A Review of Current Pediatric Tele-Audiology eHealth Platforms

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Abstract

Purpose: The purpose of this study was to identify current pediatric tele-audiology hearing technology platforms for young children who are deaf or hard of hearing and their families.

Method: An exploratory, descriptive design was used to evaluate features of available pediatric tele-audiology platforms for parents and audiologists to implement for young children. The study explored internet resources including hearing industry websites, for information related to specific eHealth platform features designed to support pediatric hearing devices currently available to audiologists and families.

Results: Of the websites reviewed, only four major technology companies were found to have pediatric tele-audiology ready platforms designed to support young children and their families.

Conclusions: Tele-audiology technology platforms for young children are available but limited in comparison to what may be available to older children and adults. A need for more consistency across platforms was identified based on the inconsistent features observed in the available platforms that could be a hinderance to pediatric recipients of tele-audiology services. Future research directions to move eHealth applications forward and determine efficacy are discussed.

Keywords: children, deaf or hard of hearing, hearing aids, telehealth, audiology

Acronyms: DHH = deaf or hard of hearing; EHDI = early hearing detection and intervention; JCIH = Joint Committee on Infant Hearing

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Tele-audiology, or the implementation of audiological services via telehealth technologies, has increasingly become a growing means for improving access to audiology services for persons who are deaf or hard of hearing (DHH) worldwide. Over the last decade, professional position statements (American Academy of Audiology [AAA], 2021; Audiology Australia, 2020), clinical guidelines (American Speech-Language Hearing Association [ASHA], n.d.a; Cason & Cohn, 2014), expert opinions (Ballachanda, 2019; Montano et al., 2018), empirical reviews (Krumm, 2016; Muñoz et al., 2021; Swanepoel & Hall, 2010), training resources (e.g., National Center for Hearing Assessment and Management [NCHAM], 2021), and a myriad of online and professional publications have advocated for its wide implementation and application in audiology. Although historically reserved for populations with restricted or limited access to in-person services, advances in telecommunications have permitted tele-audiology services today to serve the needs of all patients regardless of location or proximity to an audiology clinic. Since the first iterations of tele-audiology services were developed to provide real-time assessment

of auditory thresholds via the internet (Givens et al., 2003; Givens & Elangovan, 2003), tele-audiology options have greatly expanded for both evaluation and treatment opportunities for children and adults who are DHH.

One advancement in tele-audiology is that of eHealth platforms. As defined by the World Health Organization (WHO, 2021):

> e-Health is the cost-effective and secure use of information and communication technologies (ICT) in support of health and health-related fields – [encompassing] multiple interventions, including telehealth, telemedicine, mobile health (mHealth), electronic medical or health records (eMR/eHR), big data, wearables, and even artificial intelligence. (https://www.who.int/westernpacific/activities/using-e-health-and-information-technology-to-improve-health)

As applied in multiple health professions, electronic communications link patient owned technologies to clinic managed technologies, creating new opportunities for (a) real-time synchronous videoconference appointments

in patient homes, (b) asynchronous and secure options for exchanging health information over cloud-based web portals before or between appointments, and (c) for online social networking and peer support group development. An interest in eHealth applications has been recognized in audiology by both patients and hearing care professionals (Meyer & Hickson, 2021). In addition, at least five of the leading global hearing technology companies (Sonova, Demant, WS Audiology, Starkey, and GN Hearing), have developed remote eHealth platforms for at least one or more of their product lines in recent years to meet the growing demand of eHealth related tele-audiology services (Copithorne, 2021). Despite the rapid growth in these offerings, it is unclear whether these platforms are well suited to support the needs of young children who are DHH and their families.

The current global emergency greatly limited access to pediatric audiology centers, creating challenges for timely monitoring, management, and support of pediatric patients in meeting early hearing detection and intervention (EHDI) goals set forth by the Joint Committee on Infant Hearing (JCIH, 2019) and professional pediatric practice guidelines (ASHA, n.d.b). Despite growing interest in pediatric tele-audiology applications, variability in service modalities and perceptions of audiologists surrounding tele-audiology have been identified in the tele-audiology literature (Govender & Mars, 2017; Krumm, 2016; McCarthy et al., 2018; Muñoz et al., 2021; Swanepoel & Hall, 2010). Comprehensive pediatric tele-audiology services are likewise scarce throughout the profession (Eikelboom & Swanepoel, 2016). Traditionally, in-person pediatric audiology care is the standard approach of practice in developed countries for evaluating auditory function and monitoring hearing technology to ensure optimal audibility. Limitations to administering eHealth services comprehensively, such as the inability to complete real-ear probe microphone verification measures, simulated test box measures, acoustic feedback measurements/ management, and physical device and earmold troubleshooting/management arguably may be reasons why they have not yet been widely adopted by pediatric audiologists.

Studies surrounding pediatric tele-audiology applications for young children who are DHH (birth to 5 years) have grown in the areas of infant and pediatric hearing screenings (Ameyaw et al., 2019; Botasso et al., 2015; Krumm et al., 2005; Krumm et al., 2007; Krumm et al., 2008; ; Skarzyński et al., 2016; Stuart, 2016), infant diagnostic hearing assessments (Stuart, 2016; Williams et al., 2020), pediatric cochlear implant mapping (Goehring & Hughes, 2017; Hughes et al., 2016; Hughes, Goehring et al., 2018; Hughes, Sevier et al., 2018) and pediatric hearing aid management (Muñoz et al., 2017; Neumann et al., 2021). Of all these studies, only one (Neumann et al., 2021) has explored the use of a manufacturer developed eHealth platform with young children and their families as the target population. In this study, Neumann and colleagues (2021) incorporated a repeated measures design, sampling a group of audiologists and parents of

children who are DHH (age 5–17) to gather information about the usability of the remote eHealth platform for pediatric patients. Three scheduled eHealth platform appointments were completed with the parent and child using a mobile smart device application called the myPhonak app, that was compatible with an adult hearing aid adapted for pediatric use. Parents and audiologists were asked subjectively to report their experiences after these sessions regarding the usability, convenience, confidence, and satisfaction of remote services provided while using the app. After the third visit, most of the participating parents (*n* = 18) and audiologists (*n* = 18) reported they were either extremely likely or very likely to use remote services again in the future. In addition, more than half of the parents (10/18) reported they preferred a remote support visit over a face to face or hybrid visit.

Although a rapid growth in research is encouraging, it is anticipated that pediatric applications for eHealth will continue to evolve as new evidence becomes available and other legal and logistical eHealth clearances are granted. As the number of individuals and families seeking tele-audiology services increases, the need for access to appropriate evidence-based tele-services from audiologists and multidisciplinary teams will continue to grow as well. Given increased numbers of families and children who could benefit from the expansion of pediatric tele-audiology services, and a lack of well-defined studies on children using them, the need for a concise clinical guide to existing commercially available platforms and their pediatric applications was identified. The purpose of this study was to provide a review on current tele-audiology eHealth platforms and their application for young children who are DHH and their families.

Method

Hearing industry websites in the United States with published information related to eHealth or remote care platforms were included in this review, provided the scope of their website addressed topics related to tele-audiology and possible pediatric applications for young children age birth to 5 years. In an effort to provide a concise reference for pediatric audiologists in the United States who provide services to young children who are DHH, only the six major hearing aid brands (Phonak, Oticon, ReSound, Widex, Signia, and Starkey), the three major makers of bone anchored (i.e., osseointegrated implant) hearing systems (Cochlear, MED EL, and Oticon Medical), and the three major cochlear implant company websites (Advanced Bionics, Cochlear, and MED EL) in the United States were reviewed for this study. Company websites were accessed and reviewed in November and December 2021.

Procedures

An initial search of hearing aid manufacturer websites known to have developed eHealth platforms was completed, using listings from published resources made available online by NCHAM and Copithorne (2021). See Appendix for full list of URL hyperlinks.

Other implantable technology manufacturer websites, hearing health consumer focused sites, and websites that included information related to eHealth features in hearing technology for children who are DHH in the United States were also reviewed using a Google Chrome search engine. Only one news website was found from this latter search, from MedicalNewsToday.com, that yielded recommendations and hyperlinks of where to potentially consider ordering pediatric hearing aids online.

During the review, it was noted if information about specific pediatric line products or eHealth tele-audiology platforms was not available for a given manufacturer. eHealth design features deemed important for families and pediatric audiologists seeking information about eHealth platforms were identified and adapted from two online resources (NCHAM, 2021; Copithorne, 2021). These were adapted further in comparing them to evidence-based recommendations for the selection and fitting of pediatric amplification on young children (AAA, 2013). In total, twelve important pediatric features were identified for use in the review of existing eHealth platforms (see Figure 1).

Figure 1
Twelve eHealth Platform Features Deemed Important for Young Children and Families

Telecommunication Support	Feedback Measurement
Telecommunication Feedback	Manual/Volume Controls
Additional Remote Accessory Requirements	Firmware Upgrades
Remote Programming/Fine Tuning Features	Datalogging
Remote Battery Status Monitoring	Apple Operating System (iOS) Compatibility
Remote Diagnosis of Hardware Issues	Android Operating System (OS) Compatibility

Analysis of available pediatric hearing technologies and compatible eHealth platforms found online were explored using a Microsoft Excel Spreadsheet. Hearing technologies deemed appropriate for young children (i.e., behind-the-ear hearing aids, bone anchored hearing systems processors, and cochlear implant processors) were analyzed by manufacturer, and a grouping of the findings of select eHealth options were described based on their pediatric design features.

Results

A total of 4 eHealth platforms (four of the six hearing aid companies) were found to have potential capabilities of being used with young children age birth to five years, and all were available via smart device (phone/tablet) online software applications. In the smart device application webstores (i.e., Apple App Store, Google Play Store), the four tele-audiology eHealth platforms identified were advertised with age/content ratings for users age 4 and older for Apple iOS/ iPadOS users, and all ages (i.e., "Everyone") for Android OS users. Apps found with ratings for older age groups on the Apple store were excluded from the review, including the Starkey Thrive app (for users ≥ 12 years), the Signia app (for users ≥ 17 years), and the Oticon Medical Ponto Care™ app (for users ≥ 12 years), due to these ratings indicating a better application with children older than the younger targeted population (birth to five years). As of the time of this study, the Cochlear Remote Check system (Cochlear Limited, 2021) was listed as having approval for their newest cochlear implant processor; however, it was not yet available to access for review. Likely it would have been excluded due to it being advertised for users ≥ 6 years. Only one of the six hearing aid manufacturers (Phonak) was found to have a pediatric dedicated platform (myPhonak Junior app) separate from their app for older patients (myPhonak app, rated for users ≥ 17 years). See Table 1 for summary information related to each connecting platform or smart device app.

Pediatric Design Features

A summary of important pediatric design features important for eHealth platforms reviewed is provided in Table 2. Similarities across the platforms were identified in communication support, synchronous remote programming, datalogging, and smart device compatibility; however, ReSound and Widex were found to have slightly more features available in their eHealth platform apps compared to Phonak and Oticon. Resound and Widex both include features such as being able to remotely diagnose hearing aid hardware issues, provide remote feedback measurements for troublesome feedback issues, and send remote firmware upgrades when warranted.

Discussion

The primary purpose of this review was to identify existing eHealth platforms for hearing devices that may be used with young children, age birth to five years. This review identified four platforms that may be deemed eligible for this population, based on the age ratings of the apps in the Apple App Store (four years and older) and Google Play Store (all ages). The strength of this review is that it provides pediatric audiologists and clinical researchers with up-to-date information about available eHealth platforms that are freely accessible and available to young children who are DHH and their families. Many features of these platforms appear to be well suited to meet parent and audiologist pediatric amplification monitoring needs.

Despite the benefits of what this review found, this article also highlights there is limited evidence on the efficacy of eHealth platform use for young children who are DHH. An interesting finding is that the pediatric features from the two hearing aid manufacturers with pediatric line products were not as comprehensive in their eHealth platforms compared to the other non-pediatric line product platforms. Also evident from this review was the variety of other manufacturer developed eHealth platforms (i.e., Starkey, Signia, Cochlear, and Oticon Medical) that were designed and rated for older child (≥ 6 years) and adult populations, suggesting a lack of evidence to establish any efficacy of those platforms with young children at present.

Table 1

Summary of eHealth Platforms and Pediatric Hearing Devices Available as of December 2021

eHealth Platform	Manufacturer Compatible Pediatric Device(s)	Name of Mobile App (OS)	Cost
Phonak Remote Support	Phonak Sky M, Sky Link M, Naida P UP	myPhonak Junior (iOS, Android)	Free
Oticon RemoteCare	Oticon Xceed Play, Opn Play	Oticon ON (iOS) Oticon Remote Care (Android)	Free
ReSound Assist Live	ReSound LiNX Quattro, LiNX 3D, ENZO Q, ENZO 3D, Key	ReSound Smart 3D (iOS, Android)	Free
Widex Remote Care	Widex* MOMENT, EVOKE, BEYOND, UNIQUE, DREAM	Widex Remote Care (iOS, Android)	Free

Note: *indicates a non-pediatric line specific device.

Table 2

Summary of Pediatric Design Features Available in Reviewed eHealth Platforms

	Phonak	Oticon	ReSound	Widex
Telecommunication Support	✓	✓	✓	✓
Telecommunication Feedback	✓	-	✓	-
Additional Remote Accessory Not Required	✓	✓	✓	-
Synchronous Remote Programming	✓	✓	✓	✓
Remote Battery Status	✓	✓*	✓*	✓
Remote Diagnosis	-	-	-	✓
Remote Feedback Measurement	-	-	✓	✓
Manual/Volume Controls	✓	✓†	✓	✓†
Remote Firmware Upgrades	-	-	✓	✓
Datalogging	✓	✓	✓	✓
iOS Compatible	✓	✓	✓	✓
Android OS Compatible	✓	✓	✓	✓

Note: *indicates rechargeable models only.

†indicates a separate app is required.

As mobile technologies are becoming the mainstay worldwide, and as app/software based learning programs improve, it is critical that patients of every age, including young children, are provided with appropriate and timely access to the available features of eHealth platforms to enhance and support intervention goals. More research is needed to determine what aspects of these platforms may be best suited for pediatric audiologists to incorporate into their regular monitoring practices. The importance of EHDI practices is well-established. The reality of advanced features eHealth has to offer, such as datalogging, synchronous fitting and troubleshooting, and private telecommunication health lines, is consistent with patient, family, and clinician interests alike (Neumann et al., 2021).

Now is the time to continue advancing these technologies to reach all families where possible.

Pediatric Tele-Audiology Resources

The purpose of this article was not to advocate that eHealth platforms are the only type of tele-audiology service that should be incorporated with young children. The reader may be interested in other aspects of tele-audiology they would like to implement in their practice, and for a more sequential guide on how to set up pediatric tele-audiology services for young children, the reader is encouraged to study NCHAM's Resource Guide Supporting Tele-audiology (https://infanthearing.org/teleaudiology/index.html; NCHAM, 2021) developed by

the NCHAM Tele-Audiology Steering Committee. The processes outlined in this online resource will provide a greater depth of practical information.

Limitations and Future Directions

Although all families with young children who are DHH may benefit from some level of tele-audiology service delivery, it is important to acknowledge that tele-audiology services, including the use of eHealth platforms, may not be appropriate in all circumstances or for all pediatric patients. Pediatric audiologists work together with other professionals to evaluate outcomes and to determine if tele-audiology services will likely result in improved hearing and listening outcomes for each child. It is also important to remember that local, state, national, and international regulatory requirements surrounding telepractice must be adhered to prior to initiating any eHealth services, despite their free availability to consumers and clinicians alike. It is the responsibility of each pediatric audiologist and hearing care professional to verify the legal policies and requirements in place regarding the provision of telepractice prior to exploring the potential of meeting patients' needs through eHealth platforms and service modalities.

This review was developed to serve as a general framework, offering audiologists access to streamlined, evidence-based information to help make appropriate clinical decisions for young children who are DHH and their families who may seek tele-audiology services and eHealth platform options specifically. It should be noted, however, that pediatric tele-audiology research faces challenges in providing standards that can be applied across all young children and their families. Due to the critical developmental years where language develops, there is often limited opportunities to conduct controlled research with children birth to 5 years of age, including in areas of tele-audiology. Furthermore, the controlled research available with young children is continually limited by factors such as sample sizes, a wide range of interventions and communication modalities, accessibility to tele-audiology services, hearing technology options, and complex case histories. Therefore, it is difficult to apply evidence across all or even a larger subset of young children who are recipients of pediatric tele-audiology. It is imperative that pediatric audiologists consider the evidence alongside the needs of each child and family they serve to provide best clinical care possible.

Although new evidence is emerging in pediatric tele-audiology, particularly on the heels of the global COVID-19 pandemic, it was not considered necessary in the current document to explore every experimental application of tele-audiology with pediatric populations. Therefore, the authors acknowledge the limitations of the current document not necessarily reviewing every potential eHealth platform or service delivery modality that may incorporate similar eHealth principles. Future guidelines and revisions of this review should be developed as more empirical evidence becomes available to incorporate more rigorous and updated reviews of empirical literature surrounding the use and application of eHealth platforms in pediatric audiology.

Conclusion

The present study revealed that eHealth platforms currently available with compatible hearing technologies might benefit children who are DHH and their families. There are several available platforms at no cost to patients that indeed have many features that would benefit both families and audiologists alike for different age groups. This review highlighted that there is a dire need for more research to establish efficacy measures for the application of eHealth platforms across the lifespan, and across more types of hearing technology for young children than just hearing aids. This review can provide the assistance needed by pediatric audiologists and families of children who are DHH to make device selections if specific features of eHealth platforms are desired. In addition, this review might also provide a knowledge base on which pediatric hearing care providers and clinical researchers may build further tele-audiology intervention outcome studies.

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Appendix

Websites Accessed for the Review in November and December 2021

Source	Website URL
Hearing Tracker	• https://www.hearingtracker.com/services/remote-care
Google Sheet of comprehensive brand comparison	• https://docs.google.com/spreadsheets/d/1osFr44SNiPmZFALI5oBY-XDJlVosZyRKYPNiIJumz5s/edit
National Center for Hearing Assessment and Management's TeleAudiology Resource Guide	• https://infanthearing.org/teleaudiology/index.html
Excel spreadsheet provided to NCHAM Courtesy of the Canadian Hearing Society	• https://infanthearing.org/teleaudiology/docs/Remote%20Hearing%20Aid%20Programming.xlsx
Major Hearing Aid Manufacturer Websites	
Phonak	• https://www.phonakpro.com/us/en/products/hearing-aids/sky-marvel/overview-sky-marvel.html • https://www.phonak.com/us/en/hearing-aids/apps/myphonak-junior-app.html
Oticon	• https://www.oticon.com/professionals/pediatric • https://www.oticon.com/support/remote-care
ReSound	• https://www.resound.com/en-us/hearing-loss/children https://www.resound.com/en-us/hearing-aids/apps/smart-3d
Widex	• https://www.widex.pro/en/products/remote-hearing-aid-fitting
Signia	• https://www.signiausa.com/signia-app/
Starkey	• https://www.starkey.com/hearing-aids-for-children • https://www.starkey.com/hearing-aids/apps/thrive-hearing-control
Major Hearing Implantable Technology Company Websites	
Advanced Bionics	• https://www.advancedbionics.com/us/en/home/solutions/marvel/kids.html
Cochlear	• https://www.cochlear.com/us/en/home/products-and-accessories • https://www.cochlear.com/us/en/professionals/connected-care/remote-care • https://www.medel.com/en-us/hearing-solutions
MED EL	• https://blog.medel.pro/remote-care-telemedicine-digital-resources/
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