

# Universal newborn eye screening: an effective strategy to improve ocular health?

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Universal newborn eye screening is gaining increased interest as a potential way to reduce long-term visual impairment through early identification of ocular abnormalities. The number of skilled healthcare providers available to provide bedside examinations for a universal newborn eye screening program is inadequate, but advances in retinal fundus imaging and telemedicine systems have enabled the execution of several pilot studies in India, China and the United States.<sup>1–3</sup> In the study by Goyal and colleagues, they report on fundus image screening of 1152 newborn infants in an Eastern Indian hospital from March 2014 to October 2015.<sup>4</sup>

Basic neonatal and infant eye screening has traditionally been administered through direct patient contact by neonatologists and pediatricians, who would perform eye inspection, pupil reflex, ocular motility, and red reflex assessment. Infants may then have an examination by the ophthalmologist if determined to be at risk of eye pathology or if they qualify for routine retinopathy of prematurity (ROP) screening. Likewise, referral for specialist examination is recommended in children with a family history of childhood eye disease or with conditions associated with eye disorders. Traditional visual acuity testing using letters or age-appropriate optotypes commonly begins around 3 years of age, with preferential looking tests allowing for gross assessment of acuity at an earlier age. Subsequently, school-based and community programs present further opportunities for efficient screening. However, these traditional models of screening to identify children who are at risk of sight threatening conditions may require significant human resources and have high variability of the

number of children screened if not implemented appropriately.

A universal newborn eye screening program using fundus imaging and telemedicine approaches can be most valuable if it identifies individuals with conditions where earlier clinical intervention can influence and improve visual or clinical outcomes as compared to the identification of disease with current screening methods.

It is clear that universal newborn eye screening will identify many additional abnormalities on the initial ophthalmic examination that otherwise will never have been known without examination. What we do with this information and how clinical management may be altered from this remains less certain. As we assimilate the evidence and analyze the significance of universal newborn eye screening, we have to critically approach the crucial question of the true long-term functional benefit and cost-effectiveness of such an endeavor.

## What is the significance of retinal hemorrhages in newborns?

The reported incidence of fundus hemorrhages in infants has varied widely among studies, with rates ranging from 2 to 50%. Institutional sampling bias affects the rate of fundus hemorrhages as vaginal delivery, in particular with the use of instrumentation (eg, forceps or vacuum), is associated with a higher risk of infant fundus hemorrhages.<sup>5,6</sup> When the rate of vaginal delivery was low (3.1%), as reported in the study by Vinekar *et al.*,<sup>3</sup> the incidence of fundus hemorrhages was also low (2.4%). Many of these hemorrhages resolve spontaneously within 1–2 weeks without clinically significant long-term visual impairment. However, some hemorrhages persist for a longer duration, and accounted for 27.82% of total retinal

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hemorrhages according to Li *et al.*<sup>2</sup> Some authors have postulated that early visual limitation may limit normal optical development, potentially resulting in visual disturbances such as anisometropia and amblyopia later in life.<sup>2</sup> The ongoing newborn eye screen test (NEST) study at the Stanford University School of Medicine aims to 'determine the long-term vision outcomes of patients with various types of fundus hemorrhages and determine the incidence of amblyopia among those with and without fundus hemorrhages at birth'.<sup>1</sup> Longitudinal studies such as NEST will help uncover the significance of ocular findings in newborns.

### Can we justify the cost for universal newborn screening?

Authors of all the pilot studies investigating universal newborn eye screening recognize that system costs and labor requirements of a universal newborn eye screening system have to be balanced against potential cost benefits from improved visual outcomes. Goyal *et al.*, in this most recent study, attempt to calculate the estimated cost benefit of the project and found that the cost of the imaging system was a major factor. Overall, the investigators determined that there was a net monetary gain for the project when you take into consideration, among a number of other factors, the potential financial loss incurred by a blind child. In the future, to determine the true cost-effectiveness of a universal newborn eye screening program, studies should aim to determine the cost benefit for the detection of modifiable pathology that would not have been identified with current screening methods.

In comparison, Li *et al.* and Vinekar *et al.* present evidence that a significant number of intervention-warranted conditions will be detected specific to a universal newborn eye screening system. Conditions such as posterior uveitis, salt and pepper retinopathy, significant retinal hemorrhages and retinoblastoma may be identified in infants who would not necessarily be examined with current screening guidelines. Therefore, universal newborn eye screening programs could provide these children with the opportunity to then receive appropriate medical or surgical intervention to improve outcomes.

### Expanding the ROP telemedicine model for universal newborn eye screening

A similar fundus image screening concept on a more targeted scale is that of the use of telemedicine for retinopathy of prematurity (ROP) screening. Telemedicine in ROP developed as a potential solution to a shortage of ophthalmologists required for ROP screening.

The screening of every newborn may exacerbate the shortage of experts skilled in physical eye examinations and indirect ophthalmoscopy. Wide-field fundus imaging has been shown to be performed effectively by technicians and allied health professionals, which then allow for remote interpretation of images at a centralized location, reducing the burden of bedside examinations. In the current study, Goyal *et al.* utilized ophthalmology residents to perform the initial image interpretation. Although this is a potentially reasonable model for universal newborn eye screening, it has been demonstrated that for ROP screening, diagnostic accuracy for ROP is affected by the experience of the image grader.<sup>7–11</sup> Therefore, it would be important to understand, in a well performed prospective study, the ability of physician and non-physician graders to accurately and reliably identify disease that requires referral in a universal newborn eye screening program. Indeed, three out of four pilot studies on universal newborn eye screening have been performed as expanded versions of ongoing ROP telemedicine programs.<sup>1,3,4</sup> Establishment of an efficient fundus imaging and evaluation system for universal screening for a disease like ROP may eventually facilitate expansion to universal newborn eye screening.

### Summary

Fundus imaging of newborns has been proposed as a safe procedure with few side effects. The ideal of having every individual newborn undergo high resolution, wide-angle fundus image screening evaluation by an experienced Ophthalmologist is tempting and has promise. Nevertheless, the ultimate feasibility of any such system will have to be evaluated responsibly and ethically, and based on the balance between its costs and the true impact it may have on improving the ocular and overall health of children enrolled in these programs.

### Conflict of interest

RVPC is a consultant for Visunex Medical Systems, Allergan, Alcon, and Bausch and Lomb. RC declares no conflict of interest.

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