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Diagnostic Infant Auditory Brainstem Response Testing Via Telehealth: A Survey of Professional Opinions and Current Barriers

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Abstract

Purpose: To examine the barriers to Washington State audiologists adopting telehealth as a means of improving accessibility to diagnostic audiology for infants.

Methods: A Qualtrics survey was distributed via e-mail and social media. Survey participants were required to be audiologists practicing in Washington State. The sixteen-question survey consisted of topics related to participant demographics, previous telehealth experience, and barriers to the use of telehealth for diagnostic infant auditory brainstem response (ABR) testing. A total of 17 participants completed the survey.

Results: Survey responses indicated that Washington State audiologists are largely neutral or disagree with telehealth being an effective means of performing remote diagnostic ABRs. Participants primarily identified equipment cost as a barrier, and had varying opinions regarding insurance reimbursement, internet connection, privacy, and ability to counsel.

Conclusions: This study identified several barriers to the implementation of remote diagnostic ABR testing in Washington State. The neutral and negative view of telehealth for diagnostic infant ABR points to the need for education among Washington State audiologists. Disseminating information on the efficacy of telehealth to audiologists is a likely next step in reframing the current attitude toward remote diagnostic ABR and working toward reducing loss to follow-up rates for rural families.

Keywords: telehealth, infant, hearing loss, diagnosis, loss to follow-up, auditory brainstem response (ABR)

Acronyms: ABR = auditory brainstem response; JCIH = Joint Committee on Infant Hearing

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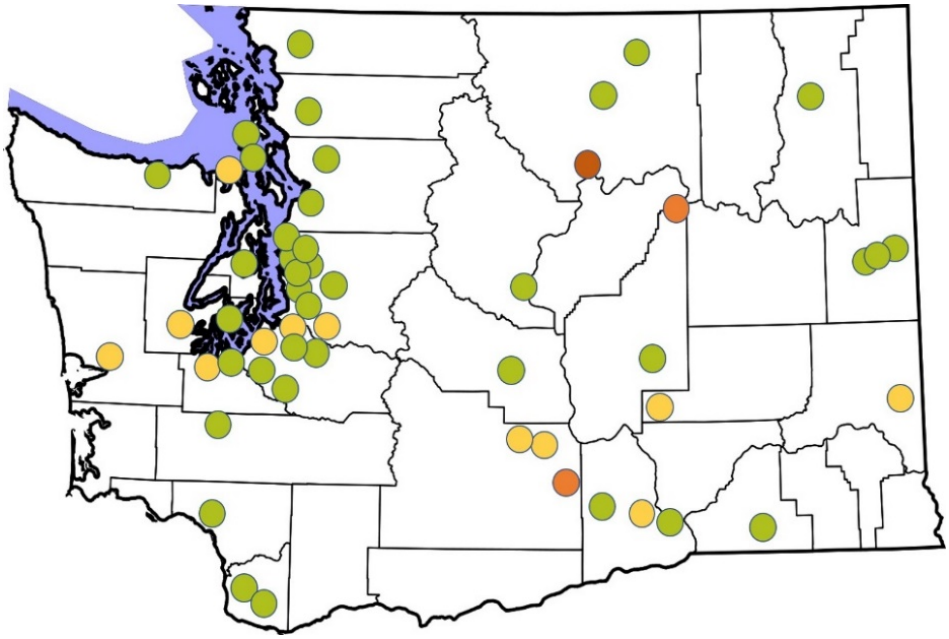
Undiagnosed childhood hearing loss inhibits the development of spoken language, social skills, and cognition. To mitigate the negative impact of hearing loss on child development, the Joint Committee on Infant Hearing (JCIH, 2019) recommends a "1-3-6" approach for early intervention; infants should: (a) be screened for hearing loss by one month of age, (b) if hearing loss is present, receive diagnosis by three months of age, and (c) if hearing loss is present, receive early intervention services by six months of age. In 2018, 25.3% of Washington State infants were lost to follow-up after a refer on newborn hearing screening (Center for Disease Control and Prevention, 2018). This percentage varies greatly among screening centers, with as many as 44% to 100% of infants remaining undiagnosed after a refer on newborn hearing screening at centers across the state (Washington State Department of Health Early Hearing Detection and Diagnosis and Intervention, 2019; Figure 1).

The wide variance in loss to follow-up rates across the state is likely due, in part, to the issue of the health service disparity between urban and rural communities, as evidenced by lower loss to follow-up rates in densely populated counties (e.g., King, Pierce, Snohomish, Spokane), and higher loss to follow-rates in sparsely populated counties in Central Washington (e.g., Yakima, Douglas, Okanogan; Washington State Department of Health Early Hearing Detection and Diagnosis and Intervention, 2019; Figure 1). Families in rural areas experience barriers to hearing health services such as travel distance and access to specialized pediatric audiologists (Hatton et al., 2019). These barriers may prevent families from receiving appropriate diagnostic services, including diagnostic auditory brainstem response (ABR) testing following a refer on newborn hearing screening. Previous studies have suggested telehealth as a viable means of service provision in rural communities (Hatton et al., 2019; Stuart, 2016). However, there has been limited progress toward implementing telehealth for diagnostic audiology in Washington State.

Figure 1

2017 Loss to Follow-up Rates in Washington State

Loss to Follow-Up Rate	Color Code
0–10%	
11–25%	
26–50%	
> 50%	



Note. The data presented here were originally published in Washington State Department of Health: Early Hearing-loss Detection, Diagnosis and Intervention. (2019, January). *Universal Newborn Hearing Screening (UNHS) Hospital Summary Report for Infants Born in 2017.* https://www.doh.wa.gov/Portals/1/Documents/Pubs/344-076-UNHSHospitalReport.pdf

Telehealth and Audiology

The American Speech-Language-Hearing Association (ASHA) 2005 position statement regards telehealth as an appropriate service delivery model, as long as remote services achieve equal quality as face-to-face services. A recent study in British Columbia, Canada, evaluated the design of a remote ABR system, including the cost/time effectiveness, accuracy of testing, and caregiver satisfaction (Hatton et al., 2019). Among 102 infants assessed using remote ABR, 50 infants were diagnosed with hearing loss. The results were established to be comparable to face-to-face assessments. In total, Hatton et al. (2019) concluded that remote ABR testing is efficient, accurate, cost-effective, and highly valued by caregivers, therefore meeting the standards established by ASHA.

Telehealth takes on many forms, including synchronous models, in which the provider interacts with the patient in real-time; or asynchronous models, in which data is collected and then sent to the provider to be reviewed. Both synchronous and asynchronous approaches offer a unique opportunity to provide clinical services to underserved populations in rural areas. Stuart (2016) used a telehealth service delivery model to perform remote diagnostic ABRs on infants in rural North Carolina. Stuart successfully employed a hybrid model in which both synchronous and asynchronous methods were used to evaluate 40 infants referred for diagnostic ABRs. Overall, the success of this model supports the use of combined synchronous and asynchronous technology for administering diagnostic ABRs (Stuart, 2016).

Ultimately, the effectiveness of a remote diagnostic ABR program is measured by its ability to improve service delivery and reduce loss to follow-up. Dharmar et al. (2016) performed remote diagnostic ABR testing on 22 infants with a referred hearing screening. Among these infants, 59.1% were diagnosed with some form of permanent or transient hearing loss. Overall, none of the infants were lost to follow-up, compared to the 22% loss to follow-up rate previously recorded in that region. This indicates that telehealth is a powerful tool in reducing loss to follow-up rates (Dharmar et al., 2016).

Together, these studies confirm the feasibility of remote diagnostic ABR testing and support the idea that telehealth lowers loss to follow-up rates in rural areas (Dharmar et al., 2016; Hatton et al., 2019; Stuart, 2016). Despite the success of remote diagnostic ABR programs, the uptake of telehealth for audiology has been limited, due to the lack of published literature, high equipment costs, and inconsistencies in internet connection (Polovoy, 2008). Audiologists themselves have identified infrastructure, training, and reimbursement as major barriers to the use of teleaudiology (Ravi et al., 2018). However, there is limited information on clinician perceptions of the applications of telehealth in audiology. Examining these barriers and perceptions among audiologists will assist in understanding why telehealth has not been adopted for remote ABR testing.

Research Questions

Several challenges have affected implementation of remote ABR testing in Washington State and across the nation. Barriers including costs, professional opinions, technical effectiveness, privacy, and counseling all require additional research (Ravi et al., 2018). The primary purpose of the present study was to investigate the lack of movement toward telehealth as a means of improving accessibility to diagnostic

audiology for infants in Washington State. Specifically, the study aimed to answer the two following questions.

1. Would professionals use telehealth for diagnostic ABR testing if made available?
2. Do professionals believe a telehealth model would improve service provision for rural families in the region?

Method

Participants

Participants included Washington State audiologists who perform pediatric ABR testing. Though the exact number of pediatric ABR providers in Washington State is unknown, the Washington State Department of Health (2020) reports 29 diagnostic audiology clinics for infants. Participant information related to years of experience, geographic location, number of diagnostic infant ABRs performed in a month, and number of infants lost to follow-up at their place of work in 2018 was collected.

Survey

Survey questions were developed based on the available literature identifying barriers to the use of telehealth in audiology. The survey consisted of two questions required for participation in research, two questions related to demographics, two questions surrounding infant ABR experience, one question regarding previous telehealth experience, and nine questions related to opinions and barriers to the use of telehealth for diagnostic infant ABR, for a total of 16 questions (see Appendix A). Among these questions were six multiple-choice questions, one drop-down menu question, nine Likert scale questions, and an additional optional text-box to give participants the opportunity to submit any questions or comments regarding the survey content. Once participants began the survey, they were given two weeks to complete it. During this two-week period, participants were able to save their progress and return later. The survey was available for 15 weeks, between December 19th, 2019 and April 4th, 2020.

Procedure

This study was approved by the Western Washington University Institutional Review Board (IRB#: 3351EX19). The survey was developed using Qualtrics, an online survey-building program licensed through Western Washington University. Participants accessed the survey through a secure and anonymous link that was distributed through social media and e-mail. The reusable link and scripted instructions were posted on December 9, 2019 and approximately one month later on January 7, 2020, to several audiology Facebook pages and emailed directly to various Washington State audiologists. In accordance with the Western Washington University Human Subjects Research Protocol, an informed consent statement was included at the beginning of the survey to inform participants of their rights and the nature of the study. All participants indicated that they read the informed consent statement and agreed to participate in the survey.

Results

A total of 45 participants opened the survey and a total of 17 participants completed it. The final responses came from King, Spokane, Whatcom, Clark, Pierce, San Juan, and Snohomish Counties. Years of experience varied greatly with 23.5% (4) of the participants reporting 0–5 years of experience, 29.4% (5) reporting 6–10 years of experience, 23.5% (4) reporting 11–15 years of experience, 11.8% (2) reporting 16–20 years of experience, and the remaining 11.8% (2) reporting greater than 20 years of experience. On average, the survey took three minutes to complete.

The majority (58.8%) of the participants reported performing 1–5 diagnostic infant ABRs per month on average, with 11.8% (2) performing 6–10, 5.9% (1) performing more than 15, and 23.5% (4) performing none, which may mean they only perform a few in any given year or previously performed ABR testing and do not do so now. When asked to report how many infants were lost to follow-up at their place of work in 2018, 53.3% (8) reported 1–10 infants lost to follow-up, 26.7% (4) reported no infants lost to follow-up, 13.3% (2) reported 11–30 infants lost to follow-up, and 6.7% (1) reported 31–50 infants lost to follow-up. Only 17.6% (3) of the participants reported using telehealth to provide audiologic services prior to taking the survey.

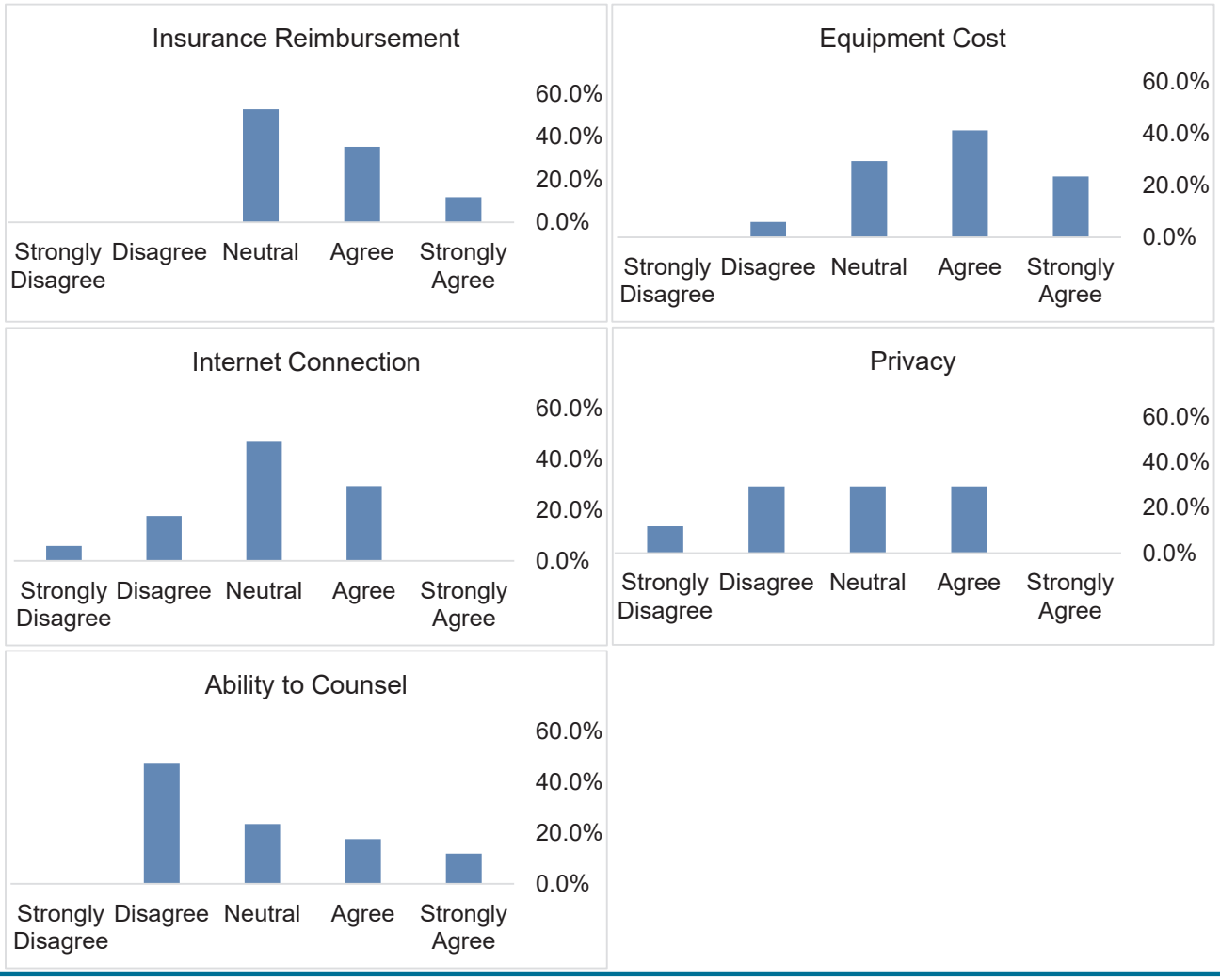
Participants responded to the following statement "I view telehealth as an effective means of performing diagnostic infant ABRs." Just over half (52.9%, 10) of participants were neutral regarding their opinion of the efficacy of telehealth for diagnostic infant ABRs or did not know enough to make an informed decision. Among the rest of the participants, 35.2% (6) either *disagreed* or *strongly disagreed* with this statement, and the remaining 11.8% (2) either *agreed* or *strongly agreed*. The majority of participants (64.7%, 11) *disagreed* or *strongly disagreed* that many infants in their community are lost to follow-up because they do not have access to diagnostic ABR. A small portion (23.5%, 4) were *neutral* with this statement, and only 11.8% (2) of participants agreed.

The participants were asked to rate their opinion of various barriers to the use of telehealth, including insurance reimbursement, equipment cost, internet connection, privacy, and ability to counsel remotely (Figure 2).

Regarding insurance reimbursement, 52.9% (9) of the participants were *neutral*, 35.3% (6) *agreed*, and 11.8% (2) *strongly agreed*. The majority of the participants (64.7%, 11) either *agreed* or *strongly agreed* with the statement, "Equipment cost is a barrier to the use of telehealth for remote diagnostic infant ABR," with 29.4% (5) being *neutral* and the remaining 5.9% (1) disagreeing with the statement. A large portion (47.1%, 8) of participants were *neutral* about internet connection being a barrier to the use of telehealth for remote diagnostic ABR, with the rest of the responses divided almost evenly between those who *agreed* (29.4%, 5) and those who either *disagreed* or *strongly disagreed* (23.5%, 4) with internet connection being a barrier. In response to the statement "Privacy is a barrier to the use of telehealth for remote diagnostic infant ABR," the participants were split evenly across responses with 29.4% (5) agreeing, 29.4% (5) disagreeing, and 29.4% (5) being neutral. The remaining 11.8% (2) of participants *strongly disagreed* with this statement. When asked to respond to the statement "Ability to counsel remotely is a barrier to the use of telehealth for remote diagnostic infant ABR," 47.1% (8) of the participants

Figure 2

Participants' Opinions of Various Barriers to Auditory Brainstem Response (ABR) Testing Via Telehealth



disagreed, 29.4% (5) either *agreed* or *strongly agreed* and, the remaining 23.5% (2) were *neutral*. Approximately half of participants (47.1%; 8) *agreed* or *strongly agreed* with the statement "If the technology and training were made available for my workplace, I would feel comfortable diagnosing an infant with hearing loss remotely." A large portion of participants (35.3%; 6) *disagreed* or *strongly* disagreed, and the remaining 17.6% (3) were *neutral*.

Discussion

Overall, results of the present study indicate that Washington State audiologists are largely neutral or disagree with remote ABR testing being an effective diagnostic tool for assessing hearing loss in infants. Admittedly, there are limited peer-reviewed studies on the applications of telehealth in audiology, which may contribute to the misconception or ambivalence among audiologists. However, the available literature supports the efficacy of a telehealth approach for infant ABRs and confirms that remote diagnostic ABR yields comparable results to traditional, face-to-face versions (Hatton et al., 2019; Stuart, 2016).

Equipment Cost

Still, many barriers obstruct the widespread use of telehealth in Washington State. One of the primary barriers identified by audiologists sampled in the current study was equipment cost. Particularly in rural communities, in which audiologists would otherwise incur travel costs to conduct ABRs, remote ABR models provide direct travel cost savings (Hatton et al., 2019). In the study design used by Hatton et al. (2019), the cost to equip a complete telehealth ABR system was $9000, indicating that this approach can be highly cost effective.

Insurance Reimbursement

Most participants of the current study stated they were neutral or did not know enough information to make an informed decision about insurance reimbursement. Though many other fields use telehealth throughout the course of diagnosis and treatment, there are no current federal or Washington State standards for reimbursement of remote audiology services. Rather, the individual payer determines reimbursement (Polovoy, 2008; ASHA, n.d.). As a result, audiologists are largely restricted to providing face-to-face services, posing a significant barrier to the use of telehealth in the field of audiology.

Currently, many audiologists are not able to provide in-person services due to the COVID-19 pandemic. In response, the Centers for Medicare & Medicaid Services released an update on April 30th, 2020 that includes audiologists as eligible providers for reimbursement of certain telehealth services

(ASHA, 2020a, 2020b). This expansion is retroactive to March 1st, 2020 and will continue for the duration of the public health emergency. To date, however, ABR testing has not been listed as a covered service under the Medicare telehealth benefit. According to the American Academy of Audiology (2020) this lack of coverage does not necessarily mean audiologists are prohibited from providing remote ABR services. Patients are able to reimburse the audiologist directly for uncovered services. Though this is an imperfect solution, it is promising that professional organizations are lobbying for audiologists to be included in coverage for telehealth services.

Internet connection

The use of telehealth has also been hampered by the internet capacity required for remote ABR technology, and its availability in rural communities. The audiologists surveyed in the present study were largely neutral regarding the issue of internet connection. In a study conducted by Hatton et al. (2019), the authors used the previously existing broadband infrastructure to conduct remote ABR testing. Reportedly, the authors did not encounter connectivity issues (Hatton et al., 2019). However, additional research is needed to determine the necessary network requirements for remote diagnostic ABR testing, particularly for a combined synchronous and asynchronous approach.

Privacy

Privacy issues may be one of the most challenging barriers to the use of telehealth, especially in cases where audiologists use video interface technology. Audiologists are bound by the Health Insurance Portability and Accountability Act of 1996 (HIPAA), as well as individual state privacy requirements (Denton & Gladstone, 2005). Though HIPAA-compliant video interface platforms are available, one must ensure that all transactions of personal health information are secured when being transmitted electronically. The respondents in the present study were split evenly between being neutral, agreeing, and disagreeing with the concept of privacy as a barrier.

Considering the recent COVID-19 pandemic, the U.S. Department of Health & Human Services (HHS; 2020) issued a statement temporarily waiving the enforcement of HIPAA requirements for the duration of the federally declared national emergency (ASHA, 2020a, 2020b). According to the HHS Office, providers can use any non-public facing video or audio communication product (e.g., Zoom, Skype, Google Hangouts) to provide telehealth during the national emergency.

Despite these recent developments, the perception of privacy issues may also limit families from wanting to partake in a telehealth model. In a study conducted by Dharmar et al. (2016), the participating parents were surveyed and overwhelmingly reported to be comfortable discussing their child's hearing status remotely. However, further research is needed to determine patient and provider perception of privacy issues and potential safeguards.

Counseling

Finally, in the case that hearing loss is diagnosed, there must be a tactful approach to counseling remotely. Polovoy (2008) interviewed William Campbell, the Infant Hearing Program audiologist at the Thunder Bay District Health Unit in Ontario. Campbell's program uses both synchronous video conferencing and a data stream, which allows the audiologist to control the remote ABR equipment. Campbell discussed the challenges of diagnosing a hearing loss remotely and how it may not be appropriate to discuss sensitive news in a telehealth format. To address this issue, social workers at the Thunder Bay District Health Unit are collaborating with audiologists to develop a protocol in the case of a remote hearing loss diagnosis.

One participant in the present study wrote, "For me, counseling via video would be the most difficult barrier to overcome. In my position, I have needed to use video interpreters for families on occasion, and these have been the most challenging counseling sessions by far. However, if a family did not have another choice, I would much rather offer telehealth service and diagnose a baby than miss them." Diagnosing a permanent childhood hearing loss during face-to-face appointments must be done clearly and empathetically. The same level of care must be achieved during remote diagnostic appointments as well.

It is promising that many audiologists responded that they would feel comfortable diagnosing a hearing loss remotely if the technology and training were made available. However, the majority of participants were either neutral or disagreed, further emphasizing the varied attitudes of audiologists toward a telehealth approach to diagnostic ABR testing and counseling.

Equipment set-up

One topic not included in this survey was audiologists' opinion on collaboration with support staff for equipment set-up (e.g., scrubbing, electrodes and impedance, filters). Multiple participants addressed this issue in their response: "There are so many nuances to performing ABR on infants. Doing this remotely would require a highly trained person on the other end [and] does not negate the need for expensive equipment"; "Through Telehealth, who will prep the infant and apply electrodes and ear inserts?"; "Electrode montage setup and proper placement of earphones cannot be done remotely. At a minimum a highly trained and competent technician would need to be with the infant in person." Certain programs have successfully employed local support personnel or technicians to place the transducers and electrodes required to record an ABR. A model described by Polovoy (2008) sends the necessary equipment to a technician at the local health center or hospital, who then connects the infant. At that point, the remote audiologist will take control of the computer, complete an impedance check, interact with the family and conduct the ABR once the infant settles or falls asleep. In this model, the technician only requires minor supplemental training, indicating that this approach can be effective even with limited resources (Polovoy, 2008).

Limitations and Future Research

The present study has several limitations. Primarily, the small sample size means the findings cannot be generalized to reflect the opinions of all audiologists in Washington State.

Future studies may be able to gather more information from a larger group of audiologists. Likewise, the majority of participants were from King County, which incorporates some of the more populated areas in Washington State. Therefore, it is not surprising that most of the participants did not identify access to diagnostic ABR testing as a major barrier. It would be beneficial to focus on gathering responses from rural communities, who tend to see more issues with loss to follow-up.

Despite the limitation of a small sample size, these data are relevant in terms of informing what to do next. The neutral and negative view of telehealth for diagnostic infant ABR points to the need for education among Washington State audiologists. Disseminating information on the efficacy of telehealth to audiologists is a vital step in reframing the current attitude toward remote diagnostic ABR and working toward reducing loss to follow-up rates for rural families.

Conclusion

Remote diagnostic infant ABR testing is an evidence-based way to diagnose infants with hearing loss in rural communities and reduce loss to follow-up. However, several barriers remain in its implementation in Washington State, including the negative view audiologists have toward telehealth and its applications. Once these barriers are addressed, the audiology community can promote the uptake of remote diagnostic ABR to improve loss to follow-up rates in Washington State and beyond.

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Appendix A

Western Washington University: A Telepractice Model for Diagnostic Infant ABR Testing: Professional Opinions and Current Barriers

Welcome!

We are asking you to take part in a research study. **Participation is voluntary.** The purpose of this form is to give you the information you will need to help you decide whether to participate. Please read the form carefully. You may ask questions about anything that is not clear. When we have answered all of your questions, you can decide if you want to be in the study or not. This process is called "informed consent."

The aim of this survey is to evaluate the reasons why telepractice has not been adopted to improve accessibility to diagnostic audiology for infants in Washington State. A secondary aim of the survey is to answer whether audiologists would use telepractice for diagnostic ABR if made available and further, if they believe a telepractice model would improve service provision for rural families.

Your perspective as an audiologist is valuable to this topic. Your responses in this survey may reveal patterns related to service provision for rural communities across Washington State.

- The survey will take less than 5 minutes to complete.
- You may use the back button to visit earlier questions.
- You will have the option to **save your progress**, exit, and return to complete the survey later.
- None of your personal information will be collected in this survey.
- **The data collected here will be kept secure and will not be traceable back to you.**
- There is no predicted risk or discomfort related to these questions.
- You may choose to **NOT** answer any question or exit the survey at any time. If you do not know the answer to a question, you can leave it blank.

If you have any questions, please contact us directly. **Haley Prins, prinsh@wwu.edu or Douglas Sladen, douglas.sladen@wwu.edu.**

If you have any questions about your rights as a research participant, you can contact the **Western Washington University Office of Research and Sponsored Programs** at **compliance@wwu.edu** or **(360) 650-2146.** Thank you for your time!

You can download a copy of this form to print for your records using the following link: Consent Form

Q1 I have read the above information and I agree to participate in this survey.

- ○ Yes, I agree to participate.
- ○ No, I do not agree to participate.

Q2 Are you at least 18 years of age?

- ○ Yes
- ○ No

Q3 How long have you worked as an audiologist?

- ○ 0-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ > 20 years

Q4 In which county do you work? Please select an option
▼ Adams (1) ... Yakima (39)

Q5 On average, how many diagnostic infant ABRs (following a referred NBHS) do you perform in a month?

- ○ 0
- ○ 1-5
- ○ 6-10
- ○ 7-15
- ○ > 15

Q6 At your place of work, how many infants were lost to follow up following a failed NBHS in 2018?

- ○ 0
- ○ 1-10
- ○ 11-30
- ○ 31-50
- ○ > 50

Q7 Have you used telehealth to provide *any* audiologic services before?

- ○ Yes
- ○ No

Q8 Please respond to the following statements.

	Strongly agree (1)	Agree (2)	Neutral, I don't know enough about it to make an informed decision (3)	Disagree (4)	Strongly disagree (5)
I view telehealth as an effective means of performing diagnostic infant ABRs.	○	○	○	○	○
Many infants in my community are lost to follow up because they do not have access to diagnostic ABR.	○	○	○	○	○
Insurance reimbursement is a barrier to the use of telehealth for remote diagnostic infant ABR.	○	○	○	○	○
Equipment cost is a barrier to the use of telehealth for remote diagnostic infant ABR.	○	○	○	○	○
Internet connection is a barrier to the use of telehealth for remote diagnostic infant ABR.	○	○	○	○	○
Privacy is a barrier to the use of telehealth for remote diagnostic infant ABR.	○	○	○	○	○
Ability to counsel remotely is a barrier to the use of telehealth for remote diagnostic infant ABR.	○	○	○	○	○
The use of telehealth for remote diagnostic infant ABR would improve service provision to families in my community.	○	○	○	○	○
If the technology and training were made available for my workplace, I would feel comfortable diagnosing an infant with hearing loss remotely.	○	○	○	○	○

Q9 Please use the space below to write any questions or comments regarding this survey.

_____

Note. ABR = auditory brainstem response; NBHS = newborn hearing screening.