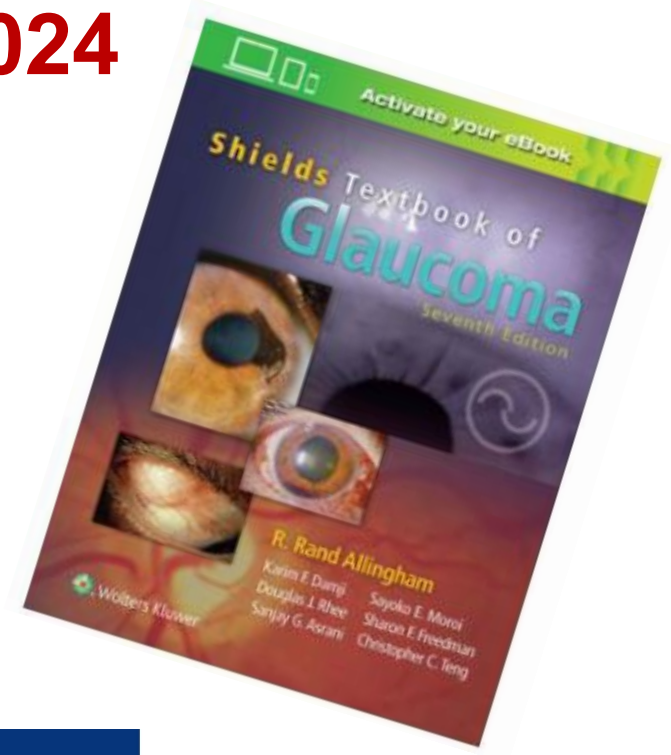
Financial Disclosures 2023 – 2024



- Wolters Kluwer Health (Moroi)
- R01 EY032621 (PI Liu)
- R21 AG080407 (PI Ma, MPI Karvonen-Gutierrez)
- ***R01 EY022124 (PI Moroi) uses iCare tonometry***
- R01 AG073113 (PI Merfeld)
- P30 EY032857 (PI Moroi)
- Research to Prevent Blindness (PI Moroi)
- Levin Family Columbus Fndn (PI Moroi)
- Ann Ellis Columbus Fndn (PI Moroi)

- US Patent #10575723 Larry Kagemann, Joel Schuman, Sayoko Moroi, U Pitt & UM (application #15/550,021initiated 5/29/2000; notified 2/12/2020)
- Patent application research on UBM analysis

Role of technology in glaucoma management

8:10 – 8:30 am, Feb. 24, 2024

Sayoko E. Moroi, MD, PhD
William H. Havener, MD Endowed Professor
Chair, Dept. Ophthalmology & Visual Sciences
The Ohio State University

https://www.earth.com/news/importance-solar-eclipses-history/

Digital Health Innovations to Transform Glaucoma Care

USING AI AND BIG DATA TO ELEVATE GLAUCOMA DETECTION AND MANAGEMENT

FEATURED SPEAKERS

ROBERT WEINREB, MD

SALLY L. BAXTER, MD, MSC

ALI TAFRESHI

PRADEEP Y RAMULU, MD, PhD

SAVE THE DATE
FRIDAY, MARCH 1 AT 7PM

SAVE YOUR SEAT
REGISTER HERE: TPHC.IO/AGS

Why Do Some People Go Blind from Glaucoma?

W. MORTON GRANT, MD, JOSEPH F. BURKE, JR., MD

NEI R01-00002

Abstract: Retrospective analysis of patients blinded by glaucoma has revealed a need to educate patients to the significance of premonitory symptoms, to investigate a higher incidence of blindness from open-angle glaucoma among blacks than whites, and to define the goals of therapy in relation to presenting pathology. Responding to this third need, circumstances of patients followed for 20 to 40 years with extensive documentation relating to open-angle glaucoma were analyzed. Some eyes with normal discs and fields were found to tolerate a tension of 30 mm Hg for many years without need of treatment. But, when abnormalities ranging from early glaucomatous cupping to advanced visual field defects were present on initial evaluation, progressive loss of field tended to occur at lower tensions. It appears that the worse the initial condition of the eye, the lower the tension needs to be to prevent further loss or blindness. [Key words: age, blindness, glaucoma, glaucoma treatment, glaucoma types, intraocular pressure, optic disc, racial difference, visual field.] Ophthalmology 89:991–998, 1982

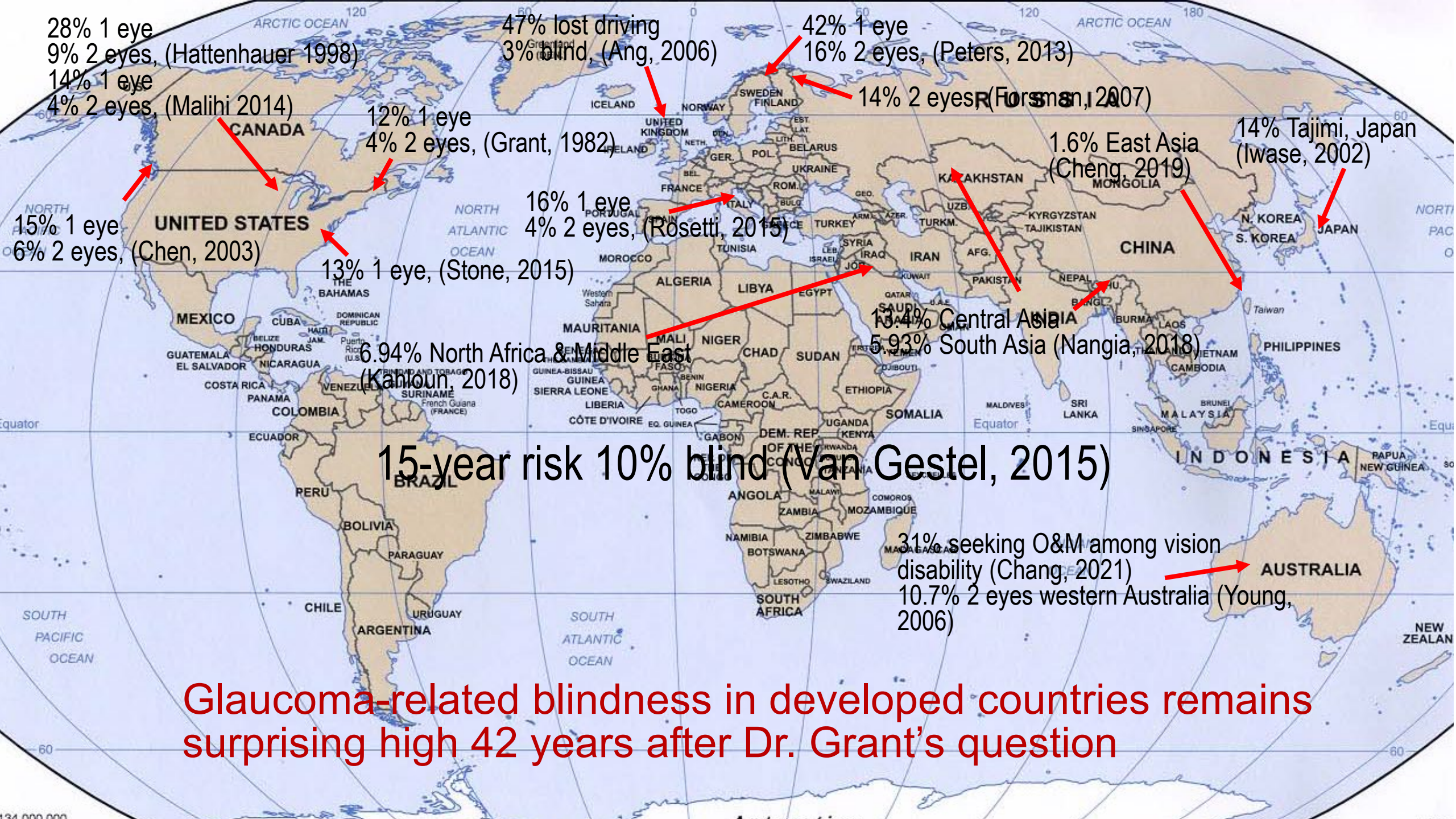
Why Do Some People Go Blind from Glaucoma?

W. MORTON GRANT, MD, JOSEPH F. BURKE, JR., MD
NEI R01-00002

Other lessons:

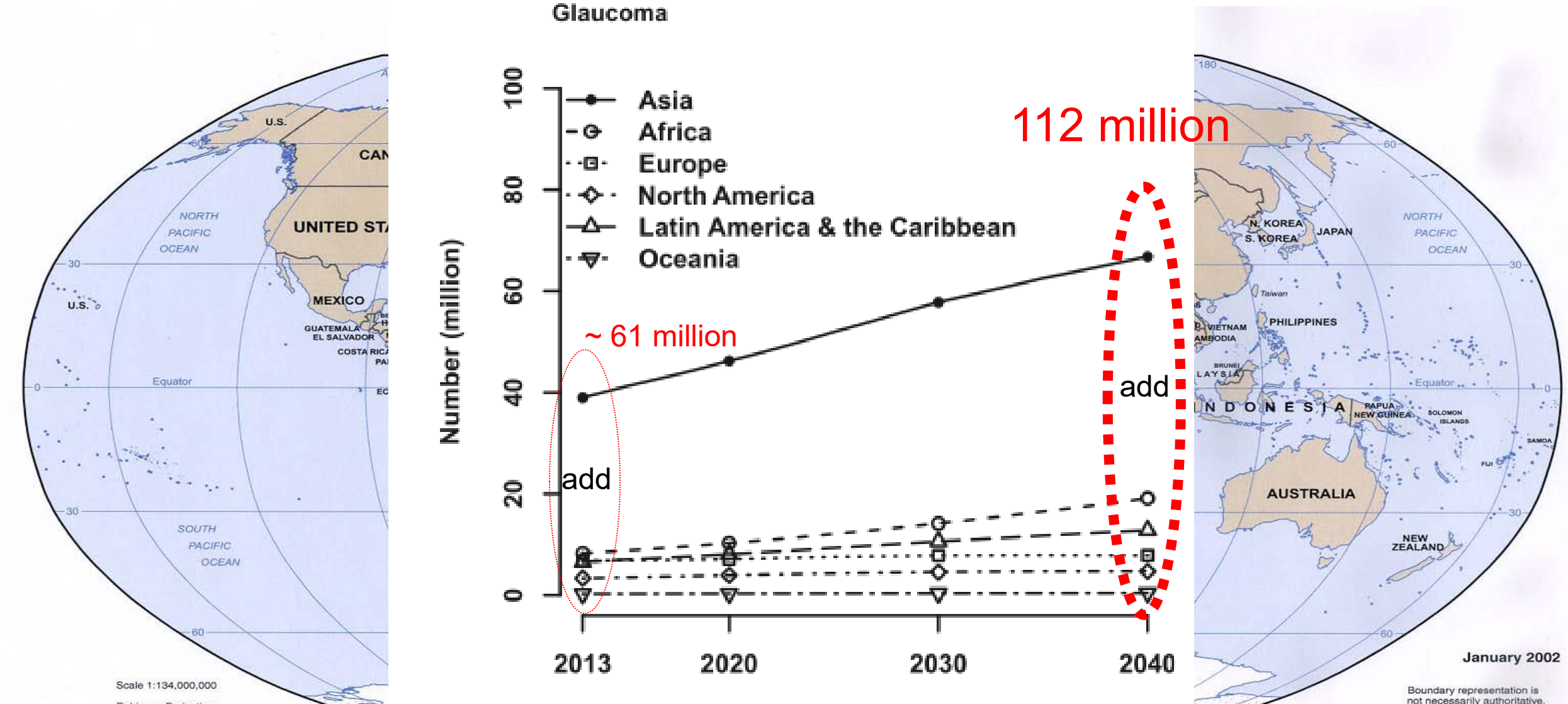
- **Innovation & new technology** = Goldmann applanation, perimetry, timolol, dipivefrin

"…. these advances are not yet the whole answer, ….. serve as great encouragement to those who are dedicated to preventing blindness through education, research, or patient care with the common goal of seeing all blindness from glaucoma prevented."


28% 1 eye
9% 2 eyes, (Hattenhauer 1998)
14% 1 eye
4% 2 eyes, (Malihi 2014)
47% lost driving
3% blind, (Ang, 2006)
42% 1 eye
16% 2 eyes, (Peters, 2013)
14% 2 eyes, (Forsman, 2007)
12% 1 eye
4% 2 eyes, (Grant, 1982)
1.6% East Asia
(Cheng, 2019)
14% Tajimi, Japan
(Iwase, 2002)
16% 1 eye
4% 2 eyes, (Rosetti, 2015)
15% 1 eye
6% 2 eyes, (Chen, 2003)
13% 1 eye, (Stone, 2015)
13.4% Central Asia
5.93% South Asia (Nangia, 2018)
6.94% North Africa & Middle East
(Kahloun, 2018)
15-year risk 10% blind (Van Gestel, 2015)
31% seeking O&M among vision disability (Chang, 2021)
10.7% 2 eyes western Australia (Young, 2006)
Glaucoma-related blindness in developed countries remains surprising high 42 years after Dr. Grant's question

Why should we change our current approach to glaucoma management?
Answer: People go blind with our current event-based approach.

Tham et al., Global prevalence of glaucoma and projections of glaucoma burden through 2040. *Ophthal* 2014

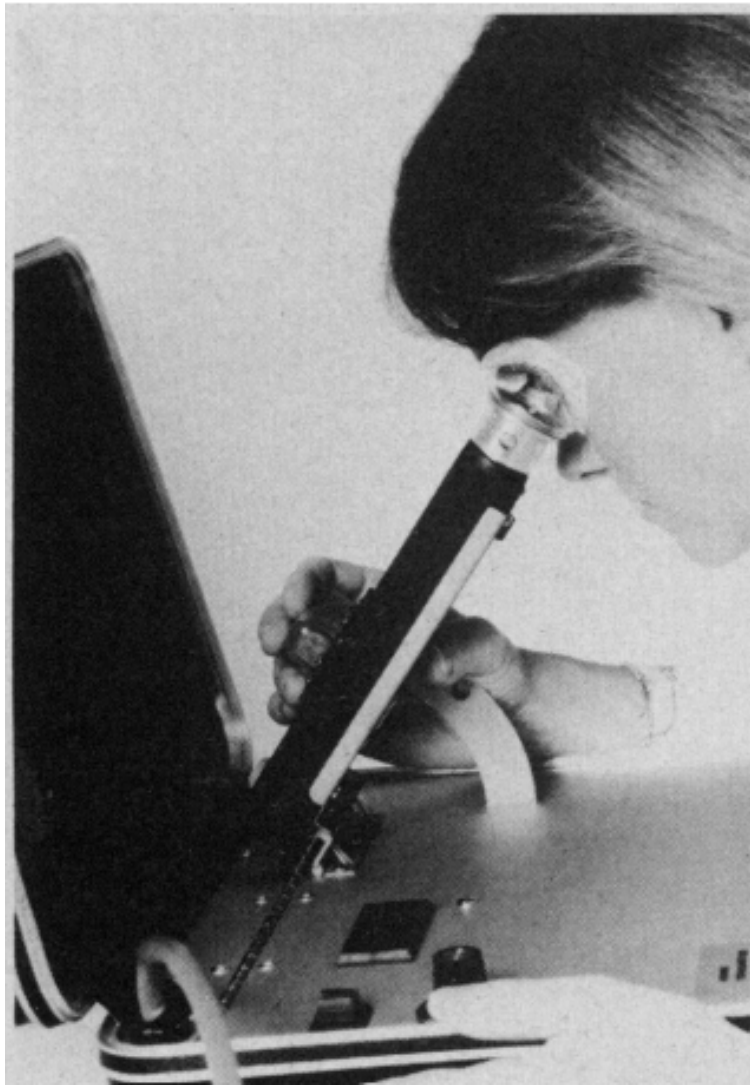


Objectives

1. Technology to gather more data to assess IOP variability
2. Technology for more comfortable visual field testing

Overview of home tonometry

Fig 1.—Subject in position at self-tonometer.



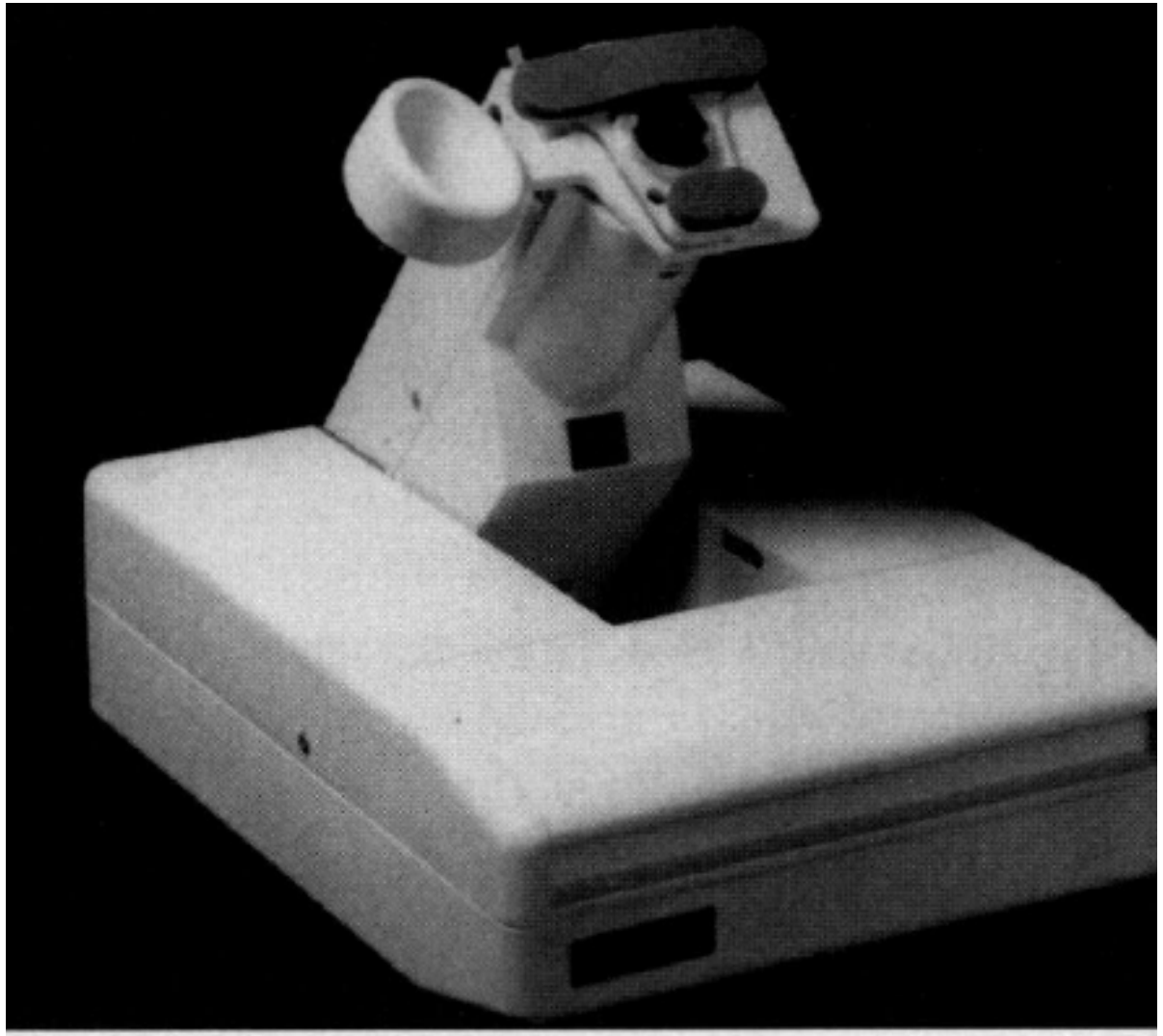
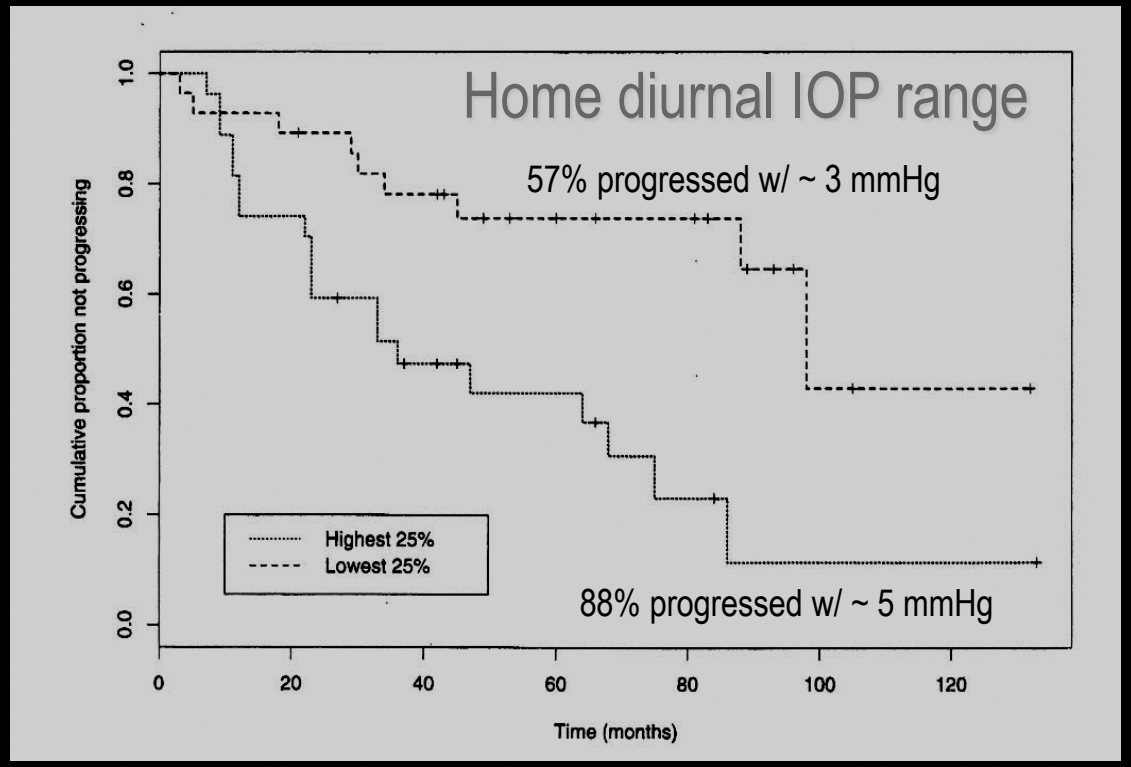


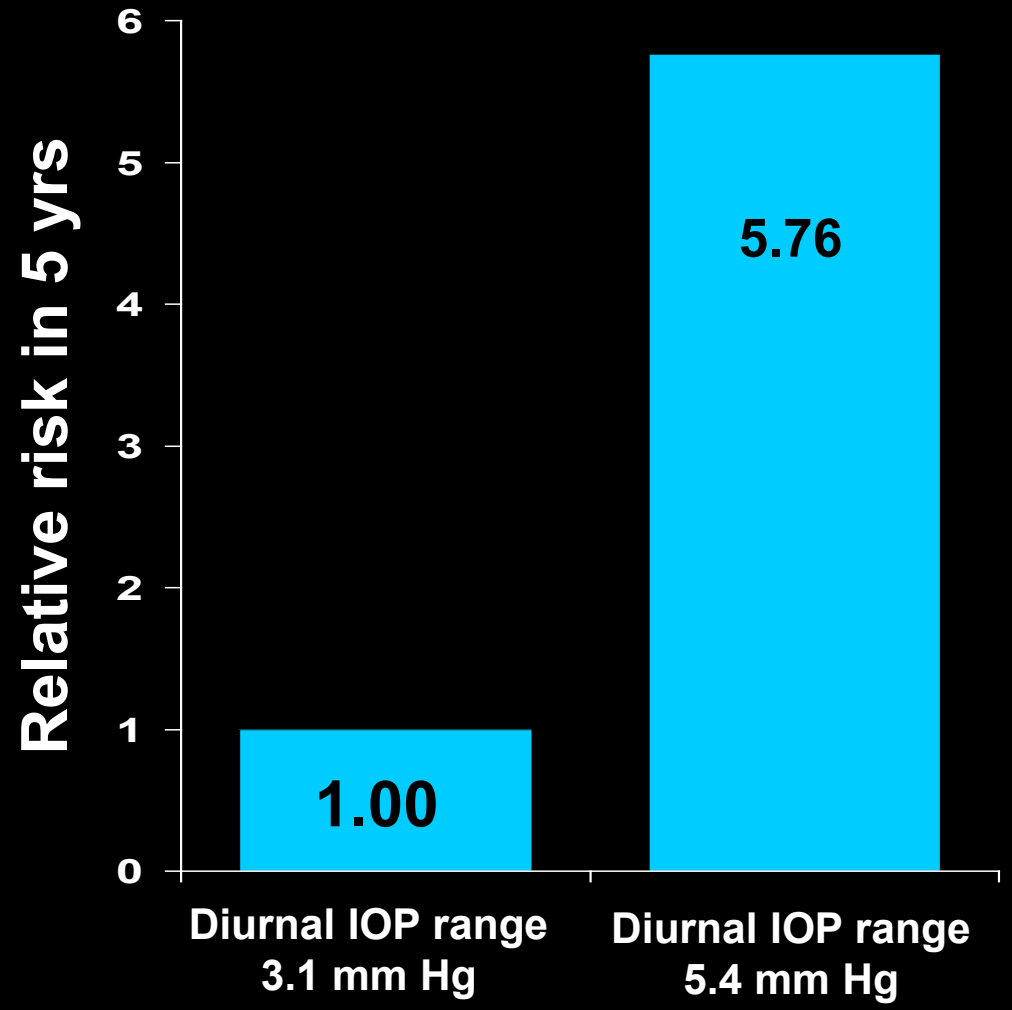
FIG. 1. Commercial version of the self-tonometer.

Diurnal IOP Range and Field Progression within 5 years

Asrani S, et al. *J Glaucoma.* 2000;9:134-142.

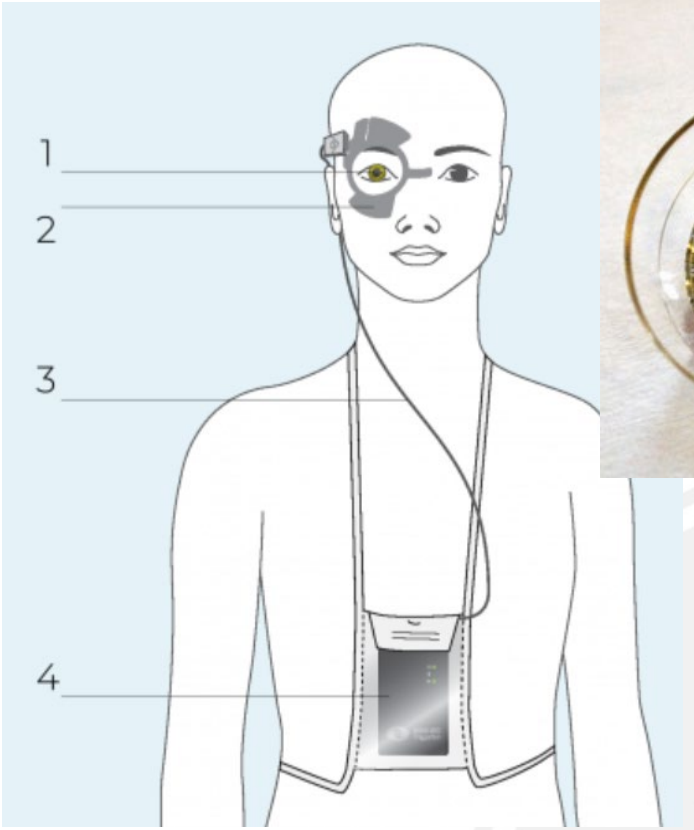
N=166 patients
n=64 patients(105 eyes) in upper or lower quartile
Mean IOP < 25 mmHg over 5 yrs
Baseline office IOP 17.6+/-3.2
Mean home IOP 16.4+/-3.6
IOP range over 5 days home IOP 10.0+/-2.9

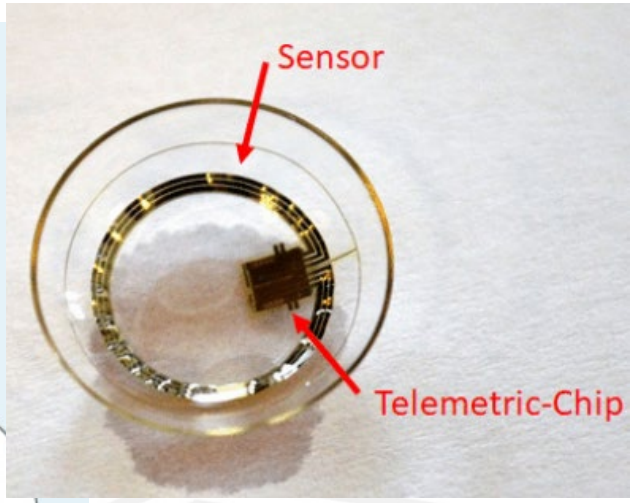


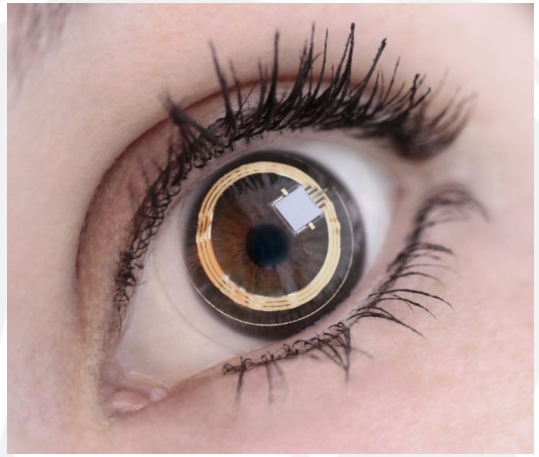


Overview of (potential) home tonometry

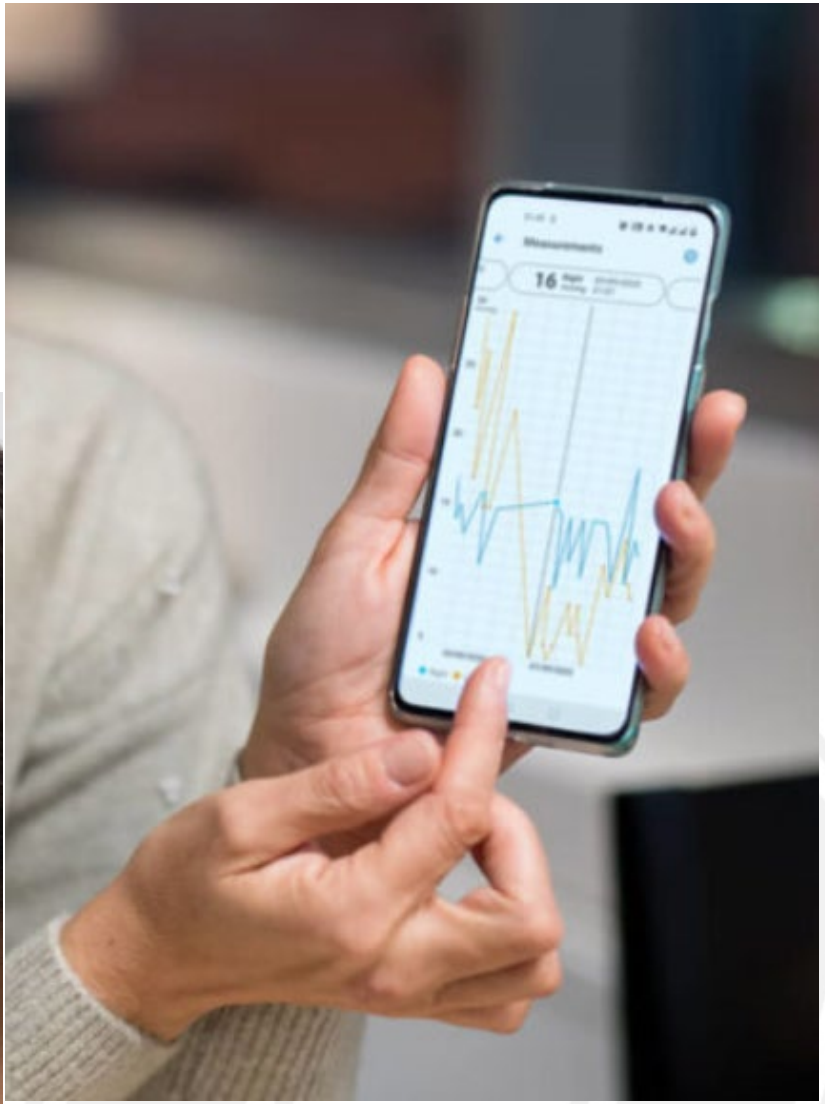
Contact lenses (SENSIMED Triggerfish®)







Overview of rebound tonometry



Comparing rebound tonometry and Goldmann applanation

FIGURE 1. Photograph of Icare ONE rebound tonometer being used by a parent to check the intraocular pressure of his child's right eye.

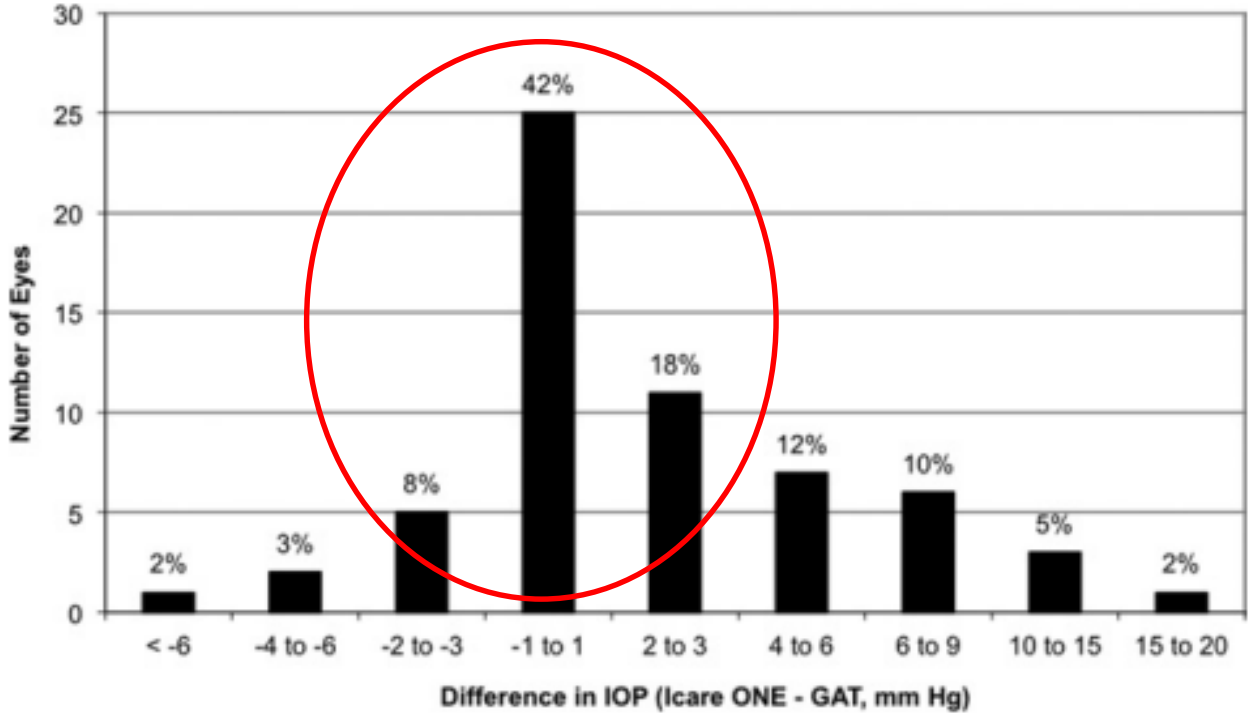
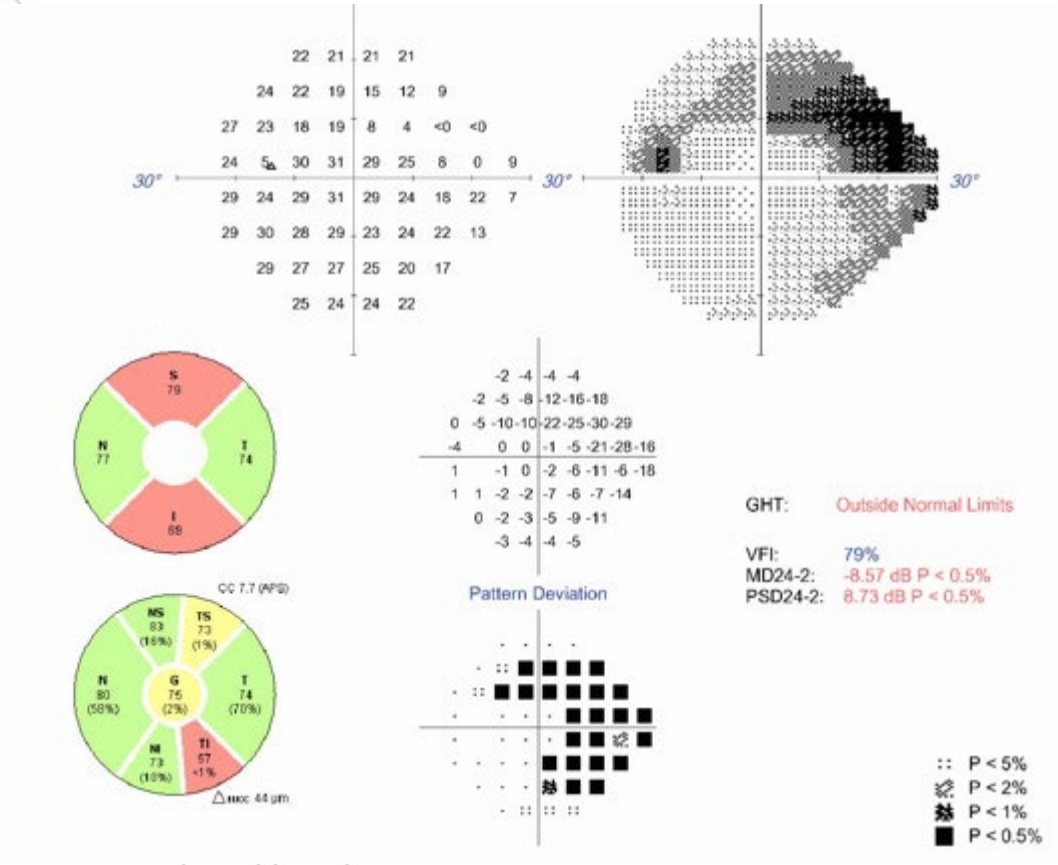
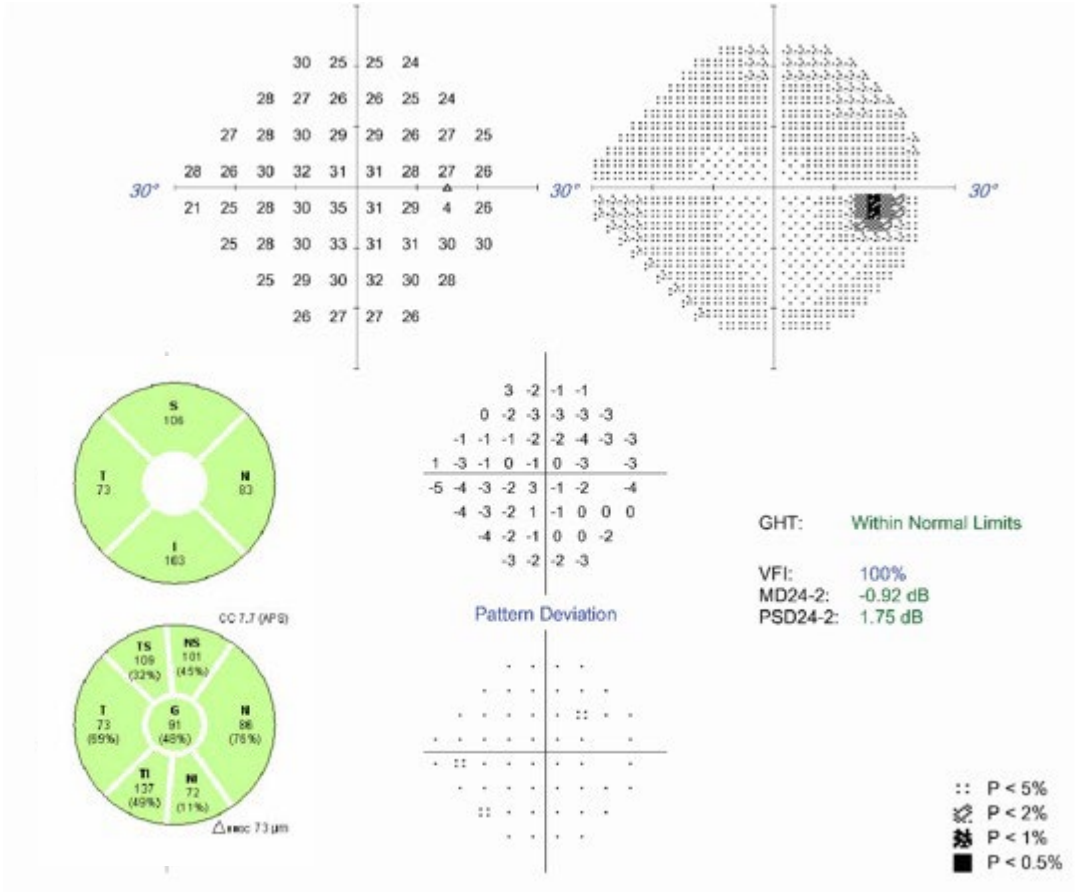
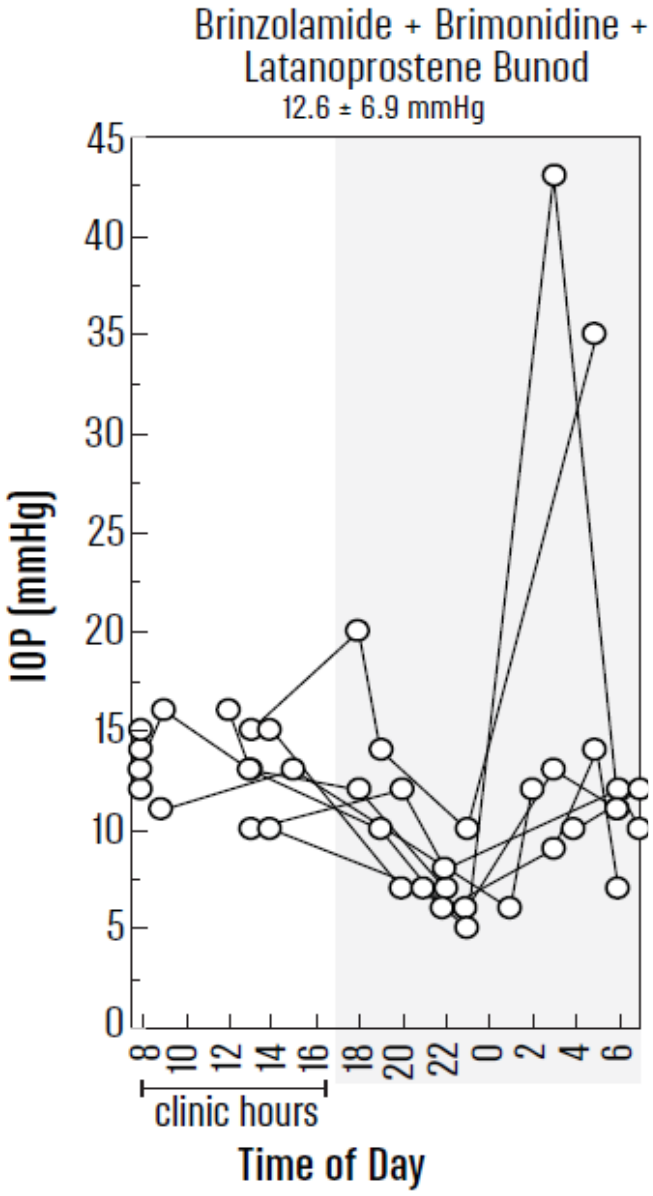


FIGURE 4. Difference in intraocular pressure (IOP, mm Hg) by Icare ONE (taken by clinic examiner) vs Goldmann applanation tonometry (GAT) in children with known or suspected glaucoma. The difference in IOP (mm Hg) between Icare ONE and Goldmann applanation is plotted on the x-axis vs number of eyes plotted on the y-axis.

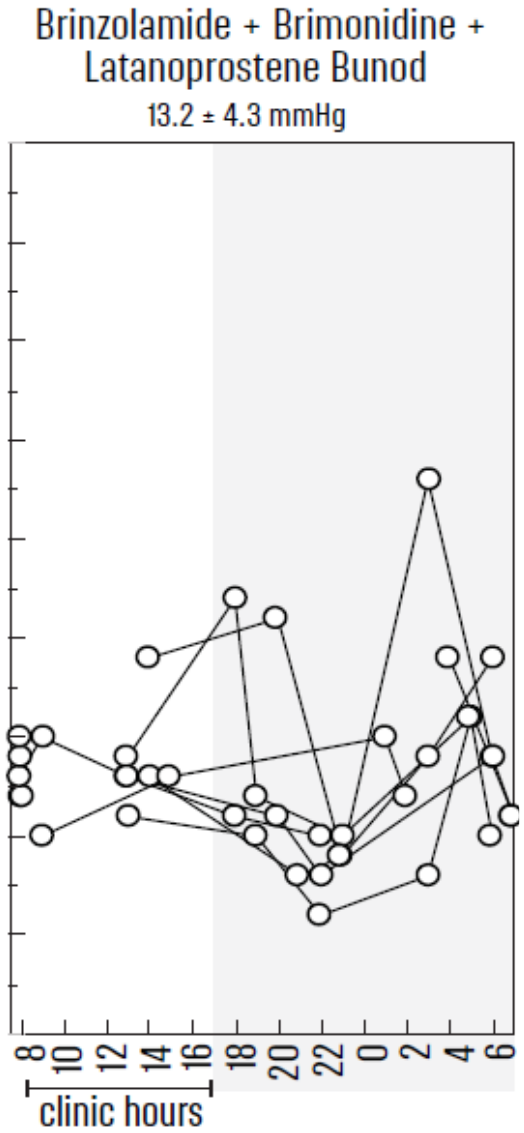
72 yo active general surgeon, progression OS. CCT 551 OD; 545 OS. IOPs 10-16 mmHg (fixed combo dorz+tim OU, travoprost OU).







OS



OD

Rojas CD, Reed DM, Moroi SE. Usefulness of iCare HOME in telemedicine … Oph Glc 2020

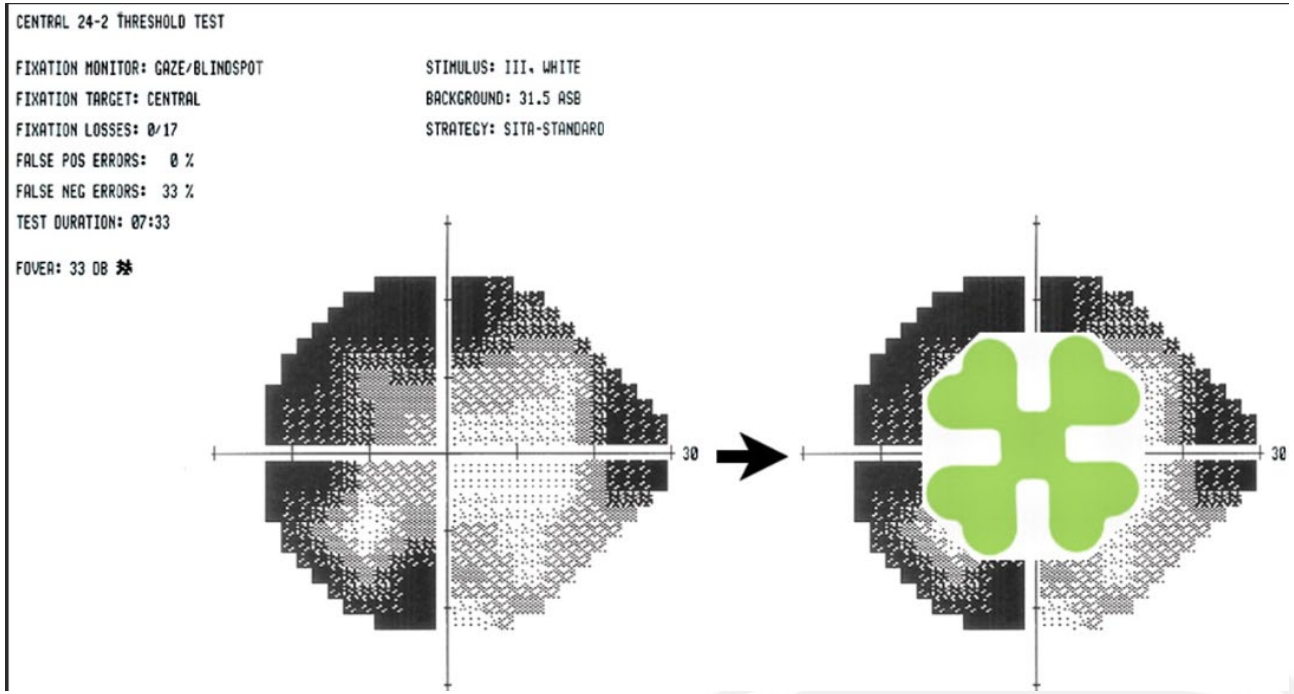
Considerations for home-based tonometry:

- Cost of instrument and probe tips
- Currently, no insurance coverage of instrument
- Bill under remote monitoring codes
- Which patient can learn to use this instrument?
- How many data points a day?
- How many days of data?

Objectives

1. Technology to gather more data to assess IOP variability
2. Technology for more comfortable visual field testing

Challenges with perimetry



Reliability (unreliable)
Fixed environment (space, tech/MA)

Selvan K., Mina M., Abdelmeguid H., Gulsha M., Vincent A., Sarhan A. Eye 2023.

TABLE. A Lexicon for Head-Mounted Display Technology in Low Vision Rehabilitation and Vision Enhancement

Term	Definition	Examples	Advantages for Vision Applications
Electronic visual aid	Any device that provides a digital image to improve visual performance	HMD, closed-circuit television	To provide any digital alteration that improves visual performance, such as magnification to improve visual acuity or minification to expand visual fields
Heads-up display	See-through display projected in user's line of sight that does not move with user; not a form of HMD	Automotive and aviation displays, industrial applications	Limited applications
Augmented reality	Presentation of information to the visual system that does not otherwise exist in the user's environment	Contour video images	Presentation of visual cues missing from a user's field of vision; information on potential obstacles in user's path
Head-mounted display	An electronic visual aid that is worn on the head, often like a pair of glasses or goggles	See various types below	Same functions as electronic visual aids but with improved ergonomics and ease of use since worn on the user's head

Ehrlich JR, Ojeda, LV, Wicker D, Day S, Howson A, Lakshminarayanan V, Moroi SE. HMD Technology for Low Vision Rehabilitation and Vision Enhancement. AJO 2017

Continued....

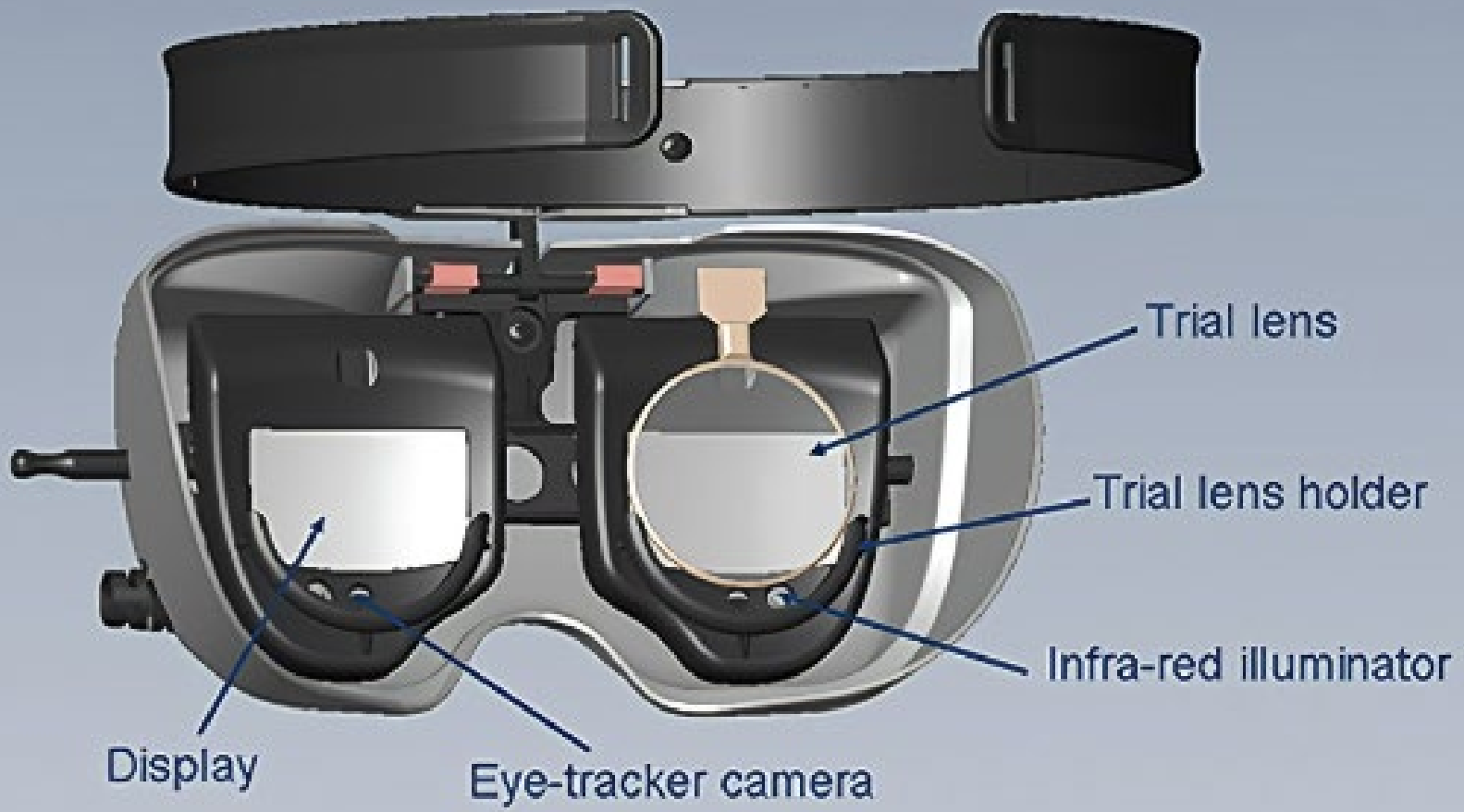
TABLE. A Lexicon for Head-Mounted Display Technology in Low Vision Rehabilitation and Vision Enhancement

Term	Definition	Examples	Advantages for Vision Applications
Types of HMD:			
Virtual reality	HMD that covers the eyes, occupying the entire visual field	eSight, Oculus Rift	Enhancement of central vision or night vision through image processing
Near-eye display	HMD that projects a see-through image in front of the eye	Epson Moverio, Microsoft Hololens	Expansion of perceived visual field
Retinal projection	HMD that directly project a see-through image onto the user's retina	Fujitsu Laser Headset, Google Glass	Expansion of perceived visual field
Optical design			
Non-pupil-forming display	Display mounted in front of a user's eyes amplifies image using simple lenses	Epson Moverio, Microsoft Hololens	Easier to design and fabricate than pupil-forming displays
Pupil-forming display	Uses complex sets of lenses so that the image source (camera) can be moved away from the eyes	Fujitsu Laser Headset, Google Glass	Improved ergonomics for retinal projection devices compared with non-pupil-forming displays

Ehrlich JR, Ojeda, LV, Wicker D, Day S, Howson A, Lakshminarayanan V, Moroi SE. HMD Technology for Low Vision Rehabilitation and Vision Enhancement. AJO 2017

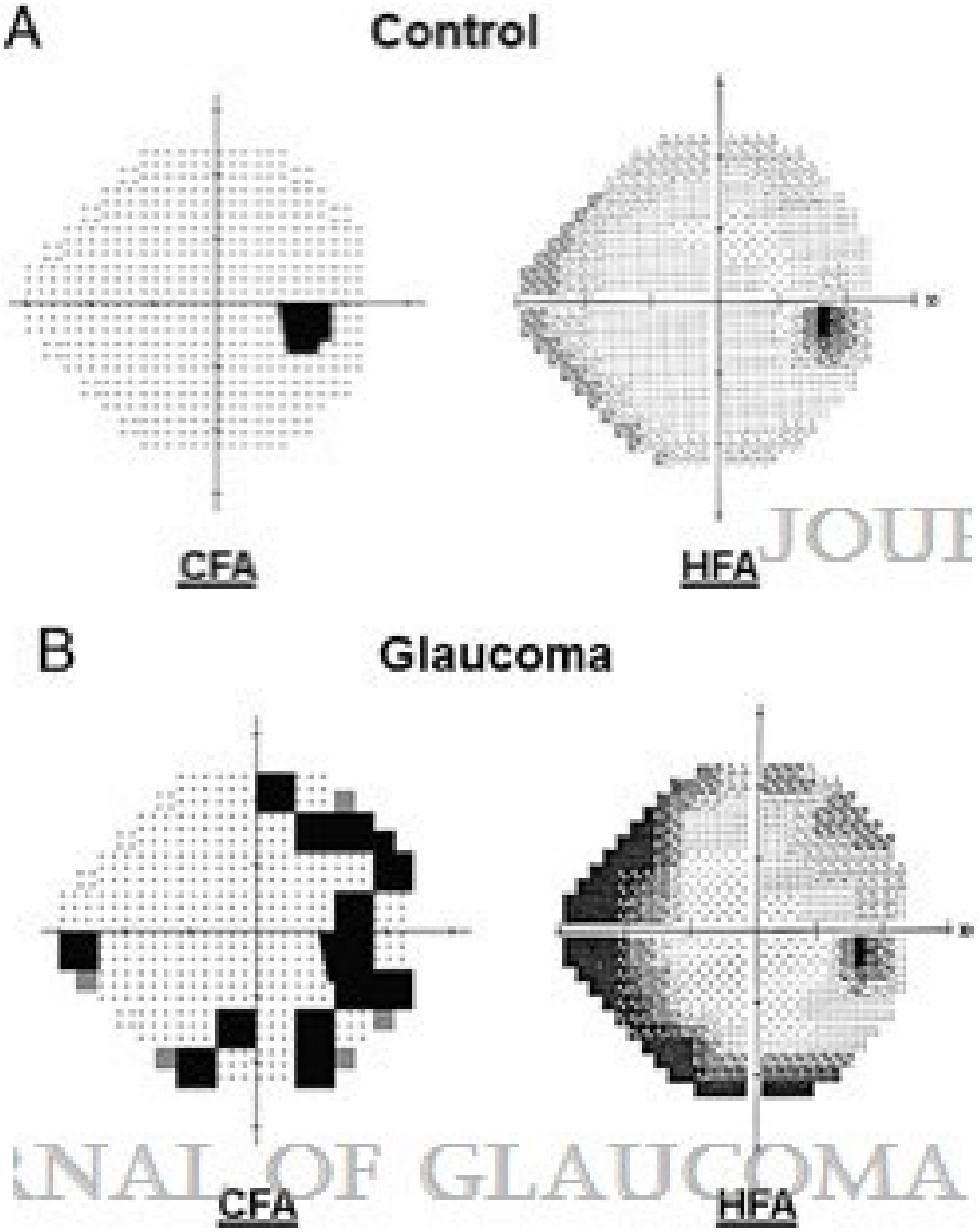
VirtualEye® Perimeter

Head-Mounted Visor



olleyes

Smart System® | VR Headset



Validation of a Head-mounted Virtual Reality Visual Field Screening Device. Mees, L., Upadhyaya, S., Kumar, P., Kotawala, S., Haran, S., Rajasekar, S., Friedman, D., Venkatesh, R. J Glauc 29(2):86-91, 2020.

OPO OPHTHALMIC AND PHYSIOLOGICAL OPTICS
JOURNAL OF THE COLLEGE OF OPTOMETRISTS

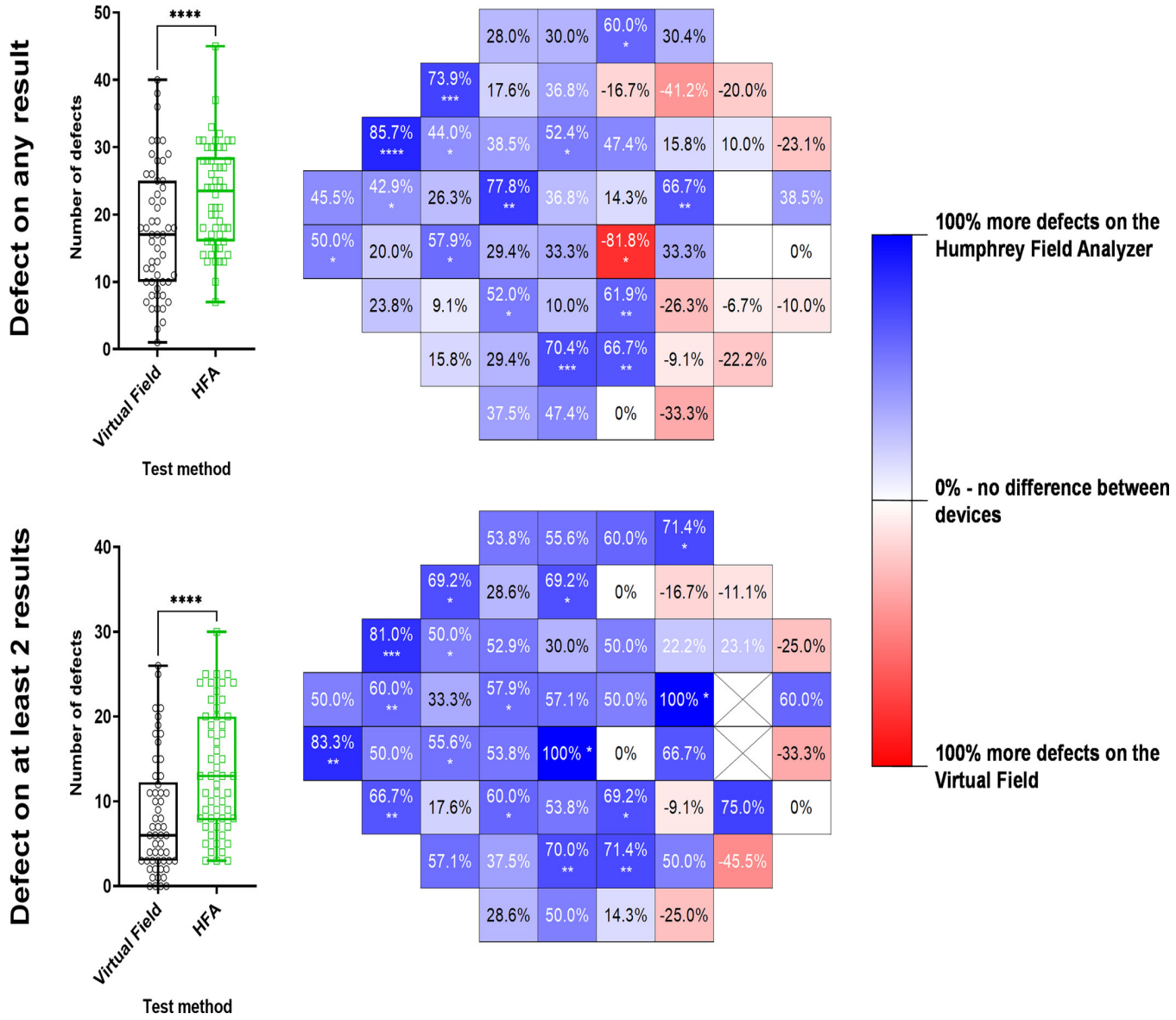
ORIGINAL ARTICLE | Open Access

Comparing a head-mounted virtual reality perimeter and the Humphrey Field Analyzer for visual field testing in healthy and glaucoma patients

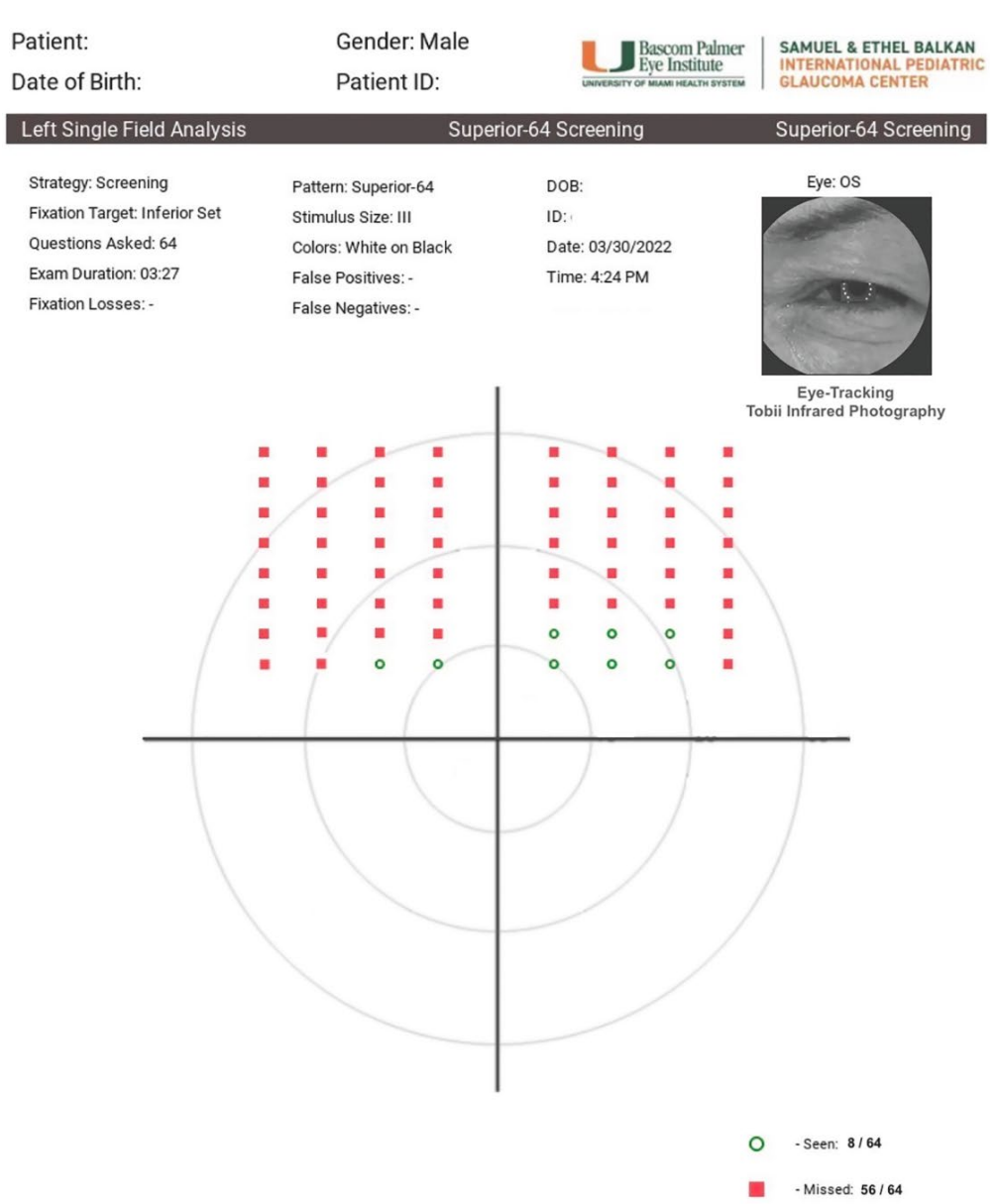
Jack Phu, Henrietta Wang, Michael Kalloniatis

First published: 06 October 2023 | https://doi.org/10.1111/opo.13229

Comparing a head-mounted virtual reality perimeter and the Humphrey Field Analyzer for visual field testing in healthy and glaucoma patients



Ophthalmic Physiologic Optic, Volume: 44, Issue: 1, Pages: 83-95, First published: 06 October 2023, DOI: (10.1111/opo.13229)



Superior Visual Field Testing Using Virtual Reality With and Without Eye Tracking for Functional Upper Eyelid Surgery Evaluation: A Pilot Study Patel, A.J., Lee, W.W., Ziff, M., Munshi, H., Chang, T.C., Grajewski, A.L., Wester, S.T., Tse, D.T., Tse, B.C. Ophth Plastic & Reconst Surg 39(4):381-385, 2023.

VIRTUALVISION
OPHTHALMIC PLASTIC & RECONSTRUCTIVE SURGERY

tvst

Clinical Trials

Virtual Reality Hemifield Measurements for Corrective Surgery Eligibility in Ptosis Patients: A Pilot Clinical Trial

Margarita Labkovich[1], Andrew J. Warburton[1], Stephanie Ying[1], Aly A. Valliani[1], Nicholas Kissel[2], Randal A. Serafini[1,3], Raj Mathew[4], Megan Paul[1], S. Malin Hovstadius[1], Vicente N. Navarro[5], Aashay Patel[1], Harsha Reddy[6], and James G. Chelnis[6]

[1] Department of Medical Education, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[2] Department of Statistics & Data Science, Carnegie Mellon, Pittsburgh, PA, USA
[3] Nash Department of Neuroscience and Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, New York, NY, USA
[4] Department of Medical Education, SUNY Downstate, Brooklyn, NY, USA
[5] Department of Uro Onc Research, Weill Cornell Medicine, New York, NY, USA
[6] Department of Ophthalmology, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Translational Relevance: In this study, we look at vision field outputs in patients with ptosis to evaluate its severity and improvement with eyelid taping on a low-profile VR-based technology and compare it with HVFA. Our results demonstrate that alternative, portable technologies such as VR can be used to grade the degree of ptosis and determine whether ptosis surgery could provide a significant superior visual field improvement of 30% or more, all while ensuring a more comfortable experience and faster testing time.

Why Do Some People Go Blind from Glaucoma?

W. MORTON GRANT, MD, JOSEPH F. BURKE, JR., MD

Considerations before adopting new technology:

Q: How does data compare to “gold standard”?

A: Clinical trials

Q: Cost?

A: Gather data, publish, improve outcome, efficiencies, less cost to health system

Q: Impact on clinic workflow

A: Model, clinical trials

Q: Which patients?

A: patient reported outcome measures

Acknowledgments: patients

MI and OSU OR, Clinic & Photography staff

EDEN team

- Michigan/OSU – Jesse Gilbert, David Reed, Dave Musch, Julia Richards, Carol Toris, Phil Yuhas, Matt Trese, Tyler Kristoff, Nadine Helmy, & study coordinators
- Mayo Clinic – Richard Brubaker, PI Arthur Sit, Jay McLaren, Arash Kazemi & study coordinators
- Univ. Nebraska Medical Center – PI Vikas Gulati, Shan Fan & study coordinators

NEIGHBORHOOD Consortium: Janey Wiggs
http://glaucomagenetics.org

IOP analysis team: Melisa Nika, Caroline Schmidt, Sara Akbari, David Reed, Kathy Scott, Frank Rozsa, Hemant Pawar, Dave Musch, Paul Lichter, Kari Branham, Jesse Gilbert, Sarah Garnai, Wei Chen, Mohamed Othman, John Heckenlively, Anand Swaroop, Goncalo Abecasis, Bilge, Ozel, Jun Li

- Mentors: Robert Machemer, Glenn Jaffe, Bruce Shields, David L. Epstein, Rand Allingham, Paul Lichter, Tim Johnson, Don Puro, Debra Thompson, Julia Richards, Paul Lee, Keith Carter

Grant Support: R01 EY022124, for NEIGHBORHOOD (19 NEI grants, 13 NIH grants), Research to Prevent Blindness (MI and **OSU**), American Health Assistance Fndn, Fndn Fighting Blindness, UM Core grant P30 EY007003, UM Mcubed, UM & **OSU** grateful donors, **OSU chair start-up, UnEYEted**, **OSU Core grant P30 EY032857, RPB New Chair Challenge Grant**


The Ohio State University
Wexner Medical Center
Eye and Ear Institute

Thank you