



— EARLY HEARING DETECTION AND INTERVENTION —

# Guidelines for Hearing Screening After the Newborn Period to Kindergarten Age

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## INTRODUCTION

This document provides recommended guidelines to those who perform hearing screening of children after the newborn period through the age of entry to kindergarten. Hearing screening during this period often occurs in both community (e.g., Early Childhood Screening, Head Start) and primary care clinic settings. Additional resources are available from the [Minnesota Department of Health \(MDH\)](http://www.health.state.mn.us)<sup>1</sup> to assist hearing screeners with specific issues of program development and management such as training, supervision, equipment options, and quality assurance.

Screeners and program managers should be aware that while this document provides best practice guidelines for screening children between the post-newborn period to kindergarten-entry for hearing loss, hearing screening does not constitute audiological assessment or evaluation. Therefore, children already identified with hearing loss or who show risk factors for hearing loss should be under supervision of a medical provider.

## BACKGROUND

The goal of an Early Hearing Detection and Intervention (EHDI) Program is to promote communication from birth for all children through the early identification of

hearing loss and the initiation of appropriate intervention services. Hearing screening in early childhood plays a critical role in the EHDI process by identifying children with permanent and longstanding fluctuating childhood hearing loss that may affect health, communication, learning and development. With prompt referral and follow-up, Minnesota children have an opportunity to receive appropriate, timely care, and services which lead to better health and educational outcomes.

Hearing screening in early childhood settings increases the likelihood that children lost to follow-up from newborn screening, along with children presenting with post-neonatal hearing loss, will receive timely



diagnostic and intervention services needed during the critical language-learning years. While questionnaires and checklists are useful in identifying a child at risk for hearing loss, the use of questionnaires and checklists alone often fails to identify children with hearing loss. Hearing screening technology such as otoacoustic emissions (OAE) or pure tone audiometry is a practical and effective means of identifying children who need further evaluation for possible hearing loss.

## PERSONNEL

Screening personnel must demonstrate an ability to work well with children. Screening may be performed by trained personnel including the following:

- Audiologists, audiological technicians/assistants,
- Speech language pathologists/therapists,
- Nurses, including public health and school nurses,
- Other trained medical personnel,
- Other trained adult personnel with a minimum of high school level literacy skills.

Licensed audiologists have extensive training and skills in the evaluation of hearing loss. Screening programs benefit from direct access to audiological consultation to address screening criteria, quality assurance, follow-up assessment, and intervention services.

## TRAINING

Training qualified screeners is an ongoing process. Training typically includes three phases: initial training and demonstration of skills, ongoing quality assurance, and refresher training. Resources for training may include [MDH hearing screening trainings](#)<sup>2</sup>, program managers, school nurses, public health nurses experienced with screening, and local licensed clinical and educational audiologists. Screening programs benefit from direct access to audiological consultation to assist in staff training, implementation, and evaluation of the screening program. Further training recommendations for specific age groups are described in each of the following sections.

## PART I:

# Hearing Screening Guidelines for the Post-Newborn Period up to Three Years (36 Months)



## HEARING SCREENING QUESTIONNAIRE

A hearing screening questionnaire based on [risk factors identified by the Joint Committee on Infant Hearing \(2007\)](#)<sup>3</sup> should be utilized to identify a child's risk factors for hearing loss. The hearing screening questionnaire is a tool that screeners can use to assess a child's particular risk factors for hearing loss, but it is not intended to be a comprehensive health history.

Children who pass their newborn hearing screening but have a risk factor for hearing loss should be referred to an audiologist (ideally one specialized in pediatrics) for at least one diagnostic audiology assessment by 24 to 30 months of age. Infants with specific risk factors, such as those who received ECMO therapy and those with CMV infection, have higher risk of delayed-onset or progressive hearing loss and should be monitored closely by an audiologist as soon as a concern is identified.

## DEVELOPMENTAL SURVEILLANCE AND SCREENING

Care providers of children and infants between the post-newborn period and three years of age should regularly provide developmental surveillance, which includes monitoring developmental milestones such as auditory skills, communication progress, and any caregiver concerns (refer to the [Bright Futures Periodicity Schedule](#)<sup>4</sup>). In addition, primary care providers should administer validated global developmental screening tools at nine, 18, 24, or 30 months of age or any time care providers, parents, or guardians have concern about the child's development (refer to [All Instruments at a Glance](#)<sup>5</sup>).

If a child does not pass the speech-language portion of the developmental screening tool or if care providers have concern regarding the child's hearing or language, the child should be immediately referred for speech language evaluation and audiological assessment. In addition, the child should receive a referral to Minnesota's Early Intervention program, also referred to as Part C, to be evaluated for eligibility for Infant and Toddler Intervention services.

## HEARING SCREENING IN INFANT AND TODDLER INTERVENTION/PART C

[Minnesota's Infant and Toddler Intervention](#)<sup>6</sup>, also referred to as Part C, provides services for children under the age of three years who demonstrate developmental delays or have been diagnosed with a condition that has a high probability of resulting in developmental delays. Services are designed to meet the unique needs of each child and their family. Accessing these services as early as possible will ensure the best developmental outcomes for the child. These services are offered at no cost to the family.

Federal Part C regulations §303.321, require that the evaluation and assessment of an infant or toddler be based on informed clinical opinion and include an evaluation of the child's level of functioning in a variety of identified areas, including hearing. In addition, for a child who has been evaluated for the first time and determined eligible under Part C, an individualized family service plan (IFSP) must include statement of the infant or toddlers present levels of physical development (including vision, hearing, and health status).

The use of family questionnaires, interviews, or observation checklists as the sole means of determining a child's hearing status is unreliable, as over 50 percent of children with hearing loss will not be identifiable through these means. Satisfaction of Part C's evaluation requirement should include information about the child's hearing status obtained through hearing screening with otoacoustic emissions (OAE) equipment, with or without integrated tympanometry screening, or information from the child's audiologist for a child with a known hearing loss. Nonetheless, hearing questionnaires and checklists may be helpful in conjunction with the results of an OAE screening to aid in rescreening or immediate full evaluation referral determinations.

All children who receive an initial Part C evaluation who do not have current documentation of hearing screening results (within the last six months) or a documented hearing loss should be screened for hearing loss using OAE technology with or without integrated tympanometry.

- All efforts should be made to complete the hearing screening during the initial evaluation. However, if completing an individual child's hearing screening would impede the 45-day timeline, and the child can otherwise be determined eligible for Early Intervention services based on other developmental needs, the child's hearing status should be documented as soon as possible.
- When Part C providers do not have OAE equipment available, the Service Coordinator should work with the family to obtain objective (as defined in the glossary) hearing screening information from a health care professional or an audiologist.
- Follow-up hearing screening with OAE is also encouraged near the time of the annual IFSP meeting, or sooner with lack of progress in speech/language acquisition or if there is parent, caregiver, or early childhood provider concern.
- For children who were referred for an initial Part C eligibility evaluation but were subsequently found to be not eligible for Early Intervention services, the Service Coordinator should help connect the family with other health and community resources and information, including information on the importance of periodic hearing screening throughout early childhood.

## SCREENING EQUIPMENT

### Otoacoustic Emissions (OAE)

OAE equipment provides a practical and effective hearing screening method for children from the post-newborn period to three years of age. All equipment must meet technical specifications, calibration standards, and safety standards. Programs should follow the manufacturer's manual recommendations for maintenance and calibration. For hygienic reasons, disposable probe tips should be used with the OAE equipment. If non-disposable tips are used, proper sanitation protocols must be followed.



TOAEs should be measured in response to a click at approximately 80dB SPL (78-82dB SPL). DPOAEs should be measured in response to a series of paired tones ( $f_1$  and  $f_2$ ), with a ratio of 1.22 at a moderate level, where  $L_1/L_2 = 65/55$  dB SPL. Default stimulus parameters of both types of OAE equipment should be reviewed by skilled professionals, such as a consulting audiologist or MDH audiologist, to assure they are appropriate or to adjust them to be in accordance with clinically-accepted national practices.

Programs that utilize OAE equipment should recognize that while OAE equipment provides a practical means to screen for possible hearing loss in the post-newborn to three years (36 months) of age population, OAE

technology does not identify all hearing loss. Specifically, OAE technology will not detect some of the mildest hearing losses and Auditory Neuropathy Spectrum Disorder. However, it remains the most practical and effective tool for screening hearing in the post-newborn to three years of age population.

### Tympanometry

Tympanometry can be a quick and non-invasive procedure to add to the screening protocol even though it does not measure hearing. Tympanometry is a viable tool for screening children for the presence of middle ear fluid and the likely presence of otitis media with effusion. The use of tympanometry screening in conjunction with OAE screening allows for strategic follow-up decision-making for children who do not pass, such as referral of the child for an audiological evaluation if the OAE result is REFER and the tympanometry is PASS.

For programs that utilize tympanometry in conjunction with OAE equipment, the chosen tympanometry equipment should quickly and easily provide measurements of compliance, ear canal volume, peak pressure, and gradient. Programs should follow the manufacturer's manual recommendations in regards to maintenance and calibration. When obtaining equipment, consideration must be given to portability, durability, ability to interface with older electrical outlets (not three-pronged), and feasibility of maintaining battery-powered units.

## PASS/REFER CRITERIA

### Otoacoustic Emission

The manufacturer's PASS/REFER criteria should be reviewed and be in accordance with clinically-accepted national practices. Default testing settings for newborn screenings may have stimulus and PASS/REFER criteria that are not appropriate for older infants and children. Specific parameters that need be considered include amplitude, signal to noise ratio (SNR), and waveform reproducibility. Programs that utilize OAE equipment should consult an audiologist to determine appropriate PASS/REFER criteria for their program's OAE equipment.

Typical passing criteria for TEOAEs include overall reproducibility greater than 50 percent, at least 50 low noise samples collected, stimulus stability of 75 percent or greater, and responses present at least 6dB above noise floor for at least three of the five test frequencies, with

## OAE SCREENING PROTOCOL

4000Hz a mandatory passing frequency. Typical passing criteria for DPOAEs requires absolute response amplitude of at least -6dB and responses at least 6dB above the noise floor at three or more of the test frequency bands, with the 4000Hz region a mandatory passing frequency.

The following best practice screening protocols have been designed for programs that use OAE equipment only and for programs that use both OAE and tympanometry, respectively.

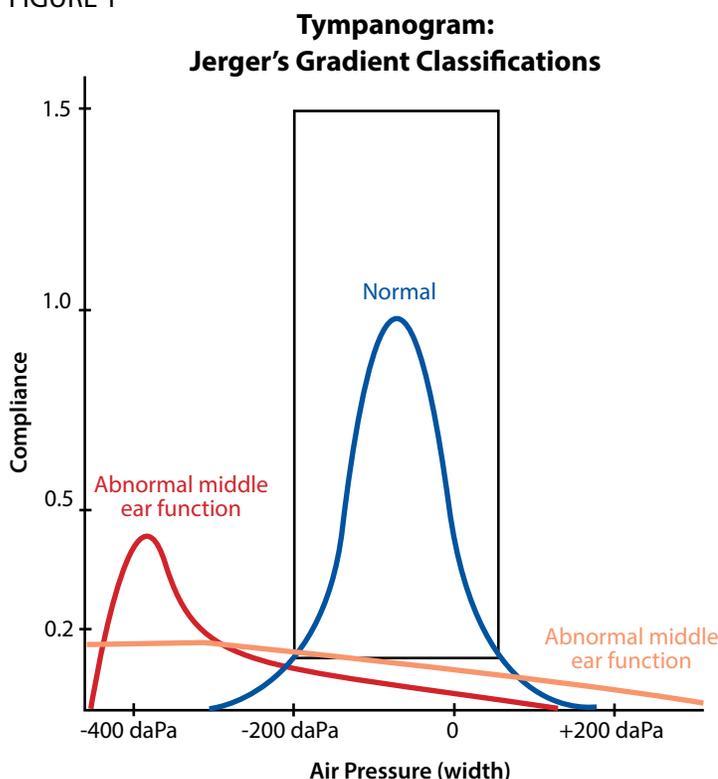
### Tympanometry

Programs that utilize tympanometry in conjunction with OAE should have personnel trained in the following defined tympanometry referral criteria for children ages six months and above: normal and abnormal Jerger's gradient, normal compliance, and pressures (table 1, figure 1). Referral criteria for infants under six months of age should be determined in consultation with an audiologist.

TABLE 1

	Value	Interpretation
Compliance Measurements	0.2 to 0.9 mmhos	Within normal range
Pressure Measurements	+50 to -200 daPa	Within normal range

FIGURE 1



### Screening and Rescreening Protocol: OAE Only

Refer to the [Screening Algorithm: OAE Only](#)<sup>7</sup> flowchart for a visual representation of this screening protocol.

#### Initial OAE Screening

Hearing screening will consist of no more than two attempts using the same screening technique on each ear, assuming that there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS result in both ears, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.

If the child has a REFER result in one or both ears, the child should have an OAE rescreening on both ears (even if a REFER result is received for only one ear) in 14 days.

#### OAE Rescreening in 14 Days

Hearing screening will consist of no more than two attempts using the same screening technique on both ears, assuming there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS result in both ears at the OAE rescreen, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section.

If a child has a REFER result in one or both ears at the OAE rescreen, the child should be referred to a primary care provider for middle ear evaluation. The screener should be in contact with the primary care provider who evaluates the child's middle ear. After the primary care provider provides middle ear clearance (refer to the [EHDI Guidelines for Medical Providers](#)<sup>8</sup>) or in 8 to 10 weeks, the child's hearing should be rescreened again.

### **OAE Rescreening in 8 to 10 Weeks**

Hearing screening will consist of no more than two attempts using the same screening technique on both ears, assuming there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS result in both ears at the 8-to-10-week OAE rescreen, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.

If the child has a REFER result in one or both ears at the 8-to-10-week OAE rescreen, the child should be referred to an audiologist (ideally one specialized in pediatrics) for audiological evaluation. Referral to the child's primary care provider is necessary, as it is often an important step in obtaining an audiology evaluation.

## **Screening and Rescreening Protocol: OAE and Tympanometry**

Performing tympanometry in conjunction with OAE screening may reduce the need for multi-stage screening and reduce loss to follow-up. For programs that have both OAE equipment and tympanometry, the following screening protocol should be followed. Refer to the [Screening Algorithm: OAE and Tympanometry](#)<sup>9</sup> flowchart for a visual representation of this screening protocol.

### **Initial OAE Screening**

Hearing screening will consist of no more than two attempts using the same screening technique on each ear, assuming there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS result in both ears, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section. If the child has a REFER result in one or both ears with OAE, tympanometry should be performed immediately.

If the child has a PASS result with tympanometry screening, there is a greater likelihood that the child has a permanent hearing loss and the child should be immediately referred for a hearing evaluation by an audiologist (ideally one specialized in pediatrics). Referral to the child's primary care provider may be necessary, as it is often an

important step in obtaining an audiology evaluation.

If the child has a REFER result with tympanometry screening, the child should have an OAE rescreening on both ears (even if a REFER result is received for only one ear) in 14 to 21 days.

### **OAE Rescreening in 14 to 21 Days**

Hearing screening will consist of no more than two attempts using the same screening technique on both ears, assuming there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS result in both ears at the 14-to-21-day OAE rescreen, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section. If the child has a REFER result in one or both ears at the 14-to-21-day OAE rescreen, tympanometry should be performed immediately.

If the child has a PASS result with tympanometry screening, there is a greater likelihood that the child has a permanent hearing loss and the child should be immediately referred for a hearing evaluation by an audiologist (ideally one specialized in pediatrics). Referral to the child's primary care provider is necessary, as it is often an important step in obtaining an audiology evaluation.

If a child has a REFER result with tympanometry screening, the child should be referred to a primary care provider for middle ear evaluation. The screener should be in contact with the primary care provider who evaluates the child's middle ear. After the primary care provider provides middle ear clearance (refer to the [EHDI Guidelines for Medical Providers](#)<sup>8</sup>) or in 8 to 10 weeks, the child's hearing should be rescreened.

### **OAE Rescreening in 8 to 10 Weeks**

Hearing screening will consist of no more than two attempts using the same screening technique on both ears, assuming there are neither equipment problems nor environmental interference during the test. The likelihood of obtaining a PASS by chance alone is increased when screening is performed repeatedly.

If a child has a PASS results in both ears on the 8-to-10-week OAE rescreening, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section.

If the child has a REFER result in one or both ears on the 8-to-10-week OAE rescreening, the child should be followed up by an audiologist. This may require another referral to the child's primary care provider.

## HEARING SCREENING FREQUENCY RECOMMENDATIONS

Although newborn screening identifies most congenital hearing loss, acquired hearing loss can develop in childhood and be unrecognizable to families or others. Therefore, hearing screening during early childhood (post-newborn period to three years of age) should occur according to the American Academy of Pediatrics' [Bright Futures Periodicity Schedule](#)<sup>4)</sup> and specific program requirements. Emerging data suggests, but is not yet conclusive, that yearly screening with OAE equipment provides a practical and effective means of hearing loss identification in the post-newborn to three years old population.

## SETTING

Well-designed OAE screening equipment should allow the screening to be conducted successfully in the child's educational, home, or other familiar environments. Ensuring very young children feel comfortable with the overall screening procedure in a natural environment, surrounded by peers and familiar caregivers, is one of the most important factors in screening success. Although a completely sound-controlled environment is unnecessary for successful screening, background noise from other children, televisions, or other sources can interfere with screening. The screening setting should be free from especially loud sounds, such as another child crying or playing with loud toys nearby.

## TRAINING

Any individual skilled in working with young children and trained on OAE use (and tympanometry use, if a program uses both screening modalities) can properly conduct hearing screening.

Initial training content should be based on current best practice procedures as reported in professional literature. Assuring competent screeners is a critical component of every screening program.

### **Screeners skilled in working with young children should receive training that:**

- ✓ Articulates the screener's role (to conduct screening and follow written screening protocol)
- ✓ Introduces OAE or OAE and tympanometry equipment (how the equipment works and proper screening technique)
- ✓ Explains the purpose of hearing screening and the program's follow-up protocol (steps taken after a REFER result)
- ✓ Instructs on equipment care and maintenance
- ✓ Explains the importance of early hearing screening for young children and the consequences of unidentified hearing loss (adverse effects on education, health, development, or communication)
- ✓ Provides hands-on practice of screening environment preparation, assessment of unobstructed outer ear canal and proper probe positioning, equipment management, and observation of the effects of various factors that can influence the hearing screening results (e.g., background noise)
- ✓ Explains how to differentiate between PASS and REFER criteria

In addition, programs should include periodic observation of each screener by a professional skilled and trained in performing hearing screening, such as an audiologist, experienced program manager, licensed school nurse, public health nurse, and/or other trained personnel. Staff should also receive an annual review of skills/ refresher training, with individual training available as needed.



## SCREENING DOCUMENTATION AND REPORTING

Screeners should complete proper written documentation of a child's OAE and tympanometry screening. This written documentation should specify the child's name, date of screening, child's date of birth, child's risk factors for hearing loss and parental concern, and results of the OAE or OAE/tympanometry hearing screening for each ear. Consistent notations with a key indicating which symbols denote PASS and REFER should be utilized so that results are clear to parents and providers. Verbal communication via an interpreter, in addition to written information regarding the necessity of the referral, should be provided to parents in their native language. Each program should develop specific protocol to ensure that appropriate follow-up occurs. Where indicated, next steps and subsequent referrals should also be documented. Screening results for children who did not pass their newborn hearing screen and for whom screeners are providing follow-up screening should be reported to the Minnesota Department of Health's Early Hearing Detection and Intervention Program (refer to the [Hearing Report for the Newborn Screening Program](#)<sup>10</sup>).

## MONITORING PROGRAM QUALITY

Success of a hearing screening program is dependent on the program's capacity to accurately track children who do not pass the initial screening through subsequent follow-up steps in the program's written protocol. The protocol should document the plan for how children will be tracked and flagged for rescreening, outline what documentation of screening results will be provided to parents and primary care providers, and identify who will explain the screening results to families. Programs should periodically review PASS rates for the initial OAE screening, ideally with the assistance of an audiologist. These initial PASS rates should be approximately 70 percent to 75 percent. Staff members' screening techniques should be observed by an audiologist or experienced program manager periodically to ensure adherence to the appropriate recommended technique. Programs should monitor and evaluate their program's compliance to their screening protocol, as well as their compliance to the recommended follow-up sequence and timing. All screening programs should have written policies and procedures.

## PART II:

## Hearing Screening Guidelines for Children 36 Months (three years) to Kindergarten



## HEARING SCREENING QUESTIONNAIRE

A [hearing screening questionnaire](#)<sup>11</sup> based on risk factors identified by the Joint Committee on Infant Hearing (2007) should be utilized to identify a child's risk-factors for hearing loss. The hearing screening questionnaire is a tool that screeners can use to assess a child's particular risk factors for hearing loss, but it is not intended to be a comprehensive health history.

## DEVELOPMENTAL SURVEILLANCE AND SCREENING

Care providers of children three years of age to kindergarten should regularly provide developmental surveillance, which includes monitoring developmental milestones such as auditory skills, communication progress, and any caregiver concerns.

In addition, primary care providers should administer a validated global developmental screening (refer to [All Instruments at a Glance](#)<sup>5</sup>) at least once during the pre-kindergarten period (three to five years of age), or any time care providers, parents or guardians have concern

about the child's development. If a child does not pass the speech-language portion of the developmental screening tool or if care providers have concern regarding the child's hearing or language, the child should be immediately referred for speech language evaluation and audiological assessment. The child should also be referred through [Help Me Grow](#)<sup>12</sup> to be evaluated for eligibility for Preschool Special Education services.

## HEARING SCREENING IN IDEA PART B

The Individuals with Disabilities Education Act (IDEA) is a law ensuring services to children with disabilities throughout the nation. Children and youth (ages three to 21) receive special education and related services under [IDEA Part B](#)<sup>13</sup>.

Part B provides rules and regulations for special education for children between the ages of three and 21 stating that programs use a variety of assessment tools and strategies to gather relevant, functional, developmental, and academic information about the child, including information provided by the parent §300.304(a)(1)(1). The rules indicate that the child be assessed in all areas related to the suspected disability, including, if appropriate, health, vision, hearing, social and emotional status, general intelligence, academic performance, communicative status, and motor abilities; §300.304(c)(4). In evaluating each child with a disability under Sec. §300.304 through §300.306, the evaluation needs to be sufficiently comprehensive to identify all of the child's special education and related service needs, whether or not the needs are commonly linked to the disability category in which the child has been classified §300.304(c)(6).

Therefore, all children receiving an initial Part B evaluation who do not have current documentation of hearing screening results (within the last six months) and do not have a documented hearing loss should be screened for hearing loss during the time of a child's initial Part B evaluation and prior to categorical eligibility determination to rule out hearing loss as a primary or contributing factor in the child's developmental status.

In addition, all children who have received Early Intervention services for more than six months and are in the process of transitioning from Part C Early Intervention to Part B Preschool Special Education should receive a hearing screening as part of their transition plan if current information (within the last six months) about the child's hearing status is not available.

The recommended method of screening is pure-tone audiometry with or without integrated tympanometry. OAE

may be the method of choice if a child is developmentally unable to be screened using pure tone audiometry.

## SCREENING EQUIPMENT

### Pure Tone Audiometers

MDH recommends pure tone audiometers that allow the screener to perform both audiometric sweep and threshold screening. Equipment must allow screeners to present pure tone signals across different frequencies. The equipment must have a range from 250-8000 Hz and 0-80/100db. It is recommended that audiometer calibration be checked annually.

MDH does NOT recommend speech stimuli screening equipment such as Verbal Auditory Screening for Children (VASC). Evidence suggests that the VASC is a much less efficient method of hearing loss identification when compared to use of a pure tone audiometry with preschool children.

### Tympanometry

MDH recommends automated acoustic immittance (tympanometry) equipment that is useful for performing screening. Equipment should quickly and easily provide measurements of compliance, ear canal volume, peak pressure, and gradient. Programs should follow the manufacturer's manual recommendations in regard to maintenance and calibration.

When obtaining equipment, consideration must be given to portability, durability, ability to interface with older electrical outlets (not three-pronged), and feasibility of maintaining battery-powered units.

## PASS/REFER CRITERIA

### Pure Tone Audiometry

Pure tone audiometry sweep screening referral criteria is a lack of response to any screening tones of 1000 Hz, 2000Hz, 4000 Hz at 20 dB and 500 Hz at 25 dB during the immediate rescreen as outlined in the pure tone screening section. Referrals are based upon pure tone audiometry sweep screening results regardless of the results of thresholds, which are solely to provide further context for the referral.

## Tympanometry

Programs that utilize tympanometry in conjunction with pure tone audiometry should have personnel trained in the following defined tympanometry referral criteria: normal and abnormal Jerger's gradient, normal compliance, and pressures (refer to page 5).

## PURE TONE SCREENING PROTOCOL

Perform environmental noise level check prior to daily screening. Refer to MDH's [Environmental Noise Level Check](#)<sup>14</sup> webpage for more information.

Screen using pure tones for populations age three (chronologically and developmentally) and older. If the child is developmentally unable to be screened using pure tone, consider following the protocol for hearing screening for children in the post-newborn period to three years (36 months) of age.

Where feasible, screening should be used in conjunction with tympanometry equipment. As always, children should be regularly monitored for signs of hearing loss, as stated in the developmental surveillance and screening section.

## Screening and Rescreening Protocol: Pure Tone Audiometry Only

For programs that have only pure tone equipment, the following screening protocol should be followed. Refer to the [Screening Algorithm: Pure Tone Audiometry Only](#)<sup>15</sup> flowchart for a visual representation of this screening protocol.

### **Initial Pure Tone Screen**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear indicates a need for further action.

If the child has a PASS result in both ears on this initial screen, no additional steps should be taken beyond typical observation as specified under the developmental surveillance and screening section.

If the child lacks a response at any frequency in either ear, perform an immediate rescreen by repeating the entire pure tone sweep (not just the missed tone) preferably by a different screener and with a different audiometer. In addition, remove earphones from the child's head and carefully replace them over the ears. Do not perform the

pure tone sweep more than twice.

If the child has a PASS result on the immediate pure tone audiometry rescreen, no additional steps should be taken beyond typical observation as specified in the developmental surveillance section.

If the child has a REFER result on the immediate pure tone audiometry rescreen, the child's hearing should be rescreened with pure tone audiometry in 14 to 21 days.

### **Pure Tone Rescreening in 14 to 21 Days**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear indicates a need for further action.

If the child has a PASS result in both ears on the 14-to-21-day pure tone audiometry rescreen, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.

If the child has a REFER result in one or both ears on the 14-to-21-day pure tone audiometry rescreen, the child should be referred to a primary care provider for middle ear evaluation. The screener should be in contact with the primary care provider who evaluates the child's middle ear. After the primary care provider provides middle ear clearance (refer to the [EHDI Guidelines for Medical Providers](#)<sup>8</sup>) or in 8 to 10 weeks, the child's hearing should be rescreened.

### **Pure Tone Rescreening in 8 to 10 Weeks**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear indicates a need for further action.

If a child has a PASS result in both ears on the pure tone audiometry rescreening in 8 to 10 weeks, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.

If the child has a REFER result in one or both ears on the pure tone audiometry rescreening, the child should be referred to an audiologist (ideally one specialized in pediatrics) for audiological evaluation. Referral to the child's primary care provider is necessary, as it is often an important step in obtaining an audiology evaluation.

## Screening and Rescreening Protocol: Pure Tone Audiometry and Tympanometry

Performing tympanometry in conjunction with pure tone audiometry screening may reduce the need for multi-stage screening and reduce loss to follow up. Refer to the [Screening Algorithm: Pure Tone Audiometry and Tympanometry](#)<sup>16</sup> flowchart for a visual representation of this screening protocol.

### **Initial Pure Tone Screen**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear constitutes a failure.

If the child has a PASS result in both ears, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.

If the child lacks a response at any frequency in either ear, perform an immediate rescreen by repeating the entire pure tone sweep (not just the missed tone), preferably by a different screener and with a different audiometer. In addition, remove earphones from the child's head and carefully replace them over the ears. Do not perform the pure tone sweep more than twice.

If the child has a PASS result on the immediate pure tone audiometry rescreen, no additional steps should be taken beyond typical observation as specified in the developmental surveillance and screening section.



If the child has a REFER result on the immediate pure tone audiometry rescreen, tympanometry should be performed immediately.

If the child has a PASS result with tympanometry screening, there is a greater likelihood that the child has a permanent hearing loss and the child should be immediately referred for a hearing evaluation by an audiologist (ideally one specialized in pediatrics). Referral to the child's primary care provider is necessary, as it is often an important step in obtaining an audiology evaluation.

If the child has a REFER result with tympanometry screening, the child's hearing should be rescreened with pure tone audiometry in 14 to 21 days.

### **Pure Tone Rescreening in 14 to 21 Days**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear indicates a need for further action.

If a child has a PASS result with pure tone audiometry at the 14-to-21-day rescreen, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section.

If the child has a REFER result in one or both ears at the 14-to-21-day rescreen with pure tone audiometry, tympanometry should be performed immediately.

If the child has a PASS result with tympanometry screening, there is a greater likelihood that the child has a permanent hearing loss and the child should be immediately referred for a hearing evaluation by an audiologist (ideally one specialized in pediatrics). Referral to the child's primary care provider is necessary, as it is often an important step in obtaining an audiology evaluation.

If a child has a REFER on tympanometry screening, then the child should be referred to a primary care provider for middle ear evaluation. The screener should be in contact with the primary care provider who evaluates the child's middle ear. After the primary care provider provides middle ear clearance (refer to the [EHDI Guidelines for Medical Providers](#)<sup>8</sup>) or in 8 to 10 weeks, the child's hearing should be rescreened.

### **Pure Tone Rescreening in 8 to 10 Weeks**

Perform a pure tone sweep at 500Hz @ 25db, 1000 @ 20db, 2000 @ 20db, and 4000 Hz @ 20db. A lack of response at any frequency in either ear indicates a need for further action.

If a child has a PASS on the 8-to-10-week pure tone audiometry rescreening, no additional steps should be taken beyond typical observation as specified in developmental surveillance and screening section.

If the child has a REFER on the 8-to-10-week pure tone audiometry rescreening, the child should be followed up by an audiologist. This may require another referral to the child's primary care provider.

## **THRESHOLD**

Threshold screening, unlike sweep screening, determines the lowest decibel at which a child can hear a tone at a broader range of pitch (500, 1000, 2000, 4000 and 8000 Hz).

Obtaining thresholds should remain an option in cases where a child has not followed up with a primary care provider and referral to audiology is not an immediate

option. Thresholds should be obtained by a nurse or other appropriate health professional who has received appropriate training. The purpose of communicating these results is to provide more detailed information on the child's hearing status, which will be used as justification for further referral and follow-up and not as a diagnosis. Thresholds should not take the place of a medical or audiological work-up.

## **FREQUENCY OF HEARING SCREENING**

### **Age Three**

Ideally, screen children with pure tone audiometry beginning at age three. If the child is unable, attempt to rescreen within six months. The Early Childhood Screening Statute (MN [§121A.16](#)<sup>17</sup> to [§121A.19](#)<sup>18</sup>) requires that children be screened once before school entry. This often occurs between three and four years of age in order to identify concerns early.

### **Age Four through Kindergarten Entry**

Screen children annually with pure tone audiometry consistent with the [American Academy of Pediatrics' Bright Futures Periodicity Schedule](#)<sup>4</sup>). If the child is four years or older and is unable to perform the screening, rescreen within 30 days. If a child is developmentally unable to be screened using pure tone, consider protocol for hearing screening for the post-newborn period to three years (36 months). In addition, children at risk for hearing loss may need to be screened more frequently or followed by an audiologist, depending on the identified risk.

## **SETTING**

The screening environment should be quiet enough to perform a biologic check where a normal hearing adult would perceive 1000, 2000, and 4000 Hz tones presented at 10 dB, and 500 Hz at 15 dB. In less than optimal settings, foregoing screening of 500 Hz may be an option, but should be clearly documented.

## **TRAINING**

Initial training content should be based on current best practice procedures as reported in professional literature. Assuring competent screeners is a critical component of every screening program. Training should include the following components:



## SCREENING DOCUMENTATION AND REPORTING

### Training components:

#### 1. Competency-based demonstration of trainees' performance, including the ability to:

- Demonstrate how to ensure snug head phone fit
- Communicate clear instructions
- Position child away from screeners/controls
- State the reason why they are performing the screening
- Recognize false positives

- \* Children who appear unable to hear when they are in actuality unable to follow directions
- \* A child's eagerness or poor positioning

- Differentiate between PASS and REFER criteria

#### 2. Periodic observation of each screener by a professional skilled and trained in performing hearing screening such as an audiologist, experienced program manager, licensed school nurse, public health nurse, and/or other trained personnel

#### 3. Annual staff review of skills/refresher training, with individual training available as needed

Screeners should complete proper written documentation of a child's screening. This written documentation should specify the child's name, date of screening, child's date of birth, child's risk factors for hearing loss and parental concern, and the results of the pure tone hearing screening and tympanometry, if performed, for each ear. Consistent notations with a key indicating which symbols denote PASS and REFER should be should be utilized so that results are clear to parents and providers. Verbal communication via an interpreter, in addition to written information regarding the necessity of the referral, should be provided to parents in their native language. Each program should develop specific protocol to ensure that appropriate follow-up occurs. Where indicated, next steps and subsequent referrals should also be documented.

Refer to the [Hearing Screening Training Manual](#)<sup>19</sup> for sample documentation forms.

## MONITORING PROGRAM QUALITY

Success of a hearing screening program is dependent on the program's capacity to accurately track children who do not pass the initial screening through subsequent follow-up steps in the program's written protocol. The protocol should document the plan for how children will be tracked and flagged for rescreening, outline what documentation of screening results will be provided to parents and primary care providers, and identify who will explain the screening results to families. Programs should use a team approach that includes program managers, school nurses, and ideally an audiologist. Programs should annually review PASS rates for initial screening and follow-up rescreening. Staff members' screening techniques should be observed by a trained audiologist, school nurse, public health nurse, or program manager periodically to ensure adherence to the appropriate recommended technique. Programs should also monitor and evaluate compliance to their screening protocol and the recommended follow-up sequence and timing (e.g., perform pure tone rescreen within the recommended time frame). All screening programs should have written policies and procedures.

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## GLOSSARY

**After the newborn period:** As used in the Minnesota Hearing Guidelines, this phrase refers to the time after birth, after hospital discharge following birth (if applicable), and after the time during which universal newborn hearing screening would typically occur (Also referred to as “Post-Newborn”).

**Assessment:** A complex process aimed at identifying specific developmental disorders that are affecting a child [1].

**Audiologist:** A licensed professional engaged in autonomous practice to promote healthy hearing, communication competency, and quality of life for persons of all ages through the prevention, identification, assessment, and rehabilitation of hearing, auditory function, balance, and other related systems [2].

**Compliance:** A measurement taken during tympanometry showing the degree of mobility within the middle ear system (tympanic membrane and ossicular chain) [3].

**Developmental delays:** A chronological delay in the appearance of normal developmental milestones achieved during infancy and early childhood, caused by organic, psychological, or environmental factors [4].

**Developmental milestones:** A set of functional skills or age-specific tasks that most children can do in a certain age range [5].

**Developmental surveillance:** The process of recognizing children who may be at risk for developmental delay [1].

**DPOAE:** Distortion product OAEs occur in response to two pure tones, which stimulates a specific region or the basilar membrane of the cochlea [6].

**Evaluation:** To determine the significance, worth, or condition of, usually by careful appraisal and study [7].

**Gradient:** An indication of the shape of the tympanogram by measuring the pressure width at one-half of its peak height, measured in daPA [6].

**Hearing screening:** The application of a reliable process through which children who do not show overt symptoms of hearing loss have their hearing tested to determine if they have an increased likelihood of hearing loss. Hearing screening does not constitute audiological assessment or evaluation and does not itself diagnose hearing loss [8].

**Jerger’s classification:** A taxonomy of tympanogram patterns related to the various conditions of the middle ear system.

**Nurse:** A health professional focused on the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy for the care of individuals, families, communities, and populations [9].

**Loss to follow-up:** When a child does not receive or complete the recommended diagnostic or intervention process [10].

**Objective:** In hearing screening, refers to a method of screening children’s hearing that is not dependent upon subjective interpretation, but instead utilizes standardized equipment to obtain reliable hearing screening results [3].

**Otoacoustic emissions:** A hearing screening tool for young children who cannot be tested using other methods, used to evaluate the reflection of inner ear mechanics [6].

**PASS:** A PASS result from a particular screening (such as one obtained with OAE equipment) indicates that a child is not at an increased likelihood for hearing loss. If a child has a PASS result, no additional steps should be taken beyond typical observation, although children may develop hearing loss later in life. Refer to page 6 for the unique situation of a PASS result from tympanometry after a REFER result from OAE screening.

**Pure tone audiometry:** A method of hearing screening used to identify children with suspected hearing loss by having the child listen to a series of pure tones and noting whether or not there is a response. This method is considered the ‘gold standard’ [6].

**Public health nurse:** A nurse health care professional whose specific area of practice focuses on factors related to biological, cultural, environmental, economic, social and political factors within communities in an effort to promote health, prevent disease, injury and disability [11].

**REFER:** A REFER result from a particular hearing screening indicates that a child is at an increased likelihood of hearing loss. The REFER result means that the child requires a hearing evaluation by a pediatrician or audiologist to determine if the child has hearing loss. A REFER result, i.e., not passing the hearing screening, does not necessarily mean that a child has a hearing loss [12].

**Registered nurse:** A professional nurse who has completed a course of study at an approved and accredited school of nursing and who has passed the National Council of Licensure Examination.

**Subjective:** In hearing screening, refers to methods of screening that are dependent upon the screener's interpretation, versus standardized equipment results [3].

**Screening:** The use of standardized tools to identify and refine the recognized risk of developmental delay [1].

**School nurse:** School nursing is a specialized practice of professional nursing that advances the well-being, academic success, and life-long achievement of students [13].

**Speech therapist:** A specialist with training in the diagnosis and treatment of a variety of speech, voice, and language disorders who works with people who are unable to make speech sounds or cannot make them clearly [14].

**TEOAE:** Transient OAEs produced by stimulation of the cochlea basilar membrane with clicks or tone bursts [6].

**Threshold:** A hearing test performed with a number of frequencies and at varying intensity levels where hearing levels are measured as each tone is audible to the person being tested [3].

**Tympanometry:** An objective measurement of middle-ear mobility and middle ear pressure through the use of sound (probe tone) and air pressure [3].

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## SELECTED LINKS

<sup>1</sup> MDH Hearing Screening Resources  
<http://www.health.state.mn.us/divs/cfh/topic/hearingscreening/>

<sup>2</sup> MDH Training Resources  
<http://www.health.state.mn.us/divs/cfh/topic/hearingscreening/>

<sup>3</sup> JCIH Risk Factors  
<http://www.health.state.mn.us/divs/fh/mch/webcourse/hearing/jcih.cfm>

<sup>4</sup> Bright Futures Periodicity Schedule  
[https://www.aap.org/en-us/professional-resources/practice-support/Periodicity/Periodicity%20Schedule\\_FINAL.pdf](https://www.aap.org/en-us/professional-resources/practice-support/Periodicity/Periodicity%20Schedule_FINAL.pdf)

<sup>5</sup> All Instruments at a Glance  
<http://www.health.state.mn.us/divs/cfh/topic/devscreening/instruments.cfm>

<sup>6</sup> Minnesota's Infant and Toddler Intervention  
<http://www.gpo.gov/fdsys/pkg/FR-2011-09-28/pdf/2011-22783.pdf>

<sup>7</sup> Screening Algorithm: OAE Only  
<http://www.improveehdi.org/mn/library/files/oaeflowchart.pdf>

<sup>8</sup> EHDI Guidelines for Medical Providers  
<http://www.improveehdi.org/wi/library/files/MDH%20Medical%20Guidelines%282%29.pdf>

<sup>9</sup> Screening Algorithm: OAE and Tympanometry  
<http://www.improveehdi.org/mn/library/files/oaetymptflowchart.pdf>

<sup>10</sup> Hearing Report for the Newborn Screening Program  
<http://www.health.state.mn.us/newbornscreening/docs/clinichearingform.pdf>

<sup>11</sup> MDH Subjective Screening Questionnaire  
<http://www.health.state.mn.us/divs/fh/mch/webcourse/hearing/subjective-screening.cfm>

<sup>12</sup> Help Me Grow  
[http://parentsknow.state.mn.us/parentsknow/Newborn/HelpMeGrow\\_SpecialNeeds/ReferChild/index.html](http://parentsknow.state.mn.us/parentsknow/Newborn/HelpMeGrow_SpecialNeeds/ReferChild/index.html)

<sup>13</sup> Individuals with Disabilities Education Act (IDEA) Part B  
<http://idea.ed.gov/download/finalregulations.pdf>

<sup>14</sup> Environmental Noise Level Check  
<http://www.health.state.mn.us/divs/cfh/topic/hearingscreening/content/downloads/EnvironmentalNoiseLevelCheck.pdf>

<sup>15</sup> Screening Algorithm: Pure Tone Audiometry Only  
<http://www.improveehdi.org/mn/library/files/puretoneflowchart.pdf>

<sup>16</sup> Screening Algorithm: Pure Tone Audiometry and Tympanometry  
<http://www.improveehdi.org/mn/library/files/puretonetymptflowchart.pdf>

<sup>17</sup> Minnesota Statute 121A.16  
<https://www.revisor.mn.gov/statutes/?id=121A.16>

<sup>18</sup> Minnesota Statute 121A.19  
<https://www.revisor.mn.gov/statutes/?id=121A.19>

<sup>19</sup> Hearing Screening Training Manual  
<http://www.health.state.mn.us/divs/cfh/topic/hearingscreening/content/downloads/HearingScreeningManual.pdf>

*These guidelines were developed collaboratively by the Child and Teen Checkups program and the Minnesota EHDI program.*