Vision Screening & Amblyopia Technology 2026

Guidelines for Pediatricians

James W O'Neil MD

Phoenix Children's Pediatric Ophthalmology

National AAPOS Vision Screening Committee

Learning Objectives

- Appreciate the importance of vision screenings throughout childhood.
- Understand methods and AAP recommendations for vision Screening
- Appreciate new technologies to enhance screening and treatment.

JWO Vision Screening Background

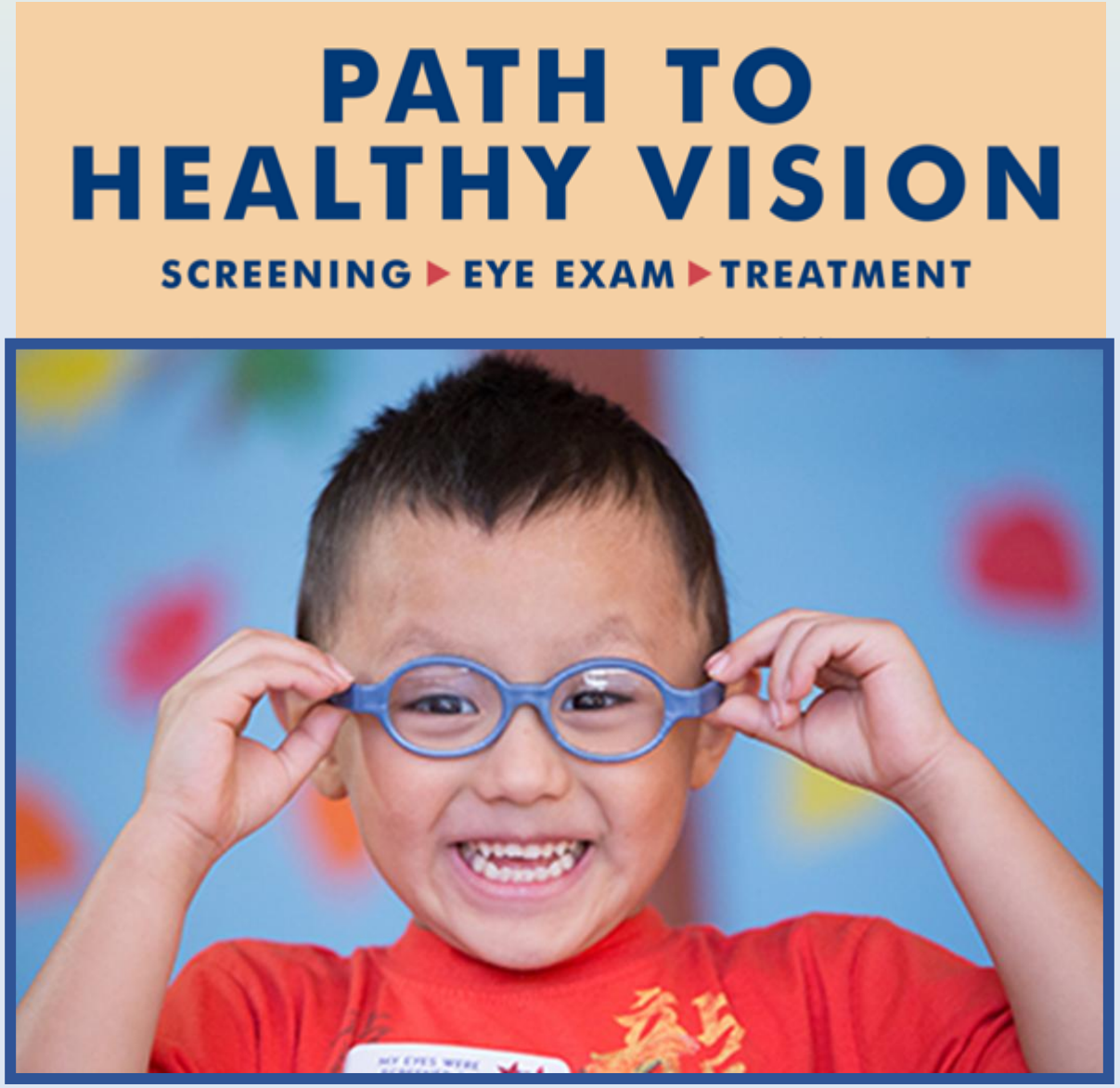
Founder VisionQuest 20/20

501c3 Non-profit

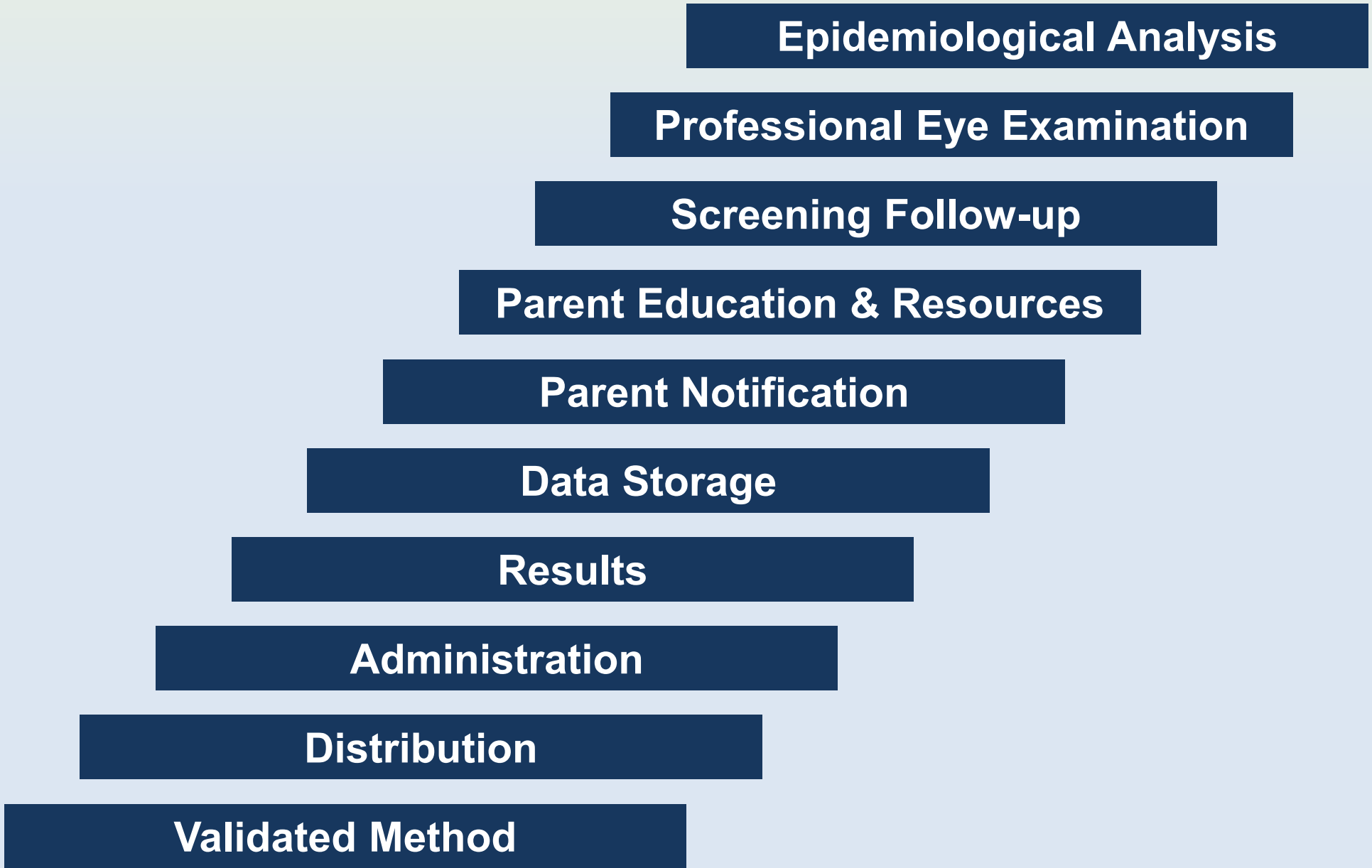
Mission: Improve school vision screenings through technology

Public Health Model

Screening Vision Is Not Enough

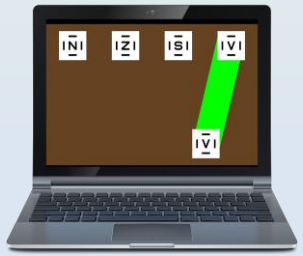


Vision Screening Public Health Model



Statewide School Data Management

Multiple sites need connection:



HIPPA/FERPA Secure Cloud

First Az. School Vision Screening Law fall Implemented 2024

Charitable distribution to all 2700 Az. Schools

U. of A. CME Sponsor:
COI Financial Disclosures Required

COI- Licensing agreement with GoCheck Kids

Computer-Based Eye charts

Not specifically endorsed by AAP

GoCheck Kids

Why Vision Screen Kids?

Many vision problems may exist without any clear outward signs.

Children rarely complain about vision problems. They think everyone sees the world the same way they do.

Why Vision Screen Kids?

Childhood Vision screenings recommended by:

- **American Academy of Pediatrics (AAP)**
- **American Academy of Ophthalmology (AAO)**
- **American Academy of Pediatric Ophthalmology & Strabismus (AAPOS)**
- **US Preventive Services Task Force (USPSTF)**

Childhood vision problems often go undetected by parents, doctors, schools, and the children themselves

Vision disorders are common in kids

Eye / Vision disorders are widespread in children and become more prevalent with age:

- **5-10%** of preschoolers
- **20%** of elementary school age children
- **30-40 %** of high schoolers (mostly nearsighted)

Vision Screenings are cost effective

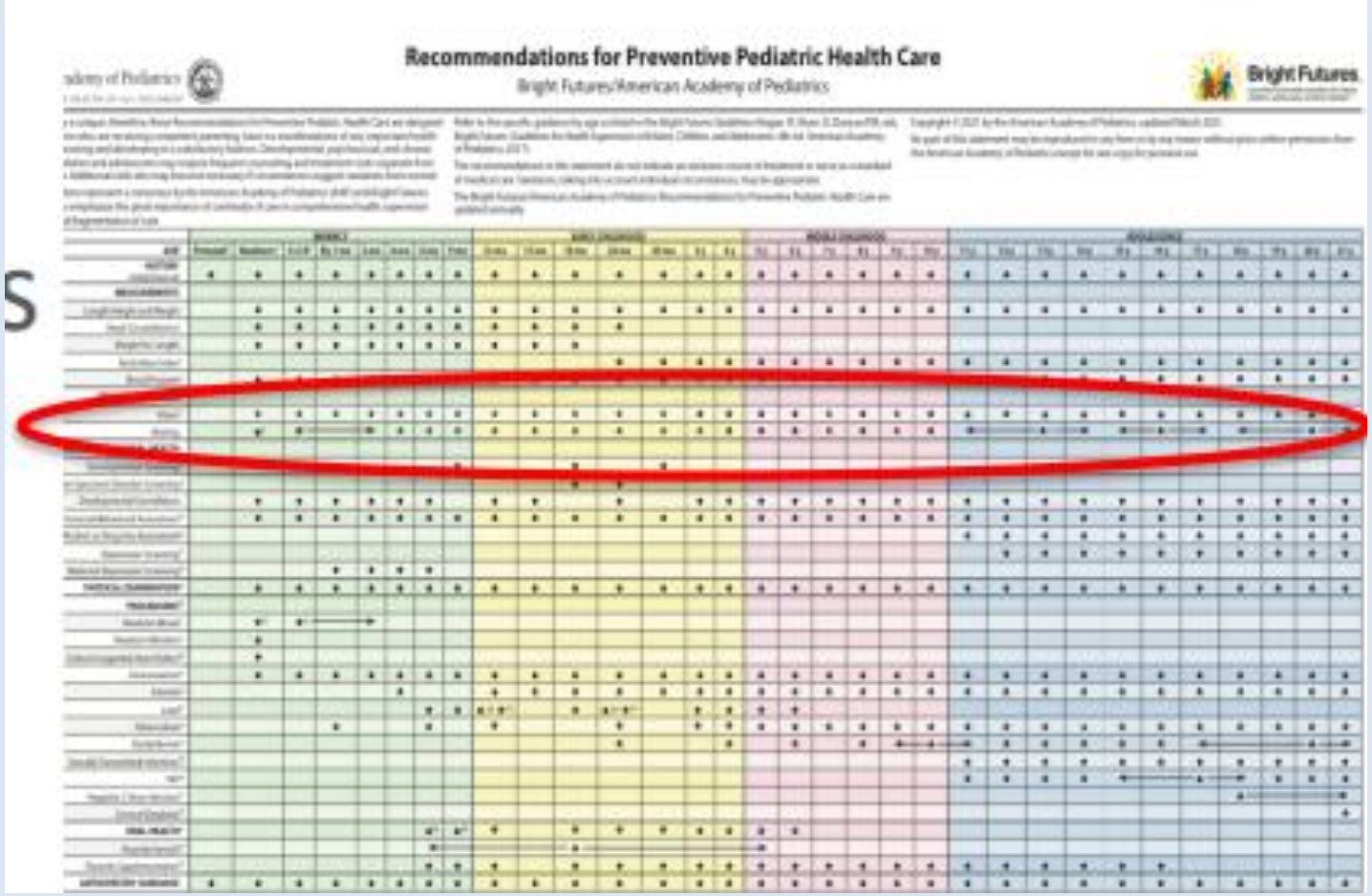
PUBLIC HEALTH SAVINGS

$1 investment in vision screenings returns $162 in life-long disability prevention

Local Public Health Service	ROI (benefit per dollar invested)	Notes
Childhood Immunizations	$22 to 1	$88 Million saved in 2009
Flu Vaccinations	$11 to 1	$91 – $141 saved per vaccination (direct medical costs only)
STD Screening	$2.50 to 1	Through pelvic inflammatory disease prevention
Infectious Disease Surveillance	$2.00 to 1	Considering ONLY bacterial meningitis prevention
Hearing Screening	$112 to 1	From gains workers' future productivity
Vision Screening	$162 to 1*	From life-long disability prevention for kids
Food-borne Illness Surveillance	Epidemic Prevention	187 cases occurred in 2009 ($1.5 Million for treatment)
Drinking Water Protection and On-Site Sewage Management	Epidemic Prevention	Gastrointestinal outbreak, South Bass Island, Ohio

Serial Vision Screenings

AAP Bright Futures
Preventive Periodicity
Health Schedule



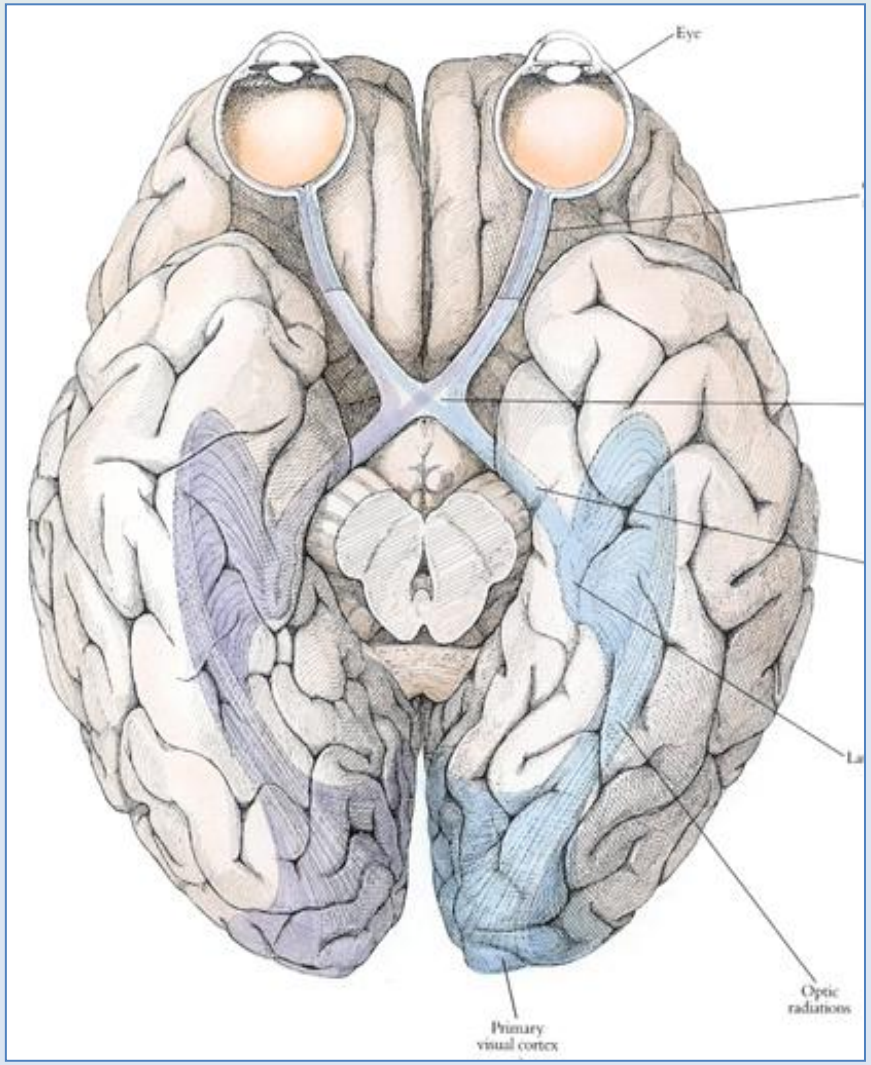
Importance of early detection and treatment

Amblyopia (“lazy eye”)

Most important visual health reason to vision screen kids

Amblyopia-
"Use It or Lose It"

- **Amblyopia is the loss of vision resulting from abnormal visual neuro-development**
- **The brain fails to "learn" to see**
- **"Critical period" for neuroplasticity of vision pathways**

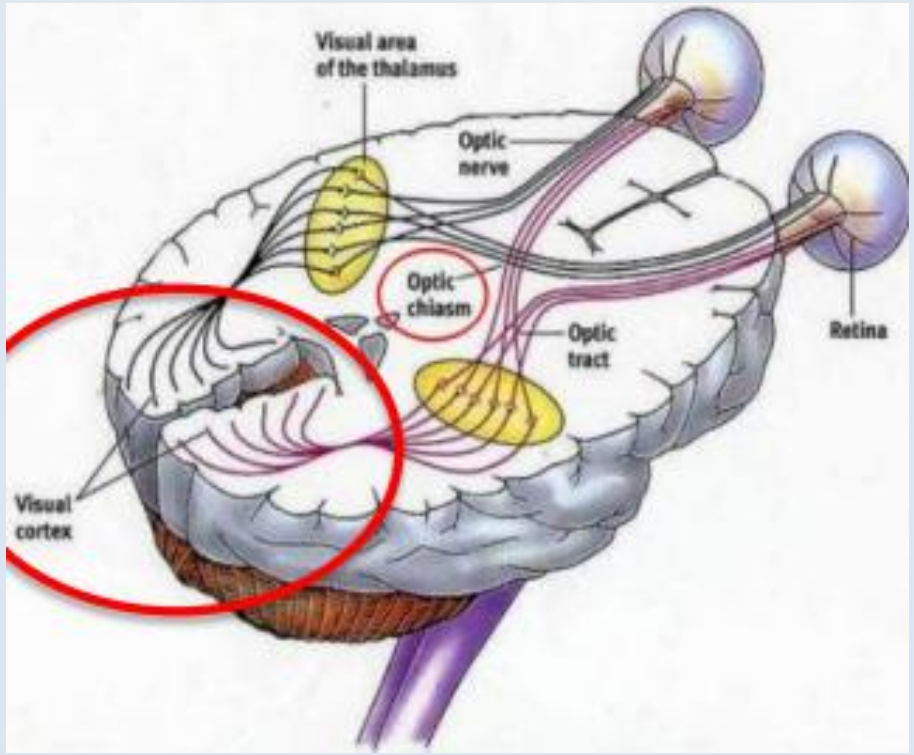


Amblyopia

Amblyopia affects 2 - 4% of children in the United States

Untreated/undertreated childhood amblyopia:

Most common cause of uncorrectable vision loss in adults 20 - 70 yo



Early screening for amblyopia is best

School-aged vision screening may occur too late!

Amblyopia becomes increasingly refractory to treatment after 5 years of age.

Permanent vision loss occurs in older children.

Why vision screen older kids?

- **Safety net for missed amblyopia**
- **New eye conditions continue to develop in older kids**

School Performance:
Another reason to vision screen

- **Non-amblyopic vision conditions may adversely affect school performance**

- **Early school struggles may result in lifelong disparities in academic achievement and lifetime earning potential.**

Vision screenings throughout childhood

Eye problems increase with age

0-1 years - Pediatrician

Cataracts, eye crossing, visual tracking, retinoblastoma

1-3 years - Pediatrician

Amblyopia risk factors, eye crossing, larger refractive errors

3-4 years - Pediatrician and Pre-school

Amblyopia risk factors, moderate refractive errors

5-18 years - K-12 Schools

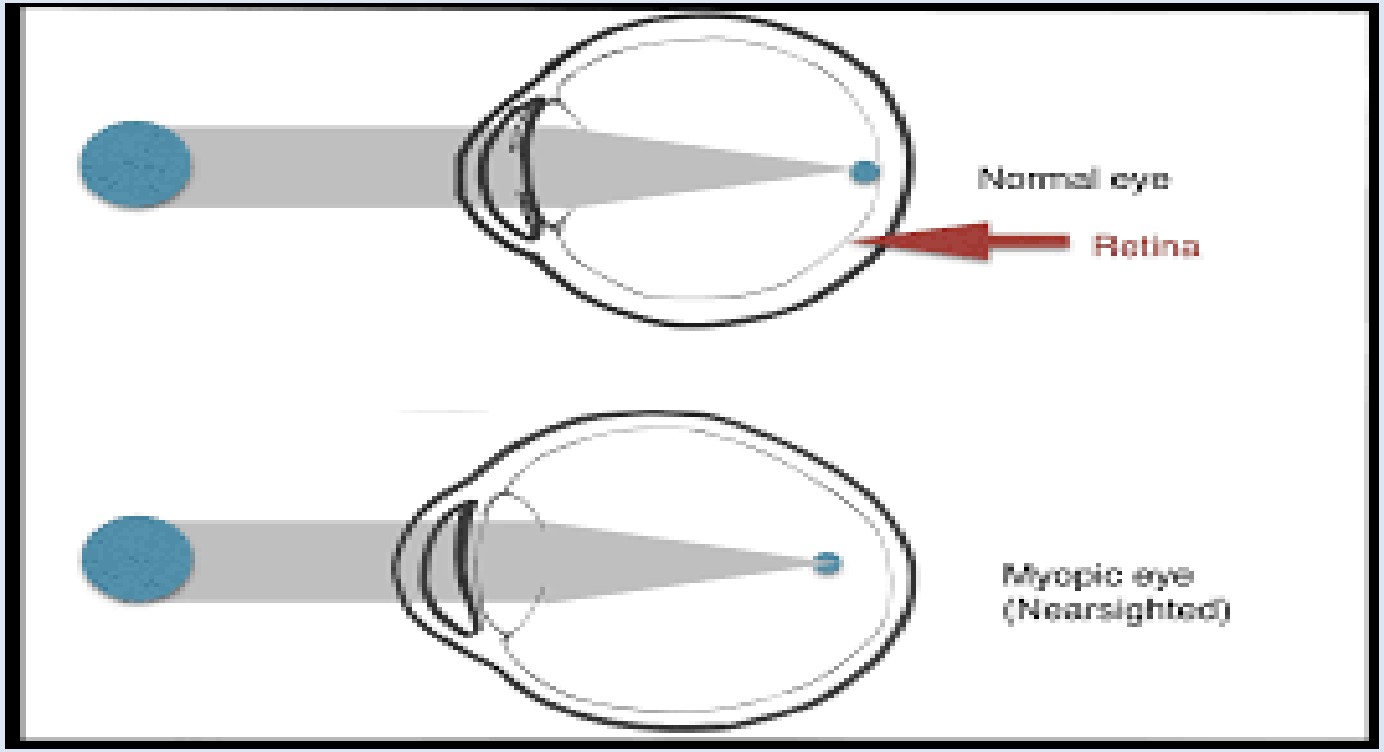
Amblyopia safety net, refractive errors (e.g., see board at school) and newly developed eye problems-myopia epidemic

School Vision Screenings

Arizona Medicaid data shows pediatrician vision screenings drop off in older kids even as % of vision problems increases with age

AAP supports school- based screenings as part of a comprehensive public health model

Myopia (nearsightedness) Epidemic
Eye is stretched “too Long”



Myopia : Genetics + Lifestyle

- 68 % increase myopia since 1970 (now 35-40% kids)

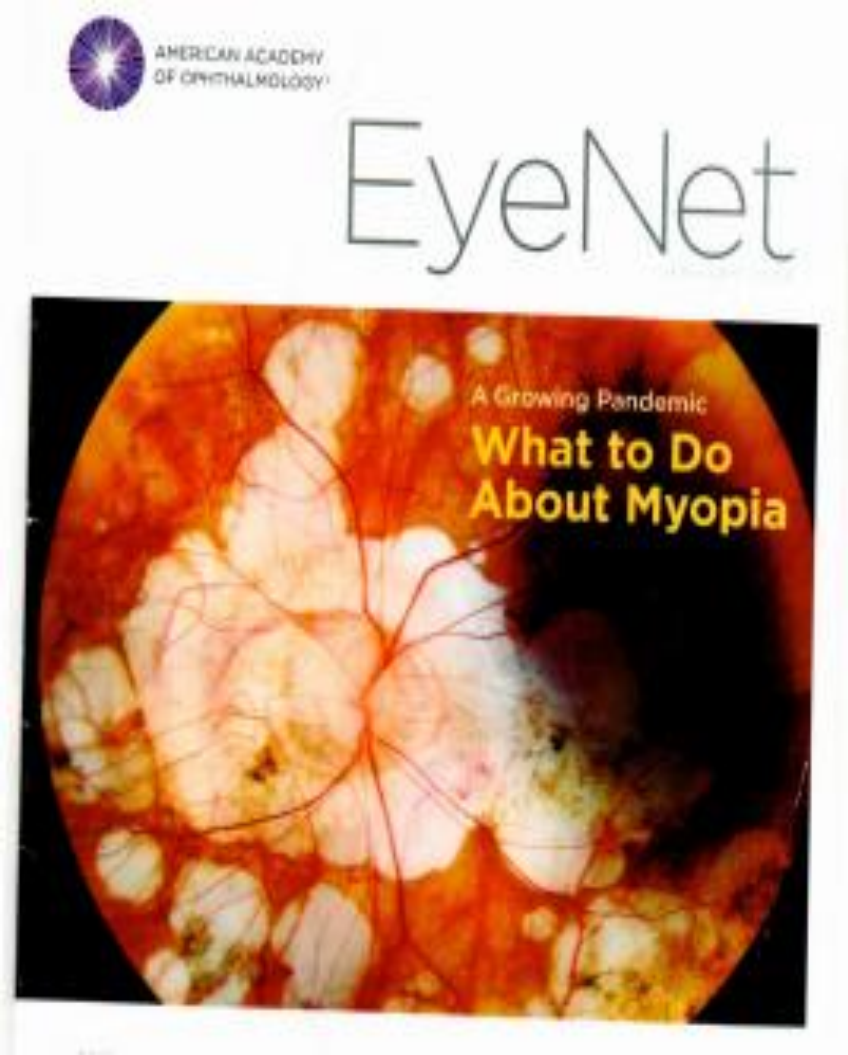
- Earlier onset & more severe

  5-6 yo vs 10-12 yo.

High Myopia -6.00= Lifelong eye health risk

- 2 ½ times more common in Urban vs Rural Kids

Myopia epidemic-Lifetime Risks



- **<u>one-diopter increase in</u> myopia has been linked with a 67% increase in in myopic maculopathy**

- **Increased risk retinal detachment, glaucoma, cataracts, strabismus**

- **Adult refractive surgery (LASIK, etc.) does not reduce axial length & does not lower risk**

Myopia prevention is key

- 1. **Low dose atropine 0.01%,0.025%,0.05%**
- 2. **Misight CL (peripheral myopic defocus)**
- 3.Orthokeratology (CRT) CL
- 4.**Peripheral myopia defocus glasses (Essilor Stellest)**
- 5. Bifocals
- 6. **Outdoor time 1 hour/day**
- 7. **Limiting near work activities**
- 8. Red light therapy (not in US)
- Combining therapies

Which of the following are true about Myopia (nearsightedness)? [SELECT ALL THAT APPLY]

Serial Vision Assessments Begin at Birth

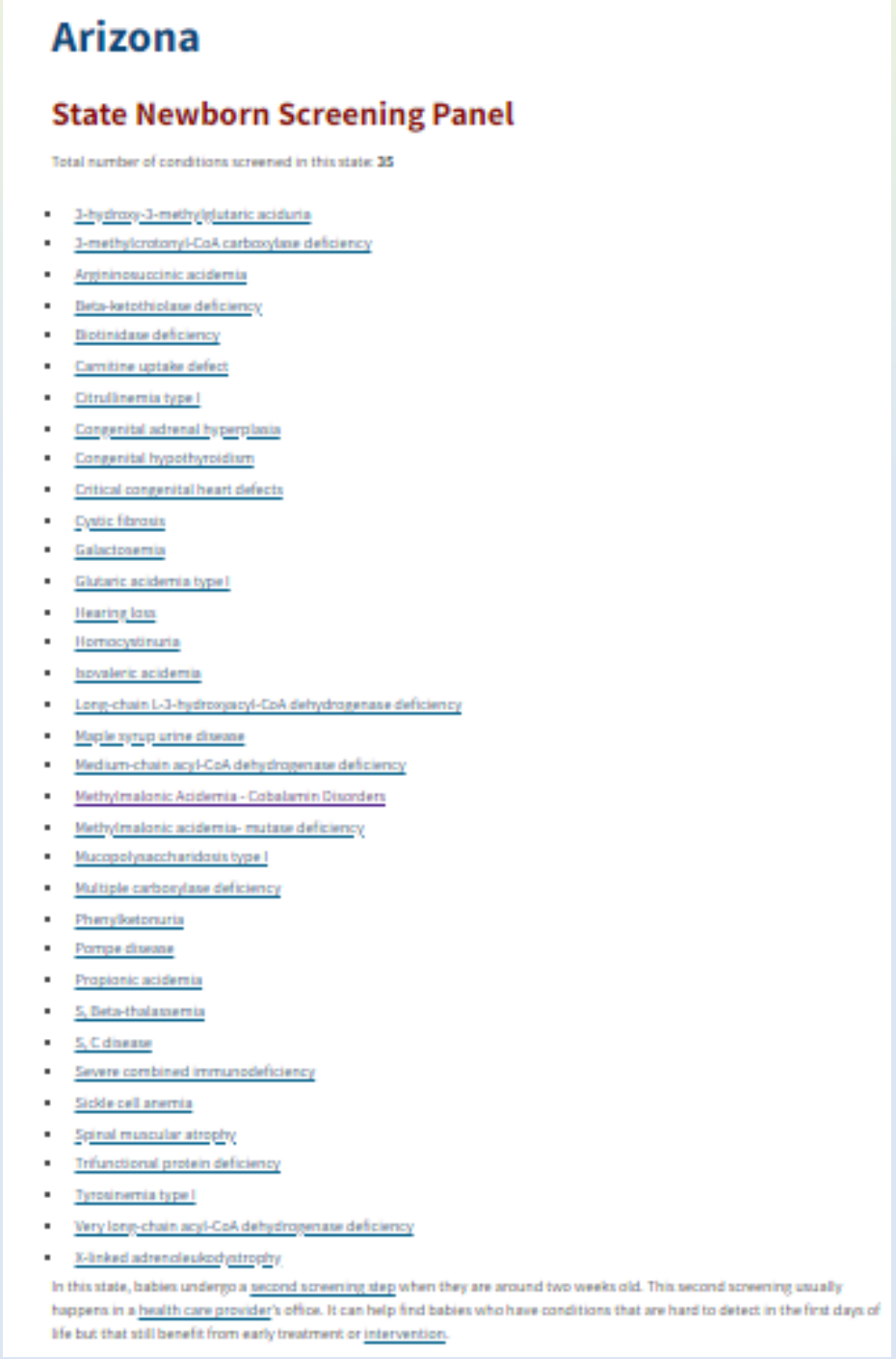
Neonatologist or Pediatrician

- **Examine the eyes, eyelids, pupils and red reflexes**
- **Critical period for amblyopia from congenital cataract < 3 months**
- **Look for congenital malformations, infections, newborn screening blood panel**

Arizona Newborn Screening for 35 genetic diseases

Second confirmatory screening at 2 weeks old

e.g., galactosemia



Arizona

State Newborn Screening Panel

Total number of conditions screened in this state: **35**

- 3-hydroxy-3-methylglutaric aciduria
- 3-methylcrotonyl-CoA carboxylase deficiency
- Argininosuccinic acidemia
- Beta-ketothiolase deficiency
- Biotinidase deficiency
- Carnitine uptake defect
- Citrullinemia type I
- Congenital adrenal hyperplasia
- Congenital hypothyroidism
- Critical congenital heart defects
- Cystic fibrosis
- Galactosemia
- Glutaric acidemia type I
- Hearing loss
- Homocystinuria
- Isovaleric acidemia
- Long-chain L-3-hydroxyacyl-CoA dehydrogenase deficiency
- Maple syrup urine disease
- Medium-chain acyl-CoA dehydrogenase deficiency
- Methylmalonic Acidemia - Cobalamin Disorders
- Methylmalonic acidemia- mutase deficiency
- Mucopolysaccharidosis type I
- Multiple carboxylase deficiency
- Phenylketonuria
- Pompe disease
- Propionic acidemia
- S, Beta-thalassemia
- S, C disease
- Severe combined immunodeficiency
- Sickle cell anemia
- Spinal muscular atrophy
- Trifunctional protein deficiency
- Tyrosinemia type I
- Very long-chain acyl-CoA dehydrogenase deficiency
- X-linked adrenoleukodystrophy

In this state, babies undergo a second screening step when they are around two weeks old. This second screening usually happens in a health care provider's office. It can help find babies who have conditions that are hard to detect in the first days of life but that still benefit from early treatment or intervention.

Newborn to 12 Months (0-1 years)

Pediatrician

- **Take a health history:**

  Down's Syndrome (etc.),

  Prematurity, pregnancy or perinatal events

- **Take family History:**

  Retinoblastoma, Stickler's,etc.

- **Pediatricians Should Refer based on risk factors… even if eyes appears normal**

Newborn -12 Months

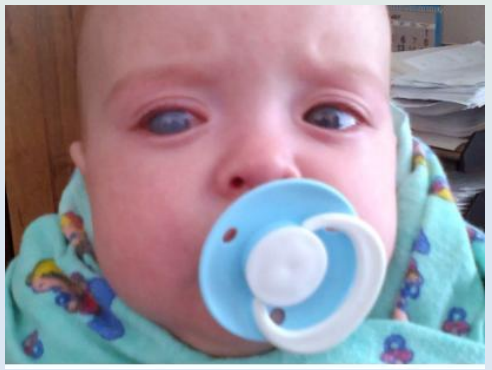
Vision assessment: Pediatrician

- **Fixation on objects @ 6 weeks**
- **Tracks Object @ 3 months**
- **Eye misalignment:**
  - **constant always abnormal**
  - **intermittent >5 months abnormal**
  - **nystagmus always abnormal**

Conditions that may cause amblyopia

Cataract

Hemangioma Tumor



Congenital glaucoma

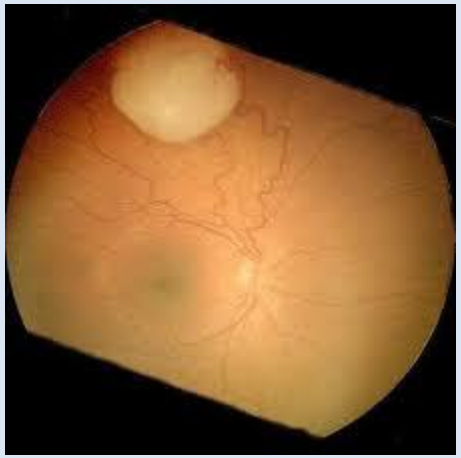
Esotropia

Ptosis (Droopy Eye)

Retinoblastoma-infants/toddlers

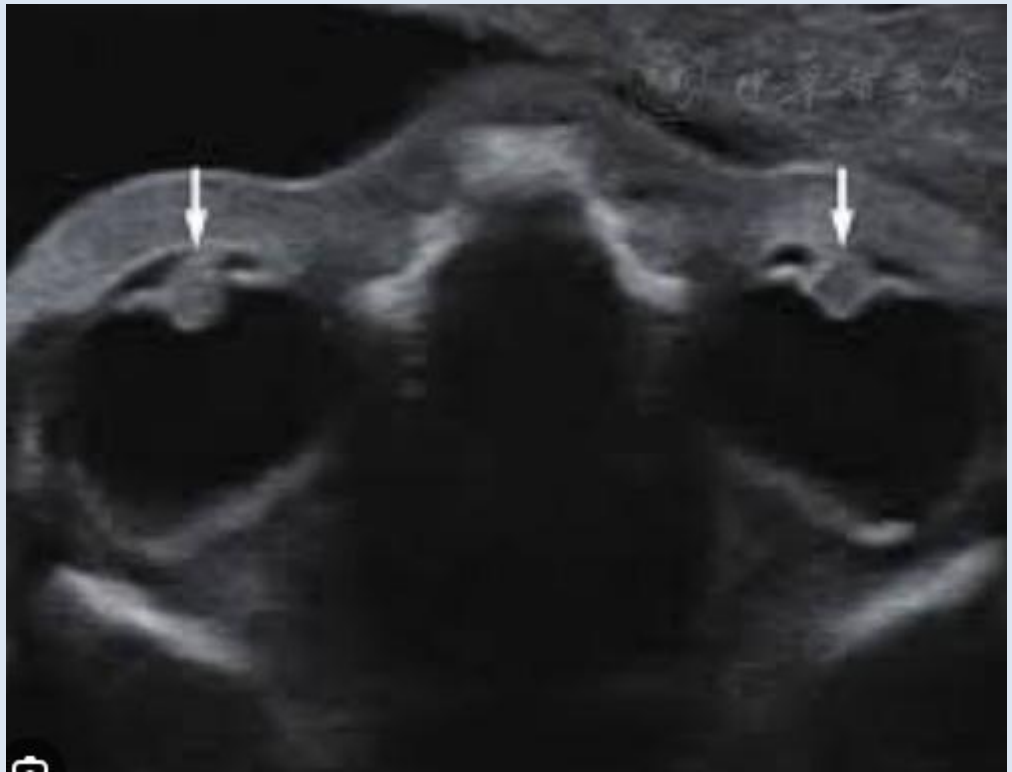
300-350 new cases/year in US

Rare after age 5

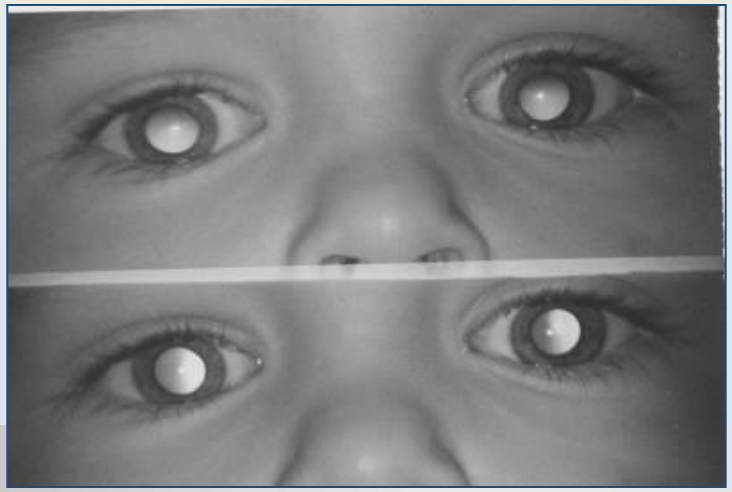


Prenatal “Vision Screening”
Ultrasound Screenings

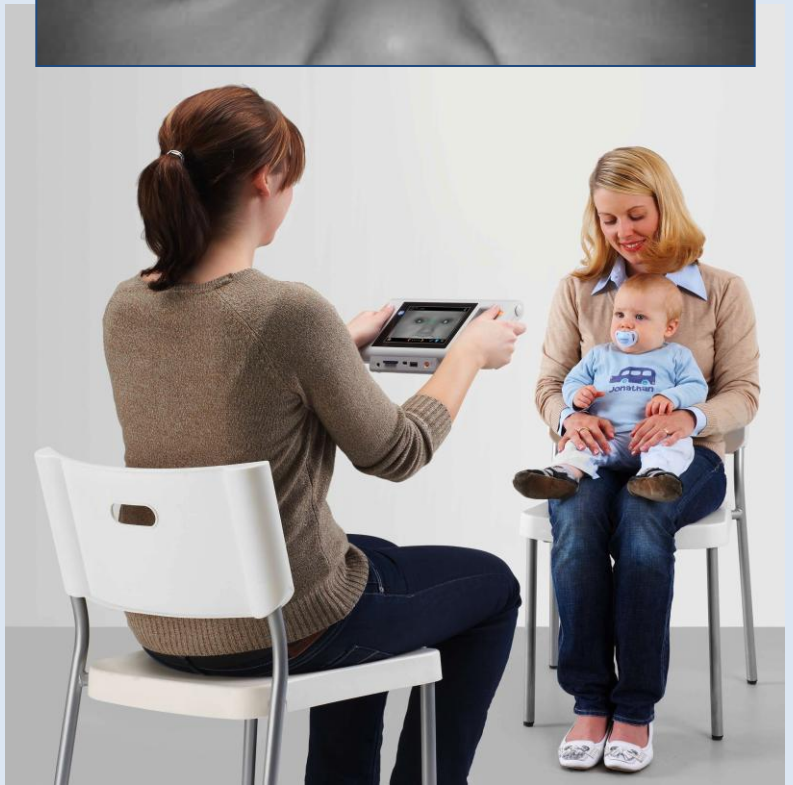
Ultrasound may detect congenital cataracts or other ocular malformations



Formal Vision Screening
1-3 years Old



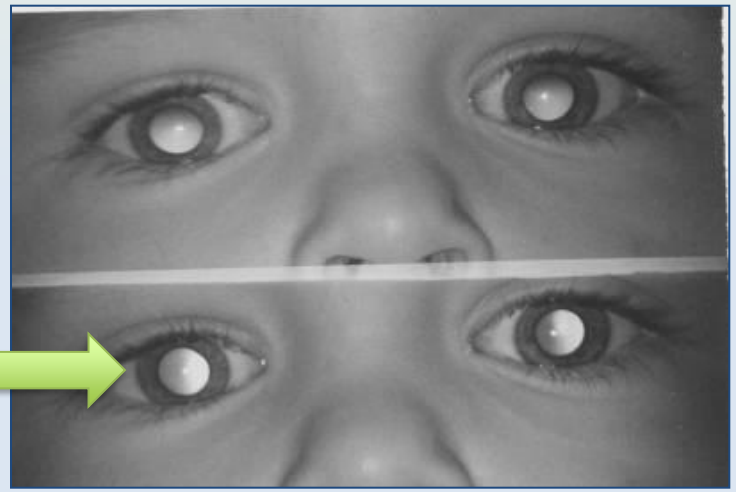
- Too young for visual acuity testing
- Refer if eye crossing, poor red reflex, or visual concerns
- Photoscreening may promote early detection of amblyopia risk factors

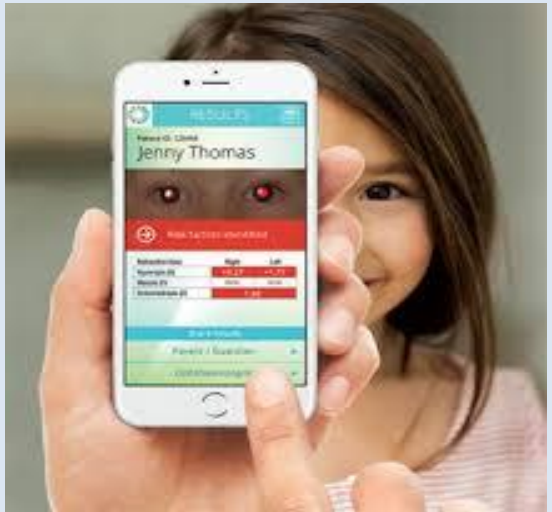


Binocular Flash Photoscreeners

Visible flash to evaluate red reflex pass/fail

These photos reveal that this child has farsightedness (hyperopia) indicated by the characteristics of the crescents formed in the red reflex





Binocular Autorefractor

Provide refractive error estimate

Infrared automated retinoscopy or wavefront technology

Vision Screening Referral Terminology

Screening Sensitivity:

- How accurate the screening is at finding all children with vision problems

Screening Specificity:

- How accurate the screening is at not referring normal children

Vision Screening Referral Terminology

- Screening sensitivity and specificity are inversely related

- More sensitive tests = more over-referrals
- More specific tests = miss milder conditions

Vision screening

Referral Criteria Strategy by Age

Design strategy:

- **Early testing goal = High Specificity**
  - **Detect the worst problems that can't wait.**

High specificity means fewer false positives but will miss some kids at lower risk who can wait to be identified and treated later.

- **Later testing Goal= High Sensitivity**
  - **Detect less severe vision problems than may affect school performance and quality of life**

High sensitivity rate of detection, but also higher rate of over-referrals. Over referrals less of problem in older, cooperative kids

Vision Screening Referral Terminology

Positive predictive value:

- Likelihood of a referred child having a true vision disorder

Referral Rates & Positive Predictive Value

- **Amblyopia** risk factors affect **<5 % of kids**
- **Positive predictive value of 50% is excellent** for amblyopia if overall screening sensitivity is high
- Refer 10 kids to find the 5 with problems

  ½ of referrals will be normal exams, but screening saves approximately 90% of children from needing a complete eye examination

Amblyopia Risk factors

Photoscreening devices refer criteria validated for 1-5 yo

TABLE 2

AMERICAN ASSOCIATION FOR PEDIATRIC OPHTHALMOLOGY AND STRABISMUS' RECOMMENDED AMBLYOPIA RISK FACTOR TARGETS

REFRACTIVE RISK FACTOR TARGETS				
Age, months	Astigmatism	Hyperopia	Anisometropia	Myopia
12-30	>2.0 diopters	>4.5 diopters	>2.5 diopters	>-3.5 diopters
31-48	>2.0 diopters	>4.0 diopters	>2.0 diopters	>-3.0 diopters
>48	>1.5 diopters	>3.0 diopters	>1.5 diopters	>-1.5 diopters
NONREFRACTIVE RISK FACTOR TARGETS				
All ages	Media opacity >1 mm Manifest strabismus >8 prism diopters in primary position			

From Donahue SP, et al.[5]

Commercially available photoscreeners

All acceptable sensitivity and specificity for amblyopia risk screening of 80-90% when used in ages 1-5 yo

PlusOptix S12R $6,535.00

Hillrom SPOT $7,500.00

iScreen

Adaptica 2WIN $5,295.00

Kaleidos $6,850.00

GoCheck Kids

Common Instrument-Based Devices

AAP endorses instrument screening but not specific products

iScreen

Adaptica 2WIN

GoCheck Kids

PlusOptix

Baxter "Spot"

Beware of free internet apps

Photoscreening device dependent

May Lack Validation

Vision screening coding

Previously Bundled in well child check
Az Medicaid approved unbundled payment 2015

CPT 99174

Use with automated photoscreening results

CPT 99177

Use with manually reviewed photoscreening

CPT 99173

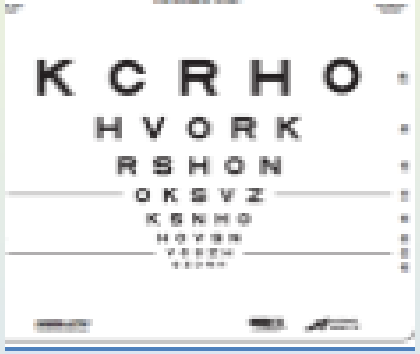
Use for tests of visual acuity but pays poorly and often bundled into well child check

Photoscreening Recommendations

- **AAP - begin at age 1 if available and repeat every 1-2 years until able to perform visual acuity testing**
- **USPSTF - evidence supports photoscreening devices between 3-5 years old**
- **AHCCCS - pays for 1 vision photoscreening between 3-5 years old**

When Not to Photoscreen?

AAP Bright Futures /AAO/AAPOS Guidelines



Generally not before 1 year of age

Poor fixation = bad measurement. High false positive rate.

Refraction status changes rapidly during infancy

Correction of refractive error is typically deferred until older

At 6 yo or older If able to read eye chart

Visual acuity is the standard of care and devices not calibrated or validated in this age group for non-amblyopic conditions

If obvious problem or concern… Just refer

Abnormal red reflex, nystagmus, eye crossing, cloudiness of eye, etc.

Vision Screening Challenges

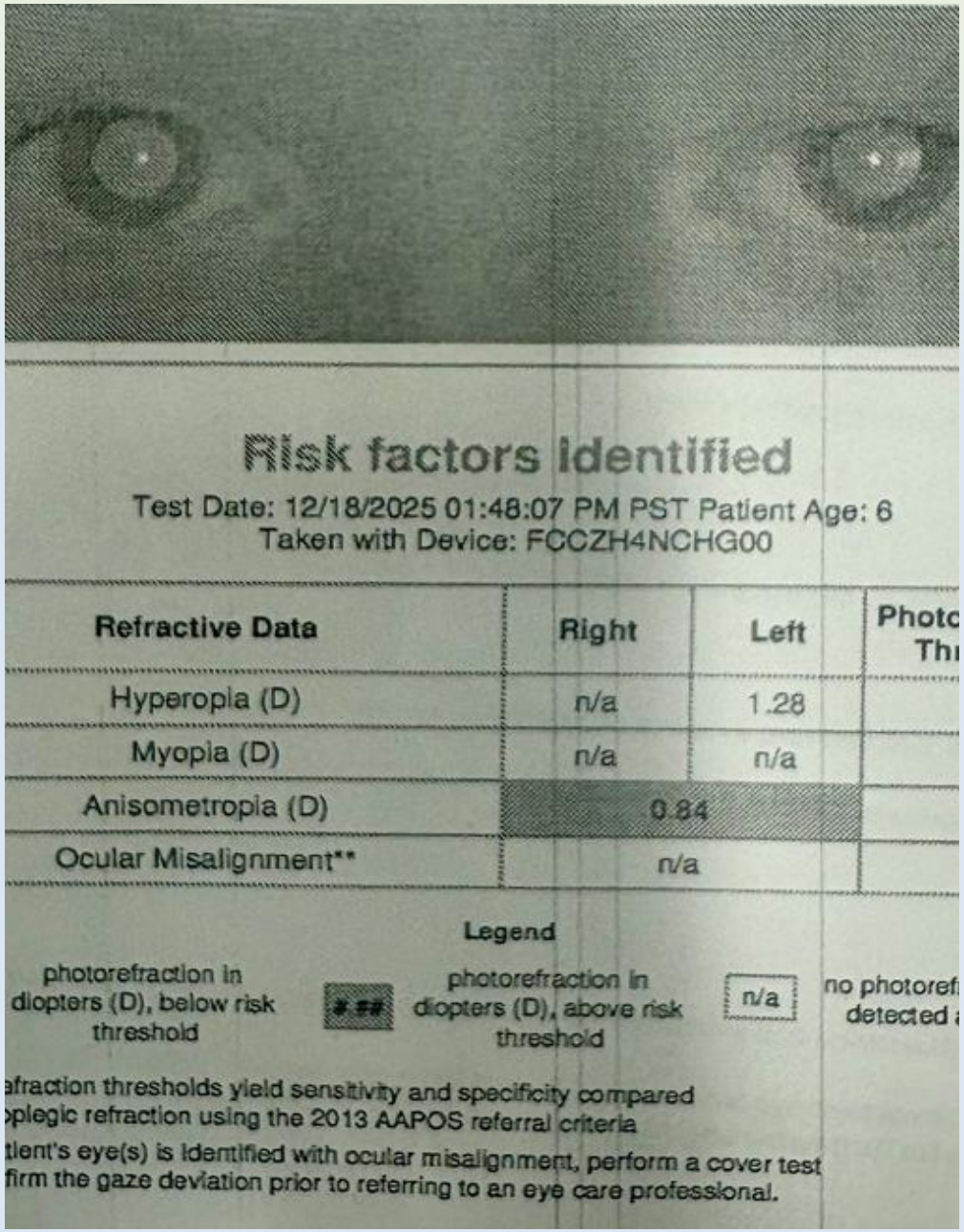
Binocular Photoscreeners

Remote assessment. No eyedrops.

Creates “safe space” for child and staff

Reason for Referral:

Details are Helpful to address specific referral concern ☺



Risk factors Identified

Test Date: 12/18/2025 01:48:07 PM PST Patient Age: 6
Taken with Device: FCCZH4NCHG00

Refractive Data	Right	Left	Photo Thr
Hyperopia (D)	n/a	1.28	
Myopia (D)	n/a	n/a	
Anisometropia (D)	0.84		
Ocular Misalignment**	n/a		

Legend

photorefraction in diopters (D), below risk threshold

##

photorefraction in diopters (D), above risk threshold

n/a

no photoref detected

efraction thresholds yield sensitivity and specificity compared
oplegic refraction using the 2013 AAPOS referral criteria

tient's eye(s) is identified with ocular misalignment, perform a cover test
firm the gaze deviation prior to referring to an eye care professional.

Objective vs Subjective Screenings:

What is the Difference Between Vision Screening with Eye Charts and Vision Screening Devices?

- Vision screening with eye charts requires a response & measures actual visual acuity (20/20 etc.)
- Photoscreening devices require no response & do not measure visual acuity
- Screening devices test for eye conditions or risk factors that may cause decreased vision or amblyopia

AAP Bright Futures

Screen Visual Acuity at the earliest age where reliable testing is possible but **no later than age 6**

Photoscreeners/Autorefractors should only be used after age 6 if visual acuity is unable to be tested

Formal visual acuity eye chart assessments
AAP Bright Futures

Ages: 4, 5, 6, 7, 8, 10, 12, 15 yo

Visual Acuity remains the gold standard for vision screening

Which of the following statements are correct based on AAP Vision Screening Guidelines? SELECT ALL THAT APPLY

AAP/AAO/AAPOS
Visual Acuity Screening Guidelines

Age-Dependent Thresholds

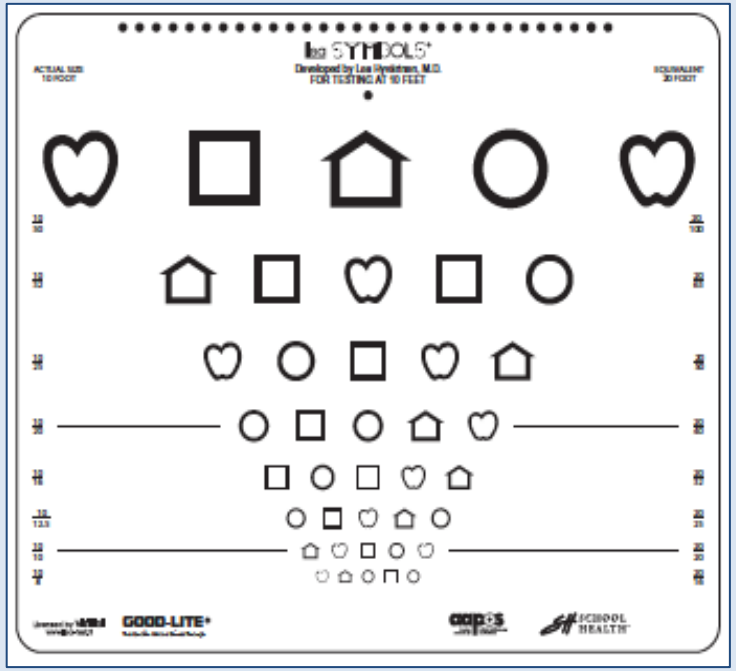
36 Months to 47 Months (3 up to 4 years)

Measure Visual Acuity:

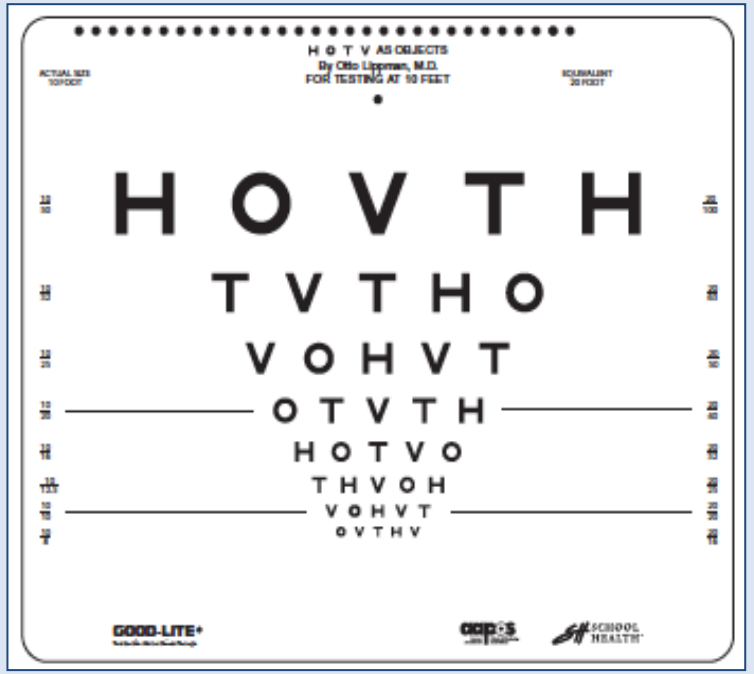
- **Must be able to identify the majority of the 20/50 line optotypes with each eye.**
- **Testing should be done at 10 feet (5 feet optional)**

36 Months to 47 Months (3-4 years) Recommended Chart Types

Lea Symbols

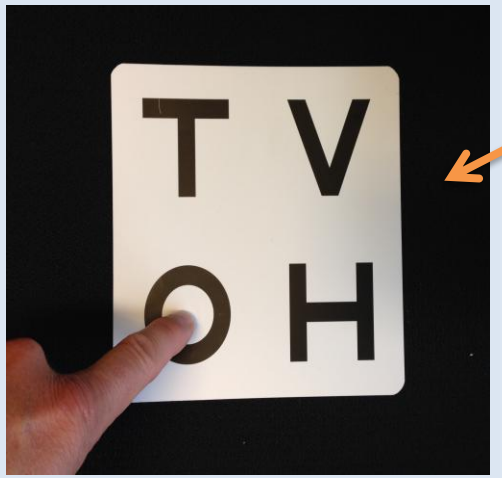


HOTV Letters



48 Months to 59 Months (4-5 years)

- **Must be able to identify the majority of the 20/40 line optotypes with each eye.**



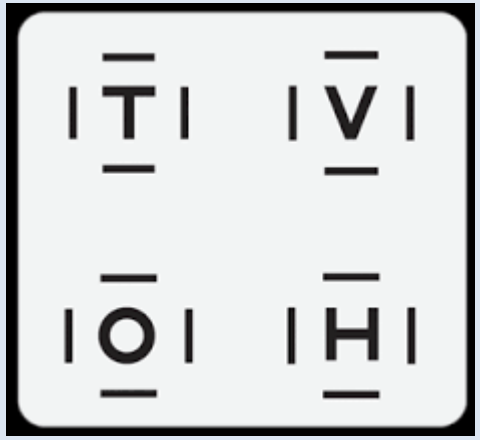
HOTV
Match Card

Opposite eye must be effectively covered.

Occluder options

Crowding Effect

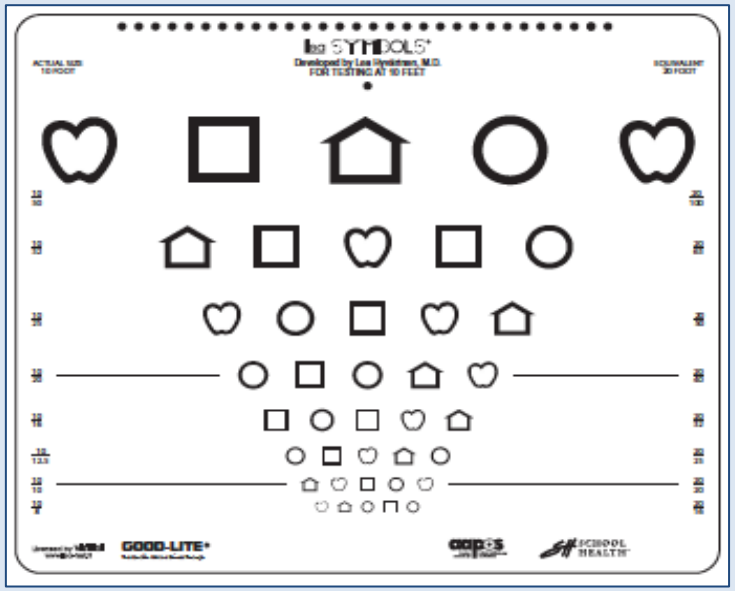
Isolated letters/Symbols require crowding bars

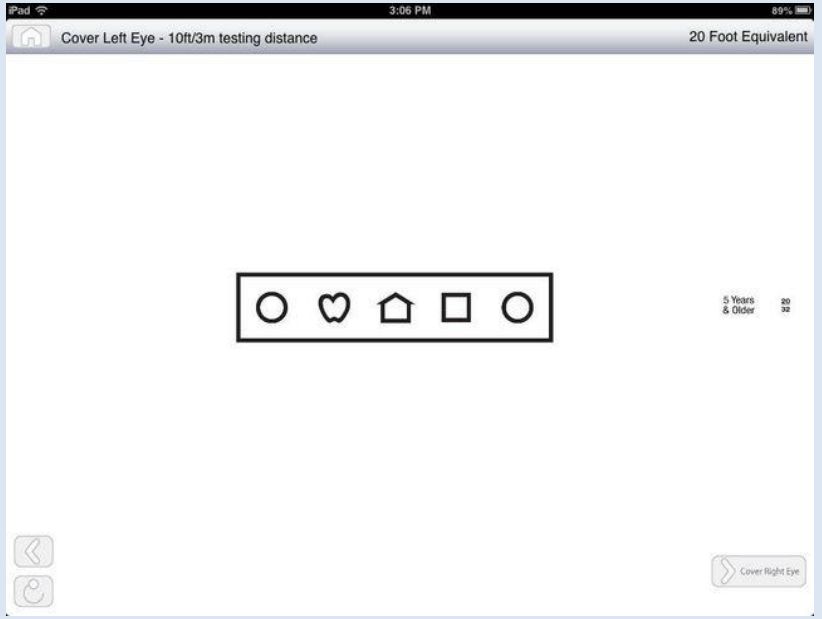


Threshold is more exact

Critical Line Screening is *Faster*

Only read a single “critical” line with each eye





Each chart has two boxed critical lines: one for each eye.

60 Months and Older (5+ years)

- **Must be able to identify the majority of the 20/32 (or 20/30)* line with each eye.**

- **Sloan letters (shown)**
  - **Preferred over Snellen Letters**

Sloan letter chart

ETDRS Chart Design

Early treatment diabetic retinopathy study

Required standardized chart for FDA funded research

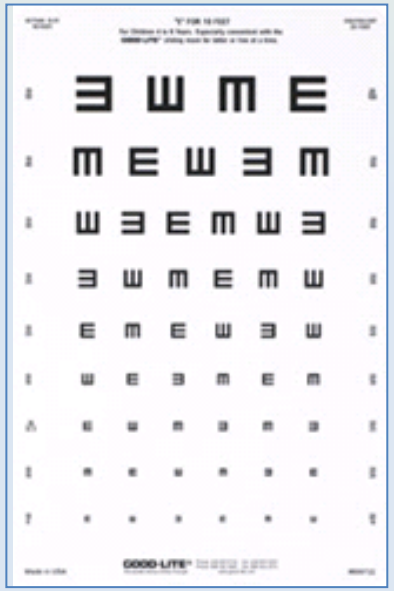
ETDRS Sloan Letters with Gold standard Design

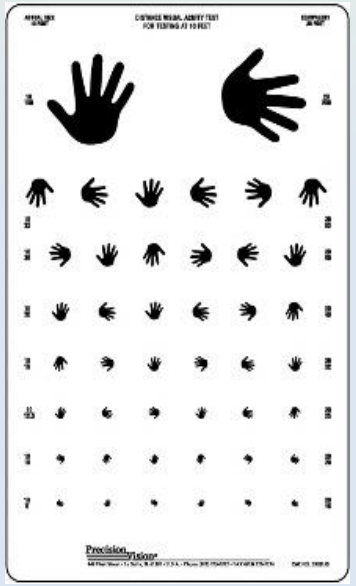
- Balanced Optotype (Sloan letter) difficulty
- LogMar Sizing progression (25% steps)
- Equal Spacing between letters and lines
- Consistent Crowding (letters on ends easier)
- # letters per line (5 is ideal)
- Standardized Testing Protocol may be used
- Letter counting to score-extended test
- Quick option - smallest line 3 of 5 correct

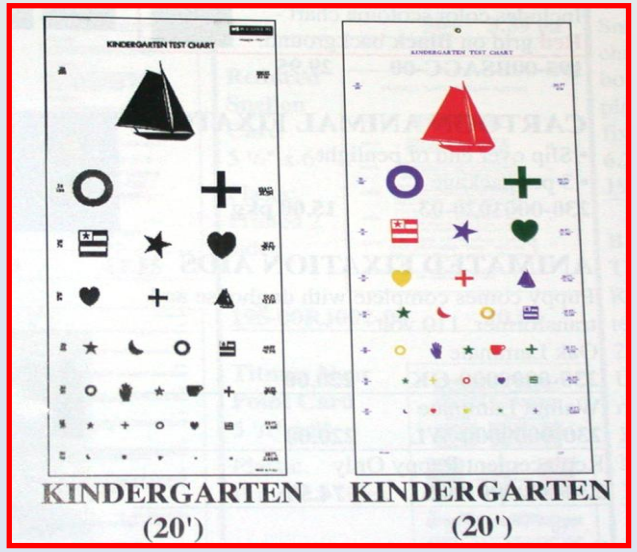
Non-Standardized Eye Charts

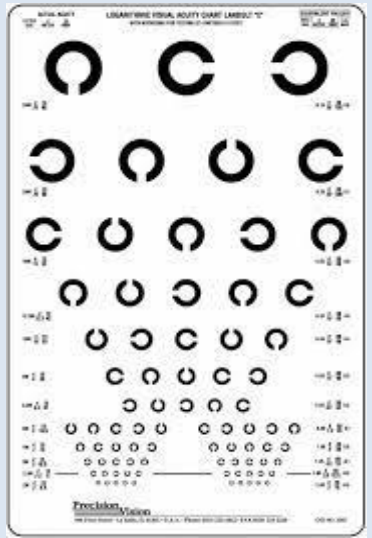
Not Recommended for Children

Poor validation and correlation to adult chart vision









Beyond The Chart
ETDRS *& ATS (*amblyopia treatment)
standardized testing protocols

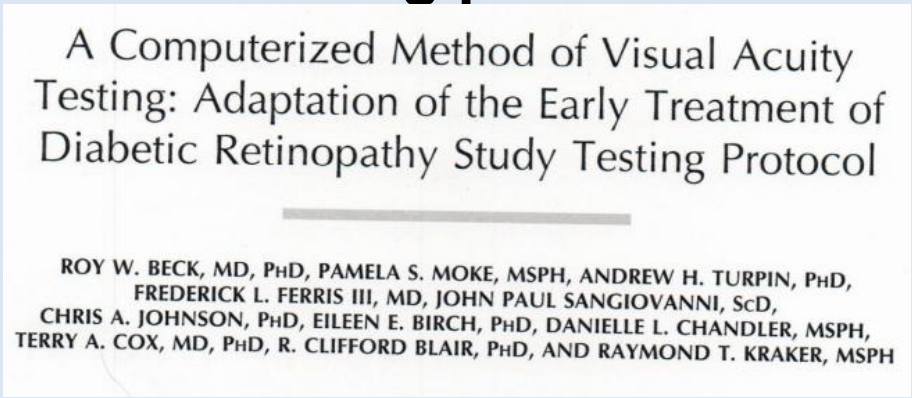
Visual acuity results may vary significantly among different test administrators and visits (e.g., substitute tech/MA)

Standardized testing protocols help ensure consistent test administration between different examiners and visits

e-ETDRS and e-ATS

- Protocols can be complex and time consuming to administer

-Electronic algorithms to administer standardized testing protocols



A Computerized Method of Visual Acuity Testing: Adaptation of the Early Treatment of Diabetic Retinopathy Study Testing Protocol

ROY W. BECK, MD, PHD, PAMELA S. MOKE, MSPH, ANDREW H. TURPIN, PHD, FREDERICK L. FERRIS III, MD, JOHN PAUL SANGIOVANNI, SCD, CHRIS A. JOHNSON, PHD, EILEEN E. BIRCH, PHD, DANIELLE L. CHANDLER, MSPH, TERRY A. COX, MD, PHD, R. CLIFFORD BLAIR, PHD, AND RAYMOND T. KRAKER, MSPH

Real world vision testing rarely use standardized, validated testing algorithms due to prolonged testing time, platform availability and, cost

Computerized Eye Charts

- Desktop and Laptop programs

- Apps for tablets / phones

- On-line programs
- Few use standardized & validated adaptive algorithms or protocols

Computer-Based Eye charts with Validated testing algorithms

Not specifically endorse by AAP

Jaeb Visual Acuity Screener

HOTV symbols

PEDIG - Public Web Site

Open Access

M&S Tech Smart System FirstTest

Computer-Based Eye charts with Validated testing algorithms

Not specifically endorsed by AAP

Jaeb Visual Acuity Screener

HOTV symbols

PEDIG - Public Web Site

Open Access

M&S Tech Smart System

GoCheck Kids

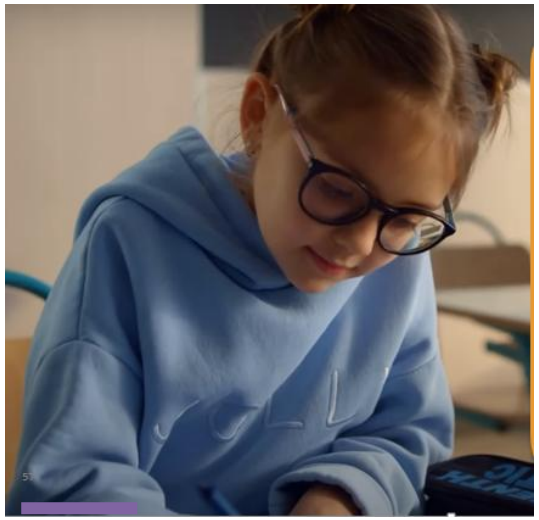
Amblopia Treatments

NIH/NEI Funded PEDIG Research
(Pediatric Eye Disease Investigator Group)

Multicenter, Evidence Based
Large Treatment Trials

Amblyopia Therapy

PEDIG Research validated Treatments



Studied and Validated Treatments:

Refractive Error Correction (glasses/CL)

Eye Patching

Atropine Therapy

Dichoptic Amblyopia Therapy

Luminopia (VR) and Curesight (eye tracking)

FDA approved 4-13 yo

Under PEDIG Investigation

Randomized Controlled Trial of a Dichoptic Digital Therapeutic for Amblyopia

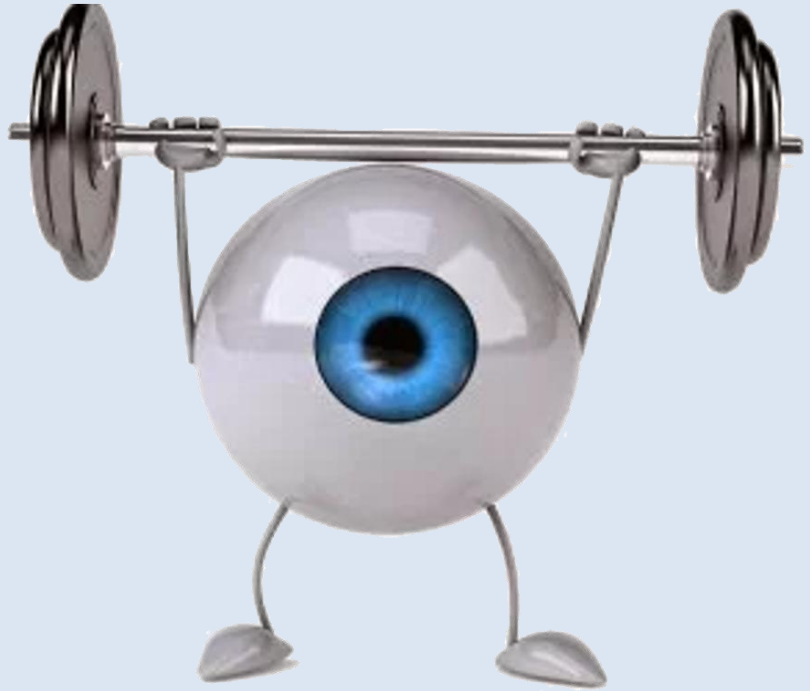
Scott Xiao,[1] Endri Angjeli, MS,[1] Hank C. Wu, MS, MBEE,[1] Eric D. Gaier, MD, PhD,[1,2] Stephanie Gomez,[1] Dean A. Travers,[1] Gil Binenbaum, MD, MSCE,[3] Robert Langer, ScD,[4] David G. Hunter, MD, PhD,[1] Michael X. Repka, MD, MBA,[5] for the Luminopia Pivotal Trial Group

Purpose: Digital therapeutics are a new class of interventions that are software driven and are intended to treat

Optometry
Childhood Vision Training
“Controversial Treatment” for Amblyopia

Not scientifically validated

Not standardized therapy. Large Variations in Care.



Vision Therapy

Eugene Helveston MD

- “Ineffective Treatment for Non-existent Disease”
- Unnecessary services expend time and financial resources
-
- May distract from treating underlying problem:

-ADHD

-Dyslexia

-Learning Disorders

-Autism Spectrum Disorder

Convergence Insufficiency:

Inability to turn both eyes in for proper alignment while reading

Home convergence exercises often use computer.

May also be performed in an optometry office - 3x/week as vision training.

The Pediatric Eye Disease Investigator Group (PEDIG) previously has established the efficacy of which standardized treatments for amblyopia? SELECT ALL THAT APPLY

Arizona Policy Win

New Language in AHCCCS/Medicaid Medical Policy Manual:

". . .eyeglasses and other vision services, **including replacement and repair of eyeglasses**, for members under the age of 21 years are covered, without restrictions.

Vision Screening "Tail End"

Any Questions??