Theory & Practice in Rural Education (TPRE)
2023, Vol. 13, No. 1, Pp. 99-126
 ISSN:2641-7170
https://doi.org/10.3776/tpre.2023.v13n1p99-126

Disparities Among Cochlear Implant Users: Language, Service Providers, and Locale

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This descriptive study aims to delineate the characteristics of select students with cochlear implants in Midwest public school districts and the professionals who received consultation services. Researchers analyzed nine years of archival grant data focused on communication modality, school district locales, and types of service providers. Findings yielded that the largest group of students communicated primarily using gestures and vocalizations followed by students using spoken English. Of the service providers, almost all Deaf educators and interpreters had a communication match with their students. Results also revealed a disproportionate number of students directly served by a deaf educator in city/suburb locales compared to rural/town. These findings suggest some students with cochlear implants may be underserved by deaf educators, especially in rural areas.

***Keywords*: cochlear implants, deaf or hard of hearing, hearing loss, modes of communication, rural education, public schools, language performance**

Due to the implementation of Least Restrictive Environment (LRE) and the emphasis on inclusive educational experiences, the majority of deaf and hard of hearing (DHH) students are in mainstream classrooms. More specifically, approximately 63% of these students spend 80% or more of their time within the mainstream general education classrooms (Gallaudet Research Institute [GRI], 2011; U.S. Department of Education, 2017, 2021) alongside their peers with typical hearing. With the advent of newborn hearing screening, considerable advancement in hearing technology (i.e., hearing aids and cochlear implants), and early intervention, the developmental landscape of deaf education has improved over the last 20 plus years (Mayer et al., 2021). However,

students who are DHH still face educational challenges and often lag behind their peers with typical hearing (Huber & Kipman, 2012; Lund et al., 2022; Trezek et al., 2010; Sarant et al., 2015; Yoshinaga-Itano, 2015). Recent research has indicated that the literacy performance of children with cochlear implant (CI) technology has improved over time. Moreover, at times performance scores are found to be comparable to their hearing peers (Mayer & Trezek, 2018).

A CI is a surgically implanted device that bypasses either damaged or non-functioning parts of the inner ear using an electrode array to stimulate the auditory nerve fibers that are then processed by the brain (Cole & Flexer, 2016; Eshrangi et al., 2012). Simply put, CIs were designed and developed to afford those who were profoundly deaf auditory access to speech frequencies that were not previously accessible by other means of technology such as hearing aids (Cole & Flexer, 2016). While CI technology has influenced positive outcomes, it has also emphasized the heterogenous nature of this diverse group (Archbold & Mayer, 2012). CI technology and its advancements are one piece of the puzzle; factors such as the age of identification, age of amplification, age of intervention, language exposure, locale, and more all directly influence the needs of students who are DHH as well as how they receive such services. The heterogeneous demographics of DHH students can lead to diverse needs and, consequently, diverse and creative methods of service delivery. This begs the question: Are students who are DHH getting the services they need, particularly if they are in rural school districts?

Service delivery complications for students who are DHH in rural school districts have been noted (Belcastro, 2004; National Deaf Center [NDC] on Postsecondary Outcomes, 2017). However, what remains relatively unknown are the nuanced demographics of the students within different locales, including rural school districts. Examination of demographics such as communication modality, service provider types, communication match, among others seeks to better inform current practices for all students who are DHH with CIs. Moreover, emphasis on data collection pertaining to school district locale is necessary as service delivery complications in certain locales are likely impacting efforts to help improve outcomes among those who are DHH.

Conceptual Framework

This study rests on the conceptual framework outlined by what was previously known as the Education for All Handicapped Children Act (P.L. 94-142) and then eventually reauthorized and amended as the Individuals with Disabilities Education Act (IDEA, 2004), which purports that children with disabilities have a right to free and *appropriate* education, along with inclusion as mandated by the LRE. While this legislation protects and intends to provide appropriate services to all children with disabilities, the individualized nature and interpretation of this legislation leads to potentially underserving specific populations, such as those who are DHH (Silvestri & Hartman, 2022). Furthermore, the heterogenous nature of students who are DHH adds layers of

complexities to the implementation of IDEA and LRE. Therefore, it is pertinent and timely to examine current practices and characteristics of students who are DHH, particularly those with CIs, to provide the educational services necessary for better outcomes.

Educational Environments

Similar to other hearing assistive technology (i.e., hearing aids), a CI is a tool for auditory access to the brain. Recipients of a CI need intervention to develop auditory pathways, processing and linguistic skills necessary to derive meaning from the input gained through the CI (Cole & Flexer, 2016). An increasing percentage of students who are DHH utilize CI technology (Archbold & Mayer, 2012; GRI, 2011; Mitchell & Karchmer, 2006). Often professionals view the use of CI technology as the solution to challenges faced in the classroom. Furthermore, professionals may be unaware that additional strategies and/or support are often needed in conjunction with the CI device for the student to successfully utilize it both academically and socially (Okalidou, 2010; Jachova & Kovacevic, 2010). Advancements in CI technology along with the knowledge and training associated with it is pertinent, not only for educators of the DHH but for general education teachers, special education teachers, speech-language pathologists, and more.

While the mandate of LRE advocates for the inclusion of students who are DHH into the mainstream setting (U.S. Department of Education, 2017), these young children and students often face a number of challenges compared to their peers with typical hearing. Therefore, thoughtful consideration of the appropriate LRE on an individual basis is necessary to ensure each student's success (Silvestri & Hartman, 2022). Decisions regarding LRE should be made based on student need, not on resources and service provider availability.

Although not all young children and students utilizing CI technology need extensive services to support their learning and education, those who require it should be given access. Due to the specialized training and understanding required, we argue that appropriate services for DHH children often should include a certified educator of the DHH. Educators of the DHH have a unique skill set and knowledge base that is unmatched by any other service provider given the formal education and development of such skills for certification (GAO, 2011; Reynolds et al., 2014). Examination and analysis of current practices in the field are necessary to have an accurate depiction of service delivery for children who are DHH.

Service Delivery for Students Who are DHH

As simple as it sounds, service delivery is not black and white; in fact, there are a number of external factors that can cloud the services DHH students receive. Service delivery complications have been presented throughout the literature for students who are DHH, including those with CIs, such as a lack of time (Antia & Rivera, 2016), a lack

of service providers (Barr et al., 2018; GAO, 2011; Sibon-Macarro et al., 2014), lack of funding available for deaf education programs or other services (Ahern, 2011; GAO, 2011), and distance constraints (Ahern, 2011; Barr et al., 2018; Furno et al., 2020; GAO, 2011; Sibon-Macarro et al., 2014). In particular, the need for certified quality teachers to provide services to students with low-incidence disabilities is arguably a paramount concern among rural school districts (Barr et al., 2018, Jameson et al., 2019; Rude et al., 2005). "Clearly, the historically persistent teacher shortage in the field of special education seriously jeopardized the quality of education provided to students with LI [low-incidence] disabilities, especially those in rural and remote areas" (Jameson et al., 2019, p. 201–202).

Providing appropriate educational experiences and services to students who are DHH presents challenges regarding recruiting and retaining quality educators with appropriate training (GAO 2011; Jameson et al., 2019). Reynolds et al. (2014) suggested that in recent years, a trend has resulted whereby districts, especially districts in rural areas, use special education teachers and speech pathologists rather than a deaf educator as service providers for these students. The barriers of funding and hiring qualified educators to work with students is prominently seen within rural settings since the population of students with hearing loss tends to be small. When school districts are unable to pay for specialized services for students who are DHH, interpreters and educators move on to receive better pay in other districts or in a non-school setting (GAO, 2011). Furthermore, rural districts may need to hire an outside consultant, which requires extensive driving, limiting availability, and can potentially be costly, connecting back to the aforementioned funding constraints (Ahern, 2011; Sibon-Macarro et al., 2014).

Other barriers such as geographical issues and inadequate teacher preparation present a critical need for teachers of the DHH to collaborate and facilitate the necessary skill development for general education teachers who work with their students who are DHH (Furno et al., 2020; NDC on Postsecondary Outcomes, 2017). Specifically, the NDC on Postsecondary Outcomes (2017) emphasized the importance of training educators on the use of technology (e.g., tools for distance learning) in rural areas to help meet the needs of the students who are DHH. The use of technology in distance learning adds potential challenges for equal access among those who are DHH; therefore, this solution may also pose an additional challenge.

Robust research investigating disparities in service delivery and its implications for students who are DHH in rural and remote areas is prudent (Lund et al., 2022), particularly for those who use CIs. This points to an imperative need for more research to better understand and serve this population. To respond to the lack of services and information regarding CI technology as well as the needs of students who are DHH, a Midwest Department of Education (MWDED) and Midwest University (these pseudonyms are used

to maintain confidentiality) collaborated by providing free consultation services to school districts with school-aged students with CIs.

Communication and Language Needs

While the literature surrounding communication and language needs is robust for children who are DHH, there is a persistent "either-or dilemma" regarding communication modality (e.g., manual communication and listening and spoken language) and its impact on language development (Hall, 2017, p. 961). Despite this dilemma, there is consensus among the professionals in the field that access to language and strong language development is arguably a priority for children who are DHH (Hall et al., 2019). There is irrefutable evidence that strong language development and foundation are imperative for consequently strong academic and social-emotional skills (Choi et al., 2020; Cole & Flexer, 2016). Furthermore, the effects of language delays and language deprivation are proven to have negative consequences as well as hindered brain development and language deficits due to the diminished neuroplasticity as children age (Cole & Flexer, 2016; Hall, 2017).

Language deprivation among those who are DHH can stem from a lack of accessible input, which can derive from language models that are not a communication match (Hall et al., 2019). Studies pertaining to language environments are largely focused on parental language models as well as school language environments (Aragon & Yoshinaga-Itano, 2012; Arora et al., 2020; Rufsvold et al., 2018). However, few if any studies have examined communication match among service providers and their students. Language-rich environments, whether school or home, are futile unless that language is accessible, and their conversational partners are fluent in the child's communication modality; in other words, they are a communication match. For this paper, communication match is defined as a communication partner (i.e., service provider) who communicates in the student's preferred communication modality (i.e., spoken language, visual communication such as American Sign Language, etc.) and to the level of fluency that matches the student.

A common thread found in the literature is that early amplification is indicative of improved auditory skills and speech production (Connor et al., 2000; Cupples et al., 2018; Ching, 2015; Ching et al., 2017). Language acquisition and development appear to be consistently linked to age of amplification; other demographics such as communication modality have reported somewhat conflicting results. For instance, studies found that method of communication yielded no significant differences in the development of language among CI users (Connor et al., 2000; Yanbay et al., 2014).

Hyde and Punch (2011) found a minority of parents (15–18%) and teachers (30%) reported using a form of sign language with their children and students. Parents indicated that though they wished for their children to develop spoken language, several still used a form of sign language to support academic development (Hyde & Punch, 2011). While

researchers have expressed that exposure to sign language is not advantageous for the development of spoken language in children with CIs (Geers et al., 2017), more robust research is needed to firmly reach this conclusion; in fact, multiple studies have disputed this claim (Hall, 2017; Fitzpatrick et al., 2016). However, what remains unknown among these studies is whether children with CIs had a communication match with their language models to truly access these language environments in efforts to maximize language development.

Grant Details

Beginning in 2008, a Midwest Department of Education (MWDED) contracted with Midwest University in direct response to a statewide priority need identified by PK–12 schools to better serve students with CIs. A grant was developed with a primary goal to enhance the knowledge and skills of educators, speech language pathologists, and other school district personnel who implement services to students who are deaf who utilized CI technology, resulting in improved achievements of these students.

School districts with one or more students who had at least one CI qualified for the consultation services. Consultation services were district initiated. Through this collaboration, free and primarily indirect CI consultations were available to any school district personnel in the state who requested and continued with the consultation services. Indirect services were provided through consultations via conference calls or virtual meetings with school district personnel and/or administrators. On rare occasions, school district personnel and parents traveled to Midwest University for consultation services and/or direct intervention with the student.

During consultations, notes were taken by the lead author and graduate student worker for this grant. Notes were used for review of consultation discussions, recommendations, and materials shared with district personnel. This facilitated collaborations with districts, specific to the individualized needs of their student(s) with CIs. For research purposes, the archival data of notes and pertinent data sources (i.e., emails) were coded retroactively and de-identified for analysis. The archival data consisted of the first nine years (2008–2017) of the grant.

Significance of the Study

Given the heterogenous nature of achievements among students who are DHH, more information and analysis are needed to discern the areas of focus in regard to improving the educational outcomes of these students. By examining the data, this study can shed light on the realities and potential pitfalls of service delivery to students who use CI technology. In doing so, this study can inform and improve educational practices of educators working with students who are DHH as well as their administrators.

Research Questions

The research questions investigated were:

1. What were the primary modes of communication used by the students with CIs who were served through the grant?
2. What were the school district locales of the students with CIs served through the grant?
3. What were the provider types of the professionals who served the students with CIs during this grant cycle?

Method

Participants

Participants were students with at least one CI whose data was available in an archived database. The participants were selected from the first nine years of archival data collected since the inception of the CI consultation grant. Of the 140 students served through this grant, 72 students were included in this data analysis as participants. Students within the districts were only counted once, during their initial year of consultation. Data included types of school district service providers serving students with CIs as well as data on students with CIs in grades early childhood through high school. Permission to use the de-identified archival data was given by a supervisor in MWDED's Office of Special Education.

Sixty-eight of the potential participants were excluded from the study due to nonexistent student data. In those cases, student data was not available as it was not needed to answer the school district's question(s) or no consultation services were received due to a lack of district follow-up. On occasion, a school district no longer required the consultation services (e.g., a student moved from the district, or the district hired a deaf education consultant for on-site services).

It is important to note that of the 72 students with CIs that received indirect services through the grant, 25 students were served directly by a deaf educator in their district. These 25 students are delineated as a subgroup of this sample as they received direct services from individuals who have the training and specialized certification as deaf educators to work with this population. Direct services are defined as services directly provided to the student to address IEP goals and educational needs.

Data Collection Procedure

IRB permission was obtained through Midwest University. The data collection procedure included three primary phases: (a) category selection, definitions, and coding definition; (b) inter-rater reliability; and (c) coding and data analysis. An initial review of archival data revealed prevalent and relevant categories for exploration. Researchers

determined the final categorical variables and corresponding definitions along with statistician input. Inter-rater reliability procedures influenced refinement of definitions.

Definitions of Categorical Variables

Modes of communication

As researchers coded the data, they selected all modes of communication that applied for each student: (a) spoken English, (b) American Sign Language (ASL), (c) sign language, and (d) gestures and vocalizations. ASL was defined by the use of elicited or spontaneous signs that followed the grammatical and lexical rules of the language, and consequently, sign language was defined by the use of elicited or spontaneous manual communication at least at the word level. The data analyzed on the total of 72 students identified the following four modes of communication categories: (a) gestures and vocalization, (b) spoken English only, (c) spoken English and sign language, and (d) sign language only. Gestures and vocalization did not have an 'only' category because students who primarily used gestures and vocalizations to communicate also, on occasion, used a spoken word(s) or sign(s) so multiple communication modes had been selected. Furthermore, no students were reported to use ASL.

Speech intelligibility

A student's speech intelligibility was determined to be overall intelligible or overall unintelligible when it was specifically stated by a service provider. If there was no explicit documentation of the student's speech intelligibility, it was recorded as unknown.

Language performance

Language performance (e.g., limited language, below, and at grade level) was measured as an explicit self-reported variable by the professional receiving consultation services. A student was declared to have limited language if there was data collected during consultation services that indicated as such. If it was not explicitly stated by the professional, it was recorded as unknown.

Locale

School district locale was coded as rural, town, city, or suburb using the National Center for Education Statistics's (NCES; 2015, 2022) definitions for each category. Specifically, the NCES (2015, 2022) defines rural school districts as a region that range from 5 to 25 miles from an urbanized area and that is located 2.5 to 10 miles from an urban cluster. A town was defined as a region inside an urban cluster that is less than or equal to 10 miles to more than 35 miles from an urbanized area. A suburban district was defined as a region outside a principal city and inside an urbanized area with 100,000 to 250,000 people, and a city was defined as a region inside a principal city and urbanized area with 100,000 to 250,000 or more people. Furthermore, the NCES (2015, 2022) further defines each of these definitions into sub-categories of distant, remote, and fringe

for rural and town or as city or suburb with sub-categories of small, mid-size, and large, based on both the districts' location and their relative distance from a more populated area. For example, rural: fringe or city: small. Initial data analysis indicated the distribution of the participants between subcategories of rural and town were nearly evenly distributed whereas there were twice as many students in city locale compared to suburb locales. The aforementioned locales were combined based on similar attributes being more rural versus more city. Specifically, the categories were labeled: (a) rural/town and (b) city/suburb.

Service provider type

Service providers were identified as professionals within the school districts who had provided services as delineated on the student's individualized education plan (IEP). In this study, data collected focused on the following service provider types: (a) general education teachers, (b) speech language pathologists, (c) special education teachers, (d) deaf education teachers, (e) interpreters, and (f) paraprofessionals.

Communication Match

A communication match was determined if the service provider was considered to be fluent in the child's primary communication mode to communicate. Furthermore, it is considered to be a communication match when the service provider directly communicates with the student, without the use of facilitators (i.e., deaf educator or interpreter).

Inter-Rater Reliability

Inter-rater reliability was established by coding one specific year by five researchers. Data areas coded during this phase were (a) communication modes of the student, (b) school district geographical locales, and (c) service provider types. Due to the number of researchers coding the data, inter-rater reliability was set at the 80% agreeance level or, in other words, requiring 4 of the 5 researchers' agreement in coding (Gersten et al., 2005). In order to achieve 80% agreement, some refinement of definitions and coding was required. Inter-rater reliability indicated over 85% category agreement among the raters in all but two of the variables. The two variables determined to be not in agreement were further addressed. There was an additional variable, mode of communication in sign language, in which 80% agreement was not reached; it fell at 75% agreement. However, the overall mode of communication percentage of agreement was 90%; therefore, the sign language category was considered to be in agreement with the inter-rater reliability.

The two categories that did not reach agreement were whether the student had intelligible speech and whether the student had language performance that was at grade level, below grade level, or limited language. Definition revisions moved from educated deductions based on the data to requiring it to be explicitly stated within the data; in other

words, it was self-reported by the professional receiving consultation services. In addition, a final inter-rater reliability check was completed on the non-agreement variables. Two researchers rated each of the aforementioned variables independently and then shared their results. If there was not agreement by the two raters, then a third rater coded the data without knowledge of the previous rater's decisions and discussed with the others to reach agreement.

Research Design and Data Analysis

The researchers have identified this study and its results as a descriptive study**.** All variables examined in this study are categorical variables as defined previously. The remaining eight years of archival data were divided and independently coded by the researchers based upon the criteria set as a result of the inter-reliability. Given that the dataset consisted of frequencies and categorical variables, analyses was conducted using cross-tabulation. The dataset does not meet the assumptions for robust statistical analyses such as Pearson's chi-squared test (Field, 2018); therefore, descriptive analysis (i.e., frequency tables) was sufficient for this dataset. The integrity of study data compilation was guided by adherence to inter-rater reliability protocol.

Results

Research Question One

What were the primary modes of communication used by the students with CIs who were served through the grant?

The breakdown of modes of communication are displayed in Table 1 for all 72 participants and the subgroup of 25 students who had direct services from a deaf educator. In both groups, more students primarily used gestures and vocalizations (44.4% of all participants and 36% of the subgroup receiving direct services from a deaf educator). The second most prevalent mode of communication was spoken English only at 34.7% and 32%, respectively.

Table 1 also illustrates the grade range at implantation and grade range at consultation measured against primary mode of communication. Across all communication modes, more students were implanted during early intervention (birth to 3 years of age). However, for those students using gestures and vocalizations primarily to communicate, there was a nearly equal distribution between those who were implanted during early intervention (40.6%) and those implanted during early childhood (37.5%); the difference reflected only one participant. Furthermore, a majority of the students primarily using gestures and vocalizations to communicate were in early childhood at the time of consult. Conversely, a majority of the students whose primary mode of communication was spoken English only were in fourth grade through 12th grade at the time of consult. Additionally, this spoken English only group did not share the nearly equal distribution at age of implantation. A majority (52%) of the spoken English only group were implanted

during early intervention followed by a decrease greater than half for participants in the spoken English only group who were implanted during early childhood (24%).

Table 1

Primary Mode of Communication According to Grade Range at Implantation and at Consult

	Primary Mode of Communication							
	Gestures and Vocalizations		Spoken English Only		Spoken English and Sign		Sign Language Only	
	%	*n*	%	*n*	%	*n*	%	*n*
Participants (n=72)	44.4%	32	34.7%	25	16.7%	12	4.2%	3
Participants receiving deaf education services (n=25)	36.0%	9	32.0%	8	28.0%	7	4.0%	1
Grade Range at Implantation (*n* = 72)								
Early Intervention	40.6%	13	52.0%	13	41.7%	5	66.7%	2
Early Childhood	37.5%	12	24.0%	6	8.3%	1	33.3%	1
Kindergarten- 3rd	12.5%	4	4.0%	1	16.7%	2	0%	0
4th- 12th	3.1%	1	8.0%	2	8.3%	1	0%	0
Unknown	6.3%	2	12.0%	3	25.0%	3	0%	0
Total	100%	32	100%	25	100%	12	100%	3
Grade Range at Consult (*n* = 72)								
Early Childhood	53.1%	17	16.0%	4	16.7%	2	0%	0
Kindergarten- 3rd	37.6%	12	32.0%	8	66.7%	8	66.7%	2
4th-12th	9.3%	3	52.0%	13	8.3%	1	33.3%	1
Unknown	0%	0	0%	0	8.3%	1	0%	0
Total	100%	32	100%	25	100%	12	100%	3

Note. The participants receiving deaf education services were the 25 students receiving direct services from a deaf educator at the time of consultation.

Language performance was compared to primary mode of communication in Table 2 for the 25 students who received direct services from a deaf educator and the 47 students without direct services from a deaf educator. Given the extensive training and knowledge base of deaf educators, researchers wanted to display the data with and without this subgroup to highlight the differences in characteristics as it relates to the service professionals. As seen in Table 2, data indicated that of the students served directly by a deaf educator, more students were reported as having limited language performance across all primary modes of communication except for spoken English only. Approximately 87% of students using spoken English only were reported to be performing at grade level for language performance. There were no students using spoken English

only and being served by a deaf educator who were at the limited or below grade level language performance. Again, a majority of the students using spoken English were in grades 4-12, at the time of consult.

Additionally, Table 2 presents the group of participants not receiving direct services by a deaf educator. Table 2 shows that 61.7% of all participants were reported as functioning with limited language performance or below grade level. There were no students whose primary mode of communication was spoken English only who fell within the limited language performance category. The only group reported with students functioning at grade level used spoken English only as their mode of communication, a total of seven students. In other words, approximately 15% of the participants, who did not receive direct services from a deaf educator and used spoken English as their mode of communication, were functioning at grade level in regard to their language performance.

Table 2

Language Performance of Participants According to the Participants' Primary Mode of Communication

		Primary Mode of Communication							
		Gestures and Vocalizations		Spoken English Only		Spoken English and Sign		Sign Language Only	
		%	*n*	%	*n*	%	*n*	%	*n*
Participants (*n* = 47)	Language Performance								
	Limited Language Performance	52.2%	12	0%	0	40.0%	2	50.0%	1
	Below Grade Level	34.8%	8	29.4%	5	40.0%	2	50.0%	1
	At Grade Level	0%	0	41.2%	7	0%	0	0%	0
	Unknown	13.0%	3	29.4%	5	20.0%	1	0%	0
	Total	100%	23	100%	17	100%	5	100%	2
		%	*n*	%	*n*	%	*n*	%	*n*
Participants receiving deaf education services (*n* = 25)	Language Performance								
	Limited Language Performance	55.6%	5	0%	0	42.8%	3	100%	1
	Below Grade Level	22.2%	2	0%	0	28.6%	2	0%	0
	At Grade Level	0%	0	87.5%	7	14.3%	1	0%	0
	Unknown	22.2%	2	12.5%	1	14.3%	1	0%	0
	Total	100%	9	100%	8	100%	7	100%	1

Table 3 indicates providers' perception of overall speech intelligibility, as compared with the student's primary mode of communication, for those students utilizing spoken English in some capacity. Less than half of the participants (18.9%) fell within the unknown category because it wasn't explicitly reported by a service provider. Of those students using spoken English alone or in combination with sign language, approximately half (48.7%) were deemed overall intelligible and 32.4% were rated overall unintelligible; the remaining were identified as unknown.

The data indicates a stark contrast between the groups of students who used spoken English only versus those using spoken English and sign language in relation to

overall speech intelligibility. Sixty percent (60%) of the spoken English only group was deemed overall intelligible while 40% were either unintelligible or listed as unknown because intelligibility was not explicitly stated in the data. Conversely, 25% of the spoken English and sign language group were reported as overall intelligible with the remaining 75% reported as overall unintelligible. Again, the majority of the students using spoken English only were in grades 4-12, at the time of consult. The majority of the students using spoken English and sign language were in K-3 grade.

Table 3

Speech Intelligibility of the Participants who use Spoken English in any Capacity

	Mode of Communication					
	Spoken English Only		Spoken English and Sign		Both Groups Combined	
	%	*n*	%	*n*	%	*n*
Speech Intelligibility						
Overall Intelligible	60.0%	15	25.0%	3	48.7%	18
Overall Unintelligible	12.0%	3	75.0%	9	32.4%	12
Unknown	28.0%	7	0%	0	18.9%	7
Total	100%	25	100%	12	100%	37

Note: Unknown selected if the archival data did not explicitly state information for that category.

Research Question Two

What were the school district locales of the students with CIs served through the grant?

Table 4 demonstrates the locale breakdown of the 72 students with CIs served indirectly through this grant and the sub-group of 25 students receiving direct services from a deaf educator. Of the 72 students, 75% (*n* = 54) were served in a school district categorized as rural/town, and 25% (*n* = 18) were served in a school district categorized as city/suburb. Twenty-five (25) of the 72 students received direct services from a deaf educator. There was an almost equal distribution between locales for students receiving direct services from a deaf educator: 52% of the students (*n* = 13) were in rural/town locales, and 48% of the students (*n* = 12) in city/suburb locales.

Of all the participants, including those who did not receive deaf education services, only 24.1% (*n* = 13) of students in the rural/town locales were receiving direct services from a deaf educator. In city/suburb locales, 66.7% (*n* = 12) of students were being serviced directly by a deaf educator.

Table 4 also delineates the locale in comparison to primary mode of communication, grade range at implantation, language performance, and speech intelligibility. In regard to primary mode of communication, data indicated that in rural/town locales, most students used either gestures and vocalizations or spoken English only. Whereas in the city/suburb districts, there was a nearly equal distribution of students among communication modes, except for sign language only. Additionally, the pattern of when students were implanted across the four grade range categories was similar in both locales. For example, data indicated that 46.3% (*n* = 25) of students in rural/town locales were implanted during early intervention and 44.4% (*n* = 8) of students served in city/suburb areas were implanted during early intervention. Lastly, a similar pattern was seen across the two locale categories for language performance. In both the rural/town and city/suburb locales, 33.3% (*n* = 6) of students were in the limited language performance sub-category.

Differences were noted by locale when analyzing student's speech intelligibility. The rural/town locale had 55.6% (*n* = 30) of students' speech stated as overall intelligible. In the city/suburb locale 33.3% (*n* = 6) of students' speech was explicitly stated as overall intelligible.

Table 4

Primary Mode of Communication, Grade Range at Implantation, Language Performance, and Speech Intelligibility According to Locale

	Locale			
	Rural/Town		City/Suburb	
	%	*n*	%	*n*
Participants (*n* = 72)	75.0%	54	25.0%	18
Participants receiving deaf education services (*n* = 25)	52.0%	13	48.0%	12
Primary Mode of Communication (*n* = 72)				
Gestures and Vocalizations	48.1%	26	33.3%	6
Spoken English Only	33.3%	18	38.9%	7
Spoken English and Sign	13.0%	7	27.8%	5
Sign Language Only	5.6%	3	0%	0
Total	100%	54	100%	18
Grade Range at Implantation (*n* = 72)				
Early Intervention	46.3%	25	44.4%	8
Early Childhood	31.5%	17	16.7%	3

Kindergarten- 3rd	13.0%	7	0%	0
4th- 12th	5.5%	3	5.6%	1
Unknown	3.7%	2	33.3%	6
Total	100%	54	100%	18
Language Performance (*n* = 72)				
Limited Language Performance	33.3%	18	33.3%	6
Below Grade Level	31.5%	17	16.7%	3
At Grade Level	20.4%	11	22.2%	4
Unknown	14.8%	8	27.8%	5
Total	100%	54	100%	18
Speech Intelligibility (*n* = 72)				
Overall Intelligible	55.6%	30	33.3%	6
Overall Unintelligible	29.6%	16	33.3%	6
Unknown	14.8%	8	33.3%	6
Total	100%	54	100%	18

Note. The participants receiving deaf education services were the 25 students receiving direct services from a deaf educator at the time of consultation. Unknown selected if the archival data did not explicitly state information for that category.

Research Question Three

What were the provider types of the professionals who served students with CIs during this grant cycle?

The data indicated that 187 service providers served the 72 students. Table 5 distributes the frequency of each service provider serving students with CIs through this grant. This data does not demonstrate a one-to-one correspondence between student and service provider because one student could have multiple service providers. The most frequently reported service providers were general education teachers followed closely by speech language pathologists. As mentioned previously, 25 of the students with CIs (35.7%) received direct services from a deaf educator. Students were over two times more likely to be served by a speech language pathologist than by a deaf educator.

Only two groups of service providers had a communication match of 96% or better with their students who had CIs, deaf educators (96%) and interpreters (100%). However, of the students served by special education teachers, 48.1% did not have a communication match with their teacher. Lastly, general educators had the highest frequency count but only had a communication match with 70.4% of the students they served. This means that in a room of 10 students, approximately three of them would not have a communication match with their general educator.

Table 5

Frequency of Service Providers and Percentage of Communication Match with Students

	Communication Match				
	Yes		No		N/A[b]
Service Provider Type	%	*n*	%	*n*	*n*
General Education	70.4%	38	29.6%	16	18
SLP[a]	76.9%	40	23.1%	12	20
Special Educator	51.9%	14	48.1%	13	45
Deaf Educator	96%	24	4%	1	47
Interpreter	100%	15	0%	0	57
Paraprofessional	64.3%	9	35.7%	5	58

Note. This does not indicate a one-to-one match between students and service provider because students could be receiving multiple services and amount of service time is unknown.

[a] Speech Language Pathology

[b] Not served by that service provider type

Further examination of the data warranted removing students identified as utilizing gestures and vocalizations since they did not, at the time of the study, display a true language. Gestures and vocalization are merely steppingstones to language development; therefore, it is pertinent to closely examine this data excluding this as a communication modality. By doing so, this eliminates 44.4% (*n* = 32) of the students. This data is displayed in Table 6, and the lack of communication match is still relevant. After removing these students who used gestures and vocalizations, 12% of general educators and 22% of special educators *did not* have a communication match with the students they were serving. Additionally, 28.6% of paraprofessionals *did not* have a communication match with the students they served.

Table 6

Frequency of Service Providers and Percentage of Communication Match with Students Whose Primary Communication Modality Was Not Gestures and Vocalizations

	Communication Match				
	Yes		No		N/A[b]
Service Provider Type	%	*n*	%	*n*	*n*
General Education	88%	29	12%	4	7
SLP[a]	87.5%	21	12.5%	3	16
Special Educator	78%	7	22%	2	31
Deaf Educator	100%	16	0%	0	24
Interpreter	100%	7	0%	0	33
Paraprofessional	71.4%	5	28.6%	2	33

Note. This does not indicate a one-to-one match between students and service provider because students could be receiving multiple services and amount of service time is unknown.

[a] Speech Language Pathology

[b] Not served by that service provider type

Upon further review of the data, researchers examined the breakdown of language performance (at grade level, below grade level and limited language) among those who did (*n* = 21) and did not (*n* = 38) receive direct services from a deaf educator. Data related to language performance was not available for 13 students, so the following results are interpreted among 59 students. Results indicated of the students that received direct deaf education services, most had either limited language performance (42.9%, *n* = 9) or were at grade level (38.1%, *n* = 8) in regard to language performance. Among those who did not receive direct deaf education services, a majority was found to have limited (39.5%, *n* = 15) or below grade level (42%, *n* = 16) in regard in language performance with only 18.4% (*n* = 7) of these students performing at grade level.

Discussion

This paper and its findings add to the existing literature by identifying the disparities in language, access to deaf education services, and communication match among students with CIs. In doing so, this study informs the field of the educational experiences these students have, namely within rural/town regions. Additionally, illuminating such disparities revealed in this study will help to identify targeted areas of needed improvement among complexities often associated with students who are DHH

Overview of the Findings

In addressing research question one, the data revealed that, alarmingly, most students in this study primarily communicated through gestures and vocalizations. It should be emphasized that gestures and vocalizations is *not* a communication modality nor is it a language. Whether these students were in early childhood (53.1%) or K-12 (46.9%) at the time of consultation, these students had not yet acquired a language. In other words, these students were unable to sufficiently access the curriculum. Given the ages of the participants, some may have diminished neuroplasticity and were past the critical period for language development, resulting in the irreversible consequences of language delays and deprivation (Cole & Flexer, 2016; Hall, 2017; Hall et al., 2019). To offset these consequences, school districts need to provide these students with direct and intensive services to help close the gap in their language performance compared to their peers who are hearing. Furthermore, school districts may need to revisit the LRE and its inclusive practices to ensure that the educational programming provided to students is one that embraces the language, academic and socioemotional needs of the child (Silvestri & Hartman, 2022).

The spoken English only group was the second largest communication mode group in this study and overall yielded the most positive results. A majority of these students were reported to be performing at grade level and exhibiting overall intelligible speech. It is important to note that the majority of the aforementioned students were in grades 4-12 at the time of the study. These results appear contrary to some literature in which “no significant difference” was found in the development of language among CI users (Connor et al., 2000; Yanbay et al., 2014). However, the benefits of early implantation (Connor et al., 2000; Cupples et al., 2018; Ching, 2015; Ching et al., 2017; Raeve, 2010) and/or early intervention (Geers et al., 2019; Vohr et al., 2011) have been well-documented and could explain the results proffered in this study.

For research question two, the data indicated that rural/town service providers sought out CI consultation services more often than service providers in city/suburb areas, 75% and 25% respectively. The data also disclosed that of the students in rural school districts, only 24.1% of these students received direct services from a deaf educator, compared to the city/suburban districts with 66.7% receiving direct deaf education services. This data suggests that students with CIs in rural school districts were disproportionately underserved by deaf educators and supports the notion that city/suburb school districts have more access to resources for students. Therefore, previous claims of challenges associated with recruitment and retention efforts of qualified educators in rural school districts are well substantiated and prove to be a consistent area of concern (Rude et al, 2005). To address recruitment, retention and preparation of qualified educators, universities may need to explore alternative teacher pathways (see Jameson et al., 2019). Consequently, MWDED and Midwest University have engaged in

a collaborative partnership to actively explore alternative teacher pathways; more on this is provided in a forthcoming section of this article. Furthermore, grants and other funding opportunities may become imperative to provide supports to university resources as well as to potential teacher candidates in rural areas to obtain the training and certification necessary to provide quality services to low-incidence populations such as students who are DHH. Additional research could be completed to aid in recruitment of deaf educators into rural areas and overcome these service complications.

With respect to research question three, results of this study indicated that only 35.7% (or 25 out of 187) of the service providers were deaf educators. Students were nearly twice as likely to be served by an speech-language pathologist (SLP) than a deaf educator. Also, when analyzing the participants' communication match (including those who primarily communicated using gestures and vocalizations) with their service providers, special educators only had a communication match with about half of the students whom they were serving. If some students with CIs are being served by special education teachers rather than deaf educators (Reynolds et al., 2014) and there is only a communication match with about 50% of the special educators, it brings into question the students' access to communication, academics, and learning.

Limitations of the Study

The results and discussion should be viewed with consideration of potential limitations. A limitation was that this study provided only a snapshot. The archival data presented one year of student information in only a student's first year of participation. Without longitudinal data, growth or change over time was unknown. Also, within the actual participant pool, the number of participants with a primary mode of communication of sign language only displayed less than an 'n' of five, which was also noted in some other variables sub-groups. As a result, the researchers were not able to conduct robust statistical analyses to determine whether there was a statistically significant difference among the frequency tables. While there is no statistical data to accompany this data, the cross-tabulation analyses allude to notable consequences that merit further examination as well as supports claims for funding and creative pathways toward providing quality services to all students who are DHH.

Although multiple variables were reported within the research to answer the research questions, there were other data points that if included (e.g., age at amplification, early intervention services, and additional disabilities) may have increased the understanding of the population studied. The researchers were limited in how much data to analyze and report; therefore, these variables warrant further investigation to increase understanding and research implications. Furthermore, the researchers coded language level according to the student's grade as opposed to their age. While this is valuable information for readers, the researchers acknowledge that this does not account

for students who might be delayed or held back. Given the study methods, age-related data regarding language level is not available and warrants further investigation.

A couple of service provider limitations surfaced. Communication match was determined for each service provider type, and data was reported individually. Service provider type was reported and analyzed in aggregate form as opposed to across participants. Therefore, while the data indicates a clear disproportionate communication modality mismatch, the data might be skewed. More specifically, the unreported crossover of an interpreter in the classroom may have positively impacted the achievements for some students regardless of the mismatch of communication modes with other professionals. There was an additional known crossover in the category of SLP. There were two additional professional groups who met appropriate state guidelines to provide direct services to the students but who were not licensed SLPs. These three professionals have differing levels of education and licensure and or certification, which may have influenced the quality and outcome of services provided. Given the premise that most districts contacted Midwest University for consultation for those students who were struggling, a complete picture of service providers for children who were performing well could not be made.

Lastly, study data did not include the data of school districts who had attempted to hire a deaf educator without success, nor did it consider the number of consultations or resources shared with given districts. This data could have shown the concerted effort by some districts to meet the educational and communication needs of students with CIs. Also, there were multiple consultation attempts to identify potential districts who not only had a deaf educator but who were also willing to allow a district to contract for services. Results yielded limited success.

Implications and Future Research

Overall, this study presented insights into the population of public school students with cochlear implants whose school districts received CI consultation services within a Midwest region. This study also identified a variety of challenges and unmet needs of some students with CIs throughout this region. Future research can potentially help to further analyze these areas of needs as well as create potential solutions to better serve students with CIs, especially in underserved rural areas and for students with limited language.

School districts, departments of education at the state and national levels, and institutions of higher education may need to think outside the box to provide deaf education services in rural areas. Rural school districts and state departments of education may consider pooling resources to form a cooperative as a means of providing direct deaf education services for these students. In recent years, the delivery of services has extended beyond the traditional methods to include telepractice or virtual options, which increases the capacity to service a wider range of individuals including those in

rural locations (Barr et al., 2018). While these methods of service delivery may provide unprecedented benefits, especially for those in rural and/or remote areas, more research and investigation regarding practices and outcomes is prudent among those who are DHH (Barr et al., 2018; Lund et al, 2022). Furthermore, increasing direct and intensive language-rich intervention services to some students with CIs, especially those students with limited language, may be warranted. Front-loading services in the early years, including early intervention years, could build a strong foundation of language on which to build academic success.

Higher education institutions may explore grants and technology to make teacher preparation programs more accessible to potential teachers from rural areas who may stay in rural areas to teach (Sindelar et al., 2018). In response to the disparity among DHH students as well as the stark need for deaf educators, MWDED and Midwest University took action to address these mounting concerns. To create statewide and even nationwide impact, Midwest University's deaf education program created a specific pathway for those teachers who have an undergraduate degree and current certification, both in special education. The pathway allows current special education teachers to take specific coursework as well as practicum to develop their knowledge and skills related to DHH students. Coursework and practica were designed to allow special education teachers to continue to teach full-time while completing this pathway part-time in a two-year timeframe. Upon completion of this pathway and state-level assessment(s), special education teachers will hold a Master of Science in Education, Special Education: Education of the Deaf and Hard of Hearing and qualify for teacher certification in Deaf/Hard of Hearing (Birth–12).

Grant support through MWDED was given to Midwest University to reduce financial barriers for a limited number of eligible special education teachers in their state. Furthermore, this pathway reduces financial and location barriers for special education teachers within rural areas as the coursework is offered almost exclusively through distance learning. Subsequently, this pathway has the potential to increase the likelihood of rural school districts employing educators who are dually certified in Special Education (K-12) and Deaf/Hard of Hearing (Birth-12). Ultimately, this innovative pathway for special education teachers may contribute to improved service delivery and educational outcomes for students who are DHH across the state and nation.

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