

## Readability of Online Hearing-Based Early Intervention Materials

Torri Ann Woodruff, MS<sup>1</sup>

Kathleen M. Cienkowski, PhD<sup>1</sup>

<sup>1</sup>Department of Speech, Language and Hearing Sciences, University of Connecticut, Storrs, CT

### Abstract

**Purpose:** A quantitative readability assessment of currently accessible online materials for parents of children who are deaf or hard of hearing (DHH).

**Design:** Consistent with current recommendations discussing grade-level of materials, Flesch-Kincaid Grade Level (FKGL) analysis, along with five other related measures, was conducted for each website. These analyses provide a readability score for each of the websites analyzed.

**Study sample:** The first five pages of results from a Google search of “early intervention deaf” and “early intervention hear” were compiled for readability assessment.

**Results:** Sixty-three websites were included in the analysis. Following article modification, inter- and intra-rater reliability were excellent ( $p < .002$ ). All websites were analyzed based on FKGL, intended audience, page displayed on, and producer. All but one of the websites ( $n = 62$ ) were written at a higher level than the recommended 6th-grade reading level ( $m = 12.62$ ,  $SD = 2.65$ ). There was no significant impact of the search page, intended audience, or producer on FKGL ( $p > .1$ ).

**Conclusion:** Currently accessible online resources for parents looking at early intervention for children who are deaf or hard of hearing (DHH) are written at a level that may not be accessible. Materials may benefit from being revised and edited with readability and health literacy recommendations in mind.

**Keywords:** readability, early intervention

**Acronyms:** ARI = Automated Readability Index; CLI = Coleman-Liau Index; DHH = deaf or hard of hearing; EHDI = early hearing detection and intervention; FKGL = Flesch-Kincaid Grade Level; FRES = Flesch Reading Ease Score; IFSP = Individualized Family Service Plan GFI = Gunning-Fog Index; LFUD = lost to follow-up/documentation; SMOG = Simple Measure of Gobbledygook

**Acknowledgements:** The authors are grateful for Jennifer Roy, who worked as a research assistant during the article modification stage of this study. The authors declare they have no conflicts of interest. This research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

**Correspondence concerning this article should be addressed to:** Torri Ann Woodruff, MS, 2 Alethia Drive, U-1085, Storrs, CT 06269. Email: [torri.woodruff@uconn.edu](mailto:torri.woodruff@uconn.edu); Phone: 860-420-2161.

In 2017, Early Hearing Detection and deaf or hard of hearing (DHH) (EHDI) programs across the United States identified 6,537 children as having hearing thresholds outside of the typical range (CDC, 2019a). EHDI is a public health service that applies screening and follow-up care to the general population to maintain and improve the community’s overall health. The first goal of EHDI is to ensure that all children, regardless of risk factors, receive a hearing screening, ideally before one month of age (Joint Committee on Infant Hearing, 2019; White, 2019). For children who refer on their hearing screening, the goal is to schedule diagnostic evaluations by three months of age. Following the identification of children as deaf or hard of hearing (DHH), early intervention services are initiated as indicated.

At any point in this system of referrals and service

providers, a child can be *lost* and not make it to the next clinically indicated step. These children who are lost to follow-up/documentation (LFUD) can contribute to the number of individuals who have delayed access to early intervention services. One way a child is LFUD is that they have been identified as being at risk for hearing differences via traditional screening measures, yet hearing levels have not been confirmed. This population can consist of children who are DHH and children who, for idiopathic or transient reasons, are referred for further testing after their initial screenings while they have hearing levels in the typical range. Alternatively, a child can be LFUD when they have been identified as DHH and have not enrolled in early intervention services. Children being LFUD after identification and before early intervention may be the most troubling element of LFUD.

Despite the federal mandate to provide hearing-related intervention services, children continue to go without support services and early intervention. Specifically, 2,837 (34.5%) children identified as DHH through EHDI programs across the United States did not receive early intervention services in 2017 and may be at risk for language deprivation (CDC, 2019b). Individuals who experience language deprivation may encounter challenges in learning languages, employment, and social-emotional development (Hall, 2017). In 2017, the most commonly reported reason for children not to get early intervention services, aside from “unknown,” is parents declined the service altogether (CDC, 2019b). The 2,837 members of this population have a developmental risk factor, and their families refuse developmental support.

Within the Early Hearing Detection and Intervention Act of 2017, the information made accessible to parents is explicitly discussed in terms of being “accurate, comprehensive, and, where appropriate, evidence-based, allowing families to make important decisions for their children in a timely way....” This statement is in stark contrast to the idea that one potential source of this disengagement with early intervention might be a lack of information about the role of early intervention. Within the literature, there are reports that parents of children who are DHH are looking for and/or need more information on early intervention topics such as what early intervention is (Khoza-Shangase, 2019; Larsen et al., 2012), the EHDI process (Krishnan et al., 2019; Pendersen & Olthoff, 2019), hearing aids and assistive technology (Haddad et al., 2019; Van der Spuy & Pottas, 2008), and parental support services (Haddad et al., 2019; Van der Spuy & Pottas, 2008). This expressed need for information may be indicative of a lack of accessible information to support decision making.

Aside from the call for appropriate information within the Early Hearing Detection and Intervention Act of 2017, various governmental and non-governmental organizations have made recommendations on how to ensure materials are accessible to the general public and available to be used in decision making. It is recommended that all health information, such as EHDI-based websites, be written at no greater than a 6<sup>th</sup>-grade reading level (Safeer & Keenan, 2005; Sax et al., 2019; U.S. Department of Health and Human Services, n.d.; Weiss, 2006). The purpose of this study was to assess the readability of commonly accessible information for parents on early intervention for children who are DHH using a similar methodology to Sax et al. (2019). From here, there can be future work to look at the necessity of editing online materials for increased readability and may serve as a mechanism for addressing lost to follow up. The potential compounding of inaccessible informational materials with a need for more information for parents of children who are DHH merits evaluation.

The concept of literacy is linked to health literacy. Health literacy is the skill of taking in, processing, and

understanding health-related content such as information and needed services (American Speech-Language-Hearing Association, n.d.). The type of language used when providing information must be consistent with an individual’s literacy level. The literature has noted that audiologists tend to speak at a level of complexity that is not accessible or is vastly different from what an individual or family may be able to understand (Donald & Kelly-Campbell, 2016; Nair & Cienkowski, 2010). Given that health literacy is already a concern across the medical field, EHDI-based information for families is not exempt from this weakness or the need for a global overhaul in the documentation and general communication provided to families (Sax et al., 2019).

The accessibility of written materials in EHDI has been approached in terms of referral for diagnostic services following hearing screening. Sax et al. (2019) evaluated the readability of the top 55 links derived from a Google search of “failed newborn hearing screening” and materials from top medical institutions on the same topic. Their study concluded that “online patient education materials about the newborn hearing screen may be too difficult for the average reader” and serves as a call for material revision to be more inclusive of potential readers (p. 168). This information provides insight into potential risk factors for children not following through for hearing evaluations after referral on their screening. It also begs the question of how accessible materials for the next step in the EHDI system, early intervention, are to the average reader. This study continues this line of inquiry to assess if materials found online about early intervention for children who are DHH conform to readability recommendations.

## Materials and Method

### Data Collection

Google searches for “early intervention deaf” and “early intervention hear” were performed on February 4, 2020, and the first five pages of English language results were compiled. Google was selected as the search engine to be used based on the precedent in the literature to use this as the primary search tool and is supported by recent publications of the use of “conventional search engines” inclusive of Google (Ahmadian et al., 2020; Sax et al., 2019; Ting & Hu, 2014). The search term “early intervention” was selected to be broad enough to include services that families of children who are DHH can access, including those governed by Part C of the Individuals with Disabilities Education Act of 2004 and services that practitioners provide outside of that system. Both “deaf” and “hear” were selected to be used in conjunction with early intervention to represent the various terms that parents may have experience with or heard, including deaf, hearing loss, hearing impairment, hard of hearing, and hearing levels (Joint Committee on Infant Hearing [JCIH], 2019). This procedure led to 53 links in response to “early intervention deaf” and 50 links in response to “early intervention hear.”

## Article Modification

Article modification is the process of preparing materials for readability analysis. The methods used here represent various readability analyses within the healthcare domain. Each link was opened and its contents copied entirely. The content was pasted as plain text into a Microsoft Word document. Documents were then modified by removing extraneous text as delineated by related studies (Badarudeen & Sabharwal, 2008, 2010; Flesch, 1948; Kong & Hu, 2015; Sax et al., 2019; Ting & Hu, 2014; Wong & Levi, 2016, 2017). Extraneous text includes navigation links, author information, dates, headers, titles, subheaders, acknowledgments, copyright notices, references, disclaimers, citations, feedback questionnaires, URLs, numbers, decimal points, bullets, abbreviations, paragraph breaks, colons, semicolons, dashes, captions, percentages, and charts/figures.

## Readability Analysis

Implementing the methodology of Sax and colleague's (2019) evaluation of newborn screening materials, this study has six assessment tools that create a rich data set. These include Flesch-Kincaid Grade Level (FKGL), Flesch Reading Ease Score (FRES), Gunning-Fog Index (GFI), Simple Measure of Gobbledygook (SMOG), Coleman-Liau Index (CLI), and Automated Readability Index (ARI). One online readability calculator was used for short samples (<https://www.webpagefx.com/tools/read-able/>) with a second calculator used for longer samples (<https://www.readable.com/>).

Statistical analysis was only conducted on FKGL. Current recommendations on the use of reliability calculations are to keep the grade level required to understand the material at a 6<sup>th</sup>-grade level, equivalent with it being below 7<sup>th</sup> grade as the average adult reads at a level consistent with an 8<sup>th</sup>-grade education (Weiss, 2006; U.S. Department of Health and Human Services, n.d.). With this, the use of the FKGL to determine the grade level of a resource fits well with providing actionable steps to assess what materials are most accessible and is a consistent measure in the literature (Kong & Hu, 2015; Sax et al., 2019; Ting & Hu, 2014; Wong & Levi, 2016, 2017). The FKGL is based on the length of a sentence in words and the number of syllables in the words that make up the sentences (Flesch, 1948; Sax et al., 2019; Weiss, 2006). The formula provides the approximate grade level of education that is required to understand the text. All other reliability calculations are included to support claims from FKGL about the grade level needed to read a text as FKGL should vary with these other measures. In addition, these measures are additional metrics to determine correlation both between and within observers.

Two raters also reviewed materials to determine the intended audience. Materials were deemed to be parent-oriented when using the possessive tense in writing about the child, rights, or expectations (e.g., You and your child will work with the early intervention team to decide what services to access), or when the information was

framed as an introduction to the topic of early intervention. Provider-oriented materials did not use the possessive or were framed as practice guidelines. The determination of the intended audience was conducted by the first author and a research assistant. Materials determined to be provider-oriented were included in the analysis as they are accessible and presented within the search results alongside parent-oriented materials. Thus, parents looking for parent-oriented materials could find these and review them as a part of their search. To determine the material source, each web page was reviewed for the group that held the copyright, provided updates, or hosted the web page.

## Statistical Analysis

Statistical analysis was completed using SPSS version 27. Descriptive statistics were calculated for all nominal categories. Statistical significance was set at .05 and calculated across groups using independent samples *t*-tests or ANOVAs.

## Results

Before the statistical analysis of the readability scores was started, the reliability of the article modifications was assessed. This step was done to ensure that while keeping with the procedure of article modification, there was replicability in the methods. The first author repeated the editing process on 30 randomly selected links over one week after their original modification to provide intra-observer reliability data. To determine inter-observer reliability of the article modification process, a research assistant performed the editing process on another 30 randomly selected links and then calculated readability scores. Intra- and inter-rater reliability were calculated using intraclass correlation coefficients. Intra-rater and inter-rater reliability were significant for each measure of readability ( $p < .002$ ).

Of the 103 links collected, 40 (38.8%) were excluded from analysis for being a video only ( $n = 1$ ), being a dead link ( $n = 1$ ), being contact information only that would have been erased during article modification for analysis ( $n = 2$ ), being a list of links only that would have been erased during article modification for analysis ( $n = 2$ ), primarily selling something ( $n = 3$ ), being a job ad only ( $n = 4$ ), being a duplicate of a link that was already accepted for analysis ( $n = 8$ ), or being a journal article ( $n = 19$ ).

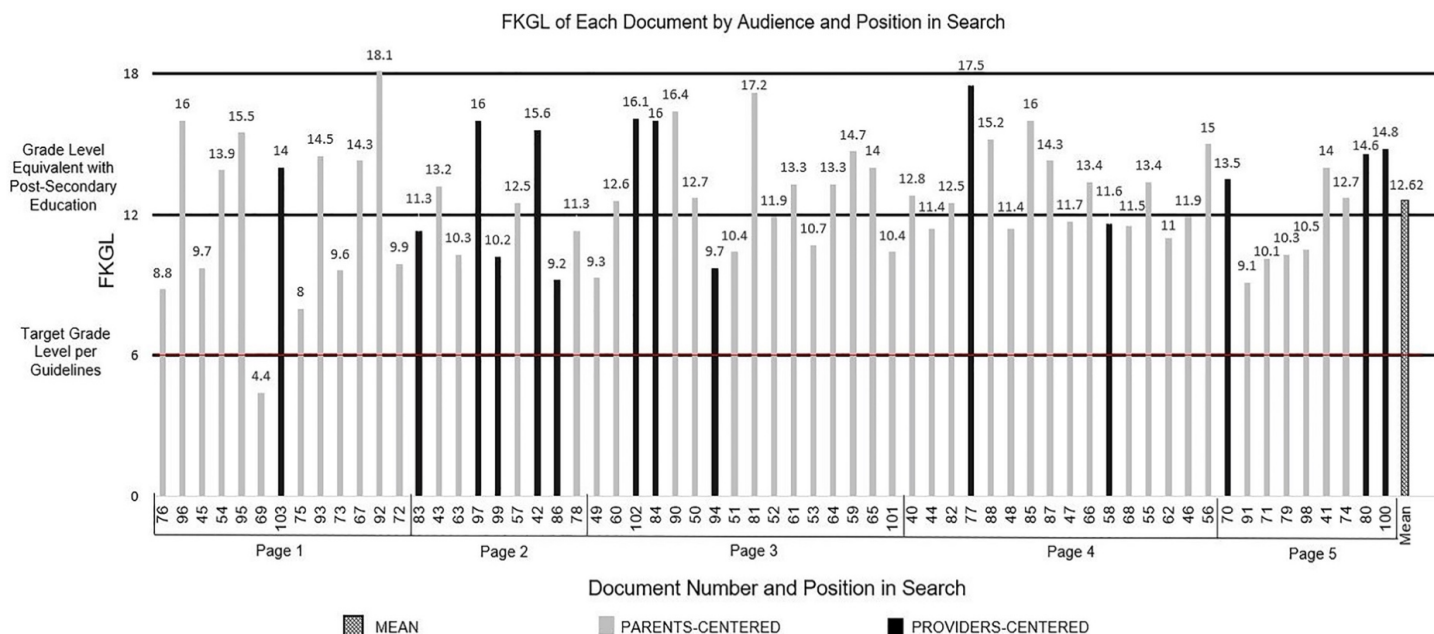
This left 63 links for evaluation, with 24 (38.10%) derived from the search term "early intervention deaf," 32 (50.79%) derived from the search term "early intervention hear," and 7 (11.11%) links appearing in both searches.

All but one of the webpages reviewed were written at a reading level above 6<sup>th</sup>-grade and thus not in line with literacy recommendations. The average FKGL of all documents ( $n = 63$ ) was 12.62 ( $SD=2.65$ ), with a range from 4.4 to 18.1 (see Figure 1).

Of those links included in the evaluation, 49 (77.78%) targeted parents/the general public and 14 (22.22%) targeted professionals. Between raters, there was no



**Figure 1**  
Flesch Kincaid Grade Level (FKGL) Scores Across Populations and Search Pages



disagreement across any of the resources in terms of the intended audience. Forty-nine resources were deemed parent-oriented with a mean FKGL of 12.41 ( $SD = 2.74$ ) and 14 were determined to be provider-oriented with a mean FKGL of 13.357 ( $SD = 2.26$ ). Using an independent samples *t*-test, results indicate no significant difference in FKGL based on the intended audience ( $p > .17$ ).

A majority of these links came from large reputable sources such as government websites ( $n = 22$ ), advocacy groups ( $n = 14$ ), educational systems ( $n = 12$ ), hospitals and other healthcare providers ( $n = 7$ ), or professional groups ( $n = 3$ ). Only five results (7.93%) were from general media outlets. With a one-way ANOVA, there was not a significant impact of the information's source on the FKGL of the document ( $p > .1$ ).

The search result page that resources were present on was also considered for analysis. Resources were grouped by the page on which the result was found, ranging from the first to the fifth page (see Figure 1). A one-way ANOVA revealed no significant impact of the display page on FKGL ( $p > .8$ ).

### Discussion

At the heart of pediatric audiology and early intervention services for children who are DHH is the family. Families shape a child's trajectory by working with professionals to set developmental goals with the Individualized Family Service Plan (IFSP; Individuals with Disabilities Education Act of 2004). Before the IFSP, parents serve as gatekeepers who decide whether or not to enroll in early intervention services. As they make this decision, they may be referred to, find, or be provided information from friends, family, professionals, and the internet. The support that parents find must be at a level that is accessible to them and meets their literacy needs while scaffolding their health literacy and decision-making skills.

Accessibility of information is a critical component to meeting parents' and caregivers' educational needs around hearing-related topics such as early intervention. Overall, current online materials related to early intervention for children who are DHH are not written in a manner that is accessible according to health literacy guidelines (see Figure 1). Some of the most apparent drivers of high FKGL scores are long sentences and multisyllabic words (Flesch, 1948). Audiology-specific recommendations to address access concerns also call for the reduction of jargon, among other components. The intersection of long sentences, jargon, and many multisyllabic words can be seen in this sentence from a parent-oriented material used in the study with a FKGL of 18.1.

The U.S. Department of Education recently published IDEA and FERPA Confidentiality Provisions [PDF] (June 2014), a side-by-side comparison of the primary legal provisions and definitions in the Individuals with Disabilities Education Act (IDEA) Parts B and C and the Family Educational Rights and Privacy Act (FERPA) that relate to the confidentiality of personally identifiable information of children served under the IDEA. (NCHAM, 2020)

Although all of this information is critical for families to know and understand, the sentence length, vocabulary, and use of jargon may be challenging for a first-time reader or new parent to understand without support. Within early intervention, there may be situations where specific vocabulary and sentence structure is required. However, to work toward accessibility, there is a need for scaffolding to support understanding in these situations. These materials may not be accessible and thus are not working to address the stated and hypothesized lack of education that impacts

parents and, thus, children who are DHH as they enter early intervention.

This study, combined with other works on health literacy, patient education, and accessible materials, suggests that all sources of information, including government-sponsored sites, educational systems, and the general media, could benefit from making materials more accessible. Given that these results are consistent with Sax et al. (2019), it leads to the conclusion that both hearing screening and hearing-related early intervention could benefit from improved accessibility. Increased accessibility could be attained by implementing readability strategies as described by several national groups, including the U. S. Department of Health and Human Services (2020) and the American Speech-Language-Hearing Association (n.d.). When looking at readability scores, the grade level is impacted by a number of features, including syllables used in words and the length of sentences (Flesch, 1948; Weiss, 2006).

Although authors have been cautioned not to write with a readability formula in mind, potential strategies to support readability and lower required FKGL do exist. Remediation for current materials to improve readability and thus accessibility include the use of short paragraphs that implement active voice, using one and two-syllable words, prioritizing information and considering the relative importance of information to be presented, reducing jargon, using simple pictures/graphics, and encouraging the potential use of audience assessment measures to determine if the material is accessible (American Speech-Language-Hearing Association, n.d.; U.S. Department of Health and Human Services, 2020, n.d.).

Of the webpages that parents and caregivers may access to learn about early intervention for children who are deaf or hard of hearing (DHH), the average readability score is higher than is recommended. Thus, parents and caregivers who turn to the internet as a source of information to help them make early intervention decisions may find inaccessible information. These results suggest that those who develop and maintain web-accessible content on early intervention for children who are DHH need to examine the role of readability in their materials. However, increased readability measures of English language materials do not explicitly address the needs for culturally- and linguistically-diverse materials on the same topics. This work can be considered a reminder to consider the current recommendations and strategies from reputable national resources to ensure accessibility of information.

## References

- Ahmadian, L., Khajouei, R., Kamali, S., & Mirzaee, M. (2020). Use of the internet by pregnant women to seek information about pregnancy and childbirth. *Informatics for Health and Social Care, 45*(4), 385–395. <https://doi.org/10.1080/17538157.2020.1769106>
- American Speech-Language-Hearing Association. (n.d.). *Health Literacy*. <https://www.asha.org/slp/healthliteracy/>
- Badarudeen, S., & Sabharwal, S. (2008). Readability of patient education materials from the American Academy of Orthopaedic Surgeons and Pediatric Orthopaedic Society of North America Web Sites. *Journal of Bone and Joint Surgery, 90*(1), 199–204. <https://doi.org/10.2106/JBJS.G.00347>
- Badarudeen, S., & Sabharwal, S. (2010). Assessing readability of patient education materials: Current role in orthopaedics. *Clinical Orthopaedics and Related Research, 468*, 2572–2580. <https://doi.org/10.1007/s11999-010-1380-y>
- Centers for Disease Control and Prevention. (2019a). 2017 summary of diagnosis among infants not passing hearing screening. <https://www.cdc.gov/ncbddd/hearingloss/2017-data/06-diagnostics.html>
- Centers for Disease Control and Prevention. (2019b). 2017 summary of reasons for no documented early intervention (EI) services among infants identified with permanent hearing loss. <https://www.cdc.gov/ncbddd/hearingloss/2017-data/11-no-early-Intervention-reasons.html>
- Donald, A. J., & Kelly-Campbell, R. J. (2016). Pediatric audiology report: Assessment and revision of an audiology report written to parents of children with hearing impairment. *Journal of Speech, Language, and Hearing Research, 59*(2), 359–372. [https://doi.org/10.1044/2015\\_JSLHR-H-15-0120](https://doi.org/10.1044/2015_JSLHR-H-15-0120)
- Early Hearing Detection and Intervention Act of 2017, Pub. L 115-71, 131 Stat. 1218, 1219, 1220, 1221, 1222 and 1223, codified as amended at title 42 U.S.C. §§ 280g and 280g-1.
- Flesch, R. (1948). A new readability yardstick. *The Journal of Applied Psychology, 32*(3), 221–233. <https://doi.org/10.1037/h0057532>
- Haddad, K. L., Steuerwald, W. W., Garland, L. (2019). Family impact of pediatric hearing loss: Findings from parent interviews and a parent support group. *Journal of Early Hearing Detection and Intervention, 4*(1), 43–53.
- Hall, W. C. (2017). What you don't know can hurt you: The risk of language deprivation by impairing sign language development in deaf children. *Journal of Maternal and Child Health, 21*, 961–965. <https://doi.org/10.1007/s10995-017-2287-y>
- Individuals with Disabilities Education Act, 20 U.S.C. § 1436 (2004).
- Joint Committee on Infant Hearing. (2019). Year 2019 position statement: Principles and guidelines for early hearing detection and intervention programs. *Journal of Early Hearing Detection and Intervention, 4*(2), 1–44. <https://doi.org/10.15142/fptk-b748>

- Khoza-Shangase, K. (2019). Early hearing detection and intervention in South Africa: Exploring factors compromising service delivery as expressed by caregivers. *International Journal of Pediatric Otorhinolaryngology*, *118*, 73–78.  
<https://doi.org/10.1016/j.ijporl.2018.12.021>
- Kong, K., & Hu, A. (2015). Readability assessment of online tracheostomy care resources. *Otolaryngology–Head and Neck Surgery*, *152*(2), 272–278.  
<https://doi.org/10.1177/0194599814560338>
- Krishnan, L. A., Van Hyfte, S., & Richards, K. A. R. (2019). Newborn hearing screening: Early education = more satisfied mothers. *American Journal of Audiology*, *28*, 617–627.  
[https://doi.org/10.1044/2019\\_AJA-19-0007](https://doi.org/10.1044/2019_AJA-19-0007)
- Larsen, R., Munoz, K., DesGeorges, J., Nelson, L., & Kennedy, S. (2012). Early hearing detection and intervention: Parent experiences with the diagnostic hearing assessment. *American Journal of Audiology*, *21*, 91–99.  
[https://doi.org/10.1044/1059-0889\(2012/11-0016\)](https://doi.org/10.1044/1059-0889(2012/11-0016))
- Nair, E. L., & Cienkowski, K. M. (2010). The impact of health literacy on patient understanding of counseling and education materials. *International Journal of Audiology*, *49*, 71–75.  
<https://doi.org/10.3109/14992020903280161>
- National Center for Hearing Assessment and Management Utah State University (NCHAM). Early intervention (2020).  
<https://www.infanthearing.org/earlyintervention/>
- Pendersen, H. F., & Olthoff, J. (2019). Listen to us: Dad-endorsed strategies for EHDI professionals. *Journal of Early Hearing Detection and Intervention*, *4*(1), 62–72.
- Safeer, R. S., & Keenan, J. (2005). Health literacy: The gap between physicians and patients. *American Family Physician*, *72*(3), 463–468.
- Sax, L., Razak, A., Shetty, K., Cohen, M., & Levi, J. (2019). Readability of online patient education materials for parents after a failed newborn hearing screen. *International Journal of Pediatric Otorhinolaryngology*, *125*, 168–174.  
<https://doi.org/10.1016/j.ijporl.2019.07.009>
- Ting, K., & Hu, A. (2014). Evaluating the quality of readability of thyroplasty information on the internet. *Journal of Voice*, *28*(3), 378–381.  
<https://doi.org/10.1016/j.jvoice.2013.10.011>
- U.S. Department of Health and Human Services. (2020). Toolkit part 2: Using a reader-centered approach.  
<https://www.cms.gov/Outreach-and-Education/Outreach/WrittenMaterialsToolkit/ToolkitPart02>
- U.S. Department of Health and Human Services. (n.d.). Making health communication programs work.  
Retrieved from <https://www.cancer.gov/publications/health-communication/pink-book.pdf>
- Van der Spuy, T., & Pottas, L. (2008). Infant hearing loss in South Africa: Age of intervention and parental needs for support. *International Journal of Audiology*, *47*, S30–S35.  
<https://doi.org/10.1080/14992020802286210>
- Weiss, B. D. (2006). Health literacy: A manual for clinicians: Part of an educational program about health literacy.  
<http://lib.ncfh.org/pdfs/6617.pdf>
- White, K. R. (2019). The evolution of EHDI: From concept to standard of care [PDF]. In National Center for Hearing Assessment and Management (Ed.), *A Resource Guide for Early Hearing Detection and Intervention (2019)* (pp. 1–32). Retrieved from <http://www.infanthearing.org/ehdi-ebook/index.html>
- Wong, K., & Levi, J. R. (2016). Readability of pediatric otolaryngology information by children’s hospitals and academic institutions. *The Laryngoscope*, *127*, E138–E144.  
<https://doi.org/10.1002/lary.26359>
- Wong, K., & Levi, J. R. (2017). Readability trends of online information by the American Academy of Otolaryngology–Head and Neck Surgery foundation. *Otolaryngology–Head and Neck Surgery*, *156*(1), 96–102.  
<https://doi.org/10.1177/0194599816674711>