

Doctors of Optometry Offer Rural Hospitals Timely Diagnosis of Retinopathy of Prematurity and Other Causes of Childhood Vision Loss

Retinopathy of prematurity (ROP) is a disorder of the developing retinal blood vessels in premature infants who are low birth weight. ROP most often develops in both eyes and is a leading cause of childhood blindness. ROP predominantly affects premature infants weighing about 2¾ pounds (1250 grams) or less who are born before 31 weeks of gestation, as opposed to a full-term gestation of 38 to 42 weeks. In almost all full-term infants, the retina and its blood vessels are fully developed, and thus full-term infants are not at risk for ROP and do not require ROP screening.

The smaller and more premature a baby is at birth, the more likely that baby is to develop ROP and it is these babies that require precisely timed dilated retinal examinations performed by an eye doctor. The examination consists of binocular indirect ophthalmoscopy (BIO), a routine procedure performed by optometrists and ophthalmologists. BIO provides a wide field of the retina and stereoscopic view. BIO also allows dynamic observation of the retina by moving the BIO device, lens and applying scleral depression. The process is “indirect” because the retina is viewed through a hand-held condensing lens.

Several complex factors are responsible for the sequential nature and development of ROP and result in precise recommendations for the premature infant eye examination schedule, based on gestational age, used by hospital neonatal intensive care units (NICUs).

The eye starts to develop at about 16 weeks of pregnancy, when the blood vessels of the retina begin to form at the optic nerve in the back of the eye. The blood vessels grow gradually toward the edges of the developing retina, supplying oxygen and nutrients. During the last 12 weeks of a normal 38-42-week gestational pregnancy, the eye develops rapidly.

When a baby is born full-term, the retinal blood vessel growth is mostly complete. But if a baby is born prematurely, before these blood vessels have reached the edges of the retina, then normal vessel growth might stop. The edges of the retina—the periphery—might not get enough oxygen and nutrients.

In response, the periphery of the retina then sends out a chemical trigger or signal (e.g. including vascular endothelial growth factor (VEGF) to other areas of the retina to stimulate vessel growth for nourishment. This trigger may start in the fetus prior to birth, indicating some prenatal conditions may play a factor. As a result, new abnormal vessels begin to grow. These new blood vessels are fragile and weak and can bleed, leading to retinal scarring. When these scars are not able to expand (as the eye continues to grow), they pull on the retina, causing it to detach from the back of the eye. If the retina does not detach, the central vision area of the retina (i.e. the macula) can become distorted and/or retinal folds can occur. All these factors lead to decreased vision.

Regardless of the gestation age at birth, ROP seems to occur at about 37-40 weeks. Therefore, recommendations for the timing of the first eye exam for premature infants are calculated by the gestational age in weeks at birth and range from four weeks to nine weeks after premature birth.ⁱ

The American Optometric Association (AOA), together with many other organizations, endorses an ROP examination schedule based on gestational age, noting that many of these children will require multiple examinations to detect the presence or development of ROP.^{ii iii} In addition to birth weight and how early a baby is born, other factors contributing to the risk of ROP include anemia, blood transfusions, respiratory distress, breathing difficulties and the infant's overall health. Very low birth weight (<1500 g), young gestational age (fewer than 30 weeks), prenatal infection, hyperbilirubinemia, respiratory disorders, asphyxia and lengthy mechanical ventilation were associated with an increased risk of visual impairment such as retinal detachment, myopia (nearsightedness), strabismus (crossed eyes), amblyopia (lazy eye), and glaucoma. In many cases, these eye problems can be treated or controlled.^{iv}

While eye examinations are critical for these high-risk children, many hospitals in rural and underserved areas lack access to an on-site qualified ophthalmologist. In fact, nearly 70 percent of primary care pediatricians in rural areas report that too few qualified ophthalmologists are available to meet the needs of their patients. They state, "implementation of routine use of this screening method for at-risk premature infants has presented challenges within our existing care systems, including relative local scarcity of qualified ophthalmologist examiners in some locations and the remote location of some NICUs."^v Continuity of eye care is also an issue, as 20 percent of these premature infants without ROP will still develop a crossing or turning out of the eyes and significant refractive problems requiring prescription eyeglasses and other treatments, such as vision therapy and vision rehabilitation.

Rural hospitals represent more than half of all hospitals in the U.S.; however, growing pediatric ophthalmology presence in rural areas is not feasible, due to very low provider numbers as pediatric ophthalmologists tend to practice near major metropolitan teaching hospitals. Fortunately, a growing optometry presence in these rural areas is feasible and can become activated to provide needed access to eye examination for high risk infants in rural NICUs.

Importantly, the "gold standard" procedures performed in ROP examinations; including but not limited to, dilation and binocular indirect ophthalmoscopy with a lid speculum and scleral depression (as needed) to detect ROP can be performed by state licensed and regulated doctors of optometry throughout the U.S. As of February 2018, doctors of optometry practiced in more than 10,176 communities and counties that account for 99 percent of the U.S. population.^{vi} This represents the possibility for immediate access for ROP eye exams in rural hospitals with a NICU, and a significant "rural growth opportunity" to fully address the vision health needs of rural children and families.

The Rural Health Association states: "Efforts must be made to attract more optometrists to rural areas" and recommended that "to improve rural Americans access to care, the Social Security Act be amended to include optometry in the Graduate Medical Education (GME) program of Medicare."^{vii}

Although these recommendations are not specific to ROP care, it does illustrate the need and future potential impact that doctors of optometry have in improving health care access in rural areas of the U.S.

Today, with advances in neonatal care, smaller and more premature infants are being saved. While pediatric ophthalmology departments within large medical centers (i.e. Children's Hospital of

Philadelphia) are now advocating for the development and wide-spread use of a hospital-based telemedicine screening program for ROP,^{viii} “large-scale” operational digital imaging systems with remote interpretation has not proven superior to binocular indirect ophthalmoscopy, performed in the NICU by a local doctor of optometry. Telemedicine screening for this neonatal population is problematic. The results of one study determined that ROP telemedicine screening was only recommended in developing countries.^{ix}

Rural hospitals in the U.S. also face both staffing and cost challenges to implementing and operating an ROP telemedicine screening program. The wide-angle camera needed to capture these pictures costs upward of \$80,000 and will likely depreciate quickly. The personnel required to perform the imaging are a recurring cost, and in small rural nurseries with few ROP cases, their skills will atrophy. The follow-up examinations required of one to three weeks is additionally problematic for telemedicine systems.

Other costs to rural hospitals arise from payments to doctors who read the images and those who are tapped to see referral-warranted cases. While a low birth weight neonatal infant could be transferred elsewhere for an eye exam, that cost is thousands of dollars. Additionally, wide-angle photography will not capture all four quadrants of the retina. Infants requiring eye care must receive treatments within 1-3 days and thus, a missed diagnosis by photo means a child will likely lose vision permanently. For these reasons, lawsuits are not likely to diminish with use of ROP telemedicine.

On the other hand, the doctor of optometry while cribside in the NICU can conduct an in-person real-time exam, study the medical record, and review the demographics, rate of disease progression, and overall status of the infant, including examination of the outside of the baby’s eyes for infection, eye turn, and lid lag, assess any neurological defects, and the lens for cataracts. Doctors of optometry should be recruited for rural hospital staff and granted hospital NICU privileges.

A policy that activates qualified doctors of optometry to rural hospitals can serve the 28,000 infants born each year weighing 2¾ pounds (1250 grams) or less. State Medicaid systems are facing high rates of lower birthweight live births. The most recent Medicaid State Health System Performance Scorecard shows that 9.1 percent of all live births recorded weigh less than 2500 grams (5.5 pounds).^x

Nationwide, about 14,000–16,000 infants at the lower end birthweight, weighing 2¾ pounds (1250 grams) or less, are affected by some degree of ROP. About 90 percent of all infants with ROP are in the milder category and do not need treatment. About 1,100–1,500 infants annually develop ROP that is severe enough to require medical treatment. Finally, the activation of qualified doctors of optometry to rural hospitals can help avert approximately 400–600 infants each year in the U.S. becoming legally blind from ROP.

ⁱ Fierson WM, AAP AMERICAN ACADEMY OF PEDIATRICS Section on Ophthalmology, AAP AMERICAN ACADEMY OF OPHTHALMOLOGY, AAP AMERICAN ASSOCIATION FOR PEDIATRIC OPHTHALMOLOGY AND STRABISMUS, AAP AMERICAN ASSOCIATION OF CERTIFIED ORTHOPTISTS. Screening Examination of Premature Infants for Retinopathy of Prematurity. *Pediatrics*. 2018;142(6):e20183061

ⁱⁱ <https://www.aoa.org/news/clinical-eye-care/aoa-leaders-question-telemedicine-screenings-for-rop>

ⁱⁱⁱ <https://www.aoa.org/news/clinical-eye-care/premature-babies-low-birthweight-eyes>

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- ^v Fierson WM, Capone A and the AMERICAN ACADEMY OF PEDIATRICS SECTION ON OPHTHALMOLOGY, AMERICAN ACADEMY OF OPHTHALMOLOGY, and AMERICAN ASSOCIATION OF CERTIFIED ORTHOPTISTS; Telemedicine for Evaluation of Retinopathy of Prematurity, *Pediatrics* January 2015, 135 (1) e238-e254
- ^{vi} <https://www.aoa.org/documents/HPI/HPI%20Uniform%20Edit%20Format%20ACCESS%20TO%20EYE%20CARE.pdf>, accessed 10.22.2019
- ^{vii} <https://www.ruralhealthweb.org/getattachment/Advocate/Policy-Documents/Workforce8EyecareOctober2009.pdf.aspx?lang=en-US>
- ^{viii} Gurwin J et. al., Tiered Approach to Retinopathy of Prematurity Screening (TARP) Using a Weight Gain Predictive Model and a Telemedicine System. *JAMA Ophthalmol*. 2017 Feb 1;135(2):131-136
- ^{ix} Karkhaneh R, The Accuracy of Digital Imaging in Diagnosis of Retinopathy of Prematurity in Iran: A Pilot Study. *J Ophthalmic Vis Res*. 2019 Jan-Mar;14(1):38-41. doi: 10.4103/jovr.jovr_187_17.
- ^x <https://www.medicaid.gov/state-overviews/scorecard/state-health-system-performance/index.html>