Phonak Target Track.

Using large-scale data analytics to understand the prescription and use of pediatric hearing aids.

Jodie Nelson, Angela Pelosi, Kaan Bulut, Laura Jagoda

Introduction

Audiology insights from large-scale data analytics

The analysis of large data sets has become a fundamental part of medical device development throughout the healthcare sector. Insights derived from these analyses have proven instrumental in numerous applications, enabling the prediction and resolution of health-related issues before they escalate, or forecasting pathways towards the improvement of patient outcomes (Cote, 2021; Flanigan, 2017; Healthcare Data Analytics, 2023). Data analytics of this nature have also been used to evaluate the efficacy of medical treatments, clinical protocols, and provide patients with insights that empower them to take a more active role in managing their health (Cote, 2021; Flanigan, 2017; Healthcare Data Analytics, 2023).

Data analytics have also proven valuable in audiology, providing insights on adherence to clinical guidelines, types of hearing loss managed with hearing aids, hearing aid use patterns, and the programming of hearing aid features. At Phonak, we use these analyses to provide valuable insights into patterns of hearing aid fittings and usage across various client demographics and levels of hearing loss. The objective of the project summarized here was to gain a deeper understanding of fitting and usage patterns among pediatric users up to 18 years. This was achieved by analyzing a substantial number of pediatric hearing aid fitting files.

Data collection

Data are collected for every fitting undertaken with the Target software in alignment with global legal and privacy requirements, see the EU Medical Devices Regulation (Regulation (EU) 2017/745 of European Parliament and the Council of 5 April 2017 on medical devices) and 45 C.F.R. § 164.501 et seq. Consent for the collection of this data is discussed in the applicable Privacy Notice of the Target fitting software, including those standards of data collection concerning an end user/patient.

During this study, we collected data pertaining to U.S. hearing care professionals' utilization of the Target software and particularly its use with pediatric recipients of a Phonak hearing aid. All data used in this study has been de-identified in compliance with United States' Health Insurance Portability and Accountability Act of 1996, as amended, and its implementing regulations (collectively, "HIPAA") (see 45 CFR § 164.514(b)(2)).

Each pediatric client's data comprises two categories—fitting logs and data logs. Fitting logs encompass all information related to the hearing aid fitting found in a Target session. Conversely, data logs are collected each time the hearing aid connects to Target. The fitting state of the hearing aids at the end of each session is sent to a central server, where the fittings can be subjected to filtering and analysis.

Methodology

Once consent is obtained through agreement with the Target privacy policy, all programming adjustments and navigation in the software are aggregated for analyses. During this project, a total of 19,201 fitting files were examined. These data were sourced from the United States and included fittings with Phonak Marvel, Paradise, and Lumity hearing aids. The fittings were conducted within a specific timeframe between February 26, 2024 and June 13, 2024. The target demographic for this study comprised children and teenagers under the age of 18 years, who had a hearing loss ranging from mild to profound, per the World Health Organization (WHO) definition (WHO, 2021).

Results

Distribution of hearing loss levels and age group

Data provided detailed insight into the audiological profiles of pediatric clients. Throughout this article, the data are frequently presented in relation to four distinct age groups: Infants and young children (0-3 years), young school-aged children (4-8 years), adolescents (9-12 years), and teenagers (13-18 years). These age groups correspond with the four Junior Modes available in the Target programming software. Figure 1 illustrates the distribution of data files gathered over this four-month period, demonstrating a balanced representation across the four age groups.

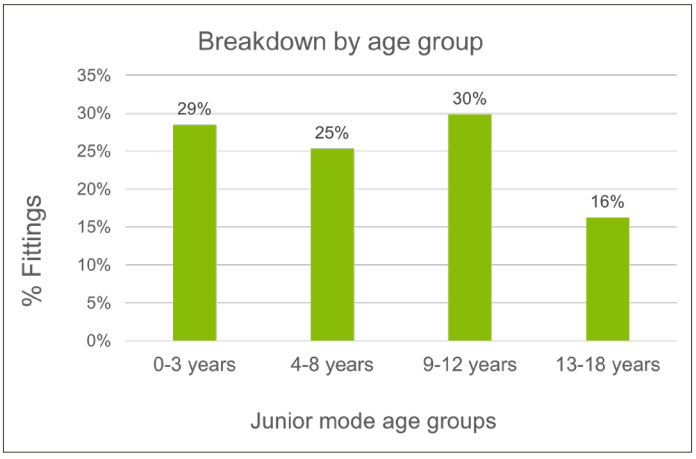

Figure 1. Percentage of fittings across four age groups

The gender of participating children was evenly distributed with male (47%), female (43%), and undefined or non-binary (10%). A majority of children in this data set have mild to moderate hearing loss (64%), with severe and profound representing 14% and 7% respectively. Considering the WHO classification of 'Normal' hearing as being up to 25 dB HL; it is unclear from these data whether children in the 'Normal' hearing category (15%) have a mild hearing loss or if they have a unilateral hearing loss.

Breaking the data down further shows the distribution of hearing loss across the Junior Mode age groups. Results confirm that the percentage of children with mild or moderate hearing loss is consistent across the age groups. Of note is a decrease in the percentage of children with profound hearing loss in the three older age groups. The shifting proportions of hearing loss severity may reflect the availability and uptake of cochlear implantation in the U.S.

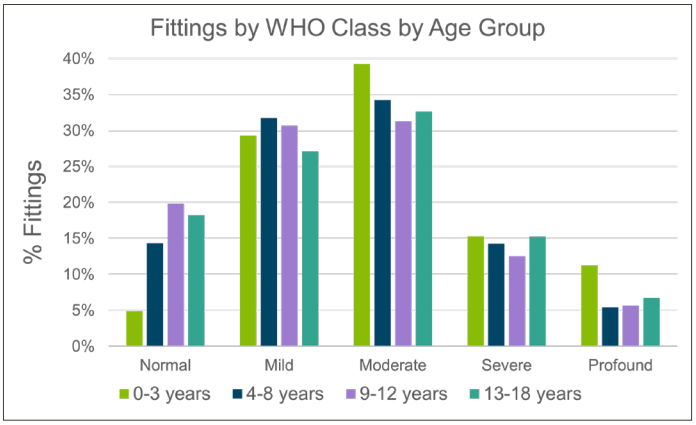

Figure 2. Hearing loss severity across four age groups as a function of percentage of fittings

Distribution of form factors

The needs of a child with hearing loss may be addressed by hearing aids of different form factors. Best practice guidelines recommend that younger children are fit with behind-the-ear (BTE) hearing aids for safety, maximum flexibility, usability, and maintenance options (American Academy of Audiology Task Force on Pediatric Amplification, 2013; Bagatto et al., 2019). For children aged 8 years and older a receiver-in-canal (RIC) device can be considered (Phonak, 2023). With advances in technology that include direct connectivity to remote microphones and the availability of shorter receiver lengths, selection of the RIC form factor is becoming more common for older children.

Analysis of the data shows most children are fit with BTE devices (see Fig 3). BTEs are fit across all age groups with the number of RICs increasing from 9 years of age. Teens are fit equally with BTEs and RICs, which may relate to increased interest in cosmetically appealing devices and an adolescent's ability to care for their own hearing devices.

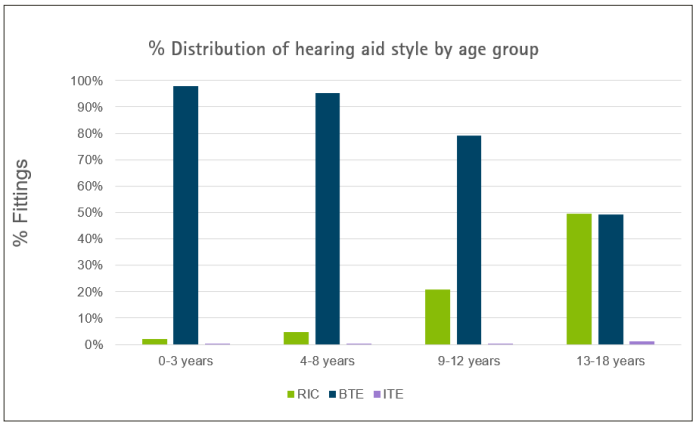

Figure 3. Distribution of hearing aid style across four age groups as a function of fitting prevalence

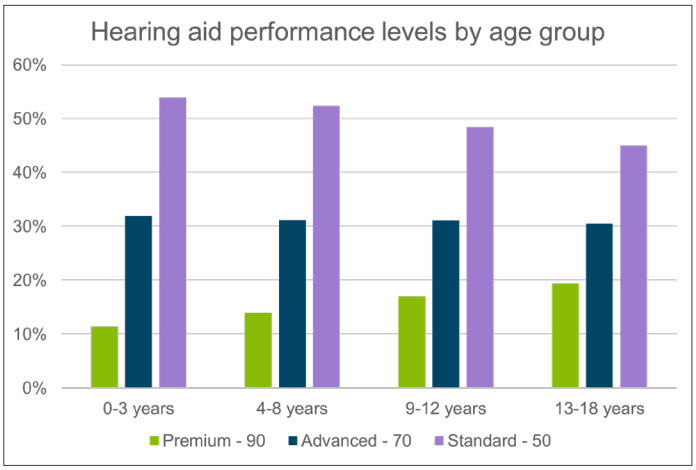

Figure 5. Distribution of hearing aid technology levels across four age groups as a function of percentage of fittings

Distribution of performance levels

In the U.S., Phonak hearing aids are available in three technology levels, premium (90), advanced (70), and standard (50). The selection of a technology level is influenced by various factors that may include: options for financial reimbursement (e.g., Medicaid or insurance options), parental preference, or hearing care professional (HCP) recommendation. The majority of pediatric hearing aids in the U.S. are the standard technology level (51.3%), followed by advanced (32.3%) and premium (16.4%), respectively.

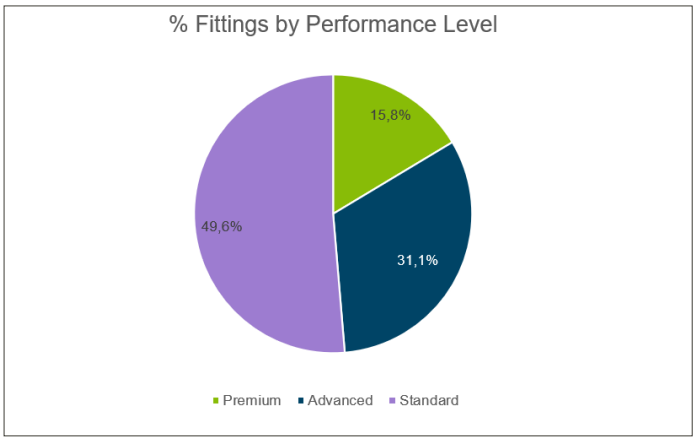

Figure 4. Distribution of hearing aid technology levels fitted to analyzed pediatric population

This pattern of technology level distribution remains relatively consistent across all four age groups as shown in Figure 5; although, there is a trend toward increasing the percentage of premium technology level fittings with older children.

Fitting Formulas

Reports from the Outcomes of Children with Hearing Loss (OCHL) study provided three guiding principles for protection against delay in speech and language. These principals indicate the need for (1) hearing aids fit to prescriptive targets, (2) wearing hearing aids a minimum of 10 hours per day, and (3) a language rich environment provides children with the means to maximize their speech and language development (Tomblin et al., 2015).

The prescription of any hearing aid begins with the selection of a validated formula that calculates gain and output targets based on a range of audiology diagnostic variables. In the case of pediatric prescriptions, the targets are most commonly derived from the DSL v5 or the NAL- NL2 algorithms, each of which have unique settings for children. These settings account for pediatric ear canal acoustics and provide output levels that are estimated to match children's listening needs. The data in Figure 6 show that the majority of children are fit with a DSL v5 pediatric prescription. This suggests that many HCPs are beginning their prescriptive routine with the selection of an appropriately validated pediatric prescription. However, as children get older, there is a small increase in the number of children that are fitted with Phonak's default prescriptive formula for adults.

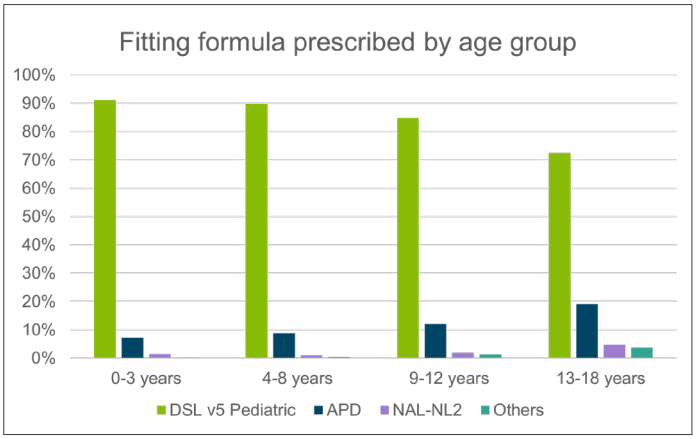

Figure 6. Distribution of hearing aid prescription formula across four age groups as a function of percentage of fittings

Following a series of studies comparing speech intelligibility and children's preferences (Wolfe et al., 2017; Feilner et al., 2016) the default program Phonak recommends in consultation with the Phonak Pediatric Advisory Board is AutoSense Sky OS (ASOS Sky). This is an automatic program that uses environmental classification to detect different listening scenarios and automatically adapt signal processing for the situational listening needs (e.g., speech in quiet, speech in noise, streamed audio inputs, etc). Figure 7 shows that the majority of fittings use the recommended ASOS Sky as the start-up program, with some instances of an alternate start-up program.

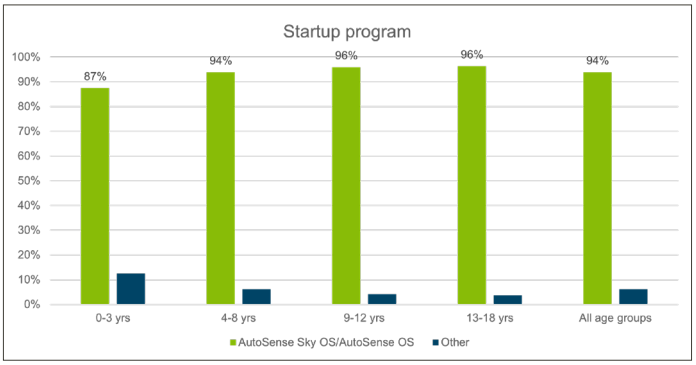

Figure 7. Distribution of hearing aid fittings that default to the AutoSense automatic program vs an alternate start-up program across four age groups

Daily Wearing Time

For children with hearing loss, the routine use of hearing aids is essential to successful development. Each additional hour of wear time returns a significant benefit in developmental progress. However, the data indicate that wearing time is influenced by degree of hearing loss, the age of the child, and device performance level. Each of these factors, combined with the realities of daily life, should be considered when discussing expectations for daily use (McCreery et al., 2015). Figure 8 shows that median use times increase systematically with increasing age during childhood. Within these data, Premium level devices were worn 1hr 19mins longer per day than Standard level devices and 55 mins longer than Advanced level devices. Note that this latter trend was observed in the data set but is not shown in Figure 8.

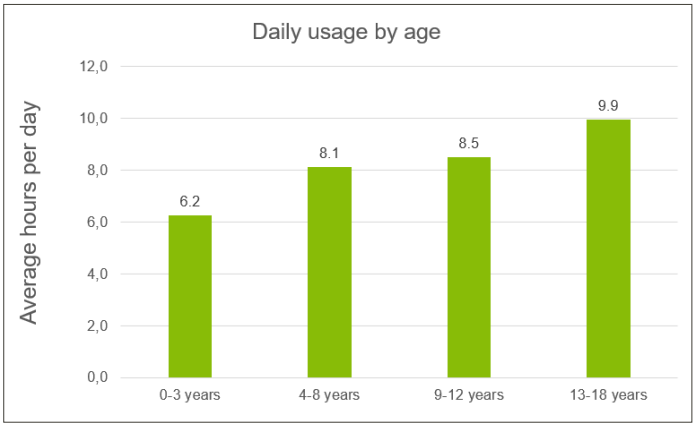

Figure 8. Median daily use time in hours as a function of age group.

Research has shown that the daily use of hearing aids can be increased by ensuring that parents and caregivers have a clear understanding of a child's hearing loss, hearing aid maintenance, and expectations for daily use (Visram et al., 2021). The myPhonak Junior mobile application provides parents with a report of wearing time on a daily and monthly basis, while also including a summary of sound environments experienced throughout the day. This information can be used to support counselling conversations including opportunities for use of Roger.

Conclusion

The use of large-scale data analytics is a relatively new occurrence in the field of audiology. Only in recent years has the technology existed to centralize data collected from hearing aid programming software and hearing aids worn during daily life. With insights collected from these large data sets, HCPs can reinforce their clinical decisions and develop more personalized treatment plans, a benefit for both pediatric and adult patients. In the data reviewed here, we see how trends in the prescription of pediatric hearing aids varied across 19,201 different fittings. Of particular interest, was a decrease in the number of patients with profound hearing loss after the age of 3 years, possibly relating to the availability of cochlear implants in the United States. Next was a systematic increase in the number of RIC fittings after the age of 8 years. It was also apparent that most pediatric fittings begin with selection of the DSL v5 or NAL-NL2 prescriptions and that a significant proportion of fittings start up in AutoSense Sky OS or AutoSense OS. Finally, median daily use times increased with age of the hearing aid wearer and with use of a higher-tier technology level.

Each of these insights are drawn from a very large data set, which will continue to be mined and support the development of future Phonak technology. In this summary, it is clear that HCPs providing pediatric services are following key elements of best practice in the treatment of their patients. They are also adapting the treatment plan to meet the needs of children as they age. It's also clear, that providing a flexible portfolio of prescription hearing aids is essential, as access to different technology levels and form-factors play a role in long-term success.

References

American Academy of Audiology Task Force on Pediatric Amplification (2013). Pediatric Amplification. American Academy of Audiology Clinical Practice Guidelines. https://www.audiology.org/practiceguideline/clinical-practice-guidelines-pediatric-amplification/

Bagatto, M., Scollie, S., Moodie, S. T., Seewald, R., Hyde, M., Glista, D., ... & Parsa, V. (2019). Protocol for the provision of amplification. Retrieved from https://ir.lib.uwo.ca/nca/5/

Cote, C. (2021). Applications of Data Analytics in Health Care. Business Insights. Retrieved from https://online.hbs.edu/blog/post/data-analytics-in-healthcare

Feilner, M., Rich, S., & Jones, C. (2016). Automatic and directional for kids - Scientific background and implementation of pediatric optimized automatic functions. Phonak Insight, retrieved from www.phonak.com/evidence

Flanigan, B., Lockwood, M., & Chang, C. (2017). Analytics to improve outcomes and reduce cost: Health systems and health plans can work together to jointly win the shift from volume to value. Deloitte. Retrieved from www.deloitte.com/us/population-health-analytics

Healthcare Data Analytics. (2023). Mercury Healthcare. Retrieved from https://www.mercuryhealthcare.com/faq/what-is-healthcare-analytics on 27/08/2024

McCreery, R. W., Walker, E. A., Spratford, M., Bentler, R., Holte, L., Roush, P., ... & Moeller, M. P. (2015). Longitudinal Predictors of Aided Speech Audibility in Infants and Children. Ear and Hearing, 36, 24S-37S.

Phonak Pediatric Solutions. Product and age recommendation overview (2023). Retrieved from www.phonak.com/evidence/Age Consideration Guide

Tomblin, J. Bruce; Moeller, Mary Pat. Editorial: The Outcomes of Children with Hearing Loss Study. Ear and Hearing 36:p 1S-3S, November/December 2015. | DOI: 10.1097/AUD.0000000000000220

Visram, A. S., Roughley, A. J., Hudson, C. L., Purdy, S. C., & Munro, K. J. (2021). Longitudinal changes in hearing aid use and hearing aid management challenges in infants. Ear and hearing, 42(4), 961-972.

Wolfe, J., Duke, M., Schafer, E., Jones, C., & Rakita, L. (2017). Evaluation of Adaptive Noise Management Technologies for School-Age Children with Hearing Loss. Journal of the American Academy of Audiology, 28(5), 415–435.

World report on hearing. Geneva: World Health Organization; 2021. License: CC BY-NC-SA 3.0 IGO.

Authors

Jodie Nelson MAudA. is Senior Product Audiologist for Pediatrics at Phonak Headquarters, Staefa, Switzerland

Angela Pelosi, MBA, MAudA. is Senior Director, Global Audiology and Customer Success at Phonak Headquarters, Staefa, Switzerland

Kaan Bulut, MSc. is Senior Solution Experience Manager at Phonak Headquarters, Staefa, Switzerland

Laura Jagoda, PhD Audiological Researcher in Sonova R&D, Staefa, Switzerland