10th Anniversary

Prevent Blindness
Focus on Eye Health National Summit

Our Changing Vision

A Virtual Interactive Event

July 14–15, 2021
Global Retinopathy of Prematurity (ROP) Program Development:
Opportunities for Innovation, Education, Advocacy, and Collaboration

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Disclosures

I will be discussing the off-label use of anti-VEGF agents

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Global ROP Program Development
ROP is a Worldwide Problem

115M Total Births / year
15M Premature
5.6M Low Income
8.2M Middle Income
1.2M High Income

ROP
~184K
32K

Severe Visual impairment/Blindness (20K)
Visual Impairment (12K)

Blencowe et al. Pediatr Res 2013; 74(Suppl 1); 35-49.
Quinn GE. Eye Brain 2016; 8:31-6.

Slide courtesy of Dr. Jayashree Kalpathy-Cramer
Global ROP Program Development
Blindness from ROP is Nearly Always Preventable

- 3rd Epidemic of ROP in Lower and Middle income countries (LMIC)
  - Economic development and increased NICU capacity

- Heavier and older babies are developing ROP
  - May be related to unregulated oxygen management

- Most cases of severe visual impairment secondary to ROP are preventable

1st epidemic
USA and Western Europe
Unmonitored 100% supplemental oxygen

2nd epidemic
USA and Western Europe
Greater survival of increasingly preterm infants

ROP blindness largely controlled
High quality neonatal care and good ROP services

1940/50s 1960/70s 1980/90s 2000/10s 2020/30s

3rd epidemic
Eastern Europe & Latin America
3rd epidemic
East and South Asia
3rd epidemic
sub-Saharan Africa

Expansion of intensive neonatal care, often of inadequate quality. Low coverage of ROP screening and treatment

Slide courtesy of J. Peter Campbell
Gilbert et al, Epidemiology of ROP update – Africa is the new frontier. Seminars in Perinatology, 2019
Global ROP Program Development
ORBIS International, Ulaanbaatar, Mongolia – 2011

• Evaluate the ROP burden in Mongolia
• No ROP screening protocols at the time
• Identify what is locally needed to manage ROP
Global ROP Program Development
ORBIS International, Ulaanbaatar, Mongolia – 2011
Global ROP Program Development
ORBIS International and National Center for Women and Children, Mongolia – September 2016

Development of Screening Criteria for Retinopathy of Prematurity in Ulaanbaatar, Mongolia, Using a Web-based Data Management System

Shelbi L. Olson, MD; Tsengelmaa Chuluunbat, MD; Emily D. Cole, MD, MPH; Karyn E. Jonas, MSN; Munkhbat Bayalag, MD; Chimgee Chuluunkhuu, MD; Nita G. Valikodath, MD; D. Hunter Cherwek, MD; Nathan Congdon, MD, MPH; Leslie D. MacKean, BSc; Joelle Hollak, PhD; Vivien Yap, MD; Susan Ostmo, MSc; Wei Chi Wu, MD; J. Peter Campbell, MD, MPH; Michael F. Chiang, MD; R. V. Paul Chan, MD

Purpose: To describe a process for identifying birth weight (BW) and gestational age (GA) screening guidelines in Mongolia.

Methods: This was a prospective cohort study in a tertiary care hospital in Ulaanbaatar, Mongolia, of 193 premature infants with GA of 36 weeks or younger and/or BW of 2,000 g or less with regression analysis to determine associations between BW and GA and the development of retinopathy of prematurity (ROP).

Results: As BW and GA decreased, the relative risk of developing ROP increased. The relative risk of developing any stage of ROP in infants born at 29 weeks or younger was 2.91 (95% CI: 1.55 to 5.44; P < .001) compared to older infants. The relative risk of developing any type of ROP in infants with BW of less than 1,200 g was 2.41 (95% CI: 1.35 to 4.29; P = .003) and developing type 2 or worse ROP was 2.05 (95% CI: 0.99 to 4.25; P = .05).

Conclusions: Infants in Mongolia with heavier BW and older GA who fell outside of current United States screening guidelines of GA of 30 weeks or younger and/or BW of 1,500 g or less developed clinically relevant ROP.


• Collaborated with neonatology, ophthalmology, nursing, and Orbis International to implement ROP screening program in Mongolia

• Collaborated to develop the infrastructure to manage children at risk for ROP in Mongolia
Global ROP Program Development
Kathmandu, Nepal – 2017

1. Expansion to district-level hospital
2. Integration of mobile phone technology
3. Artificial intelligence assisted diagnosis
Global ROP Program Development
Aravind Eye Hospital, Coimbatore, India
ROP Eradication – Save Our Sight Project (ROPE-SOS)

Retinopathy of Prematurity Eradication – Save Our Sight (ROPE-SOS)

Images courtesy of Dr. Narendran Venkatapathy
Global ROP Program Development
Aravind Eye Hospital, Coimbatore, India
ROP Eradication – Save Our Sight Project (ROPE-SOS)

- Telemedicine screening for ROP
- Plans to investigate the use of AI for screening
Economic Development
Telemedicine Infrastructure and ROP

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Abdul Al-Khaled, MD; Nita G. Valikodath, MD, MS; Samir N. Patel, MD; Emily Cole, MD, MPH; Margaret Chervinko, MUS; Christina E. Douglas, MD; Andrew S.H. Tsai, MBBS; Wei-Chi Wu, MD, PhD; J. Peter Campbell, MD, MPH; Michael F. Chiang, MD; R. V. Paul Chan, MD, MSc, MBA

ABSTRACT
The rising prevalence of retinopathy of prematurity (ROP) in low- and middle-income countries has increased the need for screening at-risk infants. The purpose of this article was to review the impact of telemedicine and technology on ROP screening programs. Adhering to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic review was performed using PubMed, ProQuest, and Google Scholar bibliographic search engines. Terms searched included retinopathy of prematurity, telemedicine, and tele-ophthalmology. Data regarding internet access and gross domestic product per capita were obtained from the World Bank. Information was also obtained about internet access, speeds, and costs in low-income countries. There has been increasing integration of telemedicine and technology for ROP screening and management. Low-income countries are using available internet options and information and communications technology for ROP screening, which can aid in addressing the unique challenges faced by low-income countries. This provides a promising solution to the third epidemic of ROP by expanding and improving screening and management. Although telemedicine systems may serve as a cost-effective approach to facilitate delivery of health care, programs (especially in low- and middle-income countries) require national support to maintain its infrastructure. [J Pediatr Ophthalmol Strabismus. 2021;58(4):261-269.]
Global ROP Program Development
iTeleGEN – Data Management and Telemedicine

- Utilized cloud based platform for data management
Global ROP Program Development

Tele-Education

THE GLOBAL EDUCATION NETWORK FOR RETINOPATHY OF PREMATURENESS (GEN-ROP):
DEVELOPMENT, IMPLEMENTATION, AND EVALUATION OF A NOVEL TELE-EDUCATION SYSTEM
(AN AMERICAN OPHTHALMOLOGICAL SOCIETY THESIS)

By R.V. Paul Chan MD, Samir N. Patel BS, Michael C. Ryan MS, Karyn E. Jonas BSN, Susan Ostmo MS,
Alexander D. Port MD, Grace I. Sun MD, Andreas K. Lauer MD, and Michael F. Chiang MD

ABSTRACT

Purpose: To describe the design, implementation, and evaluation of a tele-education system developed to improve diagnostic
competency in retinopathy of prematurity (ROP) by ophthalmology residents.

Methods: A secure Web-based tele-education system was developed utilizing a repository of over 2,500 unique image sets of ROP.
For each image set used in the system, a reference standard ROP diagnosis was established. Performance by ophthalmology residents
(postgraduate years 2 to 4) from the United States and Canada in taking the ROP tele-education program was prospectively evaluated.
Residents were presented with image-based clinical cases of ROP during a pretest, posttest, and training chapters. Accuracy and
reliability of ROP diagnosis (eg, plus disease, zone, stage, category) were determined using sensitivity, specificity, and the kappas
statistic calculations of the results from the pretest and posttest.

Results: Fifty-five ophthalmology residents were provided access to the ROP tele-education program. Thirty-one ophthalmology
residents completed the program. When all training levels were analyzed together, a statistically significant increase was observed in
sensitivity for the diagnosis of plus disease, zone, stage, category, and aggressive posterior ROP (P<.05). Statistically significant
changes in specificity for identification of stage 2 or worse (P=.027) and pre-plus (P=.028) were observed.

Conclusions: A tele-education system for ROP education is effective in improving diagnostic accuracy of ROP by ophthalmology
residents. This system may have utility in the setting of both healthcare and medical education reform by creating a validated method
to certify telemedicine providers and educate the next generation of ophthalmologists.

Global ROP
Program Development

Tele-Mentoring

Ophthalmology is well positioned for Web-based learning
Global ROP Program Development
Digital Imaging

Trans-pars-planar illumination enables a 200° ultra-wide field pediatric fundus camera for easy examination of the retina

Devrim Toslak,1,2 Felix Chau,3 Muhammet Kazim Erol,2 Changgeng Liu,1 R. V. Paul Chan,3 Taeyoon Son,1,4 and Xincheng Yao1,3,*
Tech that detects cause of preemie blindness gets federal nod

Artificial intelligence algorithm receives FDA breakthrough device status

By Franny White  January 30, 2020  Portland, Oregon

The FDA Breakthrough Device Program aims to accelerate development - and potentially approval - of medical devices for “more effective treatment or diagnosis of life-threatening or irreversibly debilitating diseases.”

The algorithm, called the i-ROP DL system, diagnoses retinopathy of prematurity, or ROP. Every year up to 16,000 prematurely born U.S. infants are affected by the disorder, which causes abnormal blood vessel growth near the retina, the light-sensitive portion in the back of an eye. About 600 U.S. babies go blind from ROP annually, making it a leading cause of childhood blindness in the U.S. and worldwide. Musician Stevie Wonder is blind as a result of ROP.

The algorithm diagnoses the condition in images of infant eyes with comparable or better accuracy than today’s standard method, which involves an examination by expertly trained ophthalmologists.

A 2018 study in JAMA Ophthalmology showed the technology diagnoses the condition 91% of the time, compared with 82% for trained ophthalmologists. Subsequent studies in 2019 described how the algorithm can be used to quantitatively measure the condition’s severity and help physicians evaluate how well treatment is working against the disease.

Oregon Health & Science University and Massachusetts General Hospital led the technology’s development, with support from Northeastern University and the University of Illinois at Chicago as well as the Imaging & Informatics in ROP (i-ROP) consortium.

OHSU and MGH are developing a commercialization plan for the technology, in the hope that it will be used by ophthalmologists and neonatologists worldwide to better diagnose and treat retinopathy of prematurity.
The key findings are the following:

1. At the individual eye examination level, the system revealed high diagnostic accuracy as a screening device for treatment requiring ROP.

2. At the population level, looking at individual NCUs, the ROP severity was higher in NCUs that did not have the resources to monitor and titrate oxygen.

Proof of principle that AI may be used to improve the efficiency of ROP screening and also as an epidemiological tool for monitoring NCU-level ROP severity across geography and time.

Global ROP Program Development
Artificial Intelligence for ROP
i-ROP DL Performance – Mongolia and Nepal

The key findings are the following:

1. The system performed well on plus disease diagnosis in Nepal and Mongolia despite being trained on data from North America.

2. Performance was as high on images from the Forus camera system compared to the Retcam, despite being trained on the Retcam.

3. The vascular severity score correlated well with overall ICROP severity and may be a useful epidemiologic and educational tool to compare assessment of disease severity across populations, and to standardize assessment of disease severity.

Unpublished Data
Global ROP Program Development Summary

- Strong Global Partners
  - Aravind Eye Hospital
  - Tilganga Eye Institute
  - National Center for Children and Maternal Health
  - Orbis International
  - Helen Keller International
- Adequate Internet Infrastructure
- Education: Telemedicine, Tele-Education, and Tele-Surgery
- Artificial Intelligence and Digital Imaging
- Economic Development
- Improved coordination Between Ophthalmology and Neonatology
- Sustainability and Financial Incentives
- Data Management
- Private Health Information and Security
- Workforce
- Technical and Engineering Support
- Software Compatibility
- Patient Follow Up
1. Prevention of ROP is the ultimate goal
   - ROP care takes a multidisciplinary team
   - Primary and secondary prevention

2. Ophthalmology and technological innovation for improving access to care
   - Address potential gaps in health equity
   - Education important for managing ROP through "low-tech" solutions e.g. screening with indirect ophthalmoscopy
   - Pediatric vision screening programs
   - Low vision services
   - Neurodevelopmental issues and cerebral visual impairment

3. Advocacy and strong partnerships to train leaders