

Mobile Screening for Retinopathy of Prematurity: The KIDROP Model

BY ANAND VINEKAR, MD, FRCS

Facing the sizeable task of treating a rapidly growing population, India's neonatal intensive care medical community has seen success with its increased efforts: Even in rural areas, where access to physicians and medicine can be scarce, infant mortality rates have fallen substantially over the last 2 decades.¹ Today, India faces the challenge of treating sickness in infants who would have, only 2 decades ago, died. Many of the 3.5 million babies born prematurely each year in India are at risk of developing retinopathy of prematurity (ROP), a condition that, especially for infants born in rural areas, can, if left untreated, render blind entire swaths of a generation.² Sixty-nine percent of India's 1.2 billion people live in rural areas with little access to medical care, necessitating a mobile screening program to identify and treat infants who are at risk for ROP.

We at the Narayana Nethralaya Postgraduate Institute of Ophthalmology (NNPIO), in Bangalore, India, developed a mobile, tele-ROP platform to address this issue. We call the program the Karnataka Internet-assisted Diagnosis of Retinopathy of Prematurity (KIDROP).³⁻⁷ Started in 2008, KIDROP combines the efforts of pediatric retina specialists and nonphysician field teams. Field teams, after rigorous validation and certification,³ travel to rural and semirural neonatal intensive care units (NICUs), scan at-risk infants for ROP on a widefield digital retinal camera (RetCam Shuttle, Clarity MSI), and send images for review to ROP specialists at the NNPIO. To ensure continuity of care in the field, technicians are trained in reporting these images using a unique triaging color code—red for type 1 ROP, orange for type 2 ROP, and green for a normal or mature retina. Although all images are uploaded on a secure tele-ROP platform for experts in NNPIO to view live and analyze, the images flagged red are given priority, because the diagnosis must be provided to the rural mother at the end of the session before she returns from the field center to her village. The ROP

specialist instantly reviews these images on his or her smart phone and determines if emergency treatment is required.³ So far, KIDROP has completed over 46 000 imaging sessions, and ROP treatment procedures have been performed on over 1000 babies.

FINANCING THE PROJECT: THE PUBLIC-PRIVATE PARTNERSHIP

The first hurdle any startup must clear is that of funding. Starting in 2008, we worked for 18 months on a pilot program covering private and public hospitals in the immediate vicinity. We submitted data from the pilot to the Karnataka state government. Determining that the data demonstrated that a mobile screening program for ROP showed promise, the Karnataka state government offered KIDROP funding for more equipment and technicians. Since receiving this funding, we have expanded our coverage from 3 to 81 neonatal health centers, which include some of the most remote and underdeveloped areas of the state. Due to its success, KIDROP has caught the attention of the federal government, which constituted a National Task Force for ROP, a group of experts who have set out to expand ROP services across the nation and are considering mobile screening initiatives that follow the KIDROP model.

Financial contributions from the public sector (state and federal funding) and the private sector (NNPIO) have allowed KIDROP to flourish. The public sector provides funding for our field teams, and the private sector finances the doctors at NNPIO who diagnose images submitted by the field teams and provides training for the key team members. As long as this public-private partnership continues to provide KIDROP with funding, the program will sustain its effectiveness and will expand. Expansion within India is impossible without this funding model.

STRUCTURE

The field teams that scan infants are made of nonphysicians. Each team is composed of 3 to 4 people: a manager,



Figure 1. A field technician scans an infant using the RetCam Shuttle as a team manager observes.

1 or 2 technicians, and a driver. Per the requests of the governments that help fund KIDROP, the team managers hold a masters of business administration degree. Managers serve as liaisons between specialists of NNPIO and local doctors and nurses. Also, managers help educate new mothers on the importance of follow-up visits, schedule visits for patient screenings, and record all data obtained during screening sessions.

The field technicians operate the equipment assigned to each field team: a RetCam Shuttle and a laptop equipped with a software system developed in-house called Tele-Care (i2i Telesolutions). Technicians scan all of the infants enrolled in the program, upload the retinal images to their laptops, and send the images through Tele-Care to specialists at NNPIO for review (Figure 1). Specialists are able to review these images remotely, either by viewing the images on the RetCam Shuttle at NNPIO or, as of 2009, on their iPhones, which offer image quality as high as a RetCam Shuttle (Figure 2).³ The ROP expert, upon review, recommends treatment and follow-up regimens.

To track and train field technicians, we developed a 20-point accreditation score which measures, among

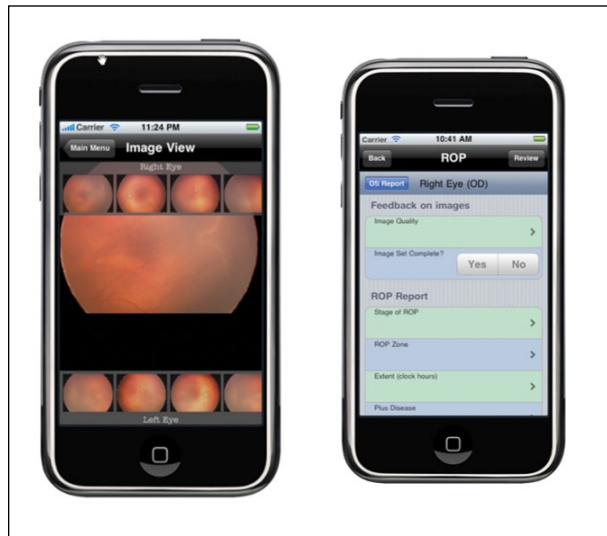


Figure 2. The Tele-Care software displayed on an iPhone, allowing retina specialists to make a diagnosis and submit it to a field team.

other things, the ability of the technician to obtain useful images, the speed at which the technician can obtain images, and the ability of a technician to accurately interpret patient images.³ Once a technician passes the 20-point accreditation system, he or she is authorized to group patients into the color triage categories. Based on their skill set, technicians become level 1, 2, or 3. We require approximately 30 working days to train a novice for a level 1 and 90 days for a level 3.³ A level 3 technician serves as a surrogate pediatric retina specialist in the outreach, a requirement germane to the success of this program in a country with fewer than 40 comprehensive ROP specialists.

SELECTION OF INFANTS

Determining the gestational age for many of our rural patients is impossible: mothers may not know the date of conception, and we do not consider their estimates a reliable factor for determining whether an infant is premature. Instead, we rely on birthweight, enrolling all infants under 2000 g (4.41 lbs).⁸ Because the birthweight cutoff is not strictly enforced, we have found that approximately 6% of babies who needed treatment were heavier than 2000 grams.^{3,4}

To increase enrollment in centers not regularly visited by our field team, we developed the REDROP strategy.⁷ This strategy (called REDROP because we gave red cards to mothers whose babies were < 2000 grams at birth) involves calling mothers on their mobile phones to schedule appointments. The cost of enrolling a baby in KIDROP is low—less than \$0.05 USD—and is highly effective at increasing awareness among other expecting mothers.⁷

TREATMENT METHODS

Once a baby flagged red is confirmed to require treatment, laser treatment is provided either at the rural outreach by a KIDROP specialist or at NNPIO in Bangalore where an ROP specialist from our team treats the child. We provide funding for the patient to travel to Bangalore if the procedure cannot be provided at the rural outreach. The field team schedules a follow-up with this patient so they can acquire post-treatment images and send them to NNPIO for analysis. In the event that a physician is unable to travel to the patient's NICU, KIDROP arranges for a local expert to visit and treat the patient.^{3,4}

The field team arranges a follow-up appointment for more imaging if a patient is placed into the orange category. If the patient's ROP has regressed and the images indicate that the retina is mature, then the field team schedules a final follow-up appointment. If the patient's ROP has advanced, is followed the protocol for a patient in the red group.³

Follow-up does not necessarily end after a patient presents with mature retinas in both eyes. Patients who have finished with treatment are encouraged to visit the KIDROP headquarters in Bangalore for follow-up visits at 3, 6, 9, 12, 18, and 36 months (of corrected age), and then annually. Based on this data, we have developed a nomogram that reliably predicts a patient's vision at 24 months based on what he or she presents at 3 months. (This nomogram will be presented at the Association for Research in Vision and Ophthalmology 2014 meeting this May).

Field teams often find indications of other eye-related conditions when screening for ROP. For example, at a government hospital in Bangalore, 4.8% of 1021 healthy term infants screened by our team had some eye abnormality that presented within 72 hours of birth. Nearly 9 in 1000 of these babies (0.9%) had medically or surgically manageable diagnoses which have included retinoblastoma and cataract. We comanaged these diseases with a pediatrician.

Encouraged by the success of our universal screening data, we initiated a new program called FOREVER: Focus on ROP, Eye care, Vision, Eye cancer and Rehabilitation. The government recently expanded universal imaging to 15 public hospitals in the KIDROP network, and the pilot results are expected in the first quarter of 2014.

EXPANSION

With more than 81 centers currently in our state and 4 other states' programs modeled on our program, the

KIDROP network is among the largest and most expansive ROP screening programs in the world. Additionally, following the FOREVER model, India's implementation of a universal screening program, the Rashtriya Bal Swasthya Karyakram—a program that covers 30 systemic conditions for all the 27 million annual live births in India—is moving forward.

The KIDROP model is successful because it addresses issues that are particular to India's unique circumstances: developing infrastructure, shrinking infant mortality rates, low rates of ROP awareness, and inadequate ROP services. The model can work in other middle-income nations that face similar problems. We have been invited to speak about the KIDROP model in a few of these nations, sharing our experience on how others can adopt KIDROP's tenets in order to build their own mobile screening programs. Despite a few differences in execution and financing, these programs share ideological and cultural similarities and are likely to be successful in their respective nations. The nations developing mobile screening programs for ROP include Thailand, the Philippines, Indonesia, Russia, Mexico, Saudi Arabia, the United Arab Emirates, and South Africa.

As in India, doctors' and patients' awareness of the long-term benefits from a program like KIDROP is integral to its success in other nations. As this awareness increases and mobile technology improves, mobile screening programs will have positive effects in the developing world, preventing curable blindness from ROP for generations.

For more information on KIDROP, please visit www.kidrop.org or scan the QR code to the left. ■



Anand Vinekar, MD, FRCS, is the Head of Pediatric Retina Services and the Program Director of KIDROP at the Narayana Nethralaya Postgraduate Institute of Ophthalmology in Bangalore, India. Dr. Vinekar states that he has no financial interests to declare. He may be reached at anandvinekar@yahoo.com.



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