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Tele-ophthalmology model for ROP management

Planning and implementing a retinopathy of prematurity management programme in developing countries

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Retinopathy of Prematurity (ROP) is a potentially blinding disease that affects premature infants when normal blood vessels fail to complete their growth cycle to the edges of the retina. In its advanced stages, the untreated disease can result in permanent and complete blindness. ROP is the leading cause of childhood and infant blindness in the developed world.

Of the 50,000 children who are blind from ROP worldwide,¹ it is thought that the majority are in middle income countries such as India and Latin America, which are currently believed to be experiencing a "third epidemic" of ROP. Several possible reasons exist for this including: higher birth rates and higher rates of premature births; compromised neonatal care due to lack of resources, leading to higher rates of severe ROP not only in extremely premature infants but also in larger, more mature infants; and lack of screening and treatment programmes due to lack of awareness, skilled personnel and financial constraints.

The magnitude of the problem in India can be gauged by looking at the government's census report. Incidence of ROP in India is reported to vary between 38–51.9% in low birth weight infants.²⁻⁴ In 2007, roughly 27 million live births were recorded in India with approximately 8.7% believed to be below 2000 g at birth⁵ and 1-2% estimated to be premature and at ROP risk. If it were to be assumed that only 50% survive and 50% reach neonatal care centres, the number of babies requiring screening would amount to 65,000 to 130,000 infants each year. Ten to fifteen percent of these have the potential of going blind if untreated.

In order to plan and implement a ROP management programme, it is essential to accurately delineate the population of 'infants at risk' for the disease. In highly developed, industrialised countries the population of premature infants who are currently at

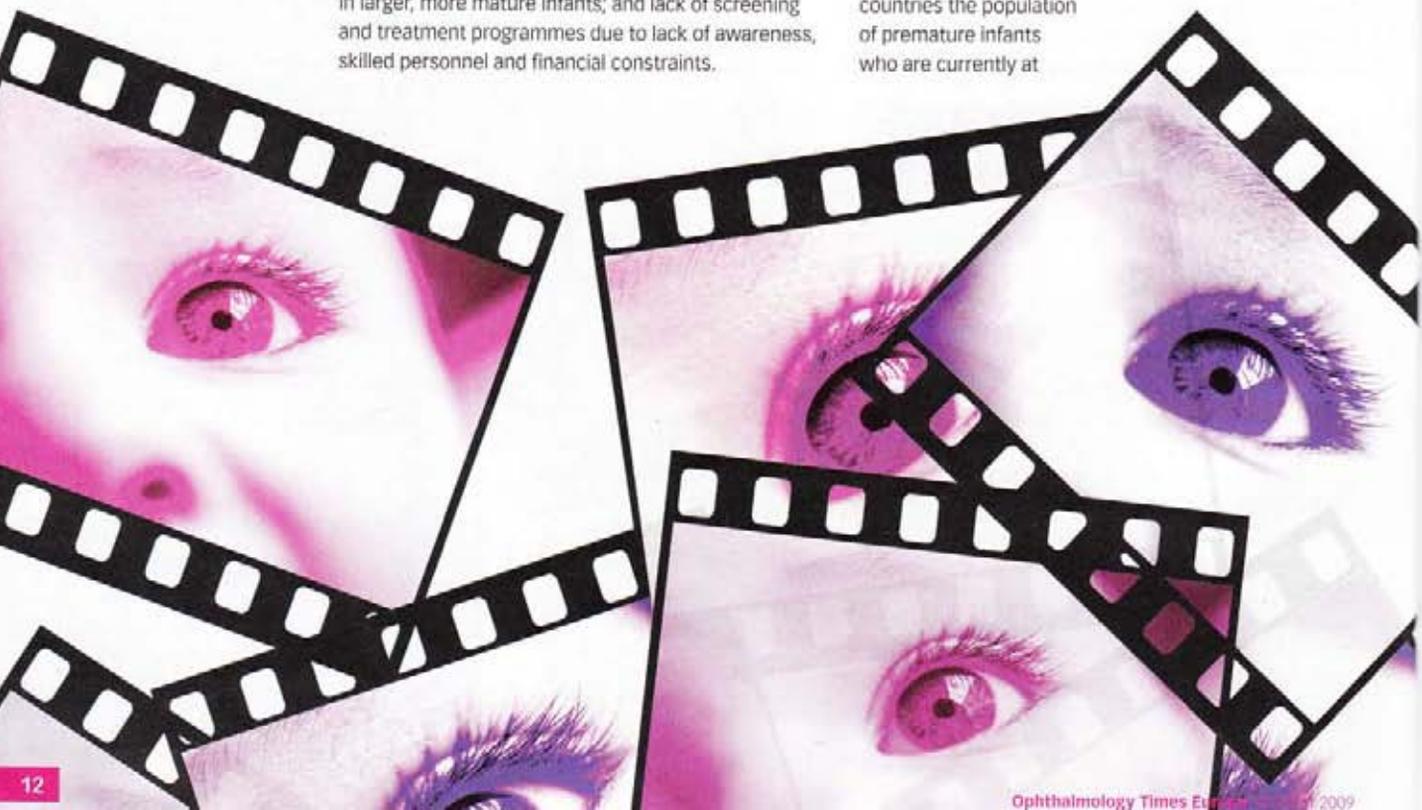


Figure 1: RetCam images of the right and left eye respectively, showing zone I disease with severe plus disease with neovascularization characteristic of aggressive posterior ROP (APROP) that was imaged and diagnosed by the non-physician in a rural centre in Southern Karnataka, India.



risk for treatment requiring ROP is extremely premature, with birth weights almost always less than 1000 g. The screening guidelines in the United States indicate that retinal examinations should be given to infants with a birth weight of less than

1500 g or with a gestational age of 32 weeks or less and selected infants with a birth weight between 1500 g and 2000 g or gestational age of more than 32 weeks with an unstable clinical course and who are believed to be at high risk.⁶

ROP screening must be completed within a very small window of time. The disease usually manifests within 3-4 weeks of birth and progresses within the subsequent 6-8 weeks to complete retinal detachment. Appropriate screening and timely treatment using the ETROP guidelines⁷ will result in > 90% success of vision preservation. Even aggressive posterior ROP (APROP) in Asian Indian babies show a satisfactory outcome if treated early.⁸

However, screening guidelines need to be more broad in developing countries, precisely the same places that already lack personnel to carry them out. Experience in India indicates that *all* babies with a birth weight less than 2000 g⁹ be screened by an ROP trained ophthalmologist within the first month of life, with subsequent screenings dictated by the initial findings.

This data coincides with a study by Gilbert *et al*¹⁰ which shows that the mean birth weights of infants with severe ROP in highly developed countries are lower than in moderately and poorly developed countries. In the three highly developed countries, the mean birth weight values all were <800 g, whereas the mean values for the other countries all were >1000 g. The mean gestational age (GA) values of infants with severe ROP in highly developed countries all were <26 weeks, which was lower than the values for the other countries, which ranged from 26.3 weeks in Lithuania to 33.5 weeks in Ecuador. Overall, 142 (13%) of 1091 infants in this study with severe ROP from moderately and poorly developed countries had birth weights and GAs exceeding those recommended for screening by the Royal College of Ophthalmologists of the United Kingdom.

With less than 400 trained retinal surgeons (2008) and less than 20 centres capable of comprehensive ROP screening and management services in all of India, the challenge lies in using these limited resources to provide screening (and treatment) to the underserved areas of the country.



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Tele-ophthalmology in action

In an ongoing tele-ROP programme in India, a team of highly trained technicians uses the RetCam (Clarity Medical, Pleasanton, CA) to take wide-field digital fundus images of infants in over 18 rural and semi-urban neonatal care centres.¹¹ The RetCam is a specially designed ophthalmic camera capable of imaging infants and small children. The portable RetCam (Shuttle) is easily transferable between hospitals and clinics and enables the digital images to be directly transferred to a network allowing timely remote evaluation of patient images by experts.

The technicians in India have not just been trained to capture the images, but also to process and store them. In addition, they perform another vital step; they analyse the images and have been trained to diagnose and decisively triage the infants screened. While the concept of trained technicians analysing images in place of ophthalmologists may worry physicians in the most developed countries, in India and other similar countries it seems almost necessary. Due to the massive numbers of babies that need to be screened and the limited number of trained physicians, there is simply no other way.¹¹

In the Indian programme, it has been found that technicians are excellent at diagnosing treatment-requiring ROP, zone 1 ROP and even aggressive posterior ROP (APROP). This expertise has been developed over 18 months and after screening over 1200 infants with over 50,000 digital images. Recently, it has been suggested that the store-and-forward protocol of telemedicine in ROP management provides a quality tool, which is accessible and cost-effective.¹² Its role in other countries (like India) with a paucity of trained ROP physicians, seems to provide an exciting opportunity.

While binocular indirect ophthalmoscopy (BIO) is currently the gold standard in ROP screening worldwide, it is perhaps only a matter of time before that is replaced by wide-field digital imaging. As more studies are completed and confidence levels increase, wide-field digital photography

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is likely to replace BIO as the primary modality of screening for ROP. Studies have already shown that the RetCam's telemedical screening programme can detect all cases of treatment requiring ROP.¹³ In addition, digital imaging requires significantly less time as compared to BIO¹⁴ and serves as a permanent document which lends itself to scrutiny and review even in a medico-legal scenario.

These factors and more could influence the manner in which we would screen and manage ROP in the years to come with growing emphasis on digital imaging. While the Indian programme is set for expansion into other parts of the country, similar

models must be validated in other developing countries with similar demographic profiles. Only concerted and swift action will help us battle the growing epidemic of ROP in middle-income countries.

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Figure 2: A montage of several RetCam images put together by the trained technician to depict the 360 degree characterization of the ora serrata.

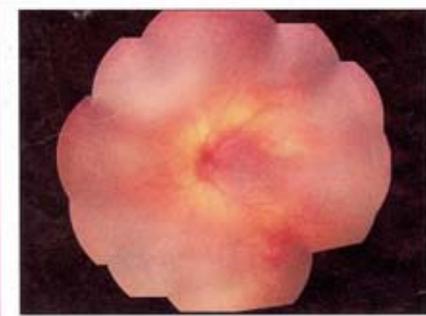
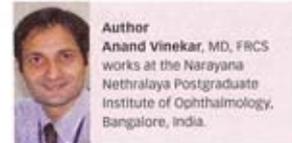


Figure 3: Mothers with their infants awaiting their turn for ROP screening by the tele-ROP team in a rural district in Southern Karnataka, India.



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