iCheckKids, SPOT, iScreen and Plusoptix performance in a high-risk, young pediatric eye practice

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Alaska Blind Child Discovery
Disclosures

• ABCD has received discounted vision screen technology from several vendors and unrestricted grants from Walmart.

• Neither Dr. Arnold nor Miss Armitage has received direct compensation

• Dr. Arnold on board of Glacier Medical Software marketing ROP-Check

• iCheckKids not yet FDA approved
Historic Battle

• Can Pediatric Ophthalmologists do a better job of battling AMBLYOPIA before it is too late?
Amblyopia still a GIANT problem

Acuity-detected (age 3-4) average 20/32 best acuity
Late detected microstrabismus and eccentric fixation
Many never screened
Anti-Instrument Goliath

Acuity-only proponents
(not which but WHEN)
Financial Disclosure advocates =
anti-industry development
Treat amblyopia Late
(Wait until acuity is lost)
Single Sensitive preSchool vs
AAP series of specific screens
Who will battle Amblyopia Goliath?
David Guyton
Advanced the merits of Dynamic Retinoscopy and Brückner Test
Amblyopia GOLIATH Fighters

David Coats

David Wallace

David Morrison

David Stager Sr

David Granet

David Hunter
David Rogers
MTI > Welch Allyn Suresight with David Plager
David Silbert

With Noelle Matta, comparative validation by AAPOS guidelines of emerging photoscreen technology
Methods

- HIPAA - IRB compliant
- AAPOS 2003 Validation Guidelines
- Consecutive children in pediatric eye practice
- Did not exclude developmental delay
Photoscreeners

- PlusoptiX A-09
- Pediavision SPOT (version 1.0.3, software 1.1.51)
- iScreen 3000
- iCheckKids iPhone 4s
“five smooth stones” 1Sa 17:40

Photoscreeners
Validation Statistics

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<th>Screen +</th>
<th>Exam +</th>
<th>Exam -</th>
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<td>B</td>
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<td>Screen -</td>
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sensitivity $\frac{A}{A+C}$
specificity $\frac{D}{B+D}$
PPV $\frac{A}{A+B}$
NPV $\frac{D}{C+D}$
Validation Statistics

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- sensitivity $A/(A+C)$
- specificity $D/(B+D)$
- PPV $A/(A+B)$
- NPV $D/(C+D)$

ABCD sensitivity $A/(A+C+E+F)$
ABCD specificity $D/(B+D+E+F)$
ir sensitivity $(A+E)/(A+C+E)$
ir specificity $(D+F)/(B+D+F)$
Delta-Center Crescent

(Center) 1mm (Crescent) (Hyperopic crescent opposite flash)
iCheckKids on iPhone 4s
Results

- n=108
- Age: mean 47 months (9-146 months)
- Pre-screen Probability 56% (normal 21%)
- Autism/Delays 10%
Risk Factors

- Refraction:
  - average +0.5 + 1 cyl
  - spherical equivalent from -22 to +6
  - Anisometropia: n=10 over 2.0 diopters
- Strabismus: 11, Nystagmus: 1.
“False negatives”

- Intermittent strabismus (10-30 PD): n=9
- Small 1mm cataract: SPOT-, Plusoptix-?, iScreen and iCheckKids-refer
<table>
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<th>iScreen</th>
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| Sensitivity | 83% | 80% | 75% | 92% | 81% |
| Specificity | 88% | 85% | 88% | 88% | 91% |
| PPV         | 87% | 87% | 89% | 90% | 92% |
| NPV         | 84% | 79% | 73% | 89% | 80% |
| ABCD Sensitivity | 52% | 75% | 60% | 92% | 77% |
| ABCD Specificity | 55% | 79% | 65% | 88% | 86% |
| irSens      | 88% | 82% | 78% | 92% | 82% |
| irSpec      | 77% | 85% | 75% | 88% | 90% |

sensitivity = \( \frac{A}{A+C} \)
specificity = \( \frac{D}{B+D} \)
positive predictive value = \( \text{PPV} = \frac{A}{A+B} \)
negative predictive value = \( \text{NPV} = \frac{D}{C+D} \)
prescreen probability = \( \frac{A+C}{A+B+C+D} \)
false positive = \( \frac{B}{A+B} \)
False negative = \( \frac{C}{C+D} \)

\( \text{ABCD specificity} = \frac{D}{B+D+E+F} \)
\( \text{irSens} = \frac{A+E}{A+C+E} \)
\( \text{ABCD sensitivity} = \frac{A}{A+G+E+F} \)
\( \text{irSpec} = \frac{D}{B+D+F} \)
Photoscreen Validation

- Sensitivity
- Specificity
- inconclusive

Bar chart showing the comparison of different photoscreen validation tools:
- Plusoptix
- SPOT
- iScreen
- iSc-DCC
- iCheck
Inconclusives

- ABCD sens
- ABCD spec
- ir Sens
- ir Spec

Bar chart comparing PlusoptiX, SPOT, iScreen, and iCheckKids.
preSchool and Delays

- Sensitivity
- Specificity
- inconclusive

Bar chart showing sensitivity, specificity, and inconclusive results for different methods: Plusoptix-pre, SPOT-pre, iScreen-pre, iCheck-pre, Plusoptix-delay, SPOT-delay, iScreen-delay, iCheck-delay.
Discussion

- **All 4 photoscreeners effective**
  - iScreen particularly useful in children with difficult fixation and attention
  - iCheckKids yielded useful photoscreen images
  - Inconclusive images best considered as “referrals”
  - Similar to Matta / Silbert validation studies
Limitations

• High prescreening probability (56% vs 21%)
• Special Needs
• Some older (autistic)
• Same examiner and interpret (DCC)
• Initial experience with iCheckKids
Summary

• New photoscreeners can hit their target, even in high-risk young and special-needs children

• Combined with CPT 99174 and new AAP photoscreen endorsement, effective weapons against the Amblyopia Goliath
David Huang

Adapted iPhone technology to obtain valid photoscreen images. Developing interpretation software.
Davids vs Goliath

*Turning Point in the Photoscreener Battle:*

- Practical Reimbursed Pediatric Tool
- Charitable Research

20 years
Goliath vs non-Davids

Howard Freedman still using objective technology that was spurred by his development of the MTI photoscreener
Goliath vs non-Davids

Jack Bellows founded iScreen and invested to obtain CPT 99174.
Goliath vs non-Davids

Sean Donahue: Vanderbilt Ophthalmic Image Center, MTI and many photoscreeners, AAPOS Uniform Guidelines