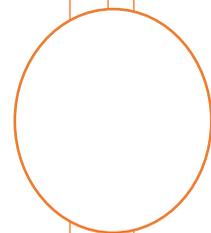


Guidelines For Childhood & Youth Hearing Screening Programs



COLORADO
Department of Education

June 2017



Acknowledgements

The following participants are acknowledged for their participation in developing the *Guidelines for Colorado Childhood Hearing Screening Programs*:

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|--|---|
| <p>Kathleen Patrick RN, MA, NCSN, FNASN Assistant Director – Health & Wellness Unit Colorado Department of Education</p> | <p>Lenita Hartman, MA Program Initiatives Manager Early Intervention Colorado</p> |
| <p>Lisa Cannon, AuD, CCC-A Educational Audiology Coordinator, CDE Educational Audiologist, Denver Public Schools</p> | <p>Alison Meagher, AuD, CCC-A Educational Audiologist Thompson School District</p> |
| <p>Heidi Adams, AuD Educational Audiologist Westminster Public Schools</p> | <p>Heidi McCaslin, MA Preschool Special Education Director Colorado Department of Education</p> |
| <p>Sarah Blumenthal MSN, RN Staff Development and Screening Coordinator Denver Public Schools</p> | <p>Jennifer Schryer, AuD Educational Audiologist Mountain BOCES - West</p> |
| <p>Sandra Gabbard, PhD Clinical Audiologist President/CEO Marion Downs Center</p> | <p>Linda Wood, BSN, RN, NCSN School Nurse Aurora Public Schools</p> |
| <p>Debbie Gwinner, AuD Educational Audiologist Cherry Creek School District</p> | |

Thank you also to the following individuals who reviewed the final guidelines:

Tara Bauman, AuD, CCC-A
Clinical Audiologist
Denver Health Hospital Authority

Kelly Grenham, RN, BSN, MPS, NCSN
School Nurse Consultant
Mapleton School District / Children’s Hospital Colorado, School Health Program

Karen O’Keeffe, RN, MSN, NCSN
School Nurse
Child Find Team, Denver Public Schools

Table of Contents

| | |
|---|-----------|
| Introduction | 3 |
| Recommended Hearing Screening Procedures | |
| I. Screening Methods | |
| A. Otoacoustic Emissions (OAE) | 6 |
| B. Pure Tone | 7 |
| C. Tympanometry | 8 |
| II. Target Population Considerations | |
| A. Goal | 10 |
| B. General Considerations | 10 |
| C. Early Childhood Considerations | 10 |
| D. School-Age Considerations | 11 |
| III. Referral Protocol & Follow Up | 11 |
| IV. Screening Program Management | |
| A. Program Design & Process | 12 |
| B. Screener Qualifications & Training | 13 |
| C. Equipment Selection & Calibration | 13 |
| D. Screening Environment | 13 |
| E. Infection Control/Universal Precautions | 13 |
| F. Recordkeeping and Data Collection | 14 |
| Appendices | |
| A. Glossary | 15 |
| B. H.E.A.R. Checklist | 19 |
| C. Hearing Screening Flowchart | 20 |
| D. Sample Referral Form: Early Childhood | 21 |
| E. Sample Referral Form: School Age | 22 |
| F. Resources | 21 |
| References | 24 |

Introduction

The Colorado Department of Education recognizes that effective hearing screening programs are critical to the identification and removal of a potentially significant barrier to student learning. In order for students to proficiently read, write, listen and speak, they must have a firm foundation of language. Age-appropriate language, cognitive and social development are all critically tied to the ability to accurately hear.

Hearing loss is the most prevalent developmental disorder in children, and although much progress has been made in identifying hearing loss at birth, there continues to be a great need for ongoing screening throughout early childhood and into adolescence. There are several key points to consider that support the need for screening.

- Approximately 35% of newborns not passing their hearing screening receive no documented follow up (CDC, 2011).
- 10-20% of cases of permanent hearing loss are not detectable at birth (Grote, 2000).
- Transient hearing loss associated with ear infections affect up to 90% of children prior to entering school and approximately 25% of school age children (Tos, 1984; Lous and Fiellau-Nikolajsen, 1981).
- Adolescents are increasingly at-risk for noise induced hearing loss due to unsafe listening practices in recreational activities including use of personal audio devices (NAHIC, 2014).
- Unidentified and late-identified educationally significant hearing loss results in increased education costs (CDC, 2004-06).

Policies Supporting Hearing Screening

Colorado House Bill 1095-97 requires all Colorado hospitals to provide a newborn hearing screening at birth. (For newborn hearing screening guidance, please refer to [“Colorado Infant Hearing Advisory Committee: Guidelines for Infant Hearing Screening, Audiologic Assessment, and Early Intervention.”](#)) Currently, 97% of infants born in Colorado are screened and if identified with hearing loss are referred to appropriate early intervention programs. Colorado’s Early Hearing Detection & Intervention ([EHDI](#)) system is coordinated among various agencies including the Colorado Department of Public Health and Environment ([CDPHE](#)), [Early Intervention Colorado](#), and the Colorado Home Intervention Program ([CHIP](#)). A significant gap exists in population-based hearing screening between birth and entry into school, a time when many children are at-risk for developing hearing loss.

Colorado state statute C.R.S. 22-1-116 states that “the sight and hearing of all children in the kindergarten, first, second, third, fifth, seventh, and ninth grades, or children in comparable age groups referred for testing, shall be tested during the school year by the teacher, principal, or other qualified person authorized by the school district. Each school in the district shall make a record of all sight and hearing tests given during the school year and record the individual results of each test on each child’s records. The parents or guardians shall be informed when a deficiency is found. The provisions of this section shall not apply to any child whose parent or guardian objects on religious or personal grounds.”

The [Individuals with Disabilities Education Act \(IDEA 2004\)](#) requires local education agencies to identify, locate, and evaluate all children with disabilities. This obligation, called child find, requires

states to have a comprehensive system to identify children from birth to age twenty one with disabilities, or suspected of having disabilities, and who have a need for early intervention or special education. Children birth through age two referred to [Early Intervention Colorado](#) receive hearing screening as a part of the initial evaluation or assessment to establish eligibility. Children over age 3 may receive hearing screening as one component of the screening and/or comprehensive evaluation activities that occur to determine eligibility for special education services.

U.S. Head Start Program Performance Standards ([45 CFR 1301-1311](#)) mandate a hearing screening within 45 days of the child's entry into a Head Start or Early Head Start program. [New performance standards effective November 2016](#)

The [Colorado Preschool Program](#) (CPP), our state funded early childhood program for children at risk of starting elementary school unprepared, encourages districts to administer hearing screening as a part of a high quality preschool program. In 2016, 96% of the district-administered programs provided hearing screenings to children enrolled in CPP.

The [American Academy of Pediatrics](#) (AAP) recommends that children receive repeated hearing screenings and be regularly assessed for risk of hearing loss. [Recommendations for Preventive Pediatric Health Care](#)

The [Centers for Disease Control \(CDC\) of the US Department of Health and Human Services](#) urges school districts to establish policies that promote hearing health, including hearing loss prevention programs. [Promoting Hearing Health in Schools](#)

The [Centers for Medicare & Medicaid Services \(CMS\)](#) recommends that children enrolled in Medicaid should receive hearing screenings at each well-child check-up. The program known as Early and Periodic Screening, Diagnostic and Treatment services (EPSDT) provides a comprehensive benefit to ensure that children are identified and treated as early as possible. [EPSDT – A Guide for States](#)

Scope of Guidelines

The purpose of these guidelines is to establish recommended childhood and youth hearing screening practices to be used statewide by all agencies or systems providing screenings to children. These guidelines are for screening purposes only. Hearing screening is the quick and efficient first step in the process of identifying normal hearing or the need for further evaluation. Audiologists are the professionals charged with diagnosing a hearing problem. Any children with a known hearing loss must be managed by an audiologist and therefore should not be seen through a screening program.

Audiology Support

All hearing screening programs should include regular consultation by an audiologist. Before setting up a screening program, identify an audiologist who can assist in the development, training, and evaluation of the screening program as well as help establish a follow-up protocol for children referred. Most often this is the local educational audiologist, who is hired by the school district or Board of Cooperative Educational Services (BOCES), and whose job role includes coordinating and assisting with hearing screening programs from birth through 21. For charter and private schools, and other programs

unaffiliated with the school system or child find activities, audiology consultation may be available through audiology regional coordinators with the Colorado Department of Public Health and Environment (CDPHE) or through various public or private health and community agencies. For more resources, see [Resource](#) page.

Recommended Hearing Screening Procedures

I. Screening Methods

A. Otoacoustic Emissions (OAE; DPOAE)

Ages: 0 to 4 years, 11 months; appropriate for older students unable to perform pure tone screening

Overview: OAEs are sounds created in the cochlea which can be measured by a sensitive microphone placed in the ear canal. OAEs are not technically a test of hearing acuity but they reflect the performance of inner ear function and are highly correlated to hearing ability. Specifically, the type of OAE screening that is recommended is known as “distortion product” or “DP” OAEs.

Equipment: Automated DPOAE screening device ([how to select a device](#)); approximate cost \$3400-4000; requires disposable probe tips; requires annual calibration; [equipment suppliers](#); examples of OAE screeners:



Procedure:

1. Select the appropriate environment.
 - a. Choose a time and setting comfortable to the child and where movement by the child will be minimal. If doing other health screenings, conduct OAE screening first.
 - b. Reduce noise from external (loud talking, toys, fans, etc.) and internal (sounds from child being screened such as talking, laughing, etc.) sources as much as possible for faster and easier screening.
2. Visually inspect the outer ear to make sure there are no obvious signs of infection, blockage or physical anomaly.
3. After noting the size of the ear canal opening, select a probe tip that will fit snugly in the child's ear
4. Place probe in the child's ear canal. The probe delivers a low-volume sound into the ear. In approximately 30 seconds, the result is displayed on the computer screen.
5. Read the results on the screen (Pass or Refer).

Helpful Tips

- ✓ Check the equipment, including all cords, at the beginning of each screening day either by screening your own ear or using the equipment's probe calibration check procedure. Discontinue if any problems are found.

- ✓ Engage the child in a quiet distraction such as a visually interesting toy or elicit help from another adult to keep the child still, quiet, and hands away from their ears. Try to create a fun feeling if possible.
- ✓ If child is afraid or unsure of the probe, familiarize by gently touching it to child’s arm, hand or cheek to point out how soft it is. Have child “help” screen a doll or stuffed animal.
- ✓ Do not hold the probe in the ear canal for an extended period of time as that increases the potential for high noise level or movement.
- ✓ Screener may screen a sleeping child during nap time.

Referral Criteria for OAEs:

Refer if either ear displays a refer screen; refer if unable to screen due to excessive noise, movement or inability to place probe. See [Screening Flow Chart](#) for further details.

B. Pure Tone

Ages: 5+; appropriate for younger students who can be reliably conditioned to respond

Overview: Pure tone signals are presented across different frequencies, and responses to the signals typically include a hand raise or a conditioned response such as dropping a block in a bucket.

Equipment: Pure tone audiometer; approximate cost: \$1000; requires annual calibration; cleaning cloths for headphones are recommended; [equipment suppliers](#); examples of pure tone screening audiometers:



Procedure:

1. Select an appropriate environment.
 - a. Choose a quiet setting; test during normal hours so concerns can be identified; test away from halls, windows, cafeterias, gyms, HVAC equipment, bathrooms, and play areas; limit visual distractions.
 - b. Consider checking noise level with sound level meter (SLM) or SLM smartphone app.
 - c. DO NOT PROCEED with screening if noise levels are too loud (greater than 50dBA).
2. Visually inspect the outer ear; remove glasses or headbands; tuck hair or headscarf behind ears.
3. Instruct or condition the child or youth.
4. Place headphones; red headphone on right ear, blue headphone on left ear.

5. Perform age-appropriate **pure tone sweep at 20 decibels (dB)** at the recommended frequencies. (Speech stimuli are not recommended for use.)
6. Present a tone (approximately 3 seconds long) more than once but no more than 4 times.

| Age of Child | Decibel Level | Recommended Frequencies to Screen |
|---|---------------|--|
| Primary: K to 5 th Grade | 20 dB | 1000 Hz., 2000 Hz., 4000 Hz. |
| Secondary: 6 th Grade and up | 20 dB | 1000 Hz., 2000 Hz., 4000 Hz., 6000 Hz. |

7. Lack of responses at any frequency in either ear constitutes a failure.
8. Rescreen immediately preferably doing one or more of the following.
 - a. Remove headphones and carefully replace them over ears.
 - b. Move child to a different tester and different audiometer if available.
 - c. Rescreen during same screening session, on following day, or soon thereafter.

Helpful Tips

- ✓ Perform a daily listening and visual check of the audiometer; inspect the headphones, cords and buttons; listen for noise while pressing buttons; ensure screening tones can be heard; if any problem is found discontinue screening.
- ✓ Use conditioned “play” techniques with younger children who need more concrete response options (drop a block in the bucket or put a peg in the pegboard when sound is heard).
- ✓ Use of warble tone stimulus (instead of steady pure tone stimulus) is acceptable and may be helpful in certain situations.
- ✓ Repositioning the headphones may be necessary in some individuals whose ears “collapse” and cause occlusion of the ear canal.

Referral Criteria:

Refer the child upon failure to respond to one or more tones presented.

C. Tympanometry (optional second tier screening added to OAE or pure tone)

Ages: Any age, but particularly useful in early childhood (not appropriate for infants under 6 months)

Overview: Not a test of hearing. Used to screen outer and middle ear functions (ear canal, eardrum, bones of middle ear and Eustachian tube) and helps delineate referral for a medical evaluation versus an audiology evaluation. Should be used *after* OAE or pure tone referral as an optional second stage screening.

Equipment: Automated tympanometer; approximate cost \$4000; requires disposable probe tips; requires annual calibration; some combined into device with audiometer; [equipment suppliers](#); examples of screening tympanometers:



Procedure:

1. Conduct a visual inspection.
2. Select appropriate size probe tip.
3. Place against ear canal and hold steady to maintain seal.
4. Review and interpret results based on type of equipment.
 - a. Automated equipment will report “pass” or “refer”
 - b. Non-automated equipment refer criteria: >250 daPa tympanometric width for children 3–12 years of age and >275 da Pa tympanometric width for children below age 3. If the use of tympanometric width is not possible, <0.2 mmhos static compliance is recommended (AAA, 2011).

Helpful Tips:

- ✓ Check calibration of machine daily, inspect all cords, and discontinue if problems are found.
- ✓ Use tympanometry as an immediate “next step” screening following failure of pure tone or OAE screening to help clarify the nature of the failure and most [efficient referral protocol](#).
- ✓ Repeat the screening if a flat tympanogram (no observable peak on graph) is obtained.
- ✓ A flat tympanogram in conjunction with ear canal volume greater than 1.0 cm³ can indicate patent pressure equalizer (PE) tubes or perforated eardrum.
- ✓ A flat tympanogram with a small ear canal volume (less than .4cm³) may indicate occlusion of the ear canal, possibly due to cerumen (earwax) build-up.
- ✓ An airtight seal may not be obtained in the presence of PE tubes or a perforated eardrum; do not keep trying to obtain the seal.
- ✓ Tympanometry screening may be most appropriately performed by audiologist during rescreening, especially for public school screening programs.
- ✓ Referrals should not be made on failed tympanometry screening alone.

Referral Criteria:

A refer on tympanometry screening PLUS failure on OAE or pure tone screening warrants medical referral and/or repeat screening in 6-8 weeks (depending upon specific program referral protocol).

II. Target Population Considerations

A. Goal

The goal of hearing screening should be to identify children who have a need for further diagnostic testing to determine the presence of an educationally significant hearing loss. Periodic screening throughout childhood is very important to prevent delays in development. Some children who pass the hearing screening may go on to develop hearing loss suddenly or gradually as hearing loss can occur at any age. Many children not passing a hearing screening may have temporary hearing loss due to middle ear conditions which require medical intervention. Oftentimes children with undetected mild, moderate or unilateral losses are mistaken for having other problems. Children being assessed for teacher- or caregiver-reported behavior and/or attention problems are prime candidates for a hearing screening to rule out a potential hearing loss before taking next steps.

B. General Considerations

In addition to [mandated screening requirements](#), the following situations warrant screening of children and youth in all circumstances.

- When caregiver, teacher, or school staff have a concern specifically about hearing
- When there is a referral due to concerns about a potential disability
- When there is no documented follow up from a previous hearing screening referral

Certain children should not or cannot participate in a hearing screening and should be immediately referred to an audiologist for a more in-depth screening or monitoring. These include children and youth:

- With known hearing loss, hearing aids, or other specialized hearing technology
- With outer ear physical abnormalities such as absence of an ear canal
- Who are unable to participate in the hearing screening

It is important to remember that neither OAE nor pure tone screening will identify all children with every type or degree of hearing disorder, therefore special attention should be paid to children with [high risk factors](#) and parent/caregiver concern. Referral directly to an audiologist for a complete audiological assessment may be warranted.

C. Early Childhood Considerations

Periodic early childhood screening will assist in identifying children who were not identified at birth or who have developed hearing loss after the newborn period. For most children, results from the newborn hearing screening should be considered valid only up until the child's first birthday. Special attention should be paid to children with high-risk factors and more frequent screening may be warranted. For example, it is recommended that children with a family history of childhood hearing loss be monitored twice a year until they reach school age. Other high-risk indicators of early childhood hearing loss are listed on the [H.E.A.R. Checklist](#) in the Appendix B.

Distortion product otoacoustic emissions (DPOAE) is Colorado's recommended method for screening children 6 months through 4 years of age. DPOAE screening, which does not require a behavioral

response from children, has been used to reliably screen children in a variety of early childhood programs. For a full discussion of implementing an OAE screening program in an early childhood setting, including training materials and resources, refer to [this resource](#) at the National Center for Hearing Assessment and Management (NCHAM).

D. School-Age Considerations

Colorado statute requires annual hearing screening of the following grades: K, 1, 2, 3, 5, 7 and 9. Although not specified in state statute, best practices suggest that preschool is a high-risk population for hearing loss and therefore, it is recommended that school screenings include mass-population preschool screening in conjunction with K-12 programs. The following school-age students should also receive a hearing screening:

- Students newly enrolled or transferred to a new school
- Students being evaluated or re-evaluated for special education services
- Adolescents who are at-risk for noise induced hearing loss due to recreational activities
- Students who report hearing problems or ringing in their ears

Pure tone screening is the recommended screening procedure for students 5 years of age and older. School-based screening programs that include preschool screenings will need to consider the feasibility of using the recommended screening method, OAE, for their preschool population. Older students who are unable to participate in a pure tone screening, such as those with cognitive or behavioral impacts may be screened using OAE either by a trained screener or by an audiologist.

III. Referral, Rescreening & Follow Up

The decision-making process of where to refer and when to rescreen should be part of a locally developed and documented screening protocol. A basic screening flowchart is included in [Appendix C](#) and may be further streamlined depending upon available resources and targeted populations being screened.

Those making referrals to health care professionals are encouraged to become familiar with [current practices in medical management of otitis media](#) (OME). OME is a major cause of hearing screening failure in children, however the medical community takes a conservative (monitoring) approach to management in children without other risk factors. For children with speech-language difficulties, developmental or other learning concerns, referral for OME should accompany details such as the type of screening, ear-specificity, and duration of problem in order to help health care professionals determine the need for medical therapies.

Screening timelines may vary among programs however, the following general practices are recommended with regard to mass-population (school-based) screening:

- Same-day/same-session rescreening to reduce the number of referrals
- Rescreen in 6-8 weeks to allow students with middle ear involvement to spontaneously resolve

It is important to be careful about how and what information is shared with caregivers about the screening results. Remembering that the screening is not a diagnostic test, it is best to use thoughtful

language either verbally or in writing that will stress the need for further follow up without causing alarm. Sample forms can be found in [Appendix D & E](#).

When documenting results from a hearing screening in a child’s health record, IFSP/IEP or other educational plan, it is important to include information about what follow up is necessary either medically or audiological. If a child is being followed by an audiologist to complete the screening or identify a hearing loss, the documentation should refer to the audiology report and audiologist’s interpretation of the impact of hearing loss on developmental or educational progress.

A screening program is only effective if the appropriate follow up for referrals occurs. Above all, ensure that a clear protocol is in place for every step of the process and that it is understood by all. Remember that the process is not complete until the child has passed the screening or been cleared or diagnosed by an audiologist.

IV. Screening Program Management

A. Program Design & Process

Screening protocols and referral processes will vary from setting to setting as the available community resources, allocated personnel, and purpose for screening differ. Mass-population screenings in the school setting may be designed to utilize district school nurses and/or educational audiologists prior to referring to health care providers. For screenings outside of school systems, referral to a private health care provider may be the appropriate first step. Some programs may choose to perform tympanometry screening as a second tier screening, which will further differentiate the decision to refer to an audiologist or a health care provider. In Colorado, educational audiologists are employed by local education agencies to support schools districts, in part to identify children with disabilities. Educational and public health audiologists may be available to take community referrals from a variety of sources. Each screening program should determine its referral and decision-making process, as well as ensure that the process is documented and consistent within each given program. See list of resources in [Appendix F](#).

Audiology involvement in hearing screening programs is imperative. Pediatric audiologists are qualified to provide guidance, development, implementation, and oversight of hearing screening programs. In situations where audiology oversight is not feasible, it is strongly recommended that non-audiologist managers of hearing screening programs utilize one or more community audiologists as an advisory body for their hearing screening programs. Audiologists should be involved in helping to determine the screening method(s) and follow-up protocol(s) best suited to the specific setting and population as well as in the training of screeners. All screening program managers should be knowledgeable about confidentiality policies, requirements for parental consent and notification, referral and counseling practices, and management of risk factors including infection control.

B. Screener Qualifications & Training

Individuals can become qualified screeners only after satisfactorily completing training and hands-on practice provided by an audiologist or other professional highly experienced in hearing screening. Trained individuals may be nurses, speech-language pathologists, technicians, volunteers and/or other trained lay persons. Annual refresher trainings for screeners should be provided to maintain screening skills, and documentation of a screener’s knowledge and skills is an important quality assurance check in an effective screening program. See [Resources](#) page for further information on training.

C. Equipment Selection and Calibration

Each screening program should consider a number of factors when determining which equipment to purchase and use. Considerations should include the target population being screened, the screening setting, and the financial resources and personnel available. Regardless of what type of equipment is used, it is critical that it be maintained and working properly. Check to be sure that all equipment has been calibrated at least annually to meet national standards ([ANSI S3.6-2010](#)). Daily checks of equipment should also be performed by screeners prior to using the equipment. Additional supplies may be needed for each device including probe tips and headphone covers. Programs should allow for the annual budgetary needs required to keep equipment functioning appropriately as well as be prepared for unexpected equipment expenses such as repair. Assistance from an audiologist and/or local manufacturers’ representative will be critical in choosing, purchasing, and maintaining equipment. It is important to note that OAE screening devices come preset with default “pass/fail criteria,” however screening programs should consult with an audiologist when determining whether the default setting is appropriate. [Appendix F](#) contains links to resources regarding equipment.

D. Screening Environment

Finding an appropriate hearing screening environment can be challenging as noise levels in childhood and school settings are often less than ideal. The importance of this task, however, cannot be stressed enough and every effort should be made to select and confirm an appropriate screening environment. Test settings should meet the specifications detailed in national standards (ANSI, 2008), which specify the maximum permissible ambient noise levels allowed in a test room. Based on these standards, it is recommended that the background noise during pure tone screening be no greater than 50dB. There are currently no standards regarding the OAE screening environment.

E. Infection Control/Universal Precautions

Adherence to infection control procedures is needed to minimize exposure of people and the environment to microorganisms that may make screeners or children being tested and/or their caregivers sick. Exposure to contaminants may occur in the hearing screening environment. For example when:

- performing visual inspection/observation of the ear
- bending over, handling, and placing headphones on ears
- handling and placing tympanometry and OAE probe tips in ears
- handling toys used for conditioned play audiometry or other screening tests
- screening children with contagious illnesses

- touching surfaces after handling any of the items above or after someone else has touched those surfaces
- screening children with suspected head lice or scalp infections

In order to minimize the potential for spread of contaminants, the following precautions should be taken:

- 1) Screener should wash his/her hands with soap and water or use an antibacterial hand sanitizing gel before screening each child.
- 2) Surfaces such as headphones and conditioned play toys used during screening should be cleaned and disinfected with a wipe before each use.
- 3) Other surfaces such as table tops, chairs, other toys, and any equipment that may have come in contact with microorganisms should be disinfected with a wipe as needed throughout the day and at minimum once a day.
- 4) Reusable probe tips for tympanometer and OAE devices should be replaced for each child screened.
- 5) Used probe tips and specula should be disinfected before being used again.
- 6) For lice outbreaks, determine the number of students affected and whether a significant portion of the population are impacted; adjust screening schedule as needed.

F. Record Keeping and Data Collection

Data should be collected in order to evaluate the effectiveness of the hearing screening. The following are recommended data points and should be used in on-going monitoring of program performance.

- Total number of children screened
- Number and/or percentage of children who did not pass the initial screening and/or rescreening
- Number and/or percentage of children who missed the initial screening and/or rescreening
- Number and/or percentage of children referred for follow up (audiological, medical, educational)
- Number and/or percentage of children diagnosed with hearing problems
- Data validating appropriate equipment calibration and performance

APPENDIX A: GLOSSARY

Acuity – Sharpness or clarity of hearing ability in humans that is measured and recorded on an audiogram in decibels (sound level) and hertz (sound pitch or frequency).

Ambient noise – Surrounding noise from all directions encompassing a combination of sources (e.g., lighting, heating, air conditioning systems, people moving about, or use of equipment/facilities).

ANSI S3.6-2010 – The American National Standards Institute’s specification which defines the technical characteristics of audiometers and calibration procedures.

ANSI, 2008 – The American National Standards Institute’s specification which defines the allowable ambient noise levels for hearing test environments.

Appropriate environment – An acceptable hearing screening setting that is free from excess noise and visual distractions; when noise levels exceed 50dB, the hearing screening environment is deemed inappropriate and should not occur.

Audiology – The study of hearing disorders, including evaluation of hearing function and rehabilitation of individuals with hearing loss

Audiologist – The professional who provides care in the prevention, identification, diagnosis, and evidence-based treatment of hearing, balance, and other auditory disorders for people of all ages. An **educational audiologist** refers to audiologists practicing in the school setting; **pediatric audiologists** are audiologists specializing in services to children.

Audiogram – a graphic record of hearing ability for various sound frequencies; used in diagnostic audiology evaluations.

Audiometer – An instrument for gauging and recording acuity of hearing.

Calibration – The electroacoustic (physical measurement) or psychoacoustic (listening check) determination that an audiometer is performing properly in terms of its acoustic output, attenuation linearity, frequency accuracy, or harmonic distortion.

Cerumen (also called Earwax) – The yellow, waxy matter secreted in the outer portion of the ear canal that keeps out foreign objects, and keeps skin in the canal and tympanic membrane moist.

Cochlea – The spiral-shaped cavity of the inner ear and the main organ of hearing. The cochlea contains the nerve endings that transmit sound vibrations from the middle ear to the auditory nerve and are responsible for producing otoacoustic emissions.

Conditioned play audiometry (also called play audiometry) – A hearing test technique that uses behavioral conditioning to teach children to respond to sound; it makes a game of the hearing test by using activity-related toys such as blocks or pegs.

Conductive hearing loss – hearing loss produced by pathologies of the external and/or the middle ear.

Decibel (dB) – A unit used to measure the relative loudness or intensity of sounds; 0.0 dB (HL) is considered to be the faintest sound that can be heard by a normal hearing person; 140 dB (sound

pressure level), a pressure 10 million times as great, is considered to be the pain threshold of the normal ear.

Diagnostic audiometry – Performed by an audiologist to determine precise hearing abilities and includes hearing thresholds for both tonal stimuli and speech stimuli.

Early childhood – Stage in human development that generally includes the toddler (ages 1-3) and preschooler (ages 3-5).

Ear canal (also called **external auditory canal**) – The narrow, tube-like passage through which sound enters the ear.

Eardrum – The thin, semitransparent, oval-shaped membrane that separates the middle ear from the external ear. Also called tympanic membrane.

Educationally significant hearing loss (ESHL) – A typically permanent hearing loss diagnosed by an audiologist and potentially determined to have a negative impact on listening and learning in the educational setting. In Colorado, ESHL can be bilateral (both ears), unilateral (one ear), high frequency (bilateral, occurring in high-frequency range of hearing), or transient (ESHL that is present for more than 3 months due to a treatable condition such as OME).

Eustachian tube – A slender tube that connects the tympanic cavity with the nasal part of the pharynx and serves to equalize air pressure on either side of the ear drum.

Frequency – The rate of repetition of the cycles of a sound wave. The unit is called Hertz (Hz) or cycles per second (cps). The frequency of a tone largely determines pitch.

Hearing loss – General term for the partial or total inability to hear, also called hearing impairment. Hearing loss has many different causes, degrees, and types.

Hertz (Hz) – The standard unit of frequency (i.e., cycles per second) in the International System of Units, equal to one cycle per second.

Inner ear – The portion of the ear within the temporal bone that is involved in hearing and balance and includes the semicircular canals, vestibule, and cochlea. Also called internal ear, labyrinth.

Mass-population screening – examination of a large group or population to determine the presence of disorder or disease.

Middle ear – An air-filled cavity bordered by and including the tympanic membrane, ossicles, and Eustachian tube and ending at the cochlea.

Middle ear condition (or pathology) – Disorder of the middle ear space that can cause hearing loss or abnormal function of the structures of the middle ear; may include but is not limited to Eustachian tube dysfunction, ear infections, perforated eardrum, and impacted earwax.

Normal hearing – The ability to perceive sound within the normal range; typically defined as hearing levels between 0 to 20dB.

Occlusion – A closing or shutting off of the external ear canal. May occur due to a blockage of cerumen or be caused in some individuals by tight fitting headphones.

Otitis media – a general term indicating inflammation of the middle ear.

Otitis media with effusion (OME) – Inflammation of the middle ear accompanied by an accumulation of fluid (liquid).

Otoacoustic emissions (OAE) – Sounds given off by the inner ear when the cochlea is stimulated by sound, and which can be measured with a small probe inserted into the ear canal. People with normal hearing produce emissions. Those with hearing loss greater than 25-30 decibels (dB) do not produce these very soft sounds. The recommended type of OAE to be used in childhood screening programs is **distortion product otoacoustic emissions (DPOAE)**, which refers to sounds measured in response to 2 simultaneous tones of different frequencies.

Outer ear (also called external ear) – the outer portion of the ear including the auricle (pinna) and the passage leading to the eardrum (ear canal).

PE tubes (pressure equalization tubes) – ear tubes inserted into the eardrum to keep the pressure equal across the eardrum thereby preventing a vacuum forming in the ear which contributes to infection; also called ventilation, tympanostomy, myringotomy tubes.

Perforated eardrum – A hole or rupture in the eardrum.

Probe tip – Refers to the slender instrument inserted into the ear canal opening to perform an OAE or tympanogram test; most often has disposable cover to use, disinfect, and replace between tests to prevent spread of microorganisms which can cause infection.

Pure tone – A sound wave of a single frequency whose sound sensation is characterized by its singleness of pitch.

Pure tone audiometry – The key hearing test used to identify hearing threshold levels of an individual, enabling determination of the degree, type and configuration of a hearing loss. Thus, providing the basis for diagnosis and management.

Pure tone sweep – An audiometric technique to identify those individuals whose thresholds do not fall within the normal limits of hearing from those individuals whose thresholds fall at or within the limits of normal hearing; using pure-tone as stimuli.

Referral – Notification of parent/guardian/caregiver regarding results of hearing screening and the recommendations for follow up.

Risk factors – Attribute or exposure of an individual that increases the likelihood of causing or developing hearing loss.

Sensorineural hearing loss (SNHL) – Hearing loss resulting from a pathological condition in the inner ear or along the nerve pathway from the inner ear to the brain stem.

Stimulus button (also called interrupter) – The control on an audiometer that when pressed presents the signal to the listener; can be turned “continuously on” using a separate control also on the audiometer.

Threshold – The sound level below which an individual is unable to detect sound; also the lowest point at which a person can hear; hearing thresholds are also referred to as hearing levels are stated in decibels (dB) at various frequencies.

Tympanogram – A graphic representation of a pressure compliance function of the middle ear.

Warble tone – A stimulus tone available on many audiometers whose frequency varies periodically several times per second over a small range and can be slightly easier to hear in certain environments; may be reliably alternated with pure tone stimulus.

APPENDIX B: H.E.A.R. CHECKLIST
Indicators Associated with Hearing Loss

Children and youth who have any of the following history are of greater concern for potential hearing loss. **Bolded items are of greatest concern for potential permanent hearing loss.**

H: Health

- Large number of episodes of ear infections, PE tubes, or ear surgeries
- Problems during pregnancy or delivery
- Neonatal Intensive Care (NICU) stay of five or more days
- Prolonged mechanical ventilation (5 days or longer)**
- Hyperbilirubinemia requiring exchange transfusion
- Congenital infections known or suspected to be associated with hearing loss (i.e. toxoplasmosis, syphilis, rubella, **cytomegalovirus (CMV)**, and herpes)
- Bacterial meningitis**
- Head trauma, especially basal skull/temporal bone fractures**
- Diagnosed or suspected neurodegenerative disorders such as Hunter syndrome, Friedreich ataxia, and Charcot-Marie-Tooth syndrome**
- Exposure to ototoxic medications (gentamicin, tobramycin, chemotherapy) or loop diuretics (Furosemide/Lasix)**
- Family history of permanent childhood or early-onset hearing loss**

E: Education

- Delayed in speech, language, or phonics development
- Difficulty following directions (watches others for cues; relies on vision heavily)
- Failing grades or retention

A: Appearance

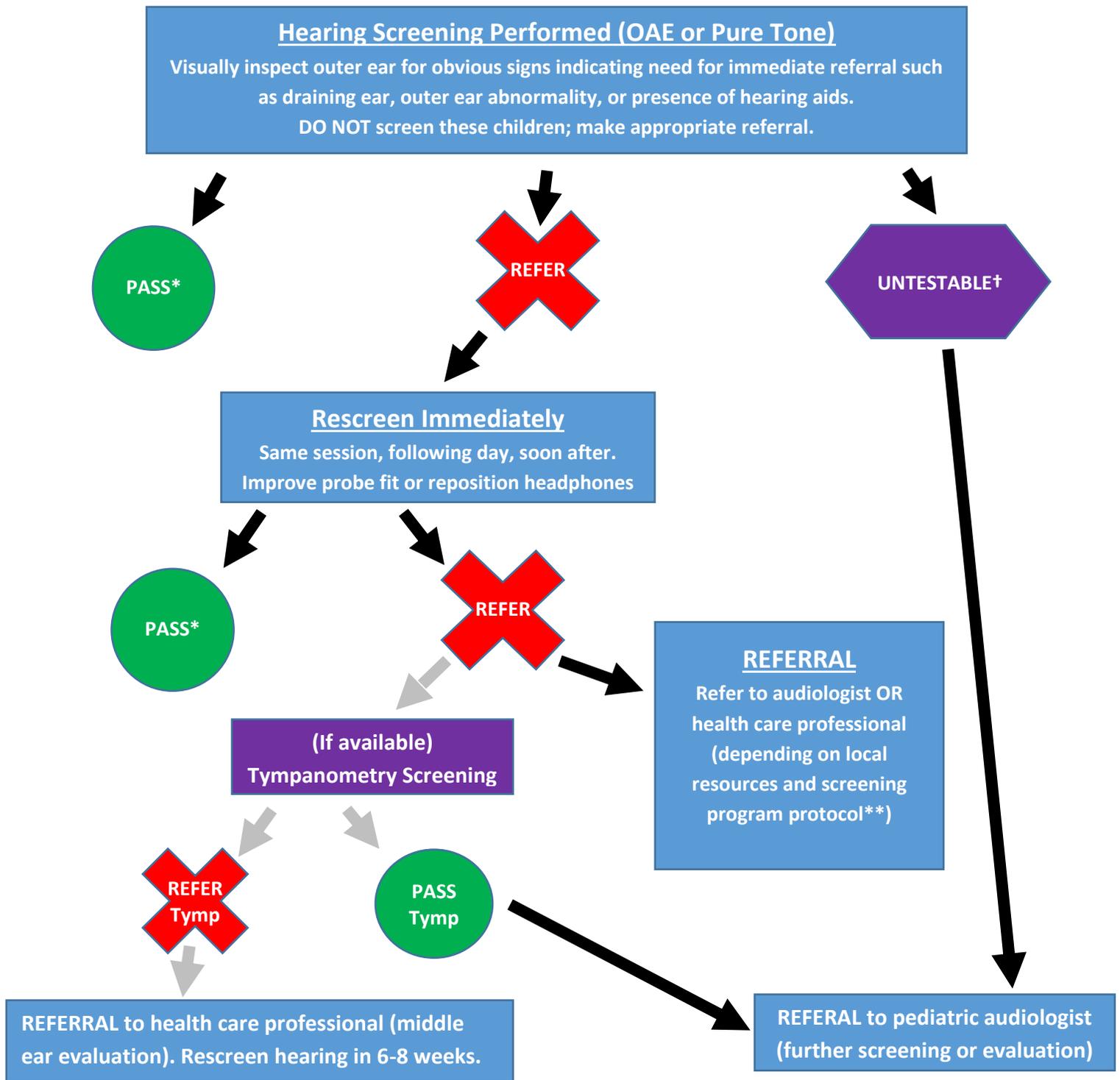
- Outer ear abnormalities such as those that involve the pinna, ear canal, ear tags, ear pits, and temporal bone anomalies
- Craniofacial anomalies, including cleft lip and cleft palate
- Syndromes associated with hearing loss or progressive or late-onset hearing loss, such as of Usher's, Waardenburg, Alport, Pendred, and Jervell and Lange-Nielson**

R: Report

- Teacher or caregiver reports concerns regarding hearing**
- Teacher or caregiver reports concern regarding behavior or attention
- Caregiver or student reports regular engagement in noise-hazardous activities
- Student reports tinnitus or ringing in the ears

HEAR Checklist Additional Comments: _____

APPENDIX C: FLOWCHART
For Children & Youth Who Receive a Hearing Screening



*A pass on an OAE screening does not rule out the possibility of a slight or later developing hearing loss. It is recommended that all children, birth through third grade have at least an annual hearing screening. Any parental concern regarding hearing, speech or language development (especially for those with risk factors) warrants referral to audiologist.

**If screening is being conducted where health care provider or audiologist is present, the protocol may be streamlined.

†Untestable children includes those not cooperative, unable to tolerate probe, or unable to perform task. An audiologist screening or referral is warranted.

APPENDIX D: SAMPLE REFERRAL FORM
Early Childhood Hearing Screening

Dear Parent/Caregiver,

As you know, all children participating in our program receive a hearing screening. We are pleased to offer this as a helpful resource in caring for your child's hearing health.

The results of your child's hearing screening are as follows:

Your Child's Left Ear:

Your Child's Right Ear:

After reviewing your child's hearing screening results, we are recommending that a more detailed examination be scheduled. Some children may not pass the hearing screening due to wax blockage in the ear canal or a mild, undetected middle ear infection. It is therefore important that your child's ears be examined as soon as possible.

We are referring your child to _____ whose contact information is as follows:

<local audiologist resource or health care practitioner>

Please make an appointment as soon as possible. If you have questions or concerns, please call us at xxx-xxx-xxxx. Let us know if you need any help in making this follow-up appointment.

Sincerely,

APPENDIX E: SAMPLE REFERRAL FORM
School Age Hearing Screening

DATE _____

TO THE PARENT/GUARDIAN OF: _____

Your child's hearing was screened at school recently and it is advisable for your child to be seen by an audiologist for further testing.

No screening program can take the place of a thorough examination. Since your child did not pass, it is strongly advised that you have your child examined. You may call the school district audiologist (information attached) for a free screening.

If your child is already under treatment for his/her hearing, please indicate this treatment by sharing appropriate documentation from a health care provider.

Even a slight hearing problem can affect your child's education. Good hearing is essential to learning and language development, so your prompt attention is very important. Please call with any questions you may have at xxx-xxx-xxxx.

Sincerely,

REFERRAL MADE ON THE BASIS OF THE FOLLOWING AREAS:

Observation and History _____

Left 1000 Hz. _____

Right 1000 Hz. _____

Left 2000 Hz. _____

Right 2000 Hz. _____

Left 4000 Hz. _____

Right 4000 Hz. _____

Left 6000 Hz. _____

Right 6000 Hz. _____

APPENDIX F: HEARING SCREENING RESOURCES

State Agencies

- Colorado Department of Education: [Audiology & Health Services](#)
- [Early Intervention Colorado](#)
- Colorado Department of Public Health & Environment ([Newborn Hearing Screening](#))

Screening & Practice Standards

- Educational Audiology Association ([EAA](#))
- American Speech-Language-Hearing Association ([ASHA](#))
- American Academy of Audiology ([AAA](#))
- National Center for Hearing Assessment & Management ([ECHO Initiative](#))
- Maternal & Child: Early Periodic Screening & Detection ([EPSDT](#))
- Centers for Disease Control ([CDC website](#); [downloadable handout](#) on EC screening)
- American Academy of Pediatrics ([AAP](#))
- Joint Committee on Infant Hearing ([JCIH](#))

Screening Program Development & Training

- Early Childhood: ECHO Initiative: Implementing a Successful OAE Screening Program ([Website](#))
- ECHO Initiative: Pure-Tone Screening 3 years old and over ([Website](#))
- School-Age: Towson University: Pure Tone Hearing Screening in Schools ([Dr. Diana Emanuel](#))

Equipment

- [MSR West](#), Longmont, CO / 800-777-4130
- [Audiology Systems](#), Schaumburg, IL / 855-283-7978
- [School Nurse Supply](#), Schaumburg, IL / 800-485-2737
- [MacGill Discount School Nurse Supplies](#), Lombard, IL / 800-323-2841
- [School Health Corporation](#), Hanover Park, IL / 866-323-5465
- ECHO Initiative OAE Equipment Options ([Website](#))

Hearing Health & Prevention

- World Health Organization: [Make Listening Safe Campaign](#)
- Dangerous Decibels ([Website](#))
- ASHA: Hearing Health [Resources for Children & Youth](#)

Hearing Loss

- Centers for Disease Control (CDC): [Free Brochures on Hearing Loss in Children](#)

Other Colorado Resources

- Colorado Academy of Audiology – Find an Audiologist ([CAA](#))
- KidScreen Program ([Marion Downs Center](#))
- CU Denver EHDI Grant, Principal Investigator: [Vickie Thomson, PhD](#)

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