

# **Introduction to Pediatric Low Vision**

# Objectives

- After this course, the participant should be able to
  - Understand the epidemiology of pediatric low vision
  - Implement adaptations to traditional exam techniques for the pediatric population
  - Understand considerations of prescribing devices for the pediatric population
  - Understand implications of pediatric development in developing a pediatric rehabilitation plan

# Poll Question #1

- ☐ What experience have you had with managing children with visual impairment or blindness?
- ☐ a. Never
- ☐ b. I primarily practice low vision with adults
- ☐ c. I see some children with low vision in practice
- ☐ d. I'm very familiar with managing pediatric low vision in practice

# Epidemiology of Pediatric Visual Impairment

- ❑ True numbers are difficult to track
  - ❑ Each country uses a different system to track children with disabilities
  - ❑ Definitions of Visual Impairment and blindness differ amongst countries
  - ❑ Low Vision vs. Uncorrected refractive error might be lumped together
- ❑ Trends
  - ❑ Cortical vision impairment is increasing
  - ❑ Nutritional causes of visual impairment are improving in some areas
  - ❑ Prevalence of visual impairment is correlated to socio-economic status



# Childhood Blindness

- ❑ 2.2% of registered blind individuals
- ❑ 1.3% of partially sighted
- ❑ According to WHO
  - ❑ Low Income countries with high under-5 mortality rates, the prevalence **1.5 per 1000 children**
  - ❑ High-income countries with low under-5 mortality rates, the prevalence is around **0.3 per 1000 children**
  - ❑ **Estimate of 1.4 million blind children worldwide**

# Epidemiology of Childhood Blindness

**Table 3. Estimates of the number of prevalent cases of children with severe visual impairment and blindness due to avoidable causes, by level of socioeconomic development**

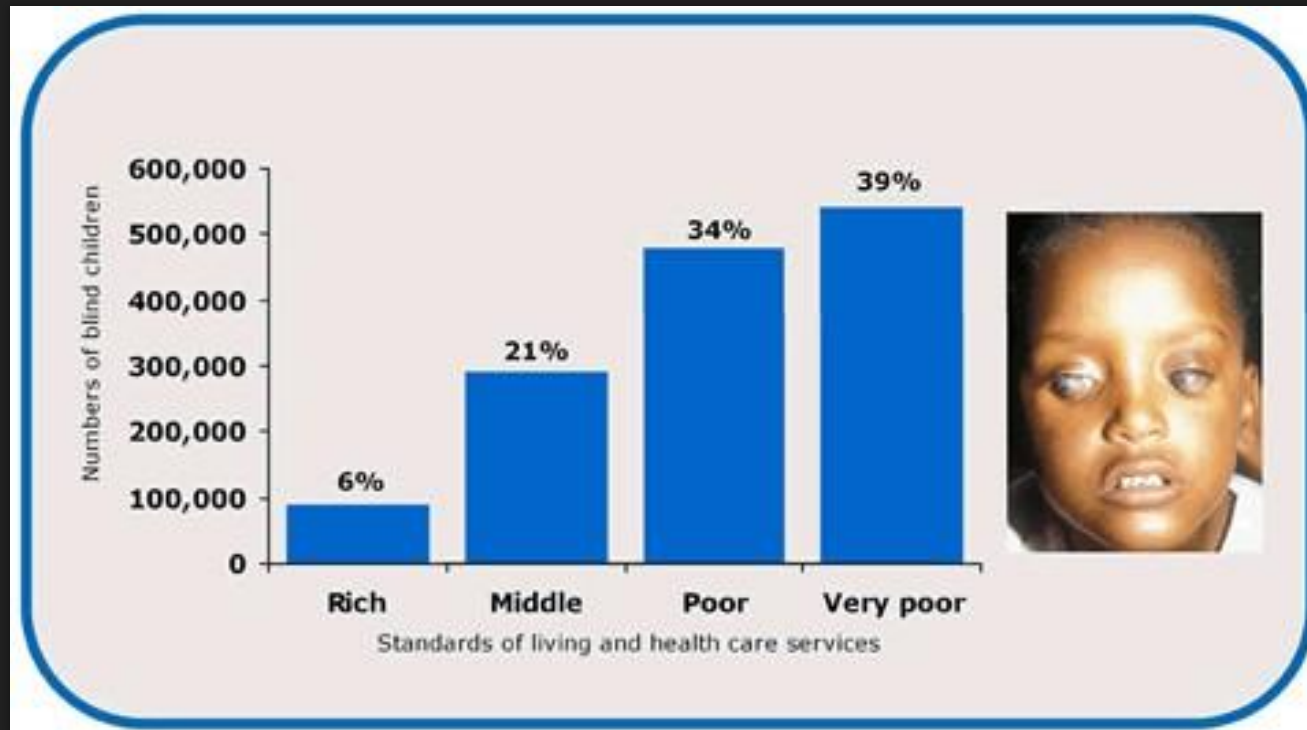
| High-income countries<br>(EME and FSE) <sup>a, b</sup> |               | Middle-income countries<br>(LAC, MEC and China) <sup>a, b</sup> |                | Low-income countries<br>(India, OAI and SSA) <sup>a, b</sup> |                |
|--|---------------|---|----------------|--|----------------|
| ROP <sup>c</sup>                                       | 9000          | Cataract  | 45 000         | Corneal scar   | 200 000        |
| Teratogens   | 5400          | ROP   | 29 000         | Cataract   | 133 000        |
| Cataract   | 5400          | Glaucoma  | 17 000         | Glaucoma   | 60 000         |
| Glaucoma   | 2000          | Teratogens  | 12 000         | Optic atrophy  | 60 000         |
| <b>Total</b>   | <b>21 800</b> | <b>Total</b>  | <b>103 000</b> | <b>Total</b>   | <b>453 000</b> |

<sup>a</sup> See footnote a, Table 1.

<sup>b</sup> Source: ref. 3.

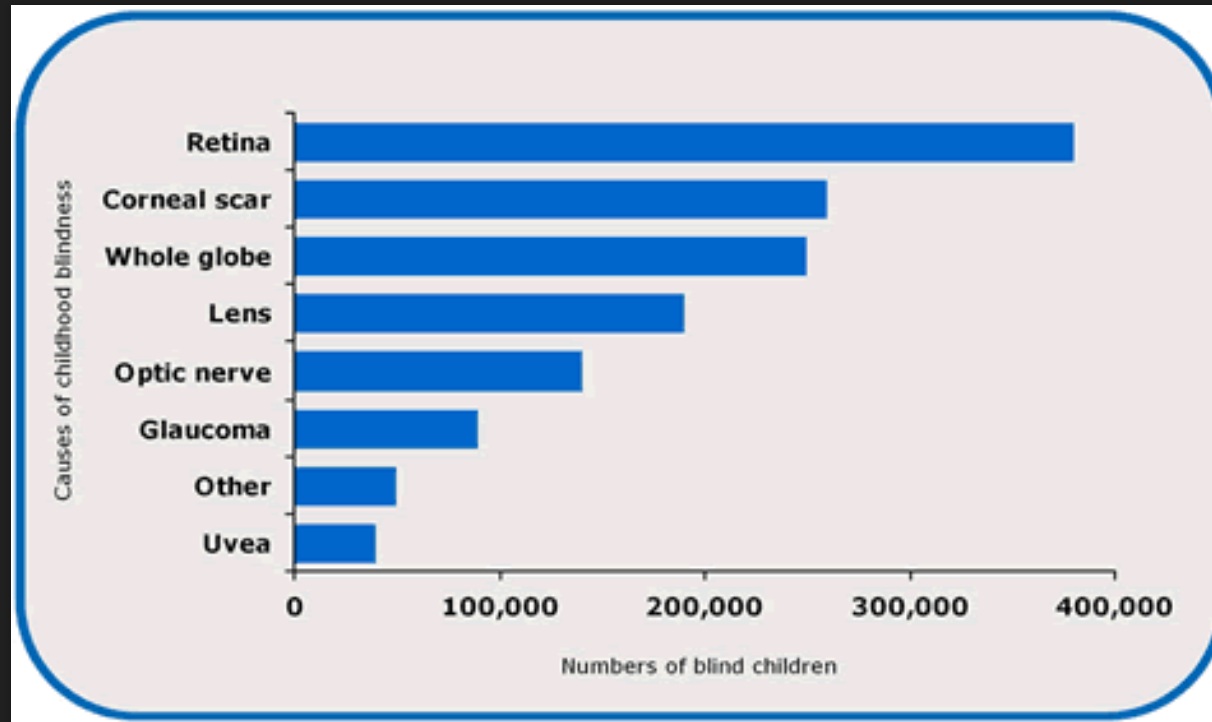
<sup>c</sup> ROP = retinopathy of prematurity.

# Trends in Pediatric visual impairment



<https://s160131.gridserver.com/wp-content/uploads/pubts0401.gif>

# Trends in Pediatric visual impairment



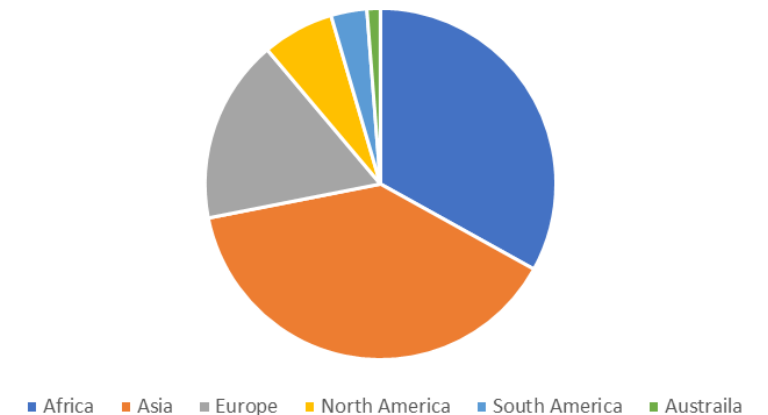
<https://s160131.gridserver.com/wp-content/uploads/pubts0401.gif>



# Poll Question #2

- ☐ What is the most common cause of pediatric low vision you encounter?  
☐ A. Corneal Disorders  
☐ B . Cataracts  
☐ C. Retinal Disorders (Retinopathy of Prematurity, Retinal Detachment)  
☐ D. Hereditary Disease (Albinism, Retinitis Pigmentosa)  
☐ E. Cortical Vision Impairment  
☐ F. Other

Location of participants today



# Why are the numbers important?

- ❑ Funding and availability of services currently targeted toward number of children with a visual impairment
  - ❑ Approach should be related to how long a child will live with a visual impairment
  - ❑ Appropriate resources for development
  - ❑ Appropriate access to technology
- ❑ Determining appropriate interventions at young ages improves global development
  - ❑ Social
  - ❑ Economic
  - ❑ Psychological

# Why are the numbers important?

- Costs to educate visually impaired child (Kirchner, 1977-1978) relative to non-handicapped child
  - 2.17x for “handicap”
  - 5.68X for functionally blind
  - 6.78 for functionally blind with itinerant special education teacher
- Costs \$ 11,189 per child in 1977
  - Adjusting for inflations: \$49,915.47 in 2019

# Beginning the exam

- ❑ Observe child before beginning exam
- ❑ Avoid distractions
- ❑ Observe how the child interacts with environment
  - ❑ Head turns/tilts
  - ❑ Adaptations to visually challenging objects
    - ❑ Get closer?
    - ❑ Avoid?
    - ❑ Squinting or closing an eye?
  - ❑ Response to glare and lighting





# Clinical Observations: Manneristic Behaviors

- ❑ Formerly known as “blindisms”
- ❑ “Repetitive or stereotyped movement that is not directed toward the observable goal.”
  - ❑ Adaptation to vision loss
  - ❑ May help with coping but don't provide a purpose
  - ❑ Reduction of quality of life
- ❑ Common manifestations
  - ❑ Body Rocking (most common)
  - ❑ Eye poking
  - ❑ Head banging
  - ❑ Finger waving
  - ❑ Light gazing

# Manneristic Behaviors

- ❑ Level of vision may relate to types of behavior
  - ❑ Visually impaired – Eye poking, staring, and body rocking
  - ❑ Totally blind-likely to pursue activities to stimulate proprioception, vestibular system
- ❑ Treatment
  - ❑ No consensus on treatment
  - ❑ Mannerisms typically decrease with age
  - ❑ When trying to eliminate the behavior must substitute with another form of stimulation  
Behaviors tend to decrease as another form of stimulation replaces cause for mannerism
  - ❑ Do not recommend psycho therapy or aversion therapy
- ❑ Additional disabilities more likely to maintain mannerisms due to lack of developmental progress

# Case history

- ❑ Special attention needs to be given to child's daily routine
  - ❑ Home environment
  - ❑ School
  - ❑ Hobbies and sports
  - ❑ ...And everything in between
- ❑ Questions should be specific to child
  - ❑ Visual complaints
  - ❑ Level of independence
  - ❑ Support for performing tasks

# Commonly reported problems in school

- ❑ Copying information from blackboard/whiteboard
  - ❑ What strategies do children use?
    - ❑ Walking up to the blackboard
    - ❑ Copying from peers
    - ❑ Using peers' notebooks
- ❑ Reading textbooks like peers
  - ❑ Traditional working distances
  - ❑ No additional accommodations
- ❑ Handwriting or drawing
  - ❑ Writing on a straight line
  - ❑ Spatial awareness



# History of Low Vision Devices and Services

- ❑ LV Services
  - ❑ Which services and what school year
  - ❑ Outcomes
  - ❑ Referrals
- ❑ LV Devices and accommodations
  - ❑ List current and past
  - ❑ Successes?
  - ❑ Failures?

# Other visual difficulties

- Depending on patient's ocular condition, history, observation
- Can also specifically ask about issues with:
  - Glare/light sensitivity
  - Night blindness
  - Color vision defects
  - Contrast

# Visual Goals of Children

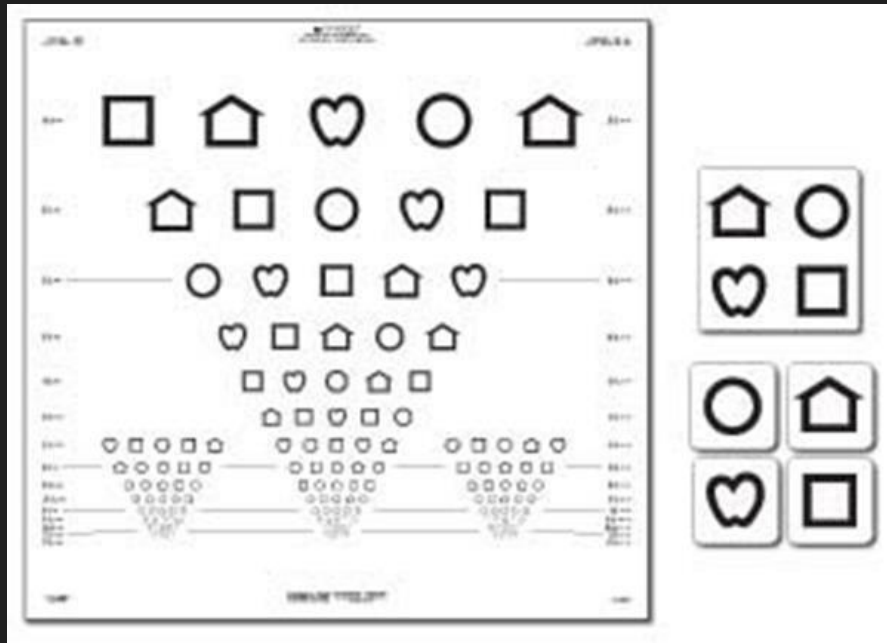
- ❑ Improve distance vision
  - ❑ Distance goals more common with children than adults
  - ❑ Dictated by classroom and social goals
- ❑ Reading
  - ❑ Reading goals increase with age
  - ❑ Improve sustained reading
  - ❑ Read at a normal working distance

# Visual Acuity Testing

- ❑ Assessment of visual discrimination
- ❑ Multiple tests are available
- ❑ Consider developmentally appropriate charts when assessing children
  - ❑ Choosing the wrong chart may create false negatives in testing
  - ❑ Test child's response to optotypes first...



# Visual Acuity Testing



# Factors Impacting visual acuity measurements

- ❑ Measurement Procedures
  - ❑ Testing distance
  - ❑ Presentation of optotypes
- ❑ Visual Field Status
  - ❑ Central field loss vs Peripheral field loss
- ❑ Lighting condition
  - ❑ Make sure to adjust for patient condition
- ❑ Child's response to patching or occlusion
  - ❑ Test both eye together first
  - ❑ Test better seeing eye next

# Teller acuity Cards

- ❑ Forced Preferential Looking
- ❑ Range of acuity 0.23 to 26.0 CPCM (Cycles per CM)
  - ❑ Three testing distances: 38 cm, 55 cm, 84 cm
  - ❑ Can present horizontally or vertically
- ❑ Quick conversion to Snellen equivalent

Snellen denominator =  $20 \times [30/(\text{cycles/deg})]$  Ex:

Patient sees 19 CPCM at 55 cm

$SD = 20 \times (30/19)$

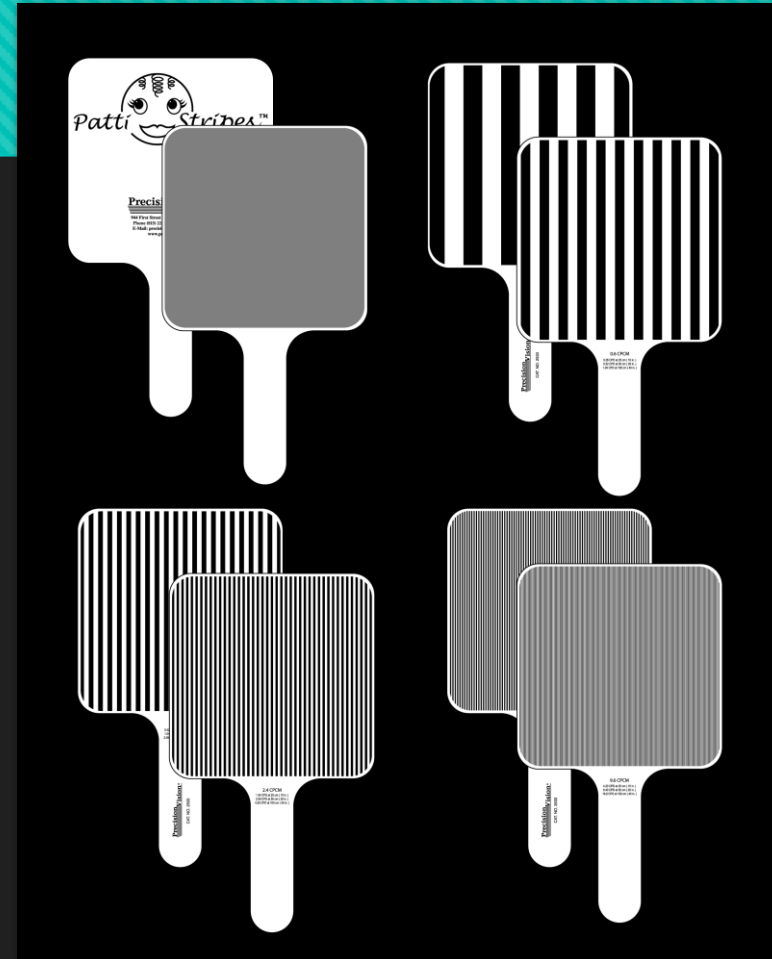
$SD = 31.6$

Snellen acuity: 20/31.6 ~ **20/32**



# Patti Stripes

- ❑ Forced Preferential Looking
- ❑ Range of acuity less than TAC
  - ❑ 0.3, 0.6, 1.2, 2.4, 4.8 and 9.6 CPCM
- ❑ Need to measure working distance
- ❑ Less structured than TAC
- ❑ More portable



<https://www.precision-vision.com/products/grating-acuity-tests/patti-stripes/patti-stripes-square-wave-4-grating-paddles/>



# Cardiff Cards

- ❑ Forced Preferential Looking
- ❑ The Cardiff card has 36 cards providing 24 acuity levels
- ❑ Testing distance: 1 meter or 0.5 meter testing distance
- ❑ Acuity ranges from 20/160 to 20/12.5 snellen equivalent
  - ❑ (6/48 to 6/3.75)

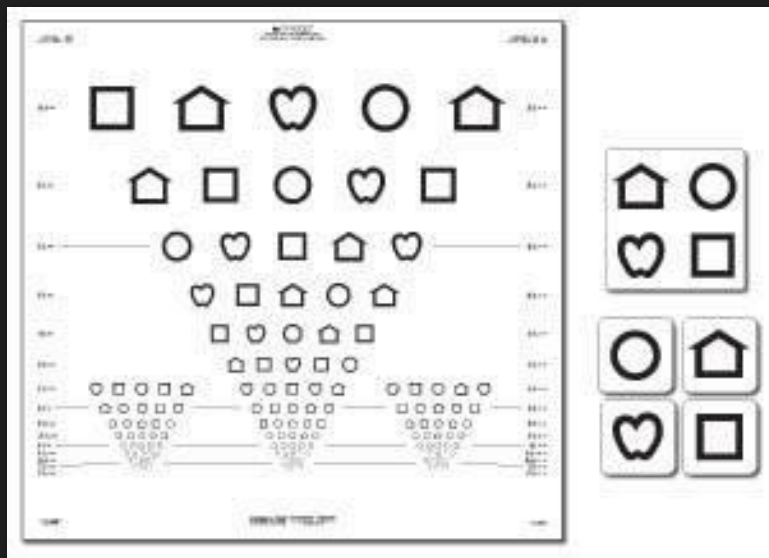
[http://akriti.co.in/index.php?route=product/product&product\\_id=1033](http://akriti.co.in/index.php?route=product/product&product_id=1033)

<https://www.good-lite.com/cw3/Assets/documents/474000%20Cardiff%20Pediatric%20Acuity%20Test-we>

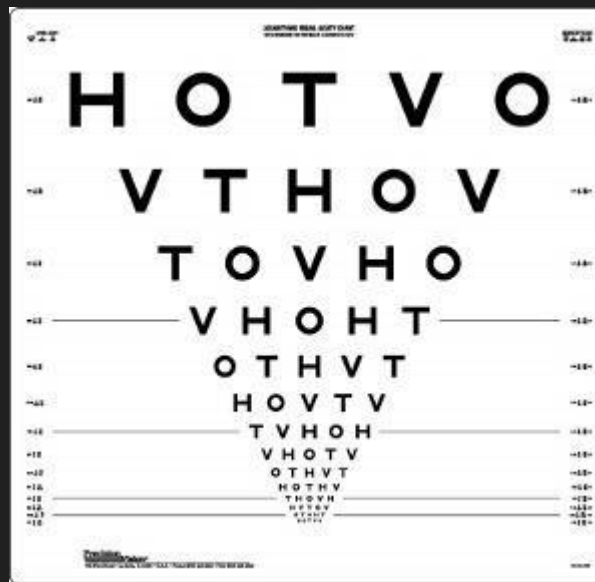


# Distance vision charts

Lea Acuity chart



HOTV chart



Feinbloom



# Near Acuity Charts

## Near Acuity Charts

- ❑ Similar to Distance Charts
  - ❑ Single optotype
  - ❑ Shapes
  - ❑ Letters
- ❑ Difficulties with Crowding?
  - ❑ Consider using a post it note or line guide to isolate a line or letter

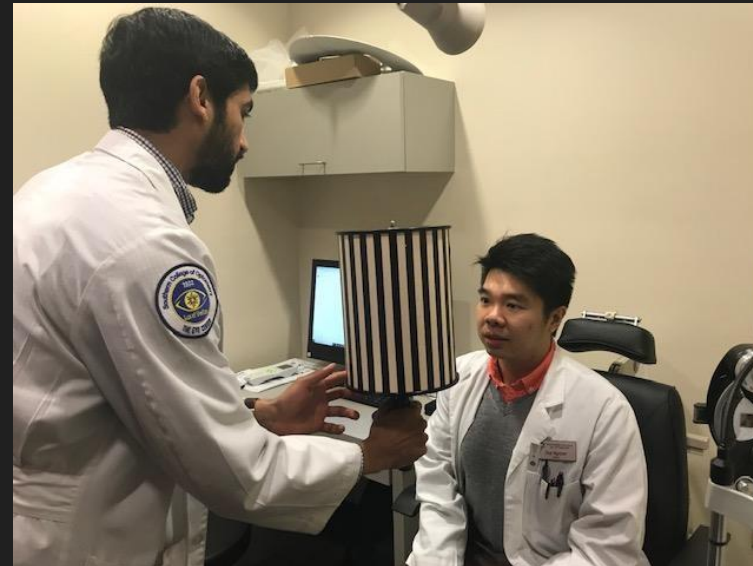
# Continuous Text



- Able to capture reading speeds
- VA may be worse than single letter charts
  - Crowding
  - Coordination of eye movements
  - Comprehension

# Visual Acuity Measurements

- ❑ For patient with significantly reduced vision, attempt to elicit gross visual responses
  - ❑ Fixate and follow
  - ❑ Pupillary responses
  - ❑ OKN responses



# Entrance testing

- EOM's :
  - Look for alignment, null points
  - Perform test at slower speed
  - Use the patient's own finger as target
  - Verbally direct patient gaze
  - Doll's Head movement
- Alignment
  - Cover Test
  - Hirschberg



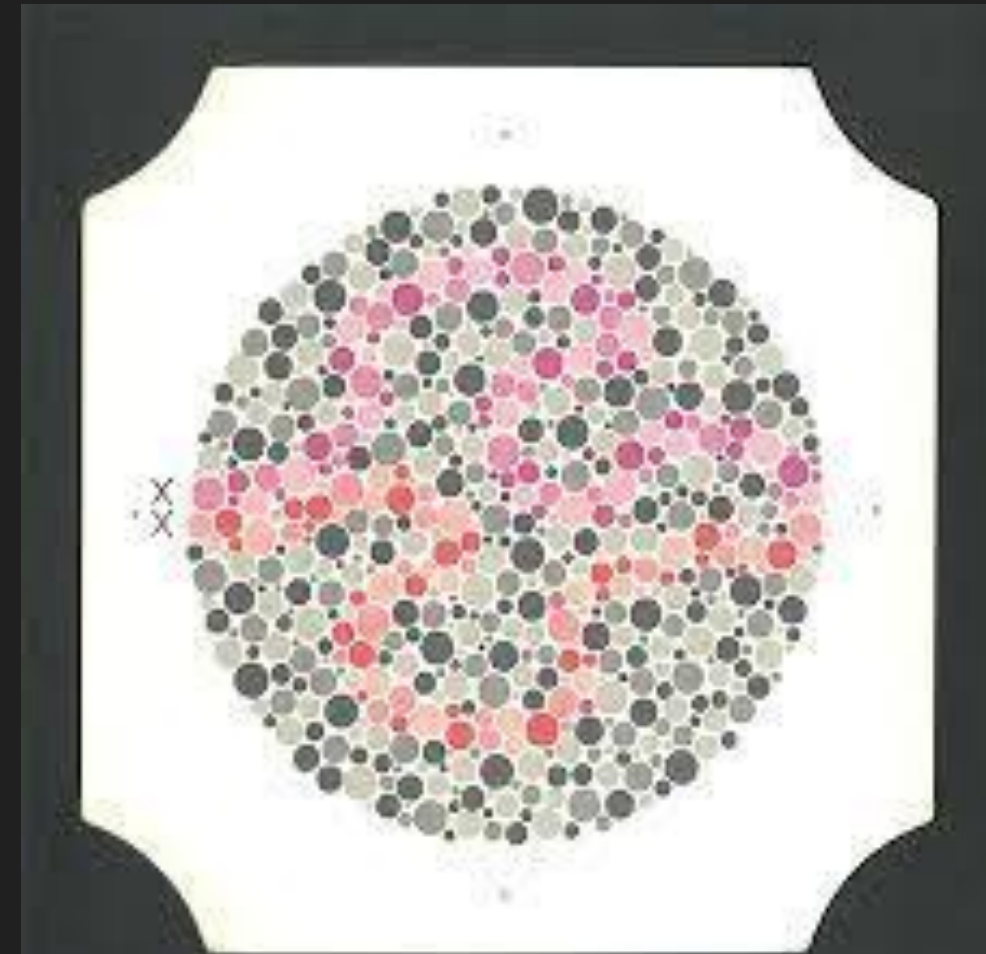


# Entrance Testing

- ❑ For most patients, standard pupils procedure
- ❑ Assess neurologic response
- ❑ Also pupillary response to lighting
- ❑ Modifications for apprehensive kids:
  - ❑ Try movement with penlight without light on
  - ❑ Use a puppet to simulate the movement

# Color vision

- ❑ Modifications:
- ❑ Color Arrangement:
  - ❑ Use Jumbo D15 Dichotomous test plates.
- ❑ Color Matching and naming
- ❑ Color Plates:
  - ❑ Ishihara
  - ❑ HRR
  - ❑ Tracing plates









# Confrontation visual field (CVF)

- CVF performed as standard procedure
- Modification:
  - For extent of horizontal field, use Vision Disc
  - Have second person stand behind patient and present targets from behind
    - Use puppets or toys
    - Smaller targets for better visual discrimination



<http://www.bing.com/videos/search?q=vision+disk&&view=detail&mid=0A5F05F5A074B055C0820A5F05F5A074B055C082&FORM=VRDGAR>, cited June 1, 2017

# Visual Deficits

| Visual Deficit                              | Percentage of participants  |
|---|---|
| Refractive Error                            | 38.6%    |
| Reduced Contrast                            | 13.1%    |
| Reduced distance/near acuity                | 8.6%     |
| Visual Field Deficit                        | 2.1%  |
| Anomalous Eye Movement                      | 11.6%    |
| Visual Processing deficits                  | 23.4%  |
| Children presenting with at least 1 deficit | 61%    |

In school eye care in special education settings has measureable benefits for children's vision and behavior. Black et al. PLOS ONE. Aug 1 2019.

# Refraction

- Refraction is a crucial part of the assessment
- Need to consider a fixation target that is going to keep attention
  - Videos
  - Parents or staff members
  - □ May need to adjust working distance
- □ Don't be afraid of damp retinoscopy
- Consider the diagnosis when performing retinoscopy





# Refractive errors with common pathology

| CONDITION          | TYPE OF REFRACTIVE ERROR   |
|--------------------|--|
| Albinism           | Moderate to high hyperopia or myopia with moderate to high WTR astigmatism |
| Cataracts          | Myopic shift   |
| Cerebral palsy     | Moderate to high hyperopia   |
| Corneal scarring   | Moderate to high astigmatism   |
| Diabetes           | Myopic shift or Hyperopic if macular edema                                 |
| Down syndrome      | Moderate to high myopia  |
| Microphthalmos     | Moderate to high hyperopia   |
| Pendular nystagmus | Moderate WTR astigmatism   |
| ROP                | High myopia  |



# Children receiving Low Vision Rehabilitation

- ❑ Lusk, Coakely and Schwartz evaluated 22 children ages 2-6
- ❑ Able to obtain appropriate measurements with children (VA, VF, contrast, color vision)
- ❑ Prescribed Optical devices
  - ❑ 50% were prescribed near devices
  - ❑ 54.6% were prescribed distance devices
    - ❑ 40.9% were prescribed near and distance devices
  - ❑ **27.3% prescribed pre-device instruction**

Comprehensive pediatric low-vision rehabilitation: effective evaluations and treatment for very young children Kelly E. Lusk, Rebecca Coakley, Terry L. Schwartz

# Relative Size Magnification

□ C



ed or magnified

[www.Wikipedia.com](http://www.Wikipedia.com)



# Relative Size Magnification

- ❑ Large Print Books
- ❑ Larger assistive technology monitors
  - ❑ Closed Circuit Television (also uses Transverse magnification)
  - ❑ Computers
  - ❑ iPads and Tablets
- ❑ Suggestions for Child
  - ❑ Large print tests and text books
  - ❑ Enlarge homework assignments
  - ❑ Using thicker pens vs pencil/pen

# Relative Distance Magnification

- ❑ Retinal image is enlarged by moving object closer
- ❑ Devices: hand held magnifier, stand magnifier, telemicroscope, microscope



# Relative Distance Magnification

- ❑ Bringing reading material closer to patient
- ❑ Bringing patient closer to items of interest
- ❑ Recommendations for child
  - ❑ Preferential seating
    - ❑ Moving closer to blackboard/whiteboard
    - ❑ Sitting in front of assembly
  - ❑ Encourage closer reading distance
    - ❑ Prescribe reading glasses

# Magnification from multiple sources

- Total retinal image magnification is determined by the product of each of the magnification sources
- For example: if a patient moves an iPad 3 times closer and makes print 2 times larger, the total amount of magnification compared to the original is 6X
- Consider combining types of magnification



# Prescribing

- ❑ Target acuity for basic calculations should take into consideration unique characteristics of children and their environment
  - ❑ Classroom environment
  - ❑ Homework
  - ❑ Hobbies and extra-curricular activities
  - ❑ Age and development
- ❑ Need to have an idea of where to start
  - ❑ Children lose attention quickly
  - ❑ Need to be quick

# Distance Device Evaluation

## Prescribing Telescopes

Determining the starting power of a telescope *based on the patient's VA and their goal:*

$$M_a = \frac{\text{Current BCVA}}{\text{Goal VA}}$$

$M_a = \frac{\text{"What they CAN see at distance"}}{\text{"What they WANT to see at distance"}}$

# Telescope Example

- Current BCVA 20/400

- Goal VA 20/50

- Calculation

$$\frac{400}{50} = 8X$$

50

- Would start telescope evaluation with an 8X to meet goal

# Poll Question #3

- ☐ A patient's best corrected visual acuity is 20/200. You want him to see text on a black board which is equivalent to 20/40. What telescope power would you start with to meet the goal of seeing 20/40?
- ☐ A. 4X
- ☐ B. 5X
- ☐ C. 6X
- ☐ D. 8X

# Types of Telescopes

- ❑ Monocular:
  - ❑ Hand-held
  - ❑ Hands-free
- ❑ Binocular:
  - ❑ Hand-held
  - ❑ Hands-free
- ❑ Custom made Monocular/Binocular:
  - ❑ Spectacle-mounted monocular TS (full field or bioptic)
  - ❑ Spectacle-mounted binocular TS (full field or bioptic)



# Near device assessment

## Prescribing near devices

Need to determine a starting dioptric power, or equivalent power (Feq) to determine what dioptric power will allow that child to read their goal print

$$\frac{\text{Current VA}}{\text{Goal VA}} \times \text{inverse of wd(D)} = \text{Equivalent power (Feq)}$$

Example:

Your 6 yo patient reads .4/4M with normal accommodation. He wants to see comic book print (equivalent to 1 M).

$$\frac{4M}{1M} \times +2.50D = +10.00D$$

A 10 Diopter equivalent power of any near device should get patient to goal of 1M

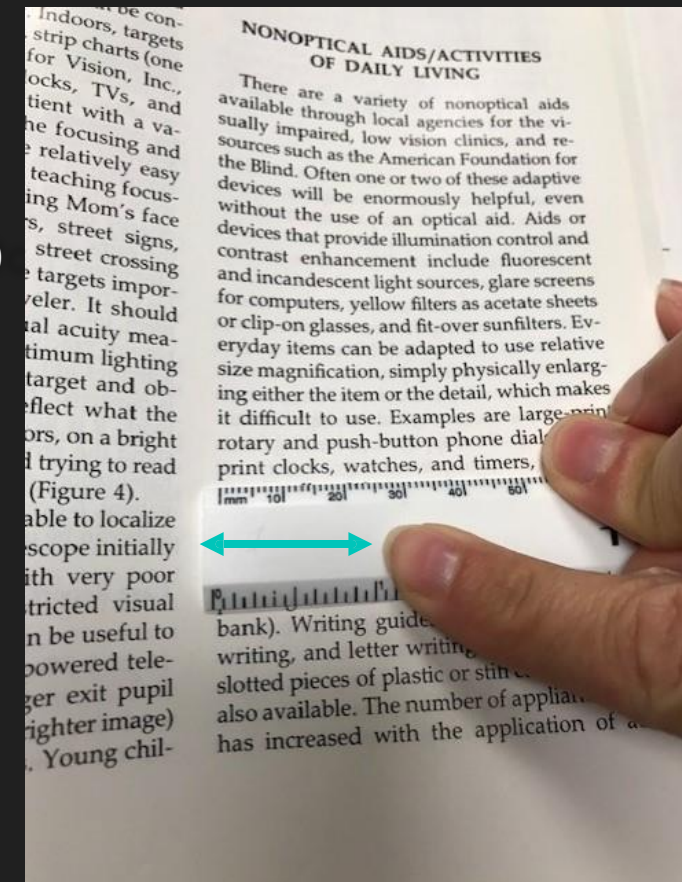


# Available Devices



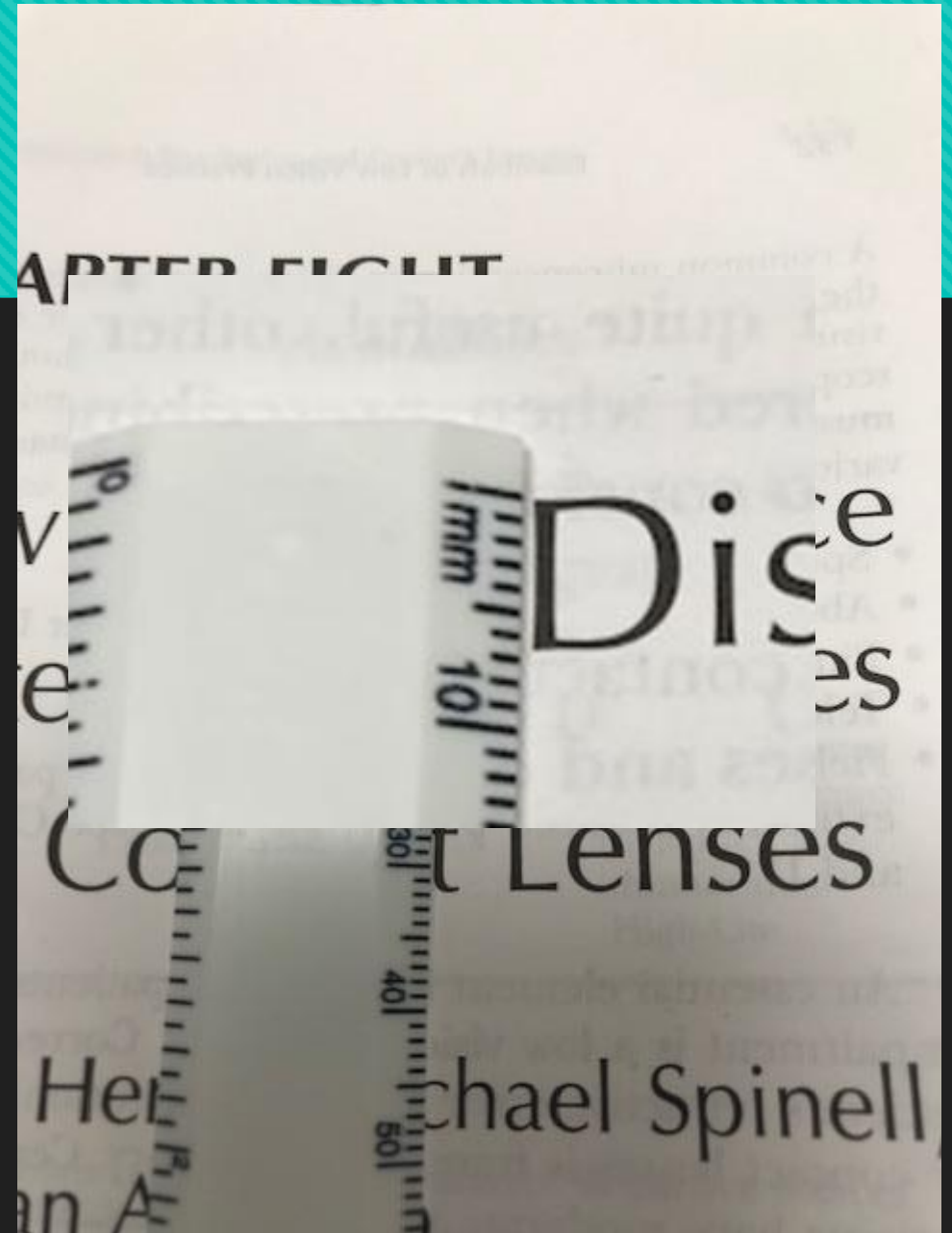
# Estimating Print size

- Several methods to estimate size of required print
  - Rule of 1000
  - Measure number of letters and spaces in 1 inch (2.54 cm), and divide into 1000
  - Gives denominator of Snellen Acuity
  - Example:
    - Letters in 1 inch space: 16
    - $1000/16=62.5$
    - 20/62.5 Snellen equivalent



# Estimating print size

- ❑ Using metric notation
- ❑ 1M letter size = 1.45 mm
- ❑ Measure height of letter
- ❑ Divide size by 1.45 = estimated M notation size
- ❑ Example:
- ❑ Letter size ~6 mm
- ❑  $6/1.45 = 4.14 = \sim 4.1\text{M}$



# Poll Question #4

- ☐ A child is having difficulty with reading text in a book. It is not available in large print or via a tablet to modify the print size. Since this is the goal print, you want to determine the appropriate optotype size to ensure your equivalent power calculations will be accurate. You measure the print size to be 4.35 mm in size. What is the closest M acuity size of this print?
  - ☐ A. 1M
  - ☐ B. 2M
  - ☐ C. 3M
  - ☐ D. 4M

# Reading

- ❑ Children compensate for decreased vision by using relative distance magnification
  - ❑ Bring print close enough to resolve detail
  - ❑ Challenges presented with this format
    - ❑ No task lighting or contrast enhancement
    - ❑ Postural problems
    - ❑ Cosmesis
- ❑ Children with low vision can approach reading rates of normally sighted children with appropriate magnification
- ❑ Corn et al found children using devices have a tendency to improve their reading rates while children who use large print tend to plateau

Lovie-Kitchen et al. Reading performance in children with low vision. Clinical Experimental Optometry, 84 (3). 148-154.

Corn AL. Optical devices or large type: Is there a debate. International Conference on Low Vision (1990).

# Reading Rates in Children

- ❑ Reading rates increase in children with age
  - ❑ Reading rate increased 9.9 wpm per year in VI vs 14 wpm for normally sighted
- ❑ Classroom activities dictate need specific reading rates
  - ❑ 60 wpm adequate up to 3<sup>rd</sup> grade, inadequate for higher grades (Mangold and Mangold)
  - ❑ Range of reading rates varies greatly (20-180 wpm-Kalliantos and Johnston), 120 “desired” by teachers
    - ❑ Lovie-Kitchin et al found Maximum Oral Reading Rate of 28 wpm-254 wpm

Corn AL. Optical devices or large type: Is there a debate. International Conference on Low Vision 1990).

Lovie-Kitchen et al. Reading performance in children with low vision. Clinical Experimental Optometry, 84 (3). 148-154.



# Smart phones and tablets

- ❑ Children are quick to pick up technology
- ❑ Learn by trial and error
- ❑ Follow trends
- ❑ Technology is a part of growing up
- ❑ Opportunities for visually impaired and blind
  - ❑ Reduce costs
  - ❑ Visual enhancement features
    - ❑ Contrast
    - ❑ Large print
  - ❑ Inclusivity

McCaughey et al, Motivations and obstacles to smartphone use by the elderly: developing a research framework, Int. J. Electronic Finance, Vol. 7, Nos. 3/4, 2013

# Glare Control

## ❑ Filters

- ❑ UV Protection
- ❑ Tinted lenses
- ❑ Sports frames/wrap around frames
- ❑ Fit-overs
- ❑ Tinted Contact Lenses



Photo courtesy of Dan Fuller, OD

# Rehabilitation Team

- ❑ Orientation and mobility training
- ❑ Vision Teacher
- ❑ Social work
- ❑ School psychologist
- ❑ Managing Eye Care Physician
- ❑ Primary Care Physician



# Vision Clinic in schools

- Consider providing exams in schools
- Mobile Clinic to provide evaluations in most natural environment
  - Assess children's behavior and interactions in classroom
  - Collaborate with vision teachers, O&M specialists
  - Tailor visual needs to environment
  - Observe interactions with peers

In school eye care in special education settings has measureable benefits for children's vision and behavior. Black et al. PLOS ONE. Aug 1 2019.

# Observations after school-based clinic

- More children wearing spectacles after examinations (n=54)
  - Some children with significant prescription not wearing prescription
  - Teachers had positive feedback
  - Other behaviors not significantly changed
    - Not visually engaged with tasks
    - Off task
    - Initiates engagement

In school eye care in special education settings has measureable benefits for children's vision and behavior. Black et al. PLOS ONE. Aug 1 2019.

# Report writing

- Upon completion of an exam, it's important to create a report of your exam findings findings
- Important to consider who is reading report report
  - Translate findings
    - Sizes of acuity
    - Contrast loss and implications
    - Prognosis
    - Recommendations
  - Use appropriate terminology for the reader reader
    - Consider referring doctor vs. parent



# Parents and Guardians: What do they know?

- ❑ Where are parents getting information?
  - ❑ Eye Care Providers (68%)
  - ❑ Internet (15%)
  - ❑ Family and Friends (8%)
  - ❑ Newspapers/Journals/Pamphlets (5%)
  - ❑ Volunteer Organizations (2%)
  - ❑ Television (1%)
- ❑ Impacts on level of health literacy
  - ❑ First language
  - ❑ Education level (high school or lower)
  - ❑ Income less than \$70,000

# Health Literacy with parents and guardians

- ❑ Include parents and guardians in rehabilitation of children
- ❑ Important that parent understands impact of visual impairment
  - ❑ Benefit of devices and rehabilitation strategies
    - ❑ Demonstrate vision loss with simulators
    - ❑ Demonstrate how to utilize prescribed low vision devices
    - ❑ Written report
  - ❑ Resources available

# Health Literacy with parents and guardians

- Reasons for lack of health literacy with parents
  - Medical terminology not “translated”
  - Embarrassment to ask questions
  - Poor recall of relayed information
  - Receiving information verbally vs. take home information
    - 40% of patients forget or misunderstand information from eye care providers