Evaluating the Benefits of Early Intervention via Internet-based Two-way Videoconferencing

A Multi-site Study funded by the Oberkotter Foundation

Conducted By
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Many young children who are deaf or hard of hearing (DHH) do not receive the intensity and type of early intervention services needed for optimal development. Shortages of well-trained early interventionists, transportation and scheduling challenges, and the fact that many of these children live at significant distances from qualified early intervention providers mean that many do not obtain the early, specialized services they need (White, 2007).

Delivering services via internet-based two-way videoconferencing equipment (referred to hereafter as "Tele-intervention") has potential for bringing much-needed hearing and communication-related services to families facing such challenges. Tele-intervention, or "TI" for short, is a term coined by the National Center for Hearing Assessment and Management (NCHAM) when using two-way videoconferencing to deliver early intervention services to families of infants and toddlers. The family still receives services in their home. Terms such as "virtual home visits" or "telepractice" also are used to describe such services. Though the terms may vary, the general concept and approach to service delivery is the same.

Importance of this Study

Most previous studies of tele-intervention have shown family satisfaction, and suggested potential cost savings in implementing TI by reducing transportation costs. A recent study conducted by NCHAM (Blaiser, Behl, White, and Callow-Heusser, 2013). raised the bar on evidence to date via the implementation of a randomized study with 27 families of infants and toddlers who are DHH in Utah. The findings showed positive language development outcomes as well as enhanced family engagement.

The multi-site study reported here plays an important role in strengthening our knowledge about the effectiveness of TI. First, it involved a larger, more diverse sample of 48 children who were drawn from 5 sites – four of which received funding from the Oberkotter Foundation to assist with the implementation of their TI program. Second, it included more measures of outcome including auditory skill development and a well established norm-referenced measure of children's language development.

Participating Sites and Subjects

Five sites participated in this study; each site recruited families for participation and obtained signed informed consent. Families were assigned to the TI group or the in-person group after matching on child chronological age, degree of hearing loss, and other disabilities/conditions. Random assignment was possible with about half of the subjects,

Table 1: Total Number of Subjects in Study

Site	# of Subjects Completed Study	# of Dropped Subjects	# of Providers Completed Study
Hear Me Now, Maine	8	0	2
Moog Center, Missouri	13	1	5
Sound Beginnings, Utah	4	0	1
Listen and Talk, Washington	15	5	5
Willamette Special School District, Oregon	8	0	2
Total	48	6	15

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while other subjects were assigned based on logistical considerations. For example, the families in the TI group from the Moog Center lived out of state and thus they required TI assignment; comparison group children were then selected after matching the children in each group on the aforementioned key characteristics.

As shown in table 1, 54 families were assigned to groups and 48 families participated in 6 months of early intervention and completed both pre- and post-testing.

Child and Family Characteristics

Table 2 provides an overview of the child and family characteristics that show how children in the TI group compared to children in the in-person group. As can be seen, children in the two groups were well matched on all key characteristics, although the families in the TI group reported slightly more use of computers and videoconferencing prior to the study. The children were 19-20 months of age on average at the start of pretest. Table 3 presents the degree of hearing loss for participating children; a chi-square test for differences showed that there were no statistically significant differences among groups (p-value = 0.71).

Provider characteristics

A total of 15 providers across 5 sites participated in the study; all of the providers except two served families in both the TI and the In-person group. Table 4 shows demographic characteristics for the providers serving children in each group. Averages are weighted based on the number of children served by each provider. For example, if a provider served three children in the TI group, they were counted three times. Roughly half the providers were deaf educators and the other half were speech/language pathologists and/or Auditory-verbal therapists. All of the providers had at least 3 years of experience working with children who are D/HH in early intervention. The amount of experience delivering services via TI was quite variable, ranging from no experience to over two years.

Table 2: Child and Family Characteristics

Characteristic	Tele-Intervention (n=23)	In-Person (n=25)	P-value
Child Age in months at beginning of study	20.2	19.0	0.72
Age of Hearing Loss Diagnosis (months)	3.27	5.72	0.25
Age at State of Early Intervention (months)	6.72	6.85	0.95
% of children using primarily Listening/Spoken Language	82%	92%	0.44
Primary Caregiver's Age (years)	32.8	34.5	0.42
Primary Caregiver's Education	14.5	14.7	0.86
Income	$60,886	$68,680	0.57
% of children receiving addtional therapy	50%	40%	0.69
Prior Computer Use*	3.87	3.40	0.04
Prior Videoconferencing Use*	1.96	1.60	0.17

* 1= Never or less than once a month, 2= More than once a month but not every week,
3= At least once a week but not every day, 4= Every day

Table 3: Degree of Hearing Loss by Group

Degree of Hearing Loss	TI (n=23)	In-Person (n=25)
Unilateral, Atresia, or Bilateral mild	5	5
Bilateral mild/moderate	3	4
Bilateral moderate	2	3
Bilateral moderate/severe	6	4
Bilateral severe	0	2
Bilateral severe/profound	1	0
Bilateral profound	6	6

Table 4: Provider Characteristics

Site or Group	—Average*—				— Prof. Role —	
	Years in EI	Years Serving HL	TI Exper. (months)	Provider Age	# of Deaf Educators	# of SLP's or ATV's
Tele-Intervetion Group	11.3	15.8	13.6	42.0	7	7
In-Person Group	10.9	14.8	13.7	41.4	7	7
Hear Me Now, Maine	17.0	17.0	18.5	42.1	0	2
Moog Center, Missouri	16.6	26.6	28.8	52.4	5	0
Sound Beginnings, Utah	3.5	3.5	66	44.0	0	1
Listen and Talk, Washington	9.8	11.7	13.0	37.5	1	4
Willamette S.S.D., Oregon	8.5	15.5	0.0	40.0	2	0

* The group averages were computed using a weighted average. For example, if a provider provided for three people in the TI group, they were counted three times.

Intervention

The intervention period for this study was 6 months. During this time, the TI group families received 90% of their early intervention services via tele-intervention, with only 10% of their visits being delivered in person. TI services were delivered via a variety of technologies. Both families and providers in two of the sites (11 of the 23 children in the TI group) used iPads and FaceTime software; these programs provided the iPads for families. Laptops were employed at the other sites, and the software included systems such as MOVI, Zoom, or Skype. Families typically used their own computer hardware. The in-person group received their services via traditional in-person home visits. The number of scheduled early intervention sessions for each family was based on what was prescribed in their IFSP and was 3.8 visits per month for the children in the TI group and 4.1 visits for children in the in-person group at the time of group assignment.

Provider Time

Providers completed forms to document the amount of time required to do TI compared to traditional in-person visits. For example, providers reported the amount of time spent doing specific activities, including preparation and documentation. As shown in Table 5, the time spent in preparation, coordination with other team members, and intervention were slightly less for the TI sessions, and the time to document visits and complete record keeping was only one minute more for the TI visits. Overall, the provider time spent to complete these routine activities was slightly less for the TI group. None of these differences were statistically significantly different.

Drive time and mileage for in-person group

The average drive time for in-person families was 60 minutes per visit (range 21 to 79 minutes). The average mileage for in-person group was 38 miles (range 14 to 49 minutes). Thus, conducting a TI visit could save about one hour of provider time per family and about $20 in mileage costs.

Time Spent Setting Up and Troubleshooting Technology

Coordination time was reported for 42 visits with TI families. The average time per family per visit for establishing the internet connection and any necessary troubleshooting was 11 minutes. This time must be considered in estimating the cost of implementing TI.

Table 5: Average Time Per Visit Spent by Providers for Children in Each Group

Average Minutes	TI	In-Person
Preparation Time	13 minutes	15 minutes
Coordination with others	13 minutes	16 minutes
Intervention	51 minutes	58 minutes
Documentation & record Keeping	15 minutes	14 minutes

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Table 6: Number of Reported Sessions Delivered by Group

Tele-Intervention Group sessions per month			
Month	Ave. # Sessions/Mo Conducted	Ave. # Sessions/Mo Cancelled	Ave. Total Minutes/Mo
December (n=24)	3.29	1.04	210.0
January (n=27)	3.59	0.96	214.4
February (n=24)	3.83	0.67	216.5
March (n=22)	3.22	1.86	193.0
April (n=25)	3.44	1.80	194.0
Average	5.03	1.27	205.4

In-Person Group sessions per month			
Month	Ave. # Sessions/Mo Conducted	Ave. # Sessions/Mo Cancelled	Ave. Total Minutes/Mo
December (n=23)	2.13	1.00	130.9
January (n=24)	2.58	0.67	144.4
February (n=27)	2.52	0.70	150.9
March (n=22)	2.55	0.77	162.3
April (n=25)	2.36	3.12	127.8
Average	3.49	1.25	143.3

Table 7: Reasons for Cancellations

Type of Cancellation	Tele-Intervention	In-Person
Sick	6	6
Weather	0	2
Transportation	0	0
Family Scheduling	7	3
Provider Scheduling	1	0
Computer/Internet	3	0
Family "No Show"	5	3
Total	22	14
Average Impact	1.24	1.25

Number of intervention sessions delivered
Providers were asked to complete monthly logs on the number of sessions completed, the number of sessions cancelled, and the total number of minutes spent delivering services. Table 6 reflects data for 5 out of 6 months for which the most complete data were provided. (Fewer than 30% of the providers provided data for May and November, so data for those months were not included.)

The TI group received a greater number of visits and more minutes of intervention. The number of cancellations were variable across both groups, with the average number being similar across groups.

Reasons for Cancellations
Providers reported the reasons for cancelled visits to ascertain to what extent TI can reduce cancellations due to weather, transportation problems, or illness. Table 7 depicts the reasons for cancelled visits for both groups. The primary reason for a cancelled visit was illness, and this was equal across both the TI and In-person group. Weather impacted only the In-person group, and computer/internet issues impacted only the TI group. Family scheduling problems and "no shows" were more predominant in the TI group. However, based on chi square analysis, these differences were not statistically significant across groups.

Additionally, providers were asked to rate the impact of a cancelled visit on their schedule. For example, a provider would record a "1" if the cancellation had minimal impact, (i.e., the provider was able to use the time efficiently), versus "3" which meant there were severe constraints on productive use of that time. Cancellations resulted in relatively minimal impact, on average, for providers serving families in both groups.

Outcomes

Several measures to assess child and family outcomes were administered prior to the start of intervention (pretest) and again following 6 months of intervention (posttest). Pre- and post-test data were collected on 48 children and families (TI, n=23; In-person, n=25).

Child Listening and Language Skills

Ultimately, the desired goal of early intervention is to promote optimal communication growth in children while enabling families to partner with early intervention providers in nurturing the child's development and ensuring that intervention fits with the family's routines, values, and needs. Three tools were used to assess growth in these areas:

•Preschool Language Scale-5th Edition (Zimmerman, Steiner & Pond, 2011) was used to assess expressive, receptive and total language. As shown in Table 8, there were no statistically significant differences between groups at pretest time. At posttest, the Analysis of Covariance (ANCOVA) results shown

in table 9 reflect statistically significant differences in favor of the TI group compared with the in-person group on Expressive Communication (p=.01); Receptive Communication (p=.02) and Total Language Scores (p=.02). The standardized mean difference effect sizes (SMDES) ranged from .41 to .50 on these measures.

•MacArthur Bates Communication Development Inventory (MBCDI): Words and Sentences (Fenson et al., 1993) was used to assess vocabulary growth, specifically number of vocabulary words within the child's expressive language. There were no statistically significant differences between groups at pretest. At posttest, the average vocabulary count for children in the TI group was 218.9 (SD=216.5) and the in-person group was 205.3 (SD= 240.0). Results of ANCOVA showed no statistically significant differences in vocabulary between these two groups (p=.65).

•Auditory Skills Checklist (Caleffe-Schenk, 2006) was used to assess acquisition of listening skills and growth in auditory development. Again, there were no

statistically significant differences between groups at pretest. At posttest, the scores for the TI group were statistically significantly higher than the in-person group, denoting more growth in their auditory skills (p=.04; SMDES=.28).

Family-centered Service Delivery

Two tools, the Family Outcomes Survey (FOS) and the Home Visiting Rating Scales (HOVRS) were used to measure the impact of mode of service delivery on the extent to which services support the family's needs and reflect characteristics of family-centered intervention. Results from each of these measures are summarized below.

Family Outcomes Survey (Early Childhood Outcomes Center, 2010) was used to assess important early intervention outcomes pertaining to supporting, educating, and increasing community inclusion of families. The first five scales represent the caregiver perceptions of how well they are able to support their child's needs. The last three scales are ratings of the caregivers' perceptions of how helpful early intervention has

Table 8: Child Pretest Scores for Subjects who Completed the Study

| Test | —Tele-Intervention— | | | — In-Person — | | | |
	N	$\overline{X}$	SD	N	$\overline{X}$	SD	P-Value
PLS Expressive	23	91.09	15.1	25	94.28	16.1	0.49
PLS Receptive	23	85.05	19.5	25	90.68	16.2	0.29
PLS Total	23	87.18	16.9	25	92.04	16.5	0.32
MBCDI	23	114.40	157.7	25	117.28	179.7	0.95
ASC	23	28.26	17.3	25	27.56	20.8	0.89

Table 9: Covariance Adjusted Child Posttest Scores

| Test | —Tele-Intervention— | | — In-Person — | | | |
	N*	$\overline{X}$	N	$\overline{X}$	P-Value	Effect Size
PLS Expressive	22	98.6	25	91.1	0.01	0.50
PLS Receptive	22	97.2	25	86.2	0.02	0.41
PLS Total	22	97.8	25	87.9	0.02	0.50
MBCDI	22	218.9	25	205.3	0.65	0.06
ASC	22	38.8	25	32.88	0.04	0.28

*PLS data missing for one subject

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Table 10: Family Outcomes Survey
(n=48) TI (n=23) In-Person (n=25)

Variable	Group	Covariance Adjusted x̄	Effect Size	P-value
Understanding my Child's strengths, needs, abilities (0-16)	TI	14.3	0.00	0.99
	In-Person	14.3		
Knowing my rights & advocating for child (0-20)	TI	16.7	0.03	0.86
	In-Person	16.6		
Helping my Child develop & learn (0-16)	TI	14.6	0.11	0.66
	In-Person	14.4		
Having Support Systems (0-20)	TI	17.2	0.12	0.67
	In-Person	16.9		
Access to Community (0-24)	TI	22.5	0.11	0.50
	In-Person	22.2		
Program helped me know my rights (0-20)	TI	17.0	0.03	0.93
	In-Person	16.9		
Program helped me understand child's needs (0-24)	TI	22.3	0.00	0.97
	In-Person	22.3		
Proram helped me learn how to support my child's dev. (0-24)	TI	22.2	0.26	0.27
	In-Person	21.6		

been to the family. Caregivers assessed themselves and the program using a Likert-type scale with high scores being better. There were no statistically significant differences at pretest, nor at posttest (See Table 10). In general, mean scale scores reflect that families view themselves as "almost always" having the skills in question, and that the early intervention services they received were rated as "generally helpful", or above average.

The Home Visit Rating Scales (HOVRS, v2.0; Roggman, et al, 2014) was used to measure the quality of interaction among the provider, the caregiver, and the child.

Ratings are based on a 7-point scale with 1 being poor and 7 being excellent. One video recording of a home visit for each subject was attempted, with recordings made within the last month of the study. Codeable recordings were obtained for 17 subjects in the TI group and 19 in the in-person group. Ratings were provided by trained, reliable raters who were independent of the study's authors.

Table 11 provides the mean scores for the HOVRS scales. Overall, ratings reflected above average performance for both groups. Analyses of covariance results showed that the TI group scored statistically significantly better in regard

to the provider's responsiveness to the caregiver as well as stronger caregiver engagement. There were no statistically significant differences on the other scales, although the mean scores were higher for the TI group compared to the in-person group for 5 of the 6 other subscales and the average SMDES for all 7 subscales was .32.

Discussion

While there is increasing interest and implementation of tele-intervention programs for children who are deaf or hard of hearing across the country, there are few studies that systematically

Table 11: Home Visit Rating Scale
(n=36) TI (n=17) In-Person (n=19)

Variable	Group	Adjusted x̄	(SD)	Effect Size	P-value
Provider Responsiveness to Family*	TI	5.28	0.83	0.77	0.01
	In-Person	4.54	0.96		
Provider Relationship Family w/family	TI	4.65	0.87	-0.05	0.91
	In-Person	4.68	0.63		
Provider Facilitation of parent-child interaction	TI	5.01	0.97	0.28	0.43
	In-Person	4.68	1.19		
Provider Non-Intrusiveness & Collaboration	TI	4.92	1.03	0.16	0.63
	In-Person	4.75	1.07		
Parent-Child Interaction	TI	5.45	0.71	0.46	0.10
	In-Person	4.97	1.05		
Parent Engagement*	TI	5.77	0.56	0.49	0.04
	In-Person	5.31	0.94		
Child Engagement	TI	5.31	1.05	0.12	0.71
	In-Person	5.14	1.38		

*Statistically significant at p≤.05

examine the differences in outcomes of children served using a TI model compared to children who have received services via a traditional in-person model.

This report reflects the findings of the primary research question – how do the outcomes for children and families receiving services primarily via tele-intervention compare to families who receive traditional in-person visits? This study contributes to the research about this question by 1) including more children who are DHH than have been involved in previously reported research studies; 2) using well established norm-referenced, standardized tools of child language development; 3) engaging diverse early intervention programs and providers from across the country.

These results support the conclusion that tele-intervention is a valuable method for providing services to children who are DHH and their families. On average, families and children receiving services via TI had better language outcomes and auditory skills than children who received services through traditional in-person visits. Families receiving services via TI were more engaged in the intervention than the in-person group families, and providers were more responsive to the families when providing services via TI. According to the family self-report measures, families who received TI services feel equally supported, knowledgeable, and confident in fostering their child's development as families who receive in-person services.

Results pertaining to the impact on service delivery itself did not reflect dramatic reductions in cancelled visits or reduced negative impact on provider schedules. Because such outcomes have been reported in previous studies, these factors are important to be assessed in future research.

Based on these findings, TI should be viewed as a valuable tool to support the development of infants and toddlers who are deaf or hard of hearing. These findings should be used to inform policy makers, program directors, providers and families of the value of incorporating tele-intervention into early intervention programs.

Note of Appreciation