termination criteria (which involve characterization of retinal maturation, zone III, or regression) for acute phase screening of ROP can be reliably and reproducibly determined by the camera alone. Therefore, no child can be discharged from acute phase screening of ROP until confirmatory bedside BIO has been performed to document that termination criteria have been satisfied. In SUNDROP, this typically occurs within 48 to 72 hours of discharge from the NICU.

In conclusion, the SUNDROP community-based clinical outreach telemedicine initiative for ROP screening has been useful for identifying children who are at risk for the sequelae of advanced ROP. Since the inception of SUNDROP in 2005, we have had no baby progress to retinal detachment or blindness, nor any camera-related adverse events. ■

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