Principles of Screening for Vision Care

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Health Screenings

- Can be a helpful, more affordable way of finding people with a disease (cost/benefit)
  - A *screening* tool is typically cheaper than a *diagnostic* (gold Standard) tool
  - ie: vision screening test (like the one for driver's license exam) is cheaper than a complete eye exam
- Could give the individual a false sense of security

Why do vision screenings?

- Full eye exams may not be accessible (especially those with the least social and economic power, like children)
- Many eye problems are asymptomatic
- Screenings may raise the awareness of the need for eye care, but they are a double-edged sword in making people believe that if they had a vision screening, they don't need an eye exam!

Screening Test vs Screening Program

- A screening test (instrument) is only as good as the people who deliver it, when used appropriately.
- A screening program includes:
  - Targeting the population
  - Marketing and implementing the program
  - Establishing effective instrument (s)
  - Ensuring access to care for referrals
  - Monitoring follow-up
  - Educating participants on advantages and disadvantages of screening program

Vision Screening Tests

- Visual Acuity charts
- Photoscreeners
- Autorefractors
- Side vision tests
- Tests of binocularity and depth perception
- Eye health assessment

What population/how frequently?

- Determine the area you will be working in
- Look up the population

http://quickfacts.census.gov/qfd/states/01000.html

- Look up the health care need areas

http://bhpr.hrsa.gov/shortage/

- Look up the prevalence of the disease or problems of interest if available

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5345a3.htm
http://www.nei.nih.gov/eyedata/pbd_tables.asp

  - Or estimate them based on the composition of the population

Once you decide where…

- Targeting the population
- Marketing and implementing the program
- Establishing effective instrument (s)
- Ensuring access to care for referrals
- Monitoring follow-up
- Educating participants on advantages and disadvantages of screening program

Targeting the population

- Decide where the target population can be reached
  - i.e. Glaucoma screenings at churches and community centers
  - i.e. Amblyopia screenings at schools and daycare centers
- Determine the number of people you plan to reach
  - Based on the population and the prevalence

Work out the administrative details

- If national, contact the county health department, the local community centers, churches, schools, etc
- If international, contact the ministry of health of the country, a religious organization, VOSH.org, or a Lions or Rotary Club
- Contact drug reps
- Contact frame reps for discontinued frames
- Order pre-made bifocals, readers and sunglasses

Marketing and implementing the program

- Get promotional and educational materials in the language needed
- http://www.nei.nih.gov/resources/
- Advertise locally!

- Has the validity of the screening test been established?
- What population/how frequently?
- Is the screening for a specific disease or a group of diseases?
- How will it be marketed?
- How will persons with positive results be referred or treated? Are they being educated on the condition suspected?
- Do you have a way to 'check in' on the screeners?

Has the validity of the screening test been established?

- Search on PubMed for articles on validity of the tools to be used
- Determine
  - Age-appropriateness of tools
  - Costs and availability of tools
  - Comparison to a 'Gold standard'

  i.e. Icare tonometer

Monitoring follow-up

- Are you doing it all?
- Are you causing more stress?
- Do they have insurance?
- What about treatment?

Screening Terminology

- Prevalence
- Incidence
- Sensitivity
- Specificity
- False Positives
- False Negatives
- PPV
- NPV

Two-by-two table for screening

	Screening test (+)	Screening test (-)
Disease (+)	True positives	False negatives
Disease(-)	False positives	True negatives

Two-by-two table for screening

	Screening test (+)	Screening test (-)
Disease (+)	a	b
Disease(-)	c	d

Sensitivity

- Proportion of individuals who *have a disease* and test *positive* with the screening test
  - Sensitivity=a/(a+b)

  If the sensitivity of a screening test is not good, you may be missing people who have the disease

Specificity

- Proportion of individuals who DO NOT *have a disease* who test *negative* with the screening test
  - Specificity=d/(c+d)

  If the specificity of a screening test is not good, you may wasting resources

Other Screening Terminology

- False Positive rate (proportion)= Proportion of individuals who DO NOT *have a disease* who test *positive* with the screening test
  False Positive proportion= 1-Specificity
- False Negative rate (proportion)= Proportion of individuals who *have a disease* and test *negative* with the screening test
  False Negative proportion=1-sensitivity

Other Screening Terminology

- Probability (P)=Proportion of occurrence
  - Can be measured for each possible outcome, i.e. Probability of receiving a positive screening test=number of positive screening result/total sample
- Positive Predictive Value (PPV)= Probability of a person having the disease when that person has a *positive* screening result PPV=a/a+c
- Negative Predictive Value (NPV) = Probability of a person NOT having the disease when that person has a *negative* screening result NPV=d/b+d

Vision In Preschoolers Study

- Comparing 11 preschool vision screening tests
- 2588 3-t-5 yo children in *Headstart*
- LEP=ODs and oMDs performed screenings and full exams (Gold Standard Exam=GSE) on all the children, however, they made sure that the LEP that screened a sample would be different from the one doing the GSE (masking)
- 4 targeted conditions:
  - Amblyopia
  - Strabismus
  - Significant refractive error
  - unexplained reduced visual acuity

11 Screening Tests/instruments evaluated

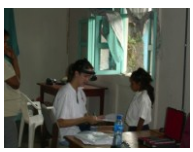
- Non-cycloplegic retinoscopy (NCR)
- Retinomax (autoref)
- SureSight (autoref)
- PowerRefractor (auto)
- Lea (cards on flip-book)
- HOTV (Chart)
- Randot E (stereo)
- Stereo Smile (stereo)
- MTI (photoscreener)
- IScreen (photoscreen)
- Cover Test

11 Screening Tests/instruments

School-based screening

Full Exam



Ask these questions about the program…

- Has the validity of the screening test been established?
- What population/how frequently?
- Is the screening for a specific disease or a group of diseases?
- How will it be marketed?
- How will persons with positive results be referred or treated? Are they being educated on the condition suspected?
- Do you have a way to 'check in' on the screeners?

TABLE 3.

TABLE 3.
Failure criteria for retinoscopy and autorefractor screening tests to maximize sensitivity when specificity was set at 90% and/or 94%

Instrument	Specificity	Screener	Sensitivity for ≥1 targeted condition (%)	Sensitivity for most severe conditions (%)	Hyperopia (D)	Myopia (D)	Astigmatism (D)	Anisometropia[a] (D)
Non-cycloplegic retinoscopy	At 90%	LEP[§]	64	90	≥2.75	≥2.75	≥1.25	≥1.50
	At 94%	LEP[§,ll]	57	87	≥2.50	≥2.75	≥2.00	≥1.50
Retinomax autorefractor	At 90%							
	Year 1	LEP[§]	63	87	≥1.50	≥2.75	≥1.50	≥2.00
	Year 2		64	88	≥1.50	≥2.75	≥1.50	≥1.75
	At 94%	LEP[§,ll]						
	Year 1		52	81	≥1.75	≥2.75	≥2.00	≥2.75
	Year 2		52	81	≥2.50	≥2.75	≥1.75	≥2.50
	At 90%	Nurse[b]	68	88	≥1.75	≥3.25	≥1.50	≥2.75
	At 90%	Lay[b]	62	85	≥1.50	≥3.00	≥1.75	≥2.00
SureSight vision screener[b]	At 90%	LEP[§]	63	81	≥4.00	≥1.00	≥1.50	≥3.00
	At 94%	LEP[§,ll]	51	75	≥4.25	≥1.00	≥1.75	≥3.50
	At 90%	Nurse[b]	64	83	≥4.00	≥1.00	≥1.75	≥2.75
	At 90%	Lay[b]	61	82	≥4.50	≥1.00	≥1.75	≥2.25

[a]The maximum of intereye differences in the power of the most positive meridian, the most negative meridian, and the magnitude of cylinder was used to determine presence of anisometropia for all tests.
[b]Used in child mode, which adds a correction for accommodation. The VIP criteria may be programmed into the SureSight by School Health, (Hanover Park, IL) such that an asterisk appears when one of the VIP criteria have been met.
LEP, licensed eye care professional.

Findings from the Vision in Preschoolers (VIP) Study.

Optometry & Vision Science. 86(6):619-623, June 2009.
DOI: 10.1097/OPX.0b013e3181a59bf5

TABLE 3. Failure criteria for retinoscopy and autorefractor screening tests to maximize sensitivity when specificity was set at 90% and/or 94%

TABLE 5.

TABLE 5.
Ranking of tests from highest to lowest sensitivity in detecting the 4 VIP-targeted disorders with specificity set at 0.94§

Ranking	Amblyopia		Strabismus		Refractive error		Reduced VA	
	Screening tests	Sensitivity (95% CI)*	Screening tests	Sensitivity (95% CI)*	Screening tests	Sensitivity (95% CI)*	Screening tests	Sensitivity (95% CI)*
1	NCR	.88 (.81, .95)	MTI	.65 (.53, .77)	NCR	.74 (.68, .80)	Lea VA	.48 (.39, .57)
2	SureSight	.80 (.72, .88)	Cover-uncover	.60 (.46, .74)	Retinomax Y1	.66 (.60, .72)	Retinomax Y1	.39 (.31, .47)
3	Retinomax Y2	.78 (.69, .87)	Stereo smile II	.58 (.46, .70)	Retinomax Y2	.63 (.58, .68)	NCR	.38 (.30, .46)
4	Retinomax Y1	.77 (.67, .87)	Retinomax Y1	.54 (.40, .68)	SureSight	.63 (.58, .68)	HOTV VA	.36 (.28, .44)
5	Lea VA	.65 (.54, .76)	SureSight	.54 (.42, .66)	Lea VA	.58 (.52, .64)	Retinomax Y2	.36 (.27, .45)
6	MTI	.63 (.53, .73)	Retinomax Y2	.53 (.41, .65)	iScreen	.43 (.37, .49)	SureSight	.35 (.26, .44)
7	iScreen	.62 (.52, .72)	iScreen	.50 (.38, .62)	MTI	.42 (.36, .42)	iScreen	.27 (.19, .35)
8	Stereo Smile II	.61 (.51, .71)	NCR	.50 (.36, .64)	Power refractor	.42 (.36, .48)	Power refractor	.27 (.19, .35)
9	Power Refractor	.57 (.47, .67)	Lea VA	.48 (.34, .62)	HOTV VA	.40 (.34, .46)	MTI	.24 (.16, .32)
10	HOTV VA	.52 (.41, .63)	HOTV VA	.44 (.30, .58)	Stereo smile II	.37 (.32, .42)	Random dot E	.24 (.17, .31)
11	Random Dot E	.28 (.18, .38)	Power refractor	.34 (.22, .46)	Random dot E	.23 (.18, .23)	Stereo smile II	.20 (.13, .27)
12	Cover-uncover	.27 (.17, .37)	Random dot E	.29 (.16, .42)	Cover-uncover	.16 (.11, .21)	Cover-uncover	.06 (.02, .10)

* The screening tests with tied sensitivities are listed alphabetically. A 0.25 difference in sensitivity in detecting amblyopia, 0.30 difference in detecting strabismus, 0.15 difference in detecting significant refractive error, and 0.20 difference in detecting reduced VA can be considered to be statistically significant.
§ 94% specificity cannot be achieved for HOTV VA, Random Dot E, and cover-uncover test. The current sensitivity comparisons were based on 93% specificity for HOTV VA, 92% specificity for Random Dot E, and 98% specificity for cover-uncover test. Their sensitivities for cover-uncover test, iScreen and MTI photoscreeners have been previously reported.[3]

Sensitivity of Screening Tests for Detecting Vision In Preschoolers-targeted Vision Disorders When Specificity Is 94%.

Optometry & Vision Science. 82(5):432-438, May 2005.

TABLE 5. Ranking of tests from highest to lowest sensitivity in detecting the 4 VIP-targeted disorders with specificity set at 0.94

TABLE 6.

TABLE 6.
Ranking of tests from highest to lowest sensitivity in detecting any condition and Group 1 conditions with specificity set at 0.94§

Ranking	Any condition		Group 1 conditions*	
	Screening tests	Sensitivity (95% CI)	Screening tests	Sensitivity (95% CI)
1	NCR	.57 (.52, .62)	NCR	.90 (.85, .95)
2	Retinomax Y1	.52 (.47, .57)	Retinomax Y1	.87 (.81, .93)
3	Retinomax Y2	.52 (.47, .57)	Retinomax Y2	.81 (.75, .87)
4	SureSight	.51 (.46, .56)	SureSight	.75 (69, .81)
5	Lea VA	.49 (.44, .54)	Lea VA	.65 (.57, .73)
6	iScreen	.37 (.32, .42)	iScreen	.57 (.50, .64)
7	MTI	.37 (.32, .42)	Stereo smile II	.57 (.50, .64)
8	HOTV VA	.36 (.31, .41)	Power refractor	.56 (.49, .63)
9	Power refractor	.36 (.31, .41)	MTI	.55 (48, .62)
10	Stereo smile II	.33 (.28, .38)	HOTV VA	.48 (.40, .56)
11	Random dot E	.22 (.18, .26)	Random dot E	.30 (.22, .38)
12	Cover-uncover	.16 (.12, .20)	Cover-uncover	.24 (.17, .31)

The screening tests with tied sensitivities are listed alphabetically.
§ 94% specificity cannot be reached for HOTV VA, Random Dot E, and cover-uncover test. The current sensitivity comparisons were based on 93% specificity for HOTV VA, 92% specificity for Random Dot E, and 98% specificity for cover-uncover test.
* Conditions very important to detect and treat early.

Sensitivity of Screening Tests for Detecting Vision In Preschoolers-targeted Vision Disorders When Specificity Is 94%.

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TABLE 6. Ranking of tests from highest to lowest sensitivity in detecting any condition and Group 1 conditions with specificity set at 0.94

Example of Children's Vision screening program in Alabama

- All children in public school in AL receive photoscreening by *VisiScreen* in kindergarten and 2nd grade
- Parents of children who fail receive a letter and are encouraged to seek a full eye exam
- Some children who pass the screening come in for a full exam and actually have an eye problem
- A large percentage of children who fail the vision screening are never taken for a full eye exam


What about adult vision screenings

- Glaucoma Screenings
- Diabetic Retinopathy Screenings
- All-eye-problem screenings

Legal and Ethical Issues in Clinical Research

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Ethics in Research

- Ethics is based on morality (sense of right and wrong)
- Ethical analysis is the process of identifying and logically thinking through moral problems, it does not provide a universal right or wrong
- For research purposes it is important that something is not only morally, but also legally right

Ethical Analysis

- Identification of an ethical question
- Assessing why the question concerns morality
- Identifying and describing different moral perspectives on the question
- Listing potential solutions to the question
- Developing and defending the answer to the question

Legal issues in Research

- The legal system is based on justice and rights
- May have a more clear answer than ethical issues
- Informed Consent
- Inclusion of minorities, women, and minors
- Child Assent
- Right to withdraw at any point
- HIPAA

Institutional Review Board (IRB)

- All personnel involved in research must undergo IRB training and certification along with HIPAA training
- All research protocols must have IRB approval
- Yearly updates are necessary for IRB renewal
- IRB approval is necessary during data collection and analysis phases
- Any changes to the protocol must be approved by IRB as an addendum