

Pediatric Amplification Management: Parent Experiences Monitoring Children’s Aided Hearing

Karen Muñoz, EdD^{1,2}
 Makynzie Larsen, BS¹
 Lauri Nelson, PhD¹
 Sarah E. Yoho, PhD¹
 Michael P. Twohig, PhD³

¹Department of Communicative Disorders and Deaf Education, Utah State University

²National Center for Hearing Assessment and Management, Utah State University

³Department of Psychology, Utah State University

Abstract: Objective: Investigate parents’ experiences monitoring aided hearing for children who use hearing aids, bone conduction hearing aids, and cochlear implants.

Design: A cross-sectional survey design, using three survey instruments, was used to collect parent data.

Study Sample: A total of 178 parents of children birth to six years were included in the analysis (81 hearing aid; 61 cochlear implant; 36 bone conduction hearing aid).

Results: Surveys explored hearing device use and monitoring. Variability was found for hearing aid use and many parents reported being unaware if their child’s device had data logging capability. Parents varied widely in how often they checked hearing device function, and approximately half did not have access to loaner hearing devices when repairs were required. Variance was observed in how often professionals explored how children are hearing at home through use of parent-report questionnaires, and related to audiology-specific services aimed at monitoring and maintaining audibility during routine appointments (e.g., checking program settings when new earmolds are received, frequency of earmold replacement, checking data logging).

Conclusion: This study revealed variability in hearing device use and monitoring for audibility by professionals and parents. Implications from this study suggest parent-professional partnerships would benefit from better understanding of barriers/facilitators for parent learning and implementation of key monitoring tasks.

Acronyms: AAA = American Academy of Audiology; BCHA = bone conduction hearing aids; CI = cochlear implant; HA = hearing aid; FM = frequency modulation; RECD = real-ear-to-coupler-difference

Correspondence concerning this article should be addressed to: Karen Muñoz, EdD, Department of Communicative Disorders and Deaf Education, Utah State University, 1000 Old Main Hill, Logan, UT, 84322. Phone: 435-797-8240; Email: karen.munoz@usu.edu

Early identification of hearing loss through newborn screening has become a standard of care in the United States (Centers of Disease Control and Prevention, 2017). Early screening allows for intervention within the first few months of life (Joint Committee on Infant Hearing, 2007), giving parents an opportunity to access needed services. For children learning to communicate using spoken language, consistent auditory access to speech sounds using hearing technology is necessary to achieve optimal language outcomes (Tomblin et al., 2015). Both audiologists and parents play critical roles in monitoring aided hearing and when there are gaps in managing hearing care, audibility is inconsistent.

Appropriate hearing device programming is fundamental for audibility. Audiologists program hearing devices specifically for each child based on their individual hearing

needs and it is necessary to monitor device settings over time. For example, children who use hearing aids are fit with new earmolds as they grow because the size of their ear canal increases. To accommodate for physical changes, a measurement (called real-ear-to-coupler-difference [RECD]) should be completed when new earmolds are fit to the child. Hearing aid programming adjustments, based on the child’s current hearing thresholds and RECD, are then made to maintain sufficient sound pressure levels for audibility (American Academy of Audiology [AAA], 2013; Seewald & Scollie, 2003). Even when hearing devices are programmed appropriately, hearing in noisy environments can be challenging. The use of a personal frequency modulation (FM) system in conjunction with hearing devices improves audibility by helping children access speech when listening in more adverse environments (AAA, 2008).

Daily hearing device management is also fundamental for audibility. Parents are responsible for having their children wear their devices and for checking that devices are functioning. Young children are in a critical language learning period and device use of less than 10 hours per day has been found to negatively affect language development (Tomblin et al., 2015). Parents have reported that various child factors (e.g., child behavior) and parent factors (e.g., frustration, depression) interfere with how often children wear their hearing devices (Caballero et al., 2017; Isarin et al., 2015; Muñoz et al., 2016; Walker et al., 2013), and wide variability has been found in average hours of use (Muñoz et al., 2015; Walker et al., 2013). Data logging is a feature built into most hearing devices. Parents and audiologists can use data logging to routinely monitor hours of use and to help recognize when device problems occur. Data logging allows the audiologist to view the average amount of time the child is wearing the device. Even when children wear their hearing devices consistently, however, audibility is compromised if the devices are not functioning. Parents have reported a lack of training in how to check devices and/or not having needed tools (Muñoz, Blaiser, & Barwick, 2013; Muñoz, et al., 2015), and this can result in infrequent monitoring of device function (Burkhalter, Blalock, Herring, & Skaar, 2011; Isarin et al., 2015; Muñoz et al., 2013; Watermeyer, Kanji, & Sarvan, 2017).

Routine monitoring by audiologists and parents is necessary to determine hearing device benefit and to identify changes or problems in audibility that need attention. Parents' observations of how their child is functioning at home and in other environments can be obtained by using questionnaires, and audiologists can assess aided speech perception during monitoring appointments (AAA, 2008, 2013). Parents can also use the Ling-Six sound test every day to check that their child is perceiving speech sounds represented across the frequency range (AAA, 2008). When device malfunctions occur, loaner hearing devices can be provided while the child's device is out for repair, so audibility is not compromised. Given that audibility can be affected by multiple factors (e.g., device use, device function) that ultimately influence child outcomes, understanding parents' experiences can provide important insights about how audiologists and parents can more effectively partner in this journey. The purpose of this study was to investigate parents' experiences monitoring aided hearing for children who use hearing aids, bone conduction hearing aids, and cochlear implants.

Method

This study used a cross-sectional survey design to explore parent experiences monitoring aided hearing. Survey responses were anonymous, and Institutional Review Board approval at Utah State University was obtained prior to conducting this study.

Participants and Procedures

Parents of young children birth to six years of age who use hearing devices (i.e., hearing aids, bone conduction hearing aids, cochlear implants) and who were proficient in English were recruited to participate in the study from February to November 2017 through parent support websites and social media (e.g., heartolearn.org, handsandvoices.org, agbell.org, Facebook groups). Data collection was completed using Qualtrics, an online survey software tool. Because this distribution method was designed to target the population of interest broadly, it was not possible to estimate the number of people reached to calculate a response rate. Completed surveys were received from 210 parents in 37 states and 8 countries. Thirty-two surveys were excluded (30 children were older than six years; 2 children were not using hearing devices [1 hearing aid, mild degree; 1 cochlear implant]); 178 surveys were analyzed. Participant demographic information can be seen in Table 1. Responses were primarily received from mothers (93%, 166/178) and few reported that their children have a caregiver who has had a hearing loss since childhood (9%, 16/178).

Survey Instruments

Three survey instruments (Hearing Aid [HA; 25 items]; Cochlear Implant [CI; 24 items]; Bone Conduction Hearing Aid [BCHA; 23 items]) were developed by the first and third authors. Items were developed based on professional guidelines (e.g., AAA, 2013) to capture fundamental practices for hearing technology monitoring. Each survey had four sections: Information About Your Child, Information About You, Device Use, and Device Monitoring.

Data Analysis

Descriptive data analysis was completed using SPSS (Version 25), including measures of central tendency to identify variance in parent experiences. Analysis of variance was used to investigate factors that may be associated with parent-reported typical hours of daily hearing device use: length of time with hearing device (i.e., 12 months or less, 13 to 24 months, more than 24 months); device type (i.e., hearing aid, bone conduction hearing aid, cochlear implant), and child age (i.e., early intervention age [0 to 36 months]; preschool age [37 to 60 months]; early elementary age [61 months and older]). Child age groupings reflected systems in the United States that support children and families based on chronological age. Two parents reported 24 hours per day of device use (HA = 1, CI = 1). Although some pediatric patients sleep with their devices on for safety or comfort, this is not common; therefore these responses were not included in hearing aid use analyses to better observe trends. The data were split for analysis (i.e., hearing aids, cochlear implants, bone conduction hearing aids) to explore differences among parents on items that may be related to device type. The sample size varies by survey item as parents were allowed to skip questions. Content analysis was completed for the open-ended questions to identify emergent themes. Appendix A details the number of

Table 1
Participant Demographics

Child and Caregiver Information	HA (<i>n</i> = 81)		CI (<i>n</i> = 61)		BCHA (<i>n</i> = 36)	
	% (<i>n</i>)	<i>M</i> (<i>SD</i>)	% (<i>n</i>)	<i>M</i> (<i>SD</i>)	% (<i>n</i>)	<i>M</i> (<i>SD</i>)
Child						
Age in months		41 (23.81)		47 (18.76)		44 (23.40)
Months since fitting		20 (18.50)		27 (15.89)		25 (18.11)
Typical hours of use per day		10 (02.52)		11 (02.49)		10 (02.92)
Uses hearing aids in both ears	78 (63)		89 (54)		42 (15)	
Degree of hearing loss*						
Mild	12 (10)					
Moderate	49 (40)					
Severe	24 (20)					
Profound	12 (10)					
Unsure	1 (1)					
Has additional disabilities	27 (22)		16 (10)		31 (11)	
Caregiver						
Age in years		35 (5.35)		35 (5.12)		36 (06.62)
Relationship to child – mother	90 (73)		95 (58)		97 (35)	
Child has a caregiver with hearing loss since childhood	11 (9)		7 (4)		8 (3)	
Race						
White	88 (71)		85 (52)		78 (28)	
Prefer not to answer	5 (4)		3 (2)		3 (1)	
Educational level						
High school diploma	6 (5)		8 (5)		3 (1)	
Some college	12 (10)		10 (6)		17 (6)	
Associates degree	12 (9)		8 (5)		22 (8)	
Bachelor's/graduate degree	70 (57)		74 (45)		58 (21)	

Note. HA = hearing aid; CI = cochlear implant; BCHA = bone conduction hearing aid. *Question only in HA survey

participants who responded, the number of statements per question, and provides examples of challenges parents experience while monitoring aided hearing. Appendix B contains advice for professionals that emerged from our findings.

Results

Parent experiences reported were for children from 3 to 83 months of age (HA [Mdn = 44, range: 3–83], BCHA [Mdn = 49, range: 3–76], CI [Mdn = 48, range: 14–78]). The children had been wearing their hearing devices for 1 to 68 months (HA [M = 20, Mdn = 15, range: 1–68], BCHA [M = 25, Mdn = 23, range: 2–68], CI [M = 27, Mdn = 24, range: 1–64]).

Hearing Device Use

Parent-reported typical hours of daily hearing device use varied for all devices (HA [Mdn = 10, range: 4–14], CI [Mdn = 12, range: 5–16], and BCHA [Mdn = 10, range: 4–16]).

Analysis of variance was used to explore three factors (i.e., length of time with device, child age groups, device type) to determine their association with hearing device use (see Table 2). All three factors had statistically significant main effects on parent-reported typical hours of daily hearing device use. First, children who have had their devices more than two years used them, on average, 1.5 hours more per day than children who have had them less than two years; length of time with device $F(2, 171) = 7.053, p = .001$. Second, children in preschool and early elementary school used their hearing devices, on average, 1.68 hours more per day than early intervention age children; for child age $F(2, 171) = 9.888, p = .000$. Third, children who use cochlear implants used their hearing devices, on average, 1.4 hours more per day than children who use hearing aids or bone conduction hearing aids; device type $F(2, 171) = 5.662, p = .004$.

There were not statistically significant main effects on parent-reported typical hours of daily device use for degree

Table 2
Effect of Child Age, Device Type, and Length of Time with Device on Parent-Reported Typical Hours Hearing Device Use

Device Use Factors	n	M (SD)	95% CI	p
Child Age				< 0.001*
Early Intervention Age (0–35 months)	73	9.58 (2.59)	8.97, 10.18	
Preschool Age (36–60 months)	46	11.00 (2.53)	10.25, 11.75	
Early Elementary Age (> 60 months)	53	11.51 (2.47)	10.83, 12.19	
Device Type				0.004*
Hearing Aid	78	10.08 (2.52)	9.51, 10.65	
Bone Conduction Hearing Aid	35	10.06 (2.92)	9.05, 11.06	
Cochlear Implant	59	11.47 (2.49)	10.82, 12.12	
Length of Time with Device				0.001*
12 months or less	58	10.09 (2.50)	9.43, 10.74	
13–24 months	49	9.86 (2.59)	9.11, 10.60	
More than 24 months	65	11.49 (2.64)	10.84, 12.15	

* statistical significance

of hearing loss for children who use hearing aids $F(5, 171) = 1.258, p = .284$, or for children who have additional disabilities $F(2, 171) = .517, p = .597$.

Data logging provides a means for audiologists and parents to monitor hearing device use. Parents were asked if their child's device had data logging capabilities. Many parents did not know if their child's device had data logging (HA [30%, $n = 23$]; BCHA [43%, $n = 15$]; CI [19%,

$n = 11$]). Parents of children with CIs indicated devices had data logging (70%, $n = 41$) more often than parents of children with HAs (37%, $n = 29$) and BCHA (26%, $n = 9$). For children that have hearing devices with data logging, parents were asked how often (i.e., *never, sometimes, often, always*) data logging is discussed; often and always were combined to better see trends. Less than half of the parents of children who use HAs or BCHA reported that audiologists often or always talk about hours of use recorded by data logging (HA: [45%, 14/31]; BCHA: [33%, 3/9]); parents of children who use CIs reported more frequent discussions (60%, 25/42).

Parents reported how often each professional, when applicable, talked with them about hearing device use (i.e., *never, sometimes, often, always*). *Often* and *always* were combined to better see trends. For each device type and for all professionals listed, there was variability in frequency, with many parents reporting device use is only discussed *sometimes* or *not at all* (see Table 3).

Loaner hearing device. Parents reported whether or not their child has received a loaner hearing device to use when their device was being repaired. For children who have had their device repaired, half of the parents or more reported never receiving a loaner (HA: [52%, 16/31]; BCHA: [68%, 15/22]; CI: [50%, 13/26]).

Replacement equipment/earmolds. Hearing device use can be affected when custom earmolds do not fit properly and when equipment needed for device function needs to be replaced. Parents of children who use hearing aids and have had them for more than a year were asked how

Table 3
Frequency Professionals Talk with Parents about Device Use

Professional	% (n)									
	HA	Never			Sometimes			Often/Always		
		BCHA	CI		HA	BCHA	CI	HA	BCHA	CI
Audiologist	7 (6)	--	5 (3)	38 (31)	24 (8)	33 (20)	54 (44)	77 (26)	62 (38)	
SLP	23 (14)	17 (5)	8 (4)	18 (11)	28 (8)	49 (25)	60 (37)	55 (16)	43 (22)	
Teacher	38 (21)	30 (7)	33 (14)	29 (16)	39 (9)	40 (17)	34 (19)	30 (7)	27 (12)	
EI	22 (11)	16 (4)	15 (6)	14 (7)	16 (4)	23 (9)	64 (32)	68 (17)	63 (25)	
Physician	38 (31)	37 (13)	25 (15)	42 (34)	40 (14)	9 (5)	20 (16)	23 (8)	24 (14)	

Note. HA = hearing aids; BCHA = bone conduction hearing aids; CI = cochlear implant; SLP = speech-language pathologist; EI = early interventionist

Table 4
Frequency of Earmold Replacement During Previous Year and Shipping Time in Weeks

Age Groups	Earmold Replacement % (n)					Shipping Time % (n)			
	Never	Once	Twice	3 times	4 times or more	1 week	2 weeks	3 weeks	4 weeks
EI	10 (3)	14 (4)	24 (7)	24 (7)	28 (8)	14 (4)	45 (13)	14 (4)	17 (5)
Preschool	13 (2)	40 (6)	40 (6)	7 (1)	--	7 (1)	60 (9)	27 (4)	--
EE	6 (1)	56 (9)	6 (1)	19 (3)	13 (2)	31 (5)	31 (5)	31 (5)	--

Note. EI = early intervention; EE = early elementary

many times during the past year their child's earmolds were replaced (see Table 4). All parents were asked about the typical shipping time to get the new earmolds and replacement components for devices (see Table 4). Five parents indicated replacement earmolds were not needed or their child does not use earmolds.

Hearing Device Monitoring

Parent confidence. Parents reported how confident they felt monitoring the hearing devices (0 = *not confident at all*; 100 = *completely confident*). For HAs, confidence was variable among parents, with the lowest confidence reported for knowing the HA settings are appropriate ($M = 47$, $SD = 32.85$); more parents were confident in determining when to replace earmolds ($M = 72$, $SD = 26.68$) and batteries ($M = 73$, $SD = 26.57$). For BCHA and CIs, most parents reported confidence for items queried: when to replace batteries (BCHA [$M = 78$, $SD = 22.78$]; CI [$M = 89$, $SD = 13.73$]); knowing device is functioning properly (BCHA [$M = 96$, $SD = 14.33$]; CI [$M = 99$, $SD = 3.77$]); interpreting indicator lights (BCHA [$M = 73$, $SD = 30.83$]; CI [$M = 88$, $SD = 18$]); and monitoring external equipment (BCHA [$M = 79$, $SD = 27.71$]; CI [$M = 88$, $SD = 19.85$]). For CI parents, there was more variability for confidence in listening to the microphone ($M = 75$, $SD = 31.31$).

All parents were asked about their confidence related to performing a speech sound check (i.e., Ling-Six sound). Parents of children who use CIs were more confident than parents of children who use HAs and BCHA (see Figure 1).

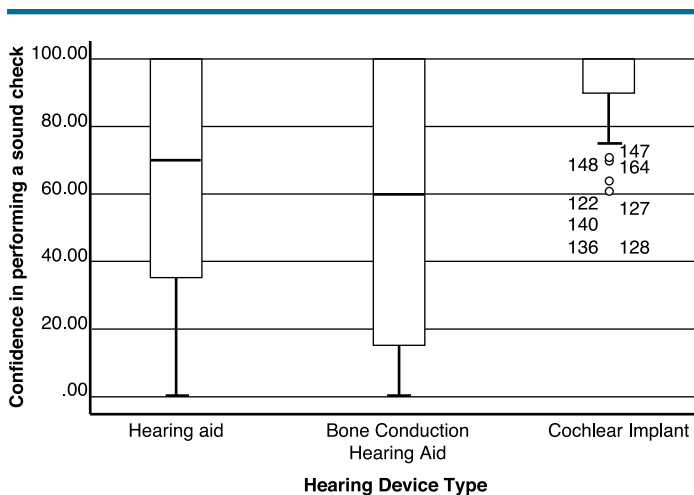


Figure 1. Parent confidence in performing a speech sound check (median and interquartile ranges [IQR]). Median confidence for parents of children who use hearing aids was 70 ($n = 70$), bone conduction hearing aids was 60 ($n = 30$), and cochlear implants was 100 ($n = 56$). The thick horizontal line within the box represents the median, the vertical lines above and below the box represent the IQR, and the circles and asterisks below the vertical line represent the outliers or the cases that were less confident.

Frequency of parent monitoring. Table 5 shows the frequency parents reported monitoring the condition and function of hearing devices (i.e., *when needed*, *never*, *every few weeks*, *weekly*, *daily*). Frequency of parent monitoring for all items varied for all devices.

Frequency of professional monitoring. Parents reported how often each professional, when applicable, asked them to complete a questionnaire to explore aided benefit in daily life (i.e., *never*, *sometimes*, *often*); see Table 6. Few parents indicated that professionals often ask them to complete questionnaires for any device.

For children who use hearing aids, device settings need to be monitored and adjusted when new earmolds are received. Parents reported how often hearing aid settings were checked when their child was fit with new earmolds (i.e., *never*, *sometimes*, *often*, *always*); *often* and *always* were combined for ease in observing trends. The majority reported this *often* or *always* occurs (71%, $n = 56$), some reported it *sometimes* occurs (12%, $n = 9$) or *never* occurs (4%, $n = 3$), and some parents *did not know* (13%, $n = 10$).

Table 5
How Often Parents Check Hearing Device Function

Device	Component Checked	% (n)				
		When needed	Never	Every few weeks	Weekly	Daily
HA (n = 75)						
	Batteries	23 (17)	--	1 (1)	35 (26)	41 (31)
	Sound Quality	15 (11)	21 (16)	16 (12)	15 (11)	33 (25)
	Wax Blockage	4 (3)	4 (3)	4 (3)	15 (11)	73 (55)
	Physical Condition	7 (5)	4 (3)	3 (2)	16 (12)	71 (53)
	Speech sound check	17 (13)	32 (24)	13 (10)	20 (15)	17 (13)
BCHA (n = 35)						
	Batteries	37 (13)	--	6 (2)	17 (6)	40 (14)
	Microphone Quality (n = 34)	29 (10)	44 (15)	12 (4)	9 (3)	6 (2)
	External Equipment	20 (7)	--	9 (3)	9 (3)	63 (22)
	Speech Sound Check	17 (6)	54 (19)	11 (4)	11 (4)	6 (2)
CI (n = 56)						
	Batteries	25 (14)	2 (1)	2 (1)	2 (1)	70 (39)
	Microphone Quality	20 (11)	30 (17)	30 (17)	11 (6)	9 (5)
	External Equipment (n = 55)	29 (16)	--	2 (1)	22 (12)	47 (26)
	Speech Sound Check	27 (15)	11 (6)	14 (8)	25 (14)	23 (13)

Note. HA = hearing aids; BCHA = bone conduction hearing aids; CI = cochlear implant; SLP = speech-language pathologist; EI = early interventionist.

Table 6
Frequency Professionals Asked Parents to Complete a Questionnaire to Explore Benefit

Professional	% (n)								
	Never			Sometimes			Often		
	HA	BCHA	CI	HA	BCHA	CI	HA	BCHA	CI
Audiologist	69 (52)	89 (31)	56 (31)	23 (17)	3 (1)	22 (12)	8 (6)	9 (3)	22 (12)
SLP	67 (39)	68 (21)	49 (24)	28 (16)	16 (5)	31 (15)	5 (3)	16 (5)	20 (10)
Teacher	76 (41)	81 (21)	72 (28)	20 (11)	4 (1)	23 (9)	4 (2)	15 (4)	5 (2)
EI	56 (28)	68 (17)	43 (16)	34 (17)	12 (3)	41 (15)	10 (5)	20 (5)	16 (6)

Note. HA = hearing aids; BCHA = bone conduction hearing aids; CI = cochlear implant; SLP = speech-language pathologist; EI = early interventionist.

For children who use hearing aids, device settings need to be monitored and adjusted when new earmolds are received. Parents reported how often hearing aid settings were checked when their child was fit with new earmolds (i.e., *never, sometimes, often, always*); *often* and *always* were combined for ease in observing trends. The majority reported this *often* or *always* occurs (71%, $n = 56$), some reported it sometimes occurs (12%, $n = 9$) or *never* occurs (4%, $n = 3$), and some parents did not know (13%, $n = 10$).

Personal FM System

Parents were asked if their child has a personal FM system. The majority of children who use CIs had an FM system (79%, 44/56), approximately half with BCHAs (57%, 20/35), and one-third with HAs (39%, 29/75). For those who have an FM system, when applicable, parents indicated how often (i.e., *never, sometimes, often*) the device is used in different locations (see Table 7); parents reported using FM systems infrequently for all locations queried.

Table 7
Frequency of FM Use in Different Locations

Location	% (n)								
	Never			Sometimes			Often		
	HA	BCHA	CI	HA	BCHA	CI	HA	BCHA	CI
Home	63 (19)	65 (17)	69 (33)	30 (9)	23 (6)	29 (14)	7 (2)	12 (3)	2 (1)
School	44 (4)	64 (7)	56 (9)	22 (2)	9 (1)	--	33 (3)	27 (3)	44 (7)
Daycare	100 (8)	100 (7)	87 (13)	--	--	13 (2)	--	--	--
Car	67 (18)	76 (19)	71 (32)	26 (7)	24 (6)	27 (12)	7 (2)	--	2 (1)
Events	46 (12)	74 (17)	54 (23)	15 (4)	17 (4)	40 (17)	39 (10)	9 (2)	7 (3)

Note. HA = hearing aids; BCHA = bone conduction hearing aids; CI = cochlear implant.

Challenges and Advice

Parents responded to two open ended questions that queried challenges they experience and advice they have for professionals. For parent challenges, three primary themes emerged for all devices (see Appendix A). Child-related challenges were most commonly reported (HA 40%, BCHA 42%, CI 47%), although parent-related challenges (HA 35%, BCHA 29%, CI 27%) and device-related challenges (HA 19%, BCHA 25%, CI 24%) were also raised. The most frequently reported child-related challenge was the inability of the child to tell their parents when there was a problem (e.g., due to young age, non-verbal, multiple disability). A common parent-related challenge reported for HA and BCHA was difficulty knowing if their child was receiving benefit from the device, and for CI parents teaching others and getting enough support from others with management (e.g., teachers, other family members) was raised. The most common device-related challenge for all device types was not knowing if the device was working properly.

Three main themes emerged from parent advice offered for all devices (see Appendix B). Parent education and

support was the most common theme (HA 41%, BCHA 45%, CI 47%). Relationship with parents (HA 37%, BCHA 38%, CI 35%) and professional practices (HA 21%; BCHA 17%; CI 18%) were also themes addressed by parents. The most frequently reported aspect of parent education and support was to provide parents with detailed information. Parents want the professionals to be patient with them, trust them, and to listen to their thoughts and concerns. Parents also offered advice related to professionals' practice, suggesting that providers have information about support (e.g., parent groups), pediatric physicians, and routine data logging. They also want professionals to be patient and have fun with their children.

Discussion

Children who are using hearing technology to learn spoken language need consistent auditory access to speech sounds. Audibility is achieved by wearing appropriately functioning hearing devices during all waking hours. Parents play a central role in monitoring audibility for their children when they are young, and they rely on professionals to support and guide them in knowing how to effectively manage the devices on a daily basis. This study explored parent experiences monitoring aided hearing (i.e., hearing aids, bone conduction hearing aids, cochlear implants) for their children birth through six years of age. Important insights emerged from this study related to consistent audibility, and parent-professional partnerships for monitoring and managing audibility, for young children with hearing loss.

Consistent Audibility

How often children wear their devices has been found to affect language development, with children who use their devices more than 10 hours per day showing better language outcomes than children who use them less (Tomblin et al., 2015). Studies have found variability in hours of use particularly for young children, based on hearing aid data logging, and that parent report often overestimates hours of use (Walker et al., 2013; Muñoz et al., 2014). Parents of young children may have difficulty monitoring and reporting on typical hours of use for young children. For example, Caballero et al. (2017) found parents reported greater hours of use on "good" days. Parents may recall "good" days when they talk about hearing aid use with their audiologist. Device data logging is a tool that can help parents and audiologists identify when there is a problem with use that needs attention. In this study, many parents either did not know if their child's device had data logging or they reported this was not something the audiologist discusses with them.

Monitoring device function is also critical for consistent audibility. Hearing devices malfunction, and young children may not be able to report problems or may inconsistently report problems. As expressed by parents in this study "She is not quite old enough to articulate when there is a problem." For this reason, daily monitoring of the physical condition and sound quality is needed. To monitor device

function parents need special monitoring tools, as well as instruction and support to integrate this habit into their daily routine. Parents in this study generally reported confidence in monitoring tasks; however, the responses varied widely in how often they monitor device function. When devices do malfunction and need repair, children need loaners to maintain audibility while repairs are done; however, in this study only about half of the parents reported receiving a loaner for their child.

Parent-Professional Partnerships

The majority of parents of children with hearing loss have normal hearing (Mitchell & Karchmer, 2004) and are likely unfamiliar with childhood hearing loss, hearing devices, or management issues. In this study, few parents (7–11% based on device type) reported that their child has a caregiver with hearing loss since childhood. Parents have much to learn, and need guidance from professionals to attend to key monitoring practices, as expressed by these parents: “*Explain as much as possible in terms parents understand. For many parents this is a new journey and we are trying to learn what we can to make the best decisions possible and support our child,*” and “*Always share info with parents on how they can help their child. Write it down for them!*” Parents have also reported wanting professionals to check on them more often and to give them support in between clinical appointments (Caballero et al. 2017).

Monitoring audibility for children with hearing loss requires a team effort and collaboration among parents and professionals is critical. In this study, variance was observed in how often professionals talk with parents about hearing device use and explore how children are hearing at home through use of parent-report questionnaires. Variance was also observed related to audiology-specific services aimed at monitoring and maintaining audibility during routine appointments (e.g., checking program settings when new earmolds are received, frequency of earmold replacement, checking data logging). It is important for parents to have confidence in how their audiologist is monitoring their child, and to be aware of best practices so they can appropriately advocate for their child. As expressed by parents in this study: “*Data log even good wearers! We found a faulty cable that way,*” and “*Be as detailed as possible in your exams/ appointment.*” Hearing in a noisy environment is a known challenge for children with hearing loss, yet few children in this study have a personal FM system, and those that do, use it infrequently.

Parents need the support from professionals to help build confidence in their abilities, particularly as they adjust and learn new monitoring tasks. Professionals can develop and nurture a working alliance with parents to support effective device management by (a) assessing and addressing parent barriers, (b) jointly setting specific device management goals, (c) exploring anticipated challenges and potential solutions, and (d) providing accountability by checking in with parents and extending support as needed.

Parent-to-parent support can be another important mechanism for parents to help build their confidence and competence in monitoring aided hearing through compassion and understanding from others who have had similar experiences with their children. Collaboration among professionals on key monitoring components can support continuity of care and parent learning.

Research Implications

Findings from this study revealed important implications for future research. Better understanding of barriers/facilitators for parent learning and implementation of key monitoring tasks as well as educational and support delivery options could inform professional practices. Further research is needed to understand barriers, for professionals and parents, that exist related to personal FM/remote microphone use with young children. Furthermore, more research is needed that focuses on critical elements of implementation of patient-centered care for monitoring aided audibility for children using hearing devices.

Limitations

There were limitations to this study that should be noted. Even though the parent needs from this study reflected response from parents of young children, the majority of parents who responded were mothers who are White with a college education. The responses are self-report and may reflect bias that overestimates hearing aid use and monitoring practices.

Conclusions

This study investigated parents’ experiences monitoring aided hearing for children who use hearing aids, bone conduction hearing aids, and cochlear implants. Findings revealed variability in hearing device use, and monitoring for audibility by professionals and parents. Implications from this study suggest parent-professional partnerships would benefit from better understanding of barriers/facilitations for parent learning and implementation of key monitoring tasks.

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APPENDIX A
Parent Responses to Open Question about Their Challenges Monitoring Aided Audibility

Responses % (n)	Themes % (n)	Quotes	
Hearing Aid 62% (53)	Child-related 40% (25/62)	She is not quite old enough to articulate when there is a problem.	
		At 3 years old it's tough to tell if there is a problem with the aid settings or if my child just doesn't want to wear them.	
	Parent-related 35% (22/62)	My child has been turning hearing aids off whenever they feel like it without anyone's knowledge. It's been a challenge to help them understand how important keeping aids turned on & in ears.	
		He's at an age where he can help monitor/share some responsibility for his hearing aids and he doesn't always tell me right away if one stops working.	
Device-related 19% (12/62)	Environment-related 5% (3/62)	Knowing what he's hearing without the hearing aids in and what is developing because of the hearing aids.	
		Being unilateral it is difficult to know whether he is only hearing because of his good ear.	
		It's challenging not knowing if hearing aids are enough. Not knowing if there's more I could be doing to help my child succeed in life.	
Bone Conduction Hearing Aid 61% (23)	Child-related 42% (10/24)	I would like to have a basic understanding of how to trouble shoot problems. I really didn't have any information regarding what to do if they aren't working correctly.	
		I wish there was an app on my phone that I could monitor the battery life or get a notification that something might not be working properly. Even better would be if the hearings could be GPS tracked by a phone app if lost.	
	Parent-related 29% (7/24)	If the aids are providing adequate sounds. Also, when the battery is dead, not a big indicator... only a small light on the aid to show battery is dead. If I'm not paying attention she could wear for hours without being able to hear.	
		My challenge is in cafeterias and gyms. My son does not hear what is going on and does not like the noise from so many other kids in those environments.	
Device-related 25% (6/24)	Parent-related 29% (7/24)	She is too young to let me know if there are any issues.	
		He don't want to use.	
		My child seems to hear very well without the device so it's hard to monitor the difference between his hearing with the device in verses when he isn't wearing it.	
Cochlear Implant 66% (45)	Child-related 47% (21/45)	I don't get to talk to the audiologist enough to ask questions.	
		I assume it helps her but honestly she acts the same with or without it.	
	Parent-related 27% (12/45)	Hard to know when battery fails. Only by touching the BAHA and listening for feedback do I know it's working. Processor often falls off the band during playtime.	
		I just have to assume that it is programmed correctly and is not too loud for my son.	
	Device-related 24% (11/45)	Device-related 24% (11/45)	She is still very young, so it isn't always easy for me to hold her attention in order to tell how well she is hearing certain speech sounds.
			Trying to figure out when he is ignoring us because that is what kids do or when he genuinely cannot hear us.
		Teaching his PreK teachers who have never worked with a deaf kid before how to best approach different situations with him.	
		Remembering to do equipment checks in all the craziness. My child is 8, and has 2 younger siblings, and both my husband and I work full time.	
		That I am the only family member that does everything because everyone else is afraid to "break them"	
		Battery life especially with disposables.	
		I'd like easier access to the microphone port to more easily listen to the sound quality.	
		They just fall off a lot because she's a toddler and busy!	
		Using the assistive technology is a challenge for me. We do not use it much at this time so I forget to use it and don't remember how to link it with my phone and things like that.	

Note. Some responses included more than one challenge.

APPENDIX B
Parent Responses to Open Question Offering Advice for Professionals

Responses % (n)	Themes % (n)	Quotes
Hearing Aid 55% (47/85)	Parent Education & Support 41% (31/75)	Explain as much as possible in terms parents understand. For many parents this is a new journey and we are trying to learn what we can to make the best decisions possible and support our child.
		Give the parents as much info, paper handouts, as possible. Most of the time parents are extremely overwhelmed and forget what was said, this way they would have a reference to look back on.
		Help the parents to become advocates for their children.
Relationship with Parents 37% (28/75)		Be patient with the kids. Be patient with the parents. Let them be involved in what you're doing and trust their feelings too. Don't brush off parent's concerns and questions.
		Be compassionate and acknowledge the difficulty of finding your child has hearing loss.
		Take the time to explain things to parents of young ones.
		Parents know their child best, so always listen to what they have to say when they think something is not right.
Professional Practices 21% (16/75)		Suggest places for support.
		Have on hand many recommendations for pediatric physicians who are familiar with hearing loss.
		I wish my audiologist would be more proactive about my daughter's hearing loss.
Bone Conduction Hearing Aid 55% (21/38)	Parent Education & Support 45% (13/29)	Be as detailed as possible in your exams/appointment.
		I think it's important to really explain and continue to reiterate the importance of consistency when it comes to having a child with hearing loss wear their BCHAs. Helping parents to understand the difference in the child's hearing when not wearing their device verses when they don't hear them. Doing hearing test with and without to show those differences. Especially for children who have hearing loss in only one ear.
		Please understand that parental comprehension may be low, even if they are well educated; it's often the first time we've heard many of these items... Also, "routine" visits/tests/equipment checks can be emotional experiences, depending on the day and parent, which makes comprehension that much more difficult. But these are our babies! We WANT to know all the information.
Relationship with Parents 38% (11/29)		Listen to the parent's gut. Often, they are seeing more than what you see. When a child has multiple developmental struggles, don't group all their speech struggles into a hearing related box; there can often be other struggles such as apraxia, aphasia, autism, or auditory processing that affect speech production, understanding, and development.
		Be honest and up front with parents.
		Be patient.
Professional Practices 17% (5/29)		Offer options and trials...have loaners available.
		Assume they are intelligent. Don't always think not responding in the booth means they simply didn't hear. Assume they are all intelligent enough to give you a hard time, even the ones with extra disabilities.
Cochlear Implant 63% (43/68)	Parent Education & Support 47% (23/49)	Give parents more time to talk and understand equipment and how to help child.
		Always share info with parents on how they can help their child. Write it down for them!
		Remember that parents are processing so much new information and it is super overwhelming, especially finding out their child isn't "perfect". Take the time to sit with parents and let them ask all the questions they have and make sure they understand how to operate and troubleshoot the equipment.
		Explain absolutely everything in great detail. Don't think that because a parent doesn't educate themselves they don't care. I spent endless hours researching hearing loss and cochlear implants but not all parents do that so you need to help bridge that gap. I wish I would have been provided with contact information to other parents of CI kids so if you're able to do that, please do. Lastly, don't become complacent in your job and forget how scary this can be for parents, especially at first. Be sympathetic and understanding.
Relationship with Parents 35% (17/49)		See the children and parents often and don't assume the child is caught up with their hearing peers and dismiss them from therapy. Stick with them and make sure they are comprehending and expanding vocabulary and understanding so they don't fall behind a couple of years later. Also, parents can get overwhelmed with information and it's hard to know what to say when working with your child. Keeping it simple and giving a simple summary of what to be working on and expecting from your child with some examples is a great resource for us to look at throughout the week for guidance.
		Stay patient and flexible!
		Don't discount a parent's concern.
		Trust the Mom! They know their child best.
Professional Practices 18% (9/49)		Be patient. Be positive. Be open to our wants and needs.
		Do not shame parents who use sign language along with cochlear implants. Allow it to be their choice and keep biased opinions to yourself. I do not think my son would understand/hear correctly a new word without sign support. Sign support can benefit cochlear implant children with similar sounding words, and so much more!
		There are tough stages and ages, eventually kids grow up and out of it, but you will always have a younger one coming. Breathe and have fun with them for the short time they are in your office.
		The European healthcare system (NHS) actually requires all pediatric audiologists to provide a retention accessory with every new fitting of a hearing aid or cochlear implant. That's something America does not practice.
		Data log even good wearers! We found a faulty cable that way.

Note. Some responses included advice in multiple areas.