PREVENT BLINDNESS
Children's Vision Screening Training Course

Module 5:
Recognition Visual Acuity Screening
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Learning Objectives:

1. Certification candidate will understand and be able to identify age-appropriate tests of recognition visual acuity.
2. Certification candidate will be able to identify an appropriate space for vision screening and set up screening area.
3. Certification candidate will be able to describe the roles and responsibilities of the Screener and the Attendant.
4. Certification candidate will be able to conduct the distance acuity screening test.
5. Certification candidate will understand passing and referral criteria and will be able to identify children in need of a complete eye examination.

Visual Acuity

Visual acuity is the quantifiable measure of the ability to identify black symbols on a white background at a standardized test distance. The most commonly measured type, recognition visual acuity, is defined as the ability to discern certain optotypes – letters, numbers, or figures – at a specified distance. Ideally, tests of visual acuity should utilize individual optotypes with black crowding bars OR a line of optotypes with a black crowding box surrounding them. Optotypes without crowding are unacceptable, because they are too easy for the child to see. When using a test with a line of optotypes – each line should have the same number of optotypes per acuity level. All tests of visual acuity must have optotypes that use the same proportional decrease in size from one acuity level to the next smaller level in logMAR progression.

Visual acuity testing for young children must include using age-appropriate and adequately illuminated test symbols that can be presented in random order, and using a lap card with the test optotypes that the child can use for matching.

Testing Symbols

Two styles of optotype – HOTV and LEA Symbols are considered best practice for use in preschool-aged children (children 36 to <72 months.) The letters H, O, T, and V have vertical symmetry, and the LEA Symbols consist of four well standardized picture optotypes – house, heart or apple, circle, and square—that blur equally and are scaled to reflect comparable visual acuities obtained with Sloan letters. Although 3-year-old Head Start children have been reported to achieve better visual acuity scores with the LEA Symbol optotypes, no statistically significant differences in sensitivity between the tests were found for 3-, 4-, or 5-year-old children. Most children 3 years and older can successfully complete visual acuity testing using either HOTV or LEA Symbols optotypes.

[LEA Symbols Image]

Letter-based optotypes are not recommended for the measurement of visual acuity in preschool-aged children. Children of this age may not know their letters sufficiently well and the letters are not equally detectable. Because Landolt C and Tumbling E tests require discrimination of left-right directionality, a skill that is not sufficiently developed in preschool
children, these tests should also not be used. Picture charts, such as the Allen Preschool Vision Test and the Kindergarten Eye Chart are also problematic because they are not standardized. Both have variable inter-line gap widths and shape cues resulting in some of the pictures being more readily identified than others. When pictures are too easily recognized, visual acuity is overestimated in children with amblyopia. Furthermore, some of the pictures have a cultural bias and others are outdated, making the pictures not readily recognizable by all children.

Symbol Presentation and Crowding Bars/Boxes
While the presentation of single optotypes generally improves testability, the use of single isolated optotypes substantially reduces the sensitivity for the detection of amblyopia. Surrounding single optotypes with four flanking bars that create a “crowding effect” improves amblyopia detection. Isolated HOTV or LEA Symbols optotypes with crowding bars presented in printed format or by computer have been used successfully in large-scale studies of preschool children, and are considered best practice for measuring visual acuity in children aged 36 to <72 months. A single line of optotypes with crowding bars on all 4 sides extended to form a crowding rectangle surrounding the line of optotypes is also preferable to isolated optotypes without crowding bars; this type of presentation is considered acceptable practice.

Testing Distance
The optimum test distance for measuring visual acuity in children aged 36 to <72 months is shorter than that used for adults and school-aged children. The advantages of a shortened test distance include improved ability to maintain the child's attention and the ability to test the child in a smaller space, thereby avoiding the distractions of a crowded hallway or large testing room. The best practice for children this age is to use single surrounded optotypes at a 5-foot test distance. Using a test calibrated for a 10-foot test distance is considered acceptable practice. Testing distances closer than 5 feet should not be used because vision problems may be missed.

Test distances greater than 10 feet, the use of near cards, or vision testing devices that optically simulate distance vision do not meet the recommended minimum standards for measuring visual acuity in children aged 36 to <72 months. Screening programs that are still using cards calibrated for 10 feet should begin moving toward the best practice of testing visual acuity at 5 feet, which will require replacement of equipment.
**Screening Location, Roles and Responsibilities, Screening Area Set-up**

Young children are easily distracted therefore vision screening should be conducted in a quiet, out-of-the-way location. There should be minimal distraction from outside noise, other students or personnel. The vision screening area must be well lit with bright, even lighting and no shadows or glare on the chart. There must be an obstruction-free lane from the chart to the child, as well as ample room for a comfortable setting for the children and screeners.

Because most young children need help understanding or cooperating with the test procedures, preschool-age vision screening is best conducted with a minimum of at least one certified screener and a screening attendant. The Certified Screener’s responsibilities include: Managing the overall screening; assist in setting up the screening area; greet children and establish rapport with them; observe signs of potential vision problems; determine the practice and referral criteria for testing; screen the children and finally, watch for proper occlusion.

The responsibilities of the Attendant include: assist in setting up screening area; point to the proper line; watch for proper occlusion and assist the certified screener in observing signs of potential vision problems.

**Screening Area Setup**

Set up the screening area by following these steps: First, find a location for the test with proper illumination. Visual acuity testing is best performed with even illumination and maximum contrast, at least 85%, between the black symbol and the white background. Best practices for illumination are: using a light box with a translucent visual acuity chart, a lighted stand designed to hold and evenly illuminate the acuity test, standard lighting in a medical exam room, or a computer screen display. Insufficient illumination of the test material and competing light sources that create glare or uneven illumination, such as testing performed beside a window, should be avoided because they can negatively affect visual acuity measurements.

If you are using a visual acuity chart for your test, look for an uncluttered wall to hang it on. A 3' x 3' piece plain paper may be used as a background when it is necessary to hang the chart on a patterned or cluttered wall. If using an illuminated cabinet, be sure it is set up in an area free of clutter and distraction. Select a wall for the chart or area for the illuminated cabinet that ensures an unobstructed view for the children. Place the test of visual acuity away from windows that may cause glare or shadows. If necessary place plain paper or curtains over windows to reduce glare. Ensure that the chart is adequately illuminated. Normal room lighting is usually sufficient. When additional lighting is necessary, a gooseneck lamp or other portable light may be directed on the chart. The test of visual acuity should be approximately at eye level with the child to be screened. In the case of an eye chart – the passing or critical line will generally be at 40 inches from the floor to midway between the 20/30 and 20/40 lines. When using a single surround optotype test, make sure that the child has a place to sit (chair or exam table) and the test is on the table at eye level for the child.

Next, measure off and mark 5 feet or 10 feet depending on the test of visual acuity you are using. Measure from the test to the child’s eyes. Note, some tests may include a measuring cord to ensure proper testing distance. Be sure to use this cord if it is included. Mark the floor with masking tape to indicate the testing line, placing the arch of the foot on the line or the back of the seat of the chair on the line of the child will sit for the test.

Finally, place a chair and near the chart for the chart attendant. And place a table, chair, optotype pointing lap card, oculuders, alcohol swabs, wastebasket, clipboard with recording forms, and incentive stickers within reach of the certified screener. If using a VIP Crowded Test of Visual Acuity the age-appropriate vision testing wheels may also be put on the table.
**Greet the Child and Observe for Signs of Potential Vision Problems**

Now you are ready to begin vision screening. It is helpful to prepare the children ahead of time. The parents and/or teachers of the children to be screened should be fully informed about the importance of healthy vision for their child and the vision screening process you will be conducting. Provide families with educational information as a part of all of your communication approaches and ideally provide them with practice cards with pictures of the optotypes to be used prior to screening. Encourage parents or teachers to practice the shapes with the children to increase the comfort level of the child with the shapes that will be used in the vision screening.

If mass screening, it may be helpful to bring between 2-4 children into the screening room at a time. Having a few other children nearby may put shy children at ease, while limiting distraction. Also, children who may be hesitant can observe the other children while they "play the picture game". Have quiet activities available (such as coloring pages) for the children that are waiting to have their vision screened. It's also important to note however, that the children should be situated far enough away from the screening area so as not to be able to memorize the sequence of optotype presentation, or to be a distraction to the child being tested.

Greet the child who you are about to screen. Though greeting the child requires little time, it serves three important functions: It ensures the child is comfortable and at ease, it allows you to confirm that you have the correct recording form for the child being screened, and it provides an opportunity to observe potential eye problems. Tips for greeting the child include: paying the child a compliment to help her or him feel comfortable with you; ask his or her name and age to establish rapport answer any questions the child might have to help him or her feel at ease; avoid questions that can be answered “yes” or “no.” For example, avoid asking “do you want to play the game?” Instead say, “Now we’re going to play a game.” Avoid offering options. For example, don’t ask “would you like to play a matching game or would you like to name the symbols?” Tell the child gently but clearly what you expect him/her to do. And finally, look for any signs of vision problems such as turned eye. Volunteers and certified screeners all watch for signs of potential vision problems. The decision to refer based on observation is made by a certified screener.

Next, practice with the child at a close distance. Prior to proceeding to the testing phase, the child to be screened should be pre-trained using large-sized optotypes at approximately two-three feet (one meter) to verify the child’s ability to name or match the optotypes on the lap card. It is acceptable for the child to provide other names for the symbols as long as the child uses them consistently. For example, the child may call the apple a heart or the circle an “O” or the rectangle a window. However, if the child ever starts using a new name or there is ever any question about which symbol the child is referring to, the child should be asked to point to the symbol on the lap card.

**Occlusion for Visual Acuity Testing**

Visual acuity testing should be conducted separately for each eye because unilateral amblyopia is masked by the better-seeing eye when amblyopic children are tested binocularly. Screening personnel need to monitor occlusion carefully because children with reduced vision in one eye often attempt to use their better eye by peeking. Preferred methods of occlusion are to use adhesive eye patches or 2-inch wide hypoallergenic surgical tape. An acceptable method is the use of specially constructed occluder glasses. Holding a tissue, hand, paper cup, or an occluder paddle over a child’s eye is not acceptable because children can easily circumvent these types of occlusion.
Occluders

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Begin by occluding the left eye and testing the right eye.

**Testing procedure: Chart-based test of visual acuity**

1. If the child is wearing glasses, do not remove them
2. Ensure the child is the correct distance from the eye chart (5 feet or 10 feet)
3. Without occlusion – ask the child to name or match the optotypes on the lap card to ensure they understand the task
4. Occlude the left eye:
   i. Place the eye patch or surgical tape over the left eye.
   ii. If using occlude glasses, be sure the left eye is fully covered.
5. Check the position of the child for testing. The child’s eyes should be at about the same height as the critical passing line. Confirm the current age of the child being screened.
6. Begin screening the right eye by asking the child to name or match the last optotype in each of the rows moving toward the critical passing line. Be careful not to break the crowding box with your finger or pointer as it will make it easier for the child to see the optotype.
7. Once you are at the critical passing line, ask the child to name or match each of the optotypes.
8. If the child correctly responds on the critical passing line, they you have completed screening the right eye and can move to screening the left eye.
9. If the child is not able to pass the critical line, move to the line above and ask the child to name or match the optotypes on that line. If the child is successful, then repeat the procedure on the critical passing line. If the child is not successful, you may stop the test and the child will require a referral for an eye exam.
10. Next, properly occlude the right eye and begin screening the left eye by asking the child to name or match the first optotype in each of the rows moving toward the critical passing line. Be careful not to break the crowding box with your finger or pointer as it will make it easier for the child to see the optotype.

11. Once you are at the critical passing line, ask the child to name or match each of the optotypes.

12. If the child correctly responds on the critical passing line, they you have completed screening the left eye.

13. If the child is not able to pass the critical line, move to the line above and ask the child to name or match the optotypes on that line. If the child is successful, then repeat the procedure on the critical passing line. If the child is not successful, you may stop the test and the child will require a referral for an eye exam.

Pass/Refer Criteria for Chart-based Test of Visual Acuity
The passing criterion for HOTV or LEA symbols is age-specific and must be met by both the right and left eyes separately. Test the right eye then occlude the right eye to test the left eye. Children ages 36 through 47 months must identify correctly more than half of the 20/50 line optotypes in each of the right and left eye to pass. Children aged 48 to <72 months must correctly identify the same number of optotypes in each of the right and left eye at the 20/40 level. Children who do not meet these age-specific criteria for each eye should be referred for a comprehensive eye examination.

Testing procedure: VIP Crowded Acuity Test (5 foot single surround optotype)
1. If the child is wearing glasses, do not remove them.
2. Position the child 5 feet from eyes to the the test.
3. Complete Testing at 5 Feet: Right eye disk
   a. Ensure that the left eye is occluded:
      i. Place the eye patch or surgical tape over the left eye.
      ii. If using occlude glasses, be sure the left eye is fully covered.
   b. Check the position of the child for testing. The child’s eyes will need to be at the same height as the cards. Confirm the current age of the child being screened.
   c. Begin age-specific visual acuity testing [show the picture of the VA testing cards for different ages]
      i. Select the age-appropriate wheel for vision testing (the card for 3 year-olds or the card for 4/5 year olds)
      ii. Turn the wheel until the first symbol (numbered 3R1 for 3 year-olds or 4R1 for 4 and 5 year-olds) is in the window. Have the child name or match the corresponding Lea Symbol.
After the child gives his/her response, rotate the wheel **clockwise** to the next symbol (numbered 3R2 for 3-year-olds or 4R2 for 4- and 5-year-olds).

iii. Whenever the child gets a symbol wrong, place an ‘X’ on the corresponding symbol on your recording form.

iv. If the child misses 1 or none of the first 4 symbols (R1, R2, R3, and R4) continue testing successive symbols (R5-R8) until a child gets 2 symbols wrong on a line of symbols on the recording form or completes testing on all symbols.

d. If the child completes all the symbols without getting any X’s, check the box on the recording form stating that all symbols were identified correctly.

iv. If the child misses 2 or more of the first 4 symbols, complete the baseline flip book testing as follows:

1. Remove the disk card from the slot on the lamp stand.
2. Place the baseline flip book on the front ledge of the lamp stand.
3. Have the child name or match each symbol for the right eye. If the child incorrectly identifies a symbol, put an X on the corresponding symbol on the recording form.
4. If the child gets 2 or more wrong (2 or more X’s on the line on the recording form), STOP and test the left eye.

v. If the child correctly identifies all the symbols or only gets 1 of the symbols on the baseline flip book wrong (1 X on the line on the recording form), put the disk card for the child’s age back into the slot on the lamp (right eye disk side towards the child). Turn the wheel until the first symbol (numbered 3R1 for 3-year-olds or 4R1 for 4- and 5-year-olds) is in the window. Have the child name or match the corresponding Lea symbol. Continue testing the right eye with successive symbols until the child gets 2 or more wrong on a line (2 or more X’s on the line on the recording form).

4. Testing at 5 Feet: Left eye

a. Occlude the right eye and flip the visual acuity testing card (disk) over so that the left eye side of the card (disk) is facing the child.

b. Begin age-specific acuity testing for the left eye (as in step 3c, above) beginning with the first symbol for the left eye (numbered 3L1 for 3-year-olds or 4L1 for 4- and 5-year-olds).
Pass/Refer Criteria for the VIP Crowded Visual Acuity Test:

1. Check the “PASS” box at the bottom of the recording sheet if a child correctly names or matches at least three of four of the smallest age-specific LEA Symbols (symbols 5-8). (For 3-year-olds, the smallest symbols are equivalent to 20/50, and for 4- and 5-year-olds, they are equivalent to 20/40).

2. Check the “REFER” box at the bottom of the recording sheet if a child is:
   a. Unable to match the LEA Symbols at 3 feet (pretesting step)
   b. Uncooperative for testing
   c. Refuses to wear the glasses (or occlusion by the other means)
   d. Unable to match at least 3 of 4 symbols on any line with either eye
      - Baseline Card (if tested)
      - LEA Symbols 1 through 4
      - LEA Symbols 5 through 8 (smallest age specific line)

**Children who do not pass must be referred for complete eye examination**

**Children Unable to Complete Screening Test**
Children who are shy, uncooperative, who will not allow patching, or do not provide a clear indication that they can match optotypes during a pre-training session are considered to be “unable” to complete the screening. Unable children are more likely to have a vision problem than children who successfully complete and pass a screening. Thus, unable children should be referred directly for a comprehensive eye examination, or rescreened by an experienced screener of preschool-aged children that same day, or no later than 6 months. Children unable to be screened with a visual acuity testing are often successfully screened using an autorefractor and vice versa. Thus, if both types of screening tests are available, one should consider using the alternate method for the rescreening.

**Children Requiring a Comprehensive Eye Examination**
Children who should be referred for a comprehensive eye examination include: Children at high risk for vision disorders and those with readily recognized eye abnormalities such as strabismus or ptosis; children with known neurodevelopmental disorders; children with systemic diseases or using medications known to cause eye disorders; those with a family history of a first-degree relative with strabismus or amblyopia; an children born prematurely at <32 completed weeks of gestation; children who do not pass the distance visual acuity test with either eye; children who are not likely to complete a rescreening, and finally, when a parent or guardian believes his or her child may have a vision-related problem.
Module 6: Instrument-Based Vision Screening
Learning Objectives:

1. Certification candidate will be able to explain what instrument-based screening is.
2. Certification candidate will be able to identify three instrument-based devices that are appropriate for screening preschool-aged children.

Instrument-Based Vision Screening

Instrument-based screening refers to vision screening using automated technology. Generally, instrument-based screening is quick to administer and requires minimal cooperation from the child, thereby making it especially useful for shy, non-communicative, or pre-verbal children. Using an automated instrument also offers the advantage of having the potential for the screening results to be integrated directly into a data management system without requiring manual data entry. A recent policy statement published by the American Academy of Pediatrics noted that an instrument-based approach can be used in the medical home as an alternative to visual acuity screening for children ages 3 through 5 years. Considerations that may impact use of an instrument include the high up-front cost of the device, maintenance, and size of population to be screened.

Refractive Instrument-Based Methods of Vision Screening

Instrument-based screening using autorefraction or photorefraction or photoscreening identifies the presence and magnitude of refractive error rather than providing a measurement of visual acuity. Each of these screening devices requires instrument–and age-specific pass/fail refractive error criteria. Abnormal refractive error is a significant risk factor for amblyopia. Hyperopic refractive error ≥ 2.00D spherical equivalent, in particular, is associated with a significantly higher risk of esotropia, which by itself is an additional risk factor for amblyopia. Because of the association among amblyopia, strabismus, and uncorrected significant refractive error, screening for refractive error alone is often successful in identifying children with constant strabismus and moderate to severe levels of amblyopia.

Autorefraction

Autorefractors are computerized instruments that use optically automated skiascopy methods or wave-front technology to provide a numeric estimate of refractive error. When used for vision screening purposes, the operator or the instrument must interpret the refractive error measurement as a pass or fail. Although accurate determination of refractive error (hyperopia in particular) requires the instillation of eye drops to provide cycloplegia, eye drops are not used in the screening environment. Accordingly, vision screening by autorefraction only provides an estimate of refractive error; it is not a substitute for an eye examination and refraction by an ophthalmologist or optometrist.

Unlike tabletop models that are often difficult to use with young children, hand-held autorefractors are suitable for vision screening because they are portable and only require a few seconds of a child’s attention. The Retinomax and the SureSight Vision Screener meet the criteria for best practice for preschool vision screening. The VIP Study has shown that these two autorefractors meet or exceed the screening performance achieved using recognition visual acuity testing in preschool children.
The Retinomax has a high testability rate and good sensitivity at both 0.90 and 0.94 specificity in 36 to <72 month old children; however, the results are reported in ophthalmic prescription format, which is not readily interpretable by most lay screeners.

The SureSight, when used in the “child mode,” provides the operator with a pass or fail determination. Software versions 2.24 or 2.25 must be used in vision screening. In addition to refractive error data, an asterisk is displayed on the printout when a child fails according to the VIP referral criteria, thus facilitating interpretation of the results for screeners who are not eye professionals.

**Photorefraction/Photoscreening**

Photorefraction or photoscreening devices use optical images of the eyes’ red reflexes to provide a simultaneous, binocular estimate of refractive error. In addition, some instruments have the capability to evaluate ocular alignment and identify media opacities. Depending on the instrument, the output is interpreted by the operator, a central reading center, or a computer. Some instruments allow the implementation of user-defined refractive error criteria to determine the pass-fail cut-offs.

The Plusoptix Photoscreener is a binocular device. It is considered to hold promise for preschool vision screenings. It provides a simultaneous measure of autorefraction and eye alignment, and allows the user to specify the desired pass/fail criteria. The device also provides a report containing the child’s name, results, and pass/fail status that can be integrated into an electronic medical record. Comparisons of the Plusoptix and clinical examination results in non-screening settings have been mixed, and there are limited results available that apply to a vision screening environment for 36 to <72-year-old children. Investigators have cautioned that the specificity of the Plusoptix is unacceptably low (37%) for field use when the manufacturer’s pass/fail criteria are used, and while modifications of these criteria can result in improved specificity without loss of sensitivity, the ideal refractive error criteria have yet to be determined. Despite these limitations and lack of robust evidence, the Plusoptix instrument appears sufficiently promising to be classed as an acceptable practice at this time, with the caveat that the optimum refractive error referral criteria have yet to be determined. Thus, when the Plusoptix is used outside of an eye care setting, consultation with a pediatric eye care professional regarding the best cut-offs to use for the particular patient population to be screened is advised until evidence-based refractive error criteria are determined.

The SPOT device by Welch Allyn is also acceptable for screening preschool-aged children. It too is a binocular device that provides measure of autorefraction and eye alignment. It allows the user to specify the desired pass/fail criteria and provides a detailed report that may be integrated into electronic data management system. The optimum refractive error referral criteria have yet to be determined. Thus, when the SPOT device is used outside of an eye care setting, consultation with a pediatric eye care professional regarding the best cut-offs to use for the particular patient population to be screened is advised until evidence-based refractive error criteria are determined.