

# Pediatric Hearing Device Management: Professional Practices for Monitoring Aided Audibility

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**Abstract: Objective.** The purpose of this study was to explore professional practices for monitoring aided audibility for children who are deaf or hard of hearing (DHH).

**Design.** A cross-sectional survey design was used to identify providers' self-reported practice patterns for monitoring aided audibility for children who use hearing aids, cochlear implants, and bone-conduction hearing aids. Three surveys were used.

**Study Sample.** Practicing audiologists, speech-language pathologists, and deaf educators providing services to children birth to six years of age who use hearing technology were recruited to participate. A total of 184 surveys were included in the analysis (96 hearing aid; 47 cochlear implant; 41 bone conduction hearing aid).

**Results.** Practice gaps were identified, including infrequent use of parent questionnaires to explore how children are hearing at home and in other environments, lack of loaner equipment for some children when hearing devices were being repaired, and inconsistent monitoring of data logging to identify challenges with hearing aid use.

**Conclusion.** Children who are DHH and their parents rely on professionals to provide evidence-based practices. This study revealed practice gaps related to monitoring audibility, suggesting opportunities for training to address provider confidence and consistent implementation of monitoring practices.

**Key Words:** hearing device, audibility, monitoring, professional practices

**Acronyms:** BCHA = Bone Conduction Hearing Aids; CI = Cochlear Implants; DHH = Deaf or Hard of Hearing; HA = Hearing Aids

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Hearing loss affects one to six of every 1000 newborns in the United States (American Speech-Language-Hearing Association, n.d.) and approximately 32 million children worldwide (World Health Organization, 2016). In the United States, 98% of newborns receive a hearing screening (Centers for Disease Control and Prevention, 2015), and this early identification offers important developmental advantages by providing opportunities to begin intervention within the first few weeks of life. Early identification coupled with advanced hearing technology and specialized intervention services provides opportunities for children to learn to communicate using spoken language, regardless of the degree of their hearing loss. Early identification, however, also presents challenges for parents and professionals. Most parents of children who are deaf or hard of hearing (DHH) have normal hearing (Mitchell

and Karchmer, 2004), and need complete and accurate information as they make decisions to support their child's development. For spoken language development, access to sound using hearing technology, also described as aided audibility (i.e., hearing aids, cochlear implants, bone-conduction hearing aids) is an important factor. Children have better outcomes when they receive amplification early, have their devices optimally programmed for their hearing loss, and wear their devices consistently (Tomblin, Oleson, Ambrose, Walker, & Moeller, 2014; McCreery, Bentler, & Roush, 2013).

There are parent and professional factors that can influence how consistently children receive adequate audibility. Parents have reported experiencing an array of challenges related to daily management of their child's

hearing needs (e.g., child behavior, parent emotions, lack of confidence) that negatively influence hours of hearing aid use (Muñoz et al., 2016; Caballero et al., 2017; Muñoz, Preston, & Hicken, 2014; Walker et al., 2013). Parents are central to the intervention process and practices to support and educate parents are vital. When professionals engage parents within a therapeutic relationship, they can help manage challenges that arise, so the parents effectively implement skills into their daily life.

In addition to parent education, it is critical that professionals employ practices to ensure children who use hearing technology experience consistent and effective audibility. All professionals do not have the same level of expertise in working with young children who are DHH, and it cannot be assumed that best practices for this population are occurring. For example, McCreery et al. (2013) investigated the proximity of pediatric fittings to prescriptive targets for hearing aid gain and found that more than half of the children had at least one ear that did not meet prescribed targets for audibility. Identifying professionals' practice patterns for monitoring aided audibility can provide insights into gaps and areas that could benefit from a focused approach to training, for both pre-service and continuing education. Therefore, the purpose of this study was to better understand professional practices related to factors that influence audibility for young children using hearing devices, and to explore factors that influence practices for teaching skills to parents.

## Method

This study used a cross-sectional survey design. There were three surveys to explore professional practice patterns for monitoring aided audibility for children who use hearing aids (HA), cochlear implants (CI), and bone-conduction hearing aids (BCHA). Survey responses were anonymous. Institutional Review Board approval was obtained through Utah State University.

### Participants and Procedures

Audiologists, speech-language pathologists, and deaf educators providing services to children who are DHH, birth to six years of age, were recruited to participate in the study February to December 2017. Participants were recruited through websites (i.e., Hear to Learn, Hands & Voices, AG Bell Association, Hearing First) and social media posts. Survey data were collected online using Qualtrics through a link posted on the website; a flyer was used to invite professionals to participate. Two-hundred and twenty-five surveys were submitted. Of those, 41 were incomplete and excluded, resulting in 184 surveys included in the analysis (96 HA; 47 CI; 41 BCHA). There were participants from 33 states and 5 countries. The majority of the participants were audiologists ( $n = 139$ ) and the remainder were intervention professionals, such as speech-language pathologists, teachers, or early interventionists ( $n = 45$ ). Most professionals had more

than 10 years of experience (audiologists [54%,  $n = 75$ ]; interventionists [51%;  $n = 23$ ]), approximately one-third had less than five years of experience (audiologists [32%,  $n = 45$ ]; interventionists [29%;  $n = 13$ ]), and the remainder had six to ten years of experience (audiologists [14%,  $n = 19$ ]; interventionists [20%;  $n = 9$ ]). Ninety-one percent of the audiologists ( $n = 126$ ) and 69% of the interventionists ( $n = 31$ ) reported working in urban areas, with the remainder working in rural areas.

### Survey Instruments

Three survey instruments (HA [17 items]; CI [16 items]; BCHA [16 items]) were developed by the first and second authors. Items were developed based on professional guidelines (e.g., American Academy of Audiology, 2013) in order to capture fundamental practices for hearing technology monitoring. Each survey had three sections: Information About You, Device Use, and Monitoring (instruments available in Appendix).

### Data Analysis

Data were analyzed in SPSS to calculate descriptive statistics to report characteristics of professional practices related to monitoring aided audibility for children who use hearing devices. To observe differences between audiologists and interventionists, data were split and analyzed separately. Participants were not required to answer each item to continue responding to the survey; therefore, the total number of responses per item varies. Percentages are reported based on the number of responses for each item. For survey items that were the same for each survey, regardless of device type (i.e., HA, CI, BCHA), responses were combined. For items that were unique to the device type, responses were reported separately. Item analysis examined practices related to teaching skills to parents that are important regardless of device type, specifically:

- Ask parents about the number of hours their child wears device(s);
- Ask parents about challenges with device use;
- Help parents resolve challenges with device use;
- Talk to parents about data logging results;
- Talk to parents about how to do a speech sound check;
- Talk to parents about difficulties their child may have hearing in different environments;
- Talk to parents about benefits of personal assistive device use in addition to device; and
- Talk to parents about monitoring personal assistive device use.

The result suggested good internal consistency across the items ( $n = 184$ ; Cronbach's  $\alpha = .765$ ). Differences in teaching practices for the eight items listed above were explored using analysis of variance for professional type (i.e., audiologist; interventionist), device type (i.e., HA; CI; BCHA), and years practicing (i.e., less than 10 years; 10 or more years).

## Results

Participants were queried about hearing device use to explore their perceptions about how often children they serve in their practice are using their hearing devices, and the professionals they think should be talking about device use with parents (see Table 1). Participants reported, on average, that approximately two-thirds of the children birth to six years of age whom they serve are using their hearing devices all waking hours; however, only 29% of audiologists and 13% of interventionists reported that they always know hours of device use. The majority of audiologists and interventionists reported that each professional (i.e., audiologist; speech-language pathologist; teacher; early interventionist) should talk with parents about device use. The participants also felt that physicians, deaf mentors, counseling professionals (e.g., social worker), and other families of children who are DHH should talk with parents about device use.

### Monitoring Practices

Participants indicated how often (i.e., *never, sometimes, often, always*) three practices for monitoring aided audibility were provided (see Table 2). Two practices were applicable to all hearing devices: *During audiology appointments, how often is speech understanding tested while children are wearing their hearing device?* and *How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life (e.g., hearing in quiet, hearing in noise)?* One item was applicable to hearing aids: *When the children you work with get new earmolds, how often are hearing aid settings checked to make sure sounds are being appropriately amplified?*

The majority of the audiologists (85%) reported performing aided speech testing *often* or *always*, and 53% of interventionists reported the children they work with receive aided speech testing. Just over one-third of audiologists and fewer than one-fourth of interventionists reported that they ask parents to complete questionnaires *often* or *always* in order to monitor their child's responses to sounds in daily life (audiologists 38%; interventionists 21%). When questionnaires are completed, participants reported using a variety of instruments: LittlEARS (Audiologist 63%; Interventionist 45%); PEACH ([Parent's Evaluation of Aural/Oral Performance of Children]; Audiologist 57%; Interventionist 10%); IT MAIS ([Infant-Toddler Meaningful Auditory Integration Scale]; Audiologist 42%; Interventionist 57%); SIFTER ([Preschool Screening Instrument For Targeting Educational Risk]; Audiologist 30%; Interventionist 29%); CHILD ([Children's Home Inventory for Listening Difficulties]; Audiologist 27%; Interventionist 14%); ELF ([Early Listening Function]; Audiologist 25%; Interventionist 17%); TEACH ([Teachers' Evaluation of Aural/oral performance of Children]; Audiologist 9%; Interventionist 7%); COW ([Children's Outcome Worksheets]; Audiologist 8%; Interventionist 0%). Other questionnaires used (ranging from < 1% to 8%) included: CASLLS (Cottage Acquisition Scales for Listening, Language, and Speech), SSQ (Speech Spatial Qualities), LIFE R (Listening Inventory For Education – Revised), ASC (Auditory Skills Checklist), ALG (Auditory Learning Guide), Starting School LIFE (Starting School Listening Inventory For Education), Sanders Questionnaire, FLI (Functional Listening Index) MAIS (Meaningful Auditory Integration Scale), and MUSS (Meaningful Use of Speech Scale). Participants reported hearing aid settings are checked *often* or *always* when new earmolds are obtained 82% of the time as reported by audiologists and 45% as reported by interventionists.

**Table 1**  
*Provider Perceptions about Hearing Device Use*

	Audiologist N = 141		Interventionist N = 147	
	% (n)	M (SD)	% (n)	M (SD)
Percent of children I serve who use devices all waking hours		64 (25.24)		64 (32.98)
I don't know		9 (.28)		7 (.25)
How often hours of device use known by professional				
Never		1 (2)		0
Sometimes		20 (28)		24 (11)
Often		49 (68)		62 (28)
Always		30 (41)		13 (6)
Professionals you think should talk about device use with parents*				
Audiologist		100 (139)		94 (44)
Speech-language pathologist		94 (130)		84 (38)
Teacher		91 (127)		98 (44)
Early Interventionist		94 (130)		93 (42)
Other		48 (67)		24 (11)

\*More than one answer allowed

**Table 2**  
**How Often Practices for Monitoring Aided Audibility are Provided**

Monitoring Practices	% (n)				
	N	S	O	A	U
<b>All Devices</b>					
Aided speech understanding is tested in audiology appointment					
Audiologist	0	14 (19)	39 (52)	46 (60)	<1 (1)
Interventionist	5 (2)	22 (9)	24 (10)	29 (12)	20 (8)
Parents complete a questionnaire about child's auditory development					
Audiologist	21 (27)	42 (55)	29 (38)	9 (12)	
Interventionist	24 (10)	55 (23)	14 (6)	7 (3)	
<b>Hearing Aid Only</b>					
Hearing aid settings are checked when new ear mold obtained					
Audiologist	3 (2)	10 (7)	42 (28)	40 (27)	5 (93)
Interventionist	0	18 (4)	27 (6)	18 (4)	36 (8)

N = Never, S = Sometimes, O = Often, A = Always, U = I don't know

**Table 3**  
**Loaner Hearing Devices Provided when Child's Device Sent for Repair**

Device Type	% (n)				
	N	S	O	A	U
Hearing Aid	7 (7)	26 (25)	35 (34)	27 (26)	4 (4)
Bone Conduction Hearing Aids	15 (6)	32 (13)	29 (12)	20 (8)	5 (2)
Cochlear Implant	15 (7)	30 (14)	11 (5)	40 (19)	4 (2)

N = Never, S = Sometimes, O = Often, A = Always, U = I don't know

**Table 4**  
**Professional's Level of Confidence**

Level of confidence in knowing how to...	M (SD)	
	Audiologist	Interventionist
<b>Hearing Aids</b>		
Recognize when earmolds need to be replaced	97 (10.15)	83 (14.44)
Verify hearing aid settings are appropriate	95 (14.59)	42 (29.23)
Conduct a speech sound check	98 (5.40)	93 (17.80)
Determine hearing aids are functioning properly	98 (7.64)	88 (11.31)
<b>Bone Conduction Hearing Aid (BCHA)</b>		
Tell when programming adjustments are needed	84 (22.68)	51 (34.50)
Conduct a speech sound check	97 (7.48)	99 (3.78)
Check BCHA function	92 (15.41)	65 (35.05)
<b>Cochlear Implant</b>		
Tell when programming adjustments are needed	93 (8.62)	75 (19.74)
Conduct a speech sound check	99 (3.81)	96 (9.32)
Check cochlear implant function	99 (2.61)	84 (16.81)



**Table 5**  
**Frequency Audiologists and Interventionists Teach Parents Monitoring Skills**

How often the following is addressed with parents...	Audiologists				Interventionists			
	N	S	O	A	N	S	O	A
<b>All Devices</b>								
Ask about the number of hours their child wears hearing device	0	5 (7)	20 (28)	75 (104)	0	16 (7)	47 (21)	38 (17)
Ask about challenges with hearing device use	0	<1 (1)	26 (36)	73 (102)	0	11 (5)	47 (21)	42 (19)
Help parents resolve challenges with hearing device use	<1 (1)	2 (3)	23 (32)	74 (103)	0	7 (3)	44 (20)	49 (22)
Talk about hearing device data logging results	4 (6)	20 (28)	32 (44)	44 (61)	29 (13)	33 (15)	29 (13)	9 (4)
How to do a speech sound check	2 (3)	16 (21)	35 (46)	47 (61)	0	17 (7)	26 (11)	57 (24)
Difficulties child may have hearing in different environments	0	4 (5)	40 (53)	56 (74)	0	17 (7)	36 (15)	48 (20)
Benefits of personal assistive device in addition to hearing device	<1 (1)	8 (11)	38 (50)	53 (70)	5 (2)	21 (9)	38 (16)	36 (15)
Monitoring personal assistive device use	3 (4)	20 (26)	41 (54)	36 (48)	12 (5)	36 (15)	24 (10)	29 (12)
<b>Hearing Aids</b>								
How often earmolds need to be replaced	2 (1)	2 (1)	39 (26)	58 (39)	0	55 (12)	32 (7)	14 (3)
Why earmolds need to be replaced	0	8 (5)	31 (21)	61 (41)	0	50 (11)	32 (7)	18 (4)
How to tell when earmolds need to be replaced	3 (2)	6 (4)	27 (18)	64 (43)	5 (1)	55 (12)	23 (5)	18 (4)
How to know settings are at level needed for their child to hear well	3 (2)	20 (13)	39 (26)	38 (25)	23 (5)	46 (10)	14 (3)	18 (4)
How to determine if their child's devices are functioning properly	3 (2)	0	18 (12)	79 (52)	0	23 (5)	55 (12)	23 (5)
<b>Bone Conduction Hearing Aid and Cochlear Implant</b>								
How to change batteries	0	9 (6)	22 (14)	69 (45)	15 (3)	25 (5)	20 (4)	40 (48)
How to interpret the indicator lights and beeps	2 (1)	9 (6)	31 (20)	59 (38)	15 (3)	20 (4)	20 (4)	45 (9)
How to monitor the condition of external equipment	0	12 (8)	25 (16)	63 (41)	10 (2)	20 (4)	35 (7)	35 (7)
<b>Cochlear Implant</b>								
How to listen to cochlear implant microphone	0	6 (2)	44 (14)	50 (16)	23 (3)	23 (3)	31 (4)	23 (3)

N = Never, S = Sometimes, O = Often, A = Always, U = I don't know

### Loaner Devices

Participants reported how often loaner hearing devices are provided when a child's device needs to be sent in for repair (See Table 3). Loaners were reported as always being provided for 27% of children using HAs, 20% using BCHAs, and 40% of children using CIs.

### Professionals' Confidence Levels

Participants indicated how confident they were in four practices related to monitoring audibility (see Table 4), on a scale from *not confident at all* (0) to *very confident* (100). Audiologists overall reported high levels of confidence ( $M = 84$  to  $99$ ) for all devices (i.e., HA, BCHA, CI). The lowest rating was in being able to tell when programming adjustments are needed for BCHA; responses for this

item also had the greatest variance ( $M = 84$ ;  $SD = 22.68$ ). Interventionists reported a wider range of confidence ratings ( $M = 42$  to  $99$ ). The highest confidence was reported for performing a speech sound test for all devices (HA [ $M = 93$ ;  $SD = 17.80$ ]; BCHA [ $M = 99$ ;  $SD = 3.78$ ]; CI [ $M = 96$ ;  $SD = 9.32$ ]). The lowest confidence was reported for knowing how to verify that hearing aid settings are appropriate ( $M = 42$ ;  $SD = 29.23$ ) and knowing how to tell when programming/mapping adjustments are needed (BCHA [ $M = 51$ ;  $SD = 34.50$ ]; CI [ $M = 75$ ;  $SD = 19.74$ ]).

### Teaching Parents

Participants indicated how frequently (i.e., *never*, *sometimes*, *often*, *always*) they address a variety of topics with parents that are important for monitoring audibility

(see Table 5). Eight topics queried were applicable to all devices (i.e., HA; BCHA; CI), three were applicable to BCHA and CI, and one was applicable to only children who use CIs. Responses revealed variability in practices for teaching parents for all topics.

For teaching practices related to all devices, the top three most frequently taught topics audiologists reported they *always* address included: asking parents about the number of hours their child wears their hearing device (75%), helping parents resolve challenges with hearing device use (74%), and asking parents about challenges with hearing device use (73%). The top three most frequently taught topics interventionists reported they *always* address included: teaching parents how to do a speech sound check (57%), helping parents resolve challenges with hearing device use (49%), and talking with parents about difficulties child may have hearing in different environments (48%). Few professionals reported always talking with parents about data logging results (audiologists 44%; interventionists 9%).

For teaching practices specific to HAs, the most frequently taught topic participants reported they *always* address is talking with parents about how to determine if their child's devices are functioning properly (audiologists 79%; interventionists 23%); remaining topics (how often earmolds need to be replaced; why earmolds need to be replaced; how to tell when earmolds need to be replaced; how to know their child's hearing aid settings are at a level needed to hear well) were addressed less frequently. For teaching practices specific to BCHA and/or CI only, the most frequently taught topic audiologists reported they always address is talking with parents about how to change batteries (69%) and for interventionists, how to interpret device indicator lights (45%). The remaining topics (how to monitor condition of external equipment; how to check CI microphone) were addressed less frequently.

### Factors Influencing Teaching

Professional type (i.e., audiologist; interventionist), device type (i.e., HA; BCHA; CI), and years practicing (i.e., less than 10 years; 10 or more years) were explored to investigate their influence on eight practices for teaching parents applicable to all hearing devices. Analysis of variance showed no statistically significant effects for professional type  $F(1, 154) = 1.233, p = .269$ , device type  $F(2, 183) = 1.095, p = .337$ , or years practicing  $F(1, 154) = 1.089, p = .298$ .

## Discussion

Monitoring aided audibility for children who are DHH is critical for supporting spoken language outcomes. This study explored professionals' perspectives on hearing device use and practices they include in their services for monitoring children's aided hearing. The findings from this study revealed practice gaps and opportunities for improvement.

### Practice Gaps

Research findings have shown that consistent use of well-functioning hearing devices positively contributes to child outcomes, and that children who use hearing aids 10 hours or more per day have better language outcomes (Tomblin et al., 2014). The professionals in this study indicated multiple professionals have the responsibility to talk with parents about hearing device use; however, approximately one-quarter of the audiologists and two-thirds of the interventionists never or only sometimes talk about hearing device data logging with parents. Studies have found that parent report of hearing aid use often over-estimates use when compared to device data logging (Walker et al., 2013; Muñoz et al., 2014), suggesting that parent report alone is insufficient for monitoring how consistently children wear their hearing devices. Hearing device malfunction can also disrupt audibility. When hearing devices are sent to the manufacturer for repair, audibility is compromised if children are not provided with loaner equipment. Participants in this study indicated at least one-quarter of children they work with never or only sometimes have access to loaner devices.

Practices to monitor audibility can be incorporated within routine interactions at home and at school. Verification and validation are important components to include and are indicated in practice guidelines (American Academy of Audiology, 2013). Asking parents to periodically complete a questionnaire about how their child responds to sounds in their daily life (validation) is an important way to understand how children are hearing in various environments. Participants in this study reported rarely using this mechanism to monitor audibility; two-thirds of audiologists and three-fourths of interventionists reported never or only sometimes asking parents to complete a questionnaire. Most of the audiologists reported checking hearing aid settings (verification) after new earmolds are obtained; however, 18% reported they do not verify settings. As children grow their earmolds need to be replaced and hearing aid settings adjusted to maintain audibility. When hearing aid settings are not monitored, children are at risk for under amplification as they grow. Both audiologists and interventionists reported lacking confidence in knowing when programming adjustments are needed for children who use BCHAs.

Teaching parents about monitoring for audibility is critical as parents are with their children every day and are central to the intervention process. Participants in this study reported talking with parents about many aspects important for monitoring audibility; however, one-quarter of the audiologists and two-thirds of the interventionists reported never or only sometimes talking with parents about how to know that their child's hearing devices are set at a level needed for their child to hear well. Professionals reported more frequently talking with parents about how to do a speech sound test. Additionally, approximately one-quarter of audiologists and one-half of the interventionists never or only sometimes talk with parents about how to monitor the function or performance

of personal assistive devices. For parents to advocate effectively for their children they need information about factors critical to audibility and support as they gain confidence implementing routine monitoring tasks.

### Opportunities

Several opportunities to enhance monitoring of aided audibility exist. For example, inter-professional collaboration can improve communication among service providers, improving continuity of care and reinforcement of and support for parent learning. In this study, audiologists reported always knowing hours of device use more often than did interventionists. Regularly sharing key information, such as hearing device data logging, results of aided speech understanding, and verification of device settings, offers opportunities to improve quality of care (Muñoz & Blaiser, 2011). Audiologists and interventionists would benefit from training opportunities to increase their confidence levels. For audiologists, training related to determining when BCHA settings need to be adjusted would be particularly beneficial. For interventionists, training related to knowing how to determine if programming adjustments are needed for all types of devices would be particularly beneficial. Improving access to loaner devices when repairs are necessary would improve consistent audibility for children. Additionally, asking parents to complete questionnaires reporting how their child is hearing at home and in other environments not only provides important information, but is also an opportunity to engage parents in the monitoring process.

### Limitations and Future Research

This survey study was self-report and may not reflect actual practices. Self-report provides insights into perspectives and perceptions of practices; however, it may also be misleading due to conscious bias by the participants to look good (Baldwin, 2000). Self-selection to complete the survey instrument may also introduce bias, artificially inflating frequency of practices reported. Participants were recruited through sources targeting professionals who work with pediatric populations; however, the extent of their case load specific to pediatric hearing loss was not explored. The response rate for intervention professionals was low and findings cannot be generalized to the broader population of speech-language pathologists, early interventionists, and deaf educators.

Further research is needed to identify how to increase professionals' implementation of practices for monitoring aided audibility. Important questions include exploring to what extent audiologists and interventionists are prepared for this aspect of practice within graduate training; what barriers, both internal (e.g., confidence) and external (e.g., equipment access) exist for routine implementation of monitoring practices; how to increase inter-professional collaboration for monitoring aided audibility; and professionals' attitudes related to monitoring aided audibility.

## Conclusion

Children who are DHH and their parents rely on professionals to provide evidence-based practices. This study revealed practice gaps related to monitoring audibility, including infrequent use of parent questionnaires to explore how children are hearing at home and in other environments, lack of loaner equipment for some children when hearing devices are being repaired, and inconsistent monitoring of data logging to identify challenges with hearing aid use. Training opportunities exist to address provider confidence and implementation of monitoring practices.

## References

- American Academy of Audiology. (2013). *Clinical practice guidelines: Pediatric amplification*. Retrieved from <http://galster.net/wp-content/uploads/2013/07/AAA-2013-Pediatric-Amp-Guidelines.pdf>
- American Speech-Language-Hearing Association. (n.d.). *The prevalence and incidence of hearing loss in children*. Retrieved from <http://www.asha.org/public/hearing/Prevalence-and-Incidence-of-Hearing-Loss-in-Children/>
- Baldwin, W. (2000). Information no one else knows: The value of self-report. In A. A. Stone, J. S. Turkkan, C. A. Bachrach, J. B. Jobe, H. S. Kurtzman, & V. S. Cain (Eds.), *The Science of Self-Report: Implications for Research and Practice* (pp. 3–7). Mahwah, NJ: Taylor & Francis e-Library.
- Caballero, A., Muñoz, K., White, K. R., Nelson, L., Domenech-Rodriguez, M., & Twohig, M. (2017). Pediatric hearing aid management: Challenges among hispanic families. *Journal of the American Academy of Audiology, 28*(8), 718–730.
- Centers for Disease Control and Prevention. (2015). *Hearing loss in children: 2015 annual data early hearing detection and intervention (EHDI) program*. Retrieved from <https://www.cdc.gov/ncbddd/hearingloss/2015-data/01-data-summary.html>
- McCreery, R. W., Bentler, R. A., & Roush, P. A. (2013). Characteristics of hearing aid fittings in infants and young children. *Ear and Hearing, 34*(6), 701–710. doi: 10.1097/AUD.0b013e31828f1033
- Mitchell, R. E. & Karchmer, M. A. (2004). Chasing the mythical ten percent: Parental hearing status of deaf and hard of hearing students in the United States. *Sign Language Studies, 4*(2), 138–163.
- Muñoz, K. & Blaiser, K. (2011, Dec.). Audiologists and speech-language pathologists: Making critical cross-disciplinary connections for quality care in EHDI. *Perspectives on Audiology, 7*(1), 34–42.
- Muñoz, K., Rusk, S., Nelson, L., Preston, E., White, K., Barrett, T., & Twohig, M. (2016). Pediatric hearing aid management: Parent reported needs for learning support. *Ear and Hearing, 37*(6), 703–709. doi:10.1097/AUD.0000000000000338
- Muñoz, K., Preston, E., & Hicken, S. (2014). Pediatric hearing aid use: How can audiologists support parents to increase consistency? *Journal of the American Academy of Audiology, 25*, 380–387. doi:10.3766/jaaa.25.4.9
- Tomblin, J. B., Oleson, J. J., Ambrose, S. E., Walker, E., & Moeller, M. P. (2014). The influence of hearing aids on the speech and language development of children with hearing loss. *JAMA Otolaryngology Head & Neck Surgery, 140*, 403–409.
- Walker, E. A., Spratford, M., Moeller, M. P., Oleson, J., Ou, H., Roush, P., & Jacobs, S. (2013). Predictors of hearing aid use time in children with mild-to-severe hearing loss. *Language Speech and Hearing Services in Schools, 44*(1), 73–88. doi:10.1044/0161-1461(2012)12-0005
- World Health Organization. (2016). Childhood hearing loss. Retrieved from [http://www.who.int/pbd/deafness/world-hearing-day/WHDD2016\\_Brochure\\_EN\\_2.pdf](http://www.who.int/pbd/deafness/world-hearing-day/WHDD2016_Brochure_EN_2.pdf)

**Appendix**  
Hearing Aid Survey

**Pediatric Hearing Aid Management: Professional Practices for Monitoring Children's Aided Hearing**

The purpose of this survey is to better understand how professionals monitor audibility for children ages birth to six years who use hearing aids. Completing the survey should take about 5 minutes.

**Your experiences are important!**

**Information About You:**

1. My profession is:

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

2. I have been working with children with hearing loss for:

- Less than 5 years
- 6–10 years
- More than 10 years

3. Approximately what percent of young children that you work with wear their hearing aids all waking hours?

- \_\_\_\_\_%
- I don't know

4. How often do you know the hours of hearing aid use for the children with whom you work?

- Never
- Sometimes
- Often
- Always

5. I work in:

- An urban area
- A rural area

6. I practice in:

- United States \_\_\_\_\_  
indicate state
- Country \_\_\_\_\_  
indicate country



### Hearing Aid Use

Consistent use of hearing aids is important for children to learn to speak. Having children wear their hearing aids consistently can be hard for many different reasons. Addressing hearing aid use can help identify problems.

7. Indicate each of the professionals you think should talk about hearing aid use with parents: (mark all that apply)

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

8. Indicate how often *you* address each of the following when you talk with parents:

	Never	Sometimes	Often	Always
Ask about the number of hours their child wears hearing aids	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ask about challenges with hearing aid use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help parents resolve challenges with hearing aid use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Talk about hearing aid data logging results	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. When the children you work with need to have their hearing aids repaired by the company, how often are they typically provided with loaner hearing aids?

- Never
- Sometimes
- Often
- Always
- I don't know

### Monitoring

Monitoring helps you know if children are hearing well with their hearing aids or if there are problems with settings, device function, how earmolds fit, and hearing in noise.

10. When the children you work with get new earmolds, how often are hearing aid settings checked to make sure sounds are being appropriately amplified?

- Never
- Sometimes
- Often
- Always
- I don't know

11. During audiology appointments, how often is speech understanding tested while children are wearing their hearing aid(s)?

- Never
- Sometimes
- Often
- Always
- I don't know

12. How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life (e.g., hearing in quiet, hearing in noise)?

- Never
- Sometimes
- Often
- Always
- I don't know

13. Indicate the questionnaires you use to monitor how children, birth to six years of age, are functioning with their hearing aids in daily life (mark all that apply):

- LittleEARS Auditory Questionnaire
- Parent's Evaluation of Aural/Oral Performance of Children (PEACH)
- Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS)
- Early Listening Function (ELF)
- Teachers' Evaluation of Aural/Oral performance of Children (TEACH)
- Preschool SIFTER: Preschool Screening Instrument For Targeting Educational Risk
- Children's Home Inventory for Listening Difficulties (CHILD)
- Children's Outcome Worksheets (COW)
- Other (specify): \_\_\_\_\_
- I do not use any questionnaires

14. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
How often earmolds need to be replaced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Why earmolds need to be replaced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to tell when earmolds need to be replaced	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to know the hearing aid settings are at the level needed for their child to hear well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to determine if their child's hearing aids are functioning properly (e.g., sound quality, batteries)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to do a speech sound check (ah, ee, oo, mm, sh, s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Indicate how confident you are in your ability to:

- Recognize when earmolds need to be replaced \_\_\_\_\_ (0-100)
- Verify hearing aid settings are appropriate \_\_\_\_\_ (0-100)
- Conduct a speech sound check \_\_\_\_\_ (0-100)
- Determine hearing aids are functioning properly \_\_\_\_\_ (0-100)

There are personal assistive devices that can help children hear better in noise. The devices work wirelessly (e.g., FM system, remote mic, mini mic) to send the speech signal from a transmitter worn by the speaker, directly to the child's hearing aids.

17. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
Difficulties their child may have hearing in different environments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benefits of personal assistive device use in addition to the hearing aids	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring personal assistive device use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. What is challenging for you in monitoring audibility for children who wear hearing aids?

**Thank You!**

## Bone Conduction Hearing Aid Survey

### **Pediatric Bone-Conduction Hearing Aid Management (BCHA): Professional Practices for Monitoring Children's Aided Hearing**

The purpose of this survey is to better understand how professionals monitor audibility for children ages birth to six years who use a bone-conduction hearing aid (BCHA). Completing the survey should take about 5 minutes.

**Your experiences are important!**

#### **Information About You:**

1. My profession is:

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

2. I have been working with children with hearing loss for:

- Less than 5 years
- 6–10 years
- More than 10 years

3. Approximately what percent of young children that you work with wear their BCHA(s) all waking hours?

- \_\_\_\_\_%
- I don't know

4. How often do you know the hours of BCHA use for the children with whom you work?

- Never
- Sometimes
- Often
- Always

5. I work in:

- An urban area
- A rural area

6. I practice in:

- United States \_\_\_\_\_  
indicate state
- Country \_\_\_\_\_  
indicate country



### Bone Conduction Hearing Aid Use

Consistent use of BCHA(s) is important for children to learn to speak. Having children wear their device(s) consistently can be hard for many different reasons. Addressing BCHA use can help identify problems.

7. Indicate each of the professionals you think should talk about BCHA use with parents: (mark all that apply)

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

8. Indicate how often you address each of the following when you talk with parents:

	Never	Sometimes	Often	Always
Ask about the number of hours their child wears the BCHA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ask about challenges with BCHA use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help parents resolve challenges with BCHA use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Talk about BCHA data logging results	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. When the children you work with need to have their BCHA repaired by the company, how often are they typically provided with loaner equipment?

- Never
- Sometimes
- Often
- Always
- I don't know

### Monitoring

Monitoring helps you know if children are hearing well with their hearing aids or if there are problems with settings, device function, how earmolds fit, and hearing in noise.

10. During audiology appointments, how often is speech understanding tested while children are wearing their BCHA?

- Never
- Sometimes
- Often
- Always
- I don't know

11. How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life (e.g., hearing in quiet, hearing in noise)?

- Never
- Sometimes
- Often
- Always
- I don't know

12. How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life (e.g., hearing in quiet, hearing in noise)?

- Never
- Sometimes
- Often
- Always
- I don't know

13. Indicate the questionnaires you use to monitor how children, birth to six years of age, are functioning with their BCHA in daily life: (mark all that apply):

- LittleEARS Auditory Questionnaire
- Parent's Evaluation of Aural/Oral Performance of Children (PEACH)
- Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS)
- Early Listening Function (ELF)
- Teachers' Evaluation of Aural/Oral performance of Children (TEACH)
- Preschool SIFTER: Preschool Screening Instrument For Targeting Educational Risk
- Children's Home Inventory for Listening Difficulties (CHILD)
- Children's Outcome Worksheets (COW)
- Other (specify): \_\_\_\_\_
- I do not use any questionnaires

14. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
How to change batteries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to interpret the indicator lights and beeps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to monitor the condition of the external equipment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to do a speech sound check (ah, ee, oo, mm, sh, s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Indicate how confident you are in your ability to:

- Tell when programming adjustments are needed \_\_\_\_\_ (0-100)
- Conduct a speech sound check \_\_\_\_\_ (0-100)
- Check BCHA function \_\_\_\_\_ (0-100)

There are personal assistive devices that can help children hear better in noise. The devices work wirelessly (e.g., FM system, remote mic, mini mic) to send the speech signal from a transmitter worn by the speaker, directly to the child's BCHA.

17. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
Difficulties their child may have hearing in different environments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benefits of personal assistive device use in addition to the BCHA	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitoring personal assistive device use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. What is challenging for you in monitoring audibility for children who wear BCHA(s)?

**Thank You!**

**Pediatric Cochlear Implant Management: Professional Practices for Monitoring Children's Aided Hearing**

The purpose of this survey is to better understand how professionals monitor audibility for children ages birth to six years who use cochlear implants. Completing the survey should take about 5 minutes.

**Your experiences are important!**

**Information About You:**

1. My profession is:

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

2. I have been working with children with hearing loss for:

- Less than 5 years
- 6–10 years
- More than 10 years

3. Approximately what percent of young children that you work with wear their cochlear implant(s) all waking hours?

- \_\_\_\_\_%
- I don't know

4. How often do you know the hours of cochlear implant use for the children with whom you work?

- Never
- Sometimes
- Often
- Always

5. I work in:

- An urban area
- A rural area

6. I practice in:

- United States \_\_\_\_\_  
indicate state
- Country \_\_\_\_\_  
indicate country



### Cochlear Implant Use

Consistent use of cochlear implants is important for children to learn to speak. Having children wear their device(s) consistently can be hard for many different reasons. Addressing cochlear implant use can help identify problems.

7. Indicate each of the professionals you think should talk about BCHA use with parents: (mark all that apply)

- Audiologist
- Speech-Language Pathologist
- Teacher
- Early Interventionist
- Other (specify) \_\_\_\_\_

8. Indicate how often you address each of the following when you talk with parents:

	Never	Sometimes	Often	Always
Ask about the number of hours their child wears the cochlear implant(s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ask about challenges with cochlear implant use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help parents resolve challenges with cochlear implant use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Talk about cochlear implant data logging results	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. When the children you work with need to have their cochlear implant repaired by the company, how often are they typically provided with loaner equipment?

- Never
- Sometimes
- Often
- Always
- I don't know

### Monitoring

Monitoring helps you know if children are hearing well with their cochlear implant(s) or if there are problems with settings, device function, and hearing in noise.

10. During audiology appointments, how often is speech understanding tested while children are wearing their cochlear implants?

- Never
- Sometimes
- Often
- Always
- I don't know

11. How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life (e.g., hearing in quiet, hearing in noise)?

- Never
- Sometimes
- Often
- Always
- I don't know

12. How often do you ask parents to complete a questionnaire about how their child is responding to sounds in their daily life while wearing their cochlear implant (e.g., hearing in quiet, hearing in noise)?

- Never
- Sometimes
- Often
- Always
- I don't know

13. Indicate the questionnaires you use to monitor how children, birth to six years of age, are functioning with their cochlear implants in daily life (mark all that apply):

- LittleEARS Auditory Questionnaire
- Parent's Evaluation of Aural/Oral Performance of Children (PEACH)
- Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS)
- Early Listening Function (ELF)
- Teachers' Evaluation of Aural/Oral performance of Children (TEACH)
- Preschool SIFTER: Preschool Screening Instrument For Targeting Educational Risk
- Children's Home Inventory for Listening Difficulties (CHILD)
- Children's Outcome Worksheets (COW)
- Other (specify): \_\_\_\_\_
- I do not use any questionnaires

14. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
How to change batteries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to listen to the cochlear implant microphone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to interpret the indicator lights and beeps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to monitor the condition of the external equipment, such as cables and headpiece	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How to do a speech sound check (ah, ee, oo, mm, sh, s)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Indicate how confident you are in your ability to:

- Tell when programming/mapping adjustments are needed \_\_\_\_ (0-100)
- Conduct a speech sound check \_\_\_\_ (0-100)
- Check cochlear implant function \_\_\_\_ (0-100)

There are personal assistive devices that can help children hear better in noise. The devices work wirelessly (e.g., FM system, remote mic, mini mic) to send the speech signal from a transmitter worn by the speaker, directly to the child's cochlear implant.

17. Indicate how often you talk with parents about each of the following:

	Never	Sometimes	Often	Always
Difficulties their child may have hearing in different environments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Benefits of personal assistive device use in addition to the cochlear implant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. What is challenging for you in monitoring audibility for children who wear cochlear implants?

**Thank You!**