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Revised Protocol for the Provision of Amplification to Infants and Young Children from Western University

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Since 2001, with the introduction of Ontario's Early Hearing Detection and Intervention (EHDI) program, the Child Amplification and the Pediatric Audiology Strategies and Systems Laboratories at the National Centre for Audiology (NCA) have been responsible for developing and implementing the protocol for the Provision of Amplification for Infants and Children within the Ontario Infant Hearing Program (IHP). This feature article describes the revised protocol, including key evidence areas that have changed pediatric amplification practices.

The Joint Committee on Infant Hearing (JCIH; 2019) identifies five principal EHDI program components which include: (1) universal hearing screening of all newborns (UNHS); (2) identification of babies with permanent hearing loss; (3) intervention services which include support for technology and language development; (4) family support; and 5) monitoring and evaluation of the program (JCIH, 2019). Ontario's IHP is Canada's oldest province-level EHDI program, offering UNHS and follow-up services. Ontario's support for consistent and evidence-based practice in EHDI has allowed the development of protocols and guidance documents spanning screening to language development (Ontario, 2023). This includes the Protocol for Provision of Amplification, which was first developed for program inception in 2001, and has been revised several times since (2007, 2014, 2019) to update the procedures in response to new technologies and new evidence. Publications of key elements of this protocol (e.g., Bagatto et al., 2016; Scollie et al., 2016) and public availability of the protocol for download (Western, 2023) have resulted in worldwide access, with over 300 downloads of the 2023 update in 28 different countries since it was released. Back home in Canada, infant hearing has significantly changed with more and more provinces offering EHDI (Bagatto et al, 2020). As part of developing new programs, several provinces have adopted key protocols from either the B.C. Early Hearing Program or the Ontario Infant Hearing Program. In our work at the NCA, we have been honoured to collaborate with new programs to share knowledge, support adaptations, and provide support like standardized education. In Ontario and elsewhere, these protocols continue to support the JCIH's recommendations to include program monitoring and evaluation.

The NCA's Approach to EHDI Continuous Quality Improvement

The NCA has committed to delivering standardized services as a Designated Training Centre for Ontario's EHDI program. This is achieved through developing and revising state-of-the-art protocols, training service providers, and continuous quality improvement. Version 2023.01 of the Amplification Protocol maintains the core aspects of previous versions, including use of the Desired Sensation Level (DSL) pediatric prescriptive formulae, RECD measurement, and wideband hearing aids with amplitude compression to support speech sound access. These include corrections to allow frequency-specific ABR threshold estimations as the basis for early fittings. In 2014, the protocol was significantly updated to revise the ABR corrections, align with systematic reviews (American Academy of Audiology, 2013), and include procedures for providing children with routine noise management and individualized frequency-lowering signal processing when indicated. With new evidence and clinical practice change, we recently completed Version 2023.01, which includes updates in three main areas:

1. Management of children with minimal/mild bilateral hearing loss (MBHL);
2. Management of children with permanent unilateral hearing loss (UHL); and
3. Selection and fitting of non-surgical transcutaneous bone conduction devices (BCD) to infants and children.

Highlights of Ontario's IHP Protocol for the Provision Amplification: Version 2023.01

A family-centred approach to hearing loss management requires consideration of the child and family contexts, especially for cases that are not straightforward. Factors to consider when determining the appropriateness of a hearing aid for a young child includes components such as: family factors, child factors, configuration and degree of loss, ear canal size and acoustics, and hearing aid gain/output and noise floor considerations. The main protocol updates in Version 2023.01 address considerations related to the configuration and degree of hearing loss.

Minimal/Mild Bilateral Hearing Loss (MBHL)

When working with children with MBHL, it is common to observe that some may experience developmental difficulties while others may not. Pediatric audiologists have lacked an evidence-based method to scientifically determine which of these young children are at risk. As such, hearing aid recommendations to families of children with MBHL often vary from clinician to clinician. Recent work by McCreery and colleagues (2020) provides an audibility-based criterion to support hearing aid candidacy considerations. In particular, using the Speech Intelligibility Index (SII) informs the child's access to speech in the aided and unaided conditions. Applying this additional tool supports a systematic approach for evaluating amplification candidacy for young children with MBHL. However, the protocol considers the SII as one of several factors, placing the overall decision in a broader context of the child and family.

Unilateral Hearing Loss (UHL)

It is well-established that a child who has permanent UHL is at risk for delays in speech and language, difficulties with localization and listening in noise, increased fatigue, and lower hearing-related quality of life (Bess & Tharpe, 1988; Lieu, 2004, 2013, 2015; Oosthuizen et al., 2021; Picou, Davis, et al., 2020). Some of these developmental impacts may be mitigated with hearing technology, depending on the degree of loss on the affected side. There is growing consensus for the provision of a hearing aid for children who have usable hearing unilaterally (Bagatto et al., 2019; Mattiazzi et al., 2023). A child has usable hearing when hearing levels range from mild to severe, and access to speech from a device is beneficial.

Children experiencing unilaterally limited usable hearing (LUHU) require different considerations. Historically referred to as single-sided deafness (SSD), LUHU is defined as UHL, often of profound degree on the affected side, characterized by the apparent or predicted lack of benefit from an air-conduction hearing aid (Picou et al., 2020).

Management options for children with LUHU vary. Recently, unilateral cochlear implants have been approved in Canada and the United States and a recent practice guideline provides evidence to support this option (Park et al., 2022). Due to the high incidence of cochlear nerve disorders (CND) in children with LUHU, magnetic resonance imaging is an important first step when considering management options (Vos et al., 2022). Other options are available when children are not candidates for a cochlear implant due to CND or when parents are not interested in a surgical solution.

Non-surgical options such as a remote microphone (RM) system, BCD, or contralateral routing of signal (CROS) device are available for children with LUHU. Recent evidence demonstrates the benefits of an RM system fitted to the typically-hearing ear as a favourable solution for children with LUHU who must listen in noise (Griffin et al., 2023). The protocol suggests recommending technologies, either on a trial basis or for ongoing use, within a broader set of child- and family-centred factors.

BCD Fitting and Verification for Children with Conductive or Mixed Hearing Loss

Building on the development of DSL-BC prescriptive targets for use with percutaneous devices (Hodgetts & Scollie, 2017), the NCA has continued to investigate procedures for fitting transcutaneous BCDs, which are most often used by children under 5 years of age. With the clinical implementation of DSL-BC targets and skull simulators, the audiologist can measure the force level output of BCDs to verify their performance. One must account for skin transmission loss when fitting transcutaneous BCDs worn on a soft headband or adhesive adapter. For babies unable to do the recommended in-situ testing with the BCD (Bagatto et al., 2022) the updated protocol provides values that predict in-situ behavioural thresholds from audiometric bone conduction thresholds. This is the first protocol supporting BCD fittings to infants and includes a technical BCD verification guide incorporating illustrative case examples.

Summary

Version 2023.01 of the Protocol for the Provision of Amplification to Infants and Young Children applies current evidence to guide clinical practice. In addition to well-known pediatric amplification procedures, audiologists have access to information for managing children who have MBHL or UHL, and for fitting BCDs to children. This protocol is used within Ontario and other

programs in a broader context of best practices for infant hearing assessment, family-centred practice, and supports for language development. Western University's NCA has a long history of collaboration in these areas, including innovation in the field of pediatric amplification. As Canada's infant hearing landscape continues to evolve, we remain committed to supporting best practices for pediatric audiology through our research and protocol development.

References

- American Academy of Audiology. (2013). *PediatricAmplificationGuidelines.pdf_539975b3e7e9f1.74471798.pdf*. https://audiology-web.s3.amazonaws.com/migrated/PediatricAmplificationGuidelines.pdf_539975b3e7e9f1.74471798.pdf
- Bagatto, M., Moodie, S., Brown, C., Malandrino, A., Richert, F., Clench, D., Scollie, S. (2016). Prescribing and verifying hearing aids applying the American Academy of Audiology Pediatric Amplification Guideline: protocols and outcomes from the Ontario Infant Hearing Program, *Journal of the American Academy of Audiology, 27*(3), 188-203.
- Bagatto, M., Gordey, D., Brewster, L., Brown, C., Comeau, M., Douglas, C., El-Naji, R., Fortier, S., Gascon, A., Godovin, J., Ittner, C., Haluschak, M., Mauro, L., Morgenstein, K., Peterson, J., Scollie, S., Scott, M., Wollet, A. (2022). Clinical Consensus document for fitting non-surgical transcutaneous bone conduction devices to children, *International Journal of Audiology, 61*(7), 531-538.
- Bagatto, M., DesGeorges, J., King, A., Kitterick, P., Laurnagaray, D., Lewis, D., Roush, P., Sladen, D. P., & Tharpe, A. M. (2019). Consensus practice parameter: Audiological assessment and management of unilateral hearing loss in children. *International Journal of Audiology*, *58*(12), 805–815. https://doi.org/10.1080/14992027.2019.1654620
- Bess, F. H., & Tharpe, A. M. (1988). Performance and management of children with unilateral sensorineural hearing loss. *Scandinavian Audiology, Suppl 30*, 75–79.
- Griffin, A. M., Atri, A., Licameli, G., & Stiles, D. J. (2023). Effect of Hearing Device Use on Speech-in-Noise Performance in Children with Severe-to-Profound Unilateral Hearing Loss. *Ear & Hearing*, *44*(3), 588–602. https://doi.org/10.1097/AUD.0000000000001310
- Hodgetts, W. E., & Scollie, S. D. (2017). DSL prescriptive targets for bone conduction devices: Adaptation and comparison to clinical fittings. *International Journal of Audiology*, *56*(7), 521–530. https://doi.org/10.1080/14992027.2017.1302605
- JCIH. (2019). JCIH 2019. *Journal of Early Hearing Detection and Intervention*, *4*(2), 1–44. https://doi.org/10.15142/FPTK-B748
- Lieu, J. E. C. (2004). Speech-Language and Educational Consequences of Unilateral Hearing Loss in Children. *Archives of Otolaryngology–Head & Neck Surgery*, *130*(5), 524–530. https://doi.org/10.1001/archotol.130.5.524
- Lieu, J. E. C. (2013). Unilateral hearing loss in children: Speech-language and school performance. *B-ENT, SUPPL. 21*, 107–115.

https://www.scopus.com/inward/record.uri?eid=2-s2.0-84890287451&partnerID=40&md5=a4732cd9a23038a15e1675eec8b8d327

- Lieu, J. E. C. (2015). Management of Children with Unilateral Hearing Loss. *Otolaryngologic Clinics of North America*, *48*(6), 1011–1026. https://doi.org/10.1016/j.otc.2015.07.006
- Mattiazzi, Â. L., de Lima Malheiros, A. C., Pinto, J. D., Battisti, I. D. E., & Biaggio, E. P. V. (2023). Hearing rehabilitation of children and adolescents with unilateral hearing loss. *CoDAS*, *35*(1), e20210065. https://doi.org/10.1590/2317-1782/20212021065
- McCreery, R. W., Walker, E. A., Stiles, D. J., Spratford, M., Oleson, J. J., & Lewis, D. E. (2020). Audibility-Based Hearing Aid Fitting Criteria for Children With Mild Bilateral Hearing Loss. *Language, Speech, and Hearing Services in Schools*, *51*(1), 55–67. https://doi.org/10.1044/2019_LSHSS-OCHL-19-0021
- Oosthuizen, Picou, Pottas, Myburgh, & Swanepoel. (2021). Listening Effort in School-Aged Children With Limited Useable Hearing Unilaterally: Examining the Effects of a Personal, Digital Remote Microphone System and a Contralateral Routing of Signal System. *Trends in Hearing*, *25*((Oosthuizen, Pottas, Swanepoel) Department of Speech-language Pathology and Audiology, University of Pretoria, Pretoria, South Africa(Picou) Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN, United States(Mybu), 2331216520984700. https://doi.org/10.1177/2331216520984700
- Park, L. R., Griffin, A. M., Sladen, D. P., Neumann, S., & Young, N. M. (2022). American Cochlear Implant Alliance Task Force Guidelines for Clinical Assessment and Management of Cochlear Implantation in Children with Single-Sided Deafness. *Ear and Hearing*, *43*(2), 255–267. https://doi.org/10.1097/AUD.0000000000001204
- Picou, E. M., Davis, H., Lewis, D., & Tharpe, A. M. (2020). Contralateral Routing of Signal Systems Can Improve Speech Recognition and Comprehension in Dynamic Classrooms. *Journal of Speech, Language, and Hearing Research*, *63*(7), 2468–2482. https://doi.org/10.1044/2020_JSLHR-19-00411
- Picou, Lewis, Angley, & Tharpe. (2020). Rerouting Hearing Aid Systems for Overcoming Simulated Unilateral Hearing in Dynamic Listening Situations. *Ear and Hearing*, *41*(4), 790–803. https://doi.org/10.1097/AUD.0000000000000800
- Scollie, S., Levy, C., Pourmand, N., Abbasalipour, P., Bagatto, M., Richert, F., Moodie, S., Crukley, J., Parsa, V. (2016). Fitting noise management signal processing applying the American Academy of Audiology Pediatric Amplification Guidelines: verification protocols, *Journal of the American Academy of Audiology, 27*(3), 237-251.
- Vos, Park, Noxon, & Brown. (2022). Cochlear Nerve Deficiency in Pediatric Unilateral Hearing Loss and Asymmetric Hearing Loss. *Audiology and Neurotology*, *27*(4), 328–335. https://doi.org/10.1159/000522566