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## Early Intervention Service Delivery Models in Mississippi: A Cost-Effectiveness Analysis

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EARLY INTERVENTION SERVICE DELIVERY MODELS IN MISSISSIPPI:  
A COST-EFFECTIVENESS ANALYSIS

By  
Claire Renae Harper

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

Oxford, MS  
May 2021

Approved By

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## ABSTRACT

CLAIRE RENAE HARPER: Early Intervention Service Delivery Models in Mississippi: A Cost-Effectiveness Analysis (Under the direction of Dr. Myriam Kornisch)

**Purpose:** The purpose of the present study was to compare two models of service delivery for early intervention in Mississippi from a health care sector perspective: (1) face-to-face therapy in the home environment and (2) a hybrid model (i.e., telepractice and face-to-face therapy in the home environment), in order to compare costs and determine the most cost-effective service delivery of early intervention.

**Methods:** Children ( $n = 10$ ) were recruited and determined to qualify for early intervention services through the Mississippi First Steps Early Intervention program. One early intervention provider, a certified SLP, from the northern health region provided early intervention services. After early intervention services were completed for a total of 20 sessions per participant, a cost-effective analysis was executed. The RITLS was used during the initial evaluation and following the completion of the 20th session to assess and compare the effectiveness, and costs were measured using a researcher-developed reporting form.

**Results:** Total cost for face-to-face service delivery of early intervention was \$5,778.32, while total cost for hybrid service delivery of early intervention was \$5,129.89. The cost-effectiveness ratio of face-to-face service delivery of early intervention was \$304.12 per developmental functioning level reached, while the cost-effectiveness ratio of hybrid service delivery of early intervention was \$320.62 per developmental functioning level reached.

**Conclusion:** The results indicate that the utilization of telepractice equipment through the hybrid model of early intervention provides cost-minimizations; however, face-to-face service delivery

was 10% more effective than hybrid service delivery. Cost-effectiveness ratios indicate face-to-face delivery is the most cost-effective service delivery model of early intervention services.

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## LIST OF ABBREVIATIONS

IDEA	Individuals with Disabilities Education Act
SLP	Speech-Language Pathologist
ASHA	American Speech-Language Hearing Association
CEA	Cost-Effectiveness Analysis
RITLS	Rossetti infant Toddler Language Scale

## INTRODUCTION

### *Early Intervention*

In the United States (U.S.), Part C of the Individuals with Disabilities Education Act (IDEA) provides financial assistance to individual states in order to develop and implement an early intervention system (IDEA, n.d.-a). Early intervention provides services and support to families with children, birth through 36 months of age, who are at-risk of acquiring a developmental delay due to established, biological, medical, and/or environmental risk factors (Majnemer, 1998; Shackelford, 2006). Early intervention is designed to meet the physical, cognitive, communicative, social, emotional, and adaptive developmental needs of at-risk children (IDEA, n.d.-b). In addition, early intervention may include one, or a combination of, the following services: assistive technology service, audiology, nutrition services, occupational therapy, physical therapy, psychological services, and speech-language therapy (Hebbeler et al., 2012; IDEA, n.d.-b). As a result, early intervention personnel, such as speech-language pathologists (SLPs), must be qualified to administer these services by having recognized certification, licensing, registration, and/ or other relevant requirements in order to provide the best service possible (IDEA, n.d.-b).

State systems must report quantifiable and qualitative indicators to measure the administration of early intervention services. These indicators may include timely services, natural environments, improved outcomes, and family involvement. In fact, Part C of IDEA requires that early intervention services be provided in the natural environment to the maximum extent

appropriate (IDEA, n.d.-b). Performing services in the natural environment further supports the child's development by allowing for individualized services based on each child's unique needs, while also taking into account the preferences and resources of each family (Paul & Roth, 2011). Therefore, early intervention personnel often travel to the child's home, which is the most frequently identified natural environment for families in the U.S. (Woods, 2008). However, natural environments do not necessarily relate to physical location, rather they refer to the child's participation in everyday activities and meaningful experiences with their family (Woods, 2008). In order to develop meaningful experiences that best enhance the child's health and development, early intervention services focus on coaching caregivers to facilitate intervention practices (Woods, 2008). Therefore, during early intervention sessions the early intervention provider must provide child-focused intervention while also coaching the caregiver in intervention strategies (Woods, 2008). Thus, imitating the natural environment through authentic caregiver interactions, especially when circumstances do not permit personnel to travel to families, is increasingly important for delivering early intervention services to populations who are not easily accessible, such as those living in rural areas.

### *Rural Health Disparities*

Rural-residing populations often experience barriers to healthcare access as they are spread broadly across large geographical expanses (Douthit et al., 2015). Therefore, rural-residing children with special health care needs often experience more system-level problems, such as transportation difficulties and shortage of available providers when accessing healthcare (Skinner & Slifkin, 2007). The U.S. Census Bureau identifies "rural" as all populations, housing, and territory not included in urban areas. Urban areas represent densely developed territory with 50,000

or more people or clusters that contain at least 2,500 and less than 50,000 people. Urban areas encompass residential, commercial, and other non-residential urban land uses (*Urban Area Criteria for the 2010 Census*, 2011).

Unfortunately, previous research indicates shortages of qualified personnel employed in many healthcare settings and systems in rural areas of the U.S. (MacDowell et al., 2010). For example, the Mississippi Part C Annual Performance Report for federal fiscal year 2018 reported that timely provision of early intervention services (i.e. “receiving all early intervention services identified on the individualized family service plan no later than 30 business days after written parental consent for services”) did not occur for 15% ( $n = 423$ ) of children who had begun the early intervention process directly due to personnel shortages (U.S. Department of Education, n.d.). The reality of health care disparities in rural populations is an important issue to address within states like Mississippi, in which 51% of the population is rural-residing (U.S. Department of Commerce, 2012).

### *Mississippi*

In accordance with Part C of IDEA, the Mississippi State Department of Health administers statewide early intervention through the Mississippi First Steps Early Intervention Program (First Steps; U.S. Department of Education, n.d.). First Steps is divided into eight local programs, which are organized into three public health regions: Northern, Central, and Southern. Each region contains approximately 52 - 55 early intervention personnel, including qualified SLPs, occupational therapists, physical therapists, and special instructors (Mississippi First Steps Early Intervention Program, n.d.). Population characteristics of Mississippi, as well as (1) the division of public health regions and (2) the locations of early intervention personnel are represented in

Figure 3 (see appendix). The shortage of personnel, which is especially notable in rural areas of Mississippi, has created barriers to the delivery of early intervention services. However, Part C of IDEA requires that individual states enhance the capacity of early intervention to meet the needs of all children, including the historically underrepresented population of rural-residing children (IDEA, n.d.-a). One approach to solve this problem involves the use of telepractice.

### *Telepractice*

The American Speech-Language-Hearing Association (ASHA) defines telepractice, also known as telehealth, telerehabilitation, telemedicine, and/or tele-intervention (see for example Agha et al., 2002; Blaiser et al., 2013; Cason, 2009; Lindgren et al., 2016), as the utilization of technology to deliver professional services at a distance, linking clinician to client for consultation, assessment, and/or intervention (ASHA, 2016). Telepractice accomplishes this by delivering services in real-time through the use of phone calls and videoconferencing (Brennan et al., 2010; Theodoros, 2011). Previous research indicates that health and therapy services delivered through telepractice are effective at minimizing costs when providing psychotherapy (Morland et al., 2013), outpatient pulmonary care (Agha et al., 2002), and early intervention services to rural populations (Blaiser et al., 2013). These cost reductions are likely linked to the reduced time and travel needed to deliver in-person care (Morland et al., 2013). Telepractice can also be effective at minimizing costs when delivering services to pediatric populations (Blaiser et al., 2013; Cason, 2009; Lindgren et al., 2016). For example, previous research demonstrates that telepractice is effective at minimizing costs when providing intervention to children with autism (Lindgren et al., 2016), children who are deaf/hard-of-hearing (Blaiser et al., 2013), and children with occupational therapy needs (Cason, 2009). More specifically, Cason (2009) explored the use of telepractice for

early intervention occupational therapy services in Kentucky. Results of the study suggest that telepractice is effective to meet the early intervention needs of children living in rural areas. Additionally, telepractice may combat increased finances of the early intervention program, due to reduced travel costs and time, that allows for better allocation of existing personnel resources. While Cason's (2009) study demonstrated that a pure telepractice service delivery model was effective at minimizing costs, previous research suggests that a hybrid service delivery model may also minimize costs while maintaining effectiveness of early intervention services (Cassel, 2016; Goldberg et al. 2012; Valentine 2014; Mashima et al., 2003).

### *Hybrid Service Delivery Model*

A hybrid service delivery model combines face-to-face and telepractice service delivery. While little research has examined a hybrid service delivery model in early intervention, previous research does broadly support the use of a hybrid model for speech-language therapy, as it allows for the cost-minimization benefit of telepractice while also maintaining face-to-face clinician interaction (Cassel, 2016; Goldberg et al. 2012; Valentine 2014; Mashima et al., 2003). While pure telepractice may be appropriate for some phases of therapy, such as follow-up and maintenance, a hybrid model would potentially allow for necessary face-to-face interactions during the beginning stages of therapy (Mashima et al., 2003). In addition, a hybrid model especially supports children due to the partnership between children, parents, and providers that is needed to effectively promote the child's health and development (American Academy of Pediatrics, 2012). While previous studies have emphasized the need for parent-child transactions in order to further the child's social and cognitive confidence (Guralnick, 2011), the telepractice component of the hybrid model would require parents to be mediators and facilitators of sessions while still allowing for

clinician interaction further promoting coaching caregivers and authentic caregiver interactions (Malandraki et al., 2014, Valentine 2014).

### *Cost-Effectiveness Analysis*

In spite of growing advances in telepractice and the acceptance of its use by national associations (see for example ASHA, 2016), little research has examined telepractice from an economic perspective, particularly as a method of early intervention service delivery. Therefore, a cost-effectiveness analysis (CEA), for comparing different intervention types, may be useful to identify which alternative will maximize quantity and quality when constrained by a particular budget (Muennig & Bounthavong, 2016). In order to compute a CEA, costs of a given intervention are divided by its effectiveness, and a cost-effectiveness ratio is derived (Levin et al., 2017). The cost-effectiveness ratio is interpreted as the cost required to obtain a single extra unit of effectiveness, and the lowest cost per unit of effectiveness is the favorable alternative (Levin et al., 2017).

Speech-language therapy is one of the most frequently provided services of early intervention (Hebbeler et al., 2012). In addition, using the hybrid service delivery model to provide speech-language therapy services is already supported by previous research (Cassel, 2016; Goldberg et al. 2012; Valentine 2014; Mashima et al., 2003). Currently, provision of early intervention services is typically conducted using a face-to-face service delivery model in which early intervention providers travel to families' homes. A hybrid service delivery model would reduce travel for the provider by allowing early intervention services to be administered partially through telepractice. Reducing costs for early intervention providers may allow for the provision of more services in areas of disparities, such as rural Mississippi. Therefore, the present study

aimed to compare the economic outcomes of children receiving two different service delivery models of early intervention speech-language therapy: (1) face-to-face therapy in the home environment, or (2) a hybrid group of telepractice and face-to-face therapy in the home environment. The purpose of the study was to determine the cost-effectiveness of two models of service delivery for early intervention in Mississippi. More specifically, the following research questions were addressed:

*Research Question 1:* How does the cost of a hybrid model of early intervention service delivery compare to the cost of a traditional face-to-face model?

*Hypothesis 1:* Based on previous research indicating the cost-minimization aspect of telepractice, we hypothesized that a hybrid service delivery model will result in less costs compared to a traditional face-to-face model.

*Research Question 2:* Is a hybrid early intervention delivery model as cost-effective, more cost-effective, or less cost-effective than a traditional face-to-face model?

*Hypothesis 2:* Based on prior research indicating the positive aspects of a hybrid service delivery model, we hypothesize it will be more cost-effective compared to the traditional, face-to-face model.



## METHOD

### *Design*

The present study compared two models of service delivery for early intervention in Mississippi from a health care sector perspective: (1) face-to-face therapy in the home environment and (2) a hybrid model combining telepractice and face-to-face therapy in the home environment. CEAs are often used to determine the most efficient way to allocate funds (Muennig & Bounthavong, 2016). Therefore, a CEA was used to compare the costs of these two models of early intervention for speech-language therapy while considering the clinical effects achieved.

### *Participants*

In total, 10 children (6 males, 4 females) aged 19 to 31 months ( $M = 25.9$ ) and their parents participated in this study. Only children who qualified for early intervention services through the Mississippi First Steps Early Intervention Program were recruited to participate in the study. Children with additional diagnosis aside from speech-language therapy delays were excluded from the study. For each child, the age in months at the beginning and end of the study is displayed in Table 5 (see appendix). All children were randomly assigned to one of two groups: (1) face-to-face service delivery ( $n = 5$ ) or (2) hybrid service delivery ( $n = 5$ ). In addition, one early intervention provider, a certified SLP who serves in the northern health region and is experienced with the provision of early intervention services, participated in the study.

## *Procedure*

The present study lasted 12-months. However, each participant took part in the study for a 5-month period. All participants completed early intervention four times a month in 45-minute sessions, for a total of 20 sessions (Mawhinney & McTeague, 2004). All sessions followed the Early Intervention Development booklet, focusing on language comprehension, verbal expression, and intelligible speech (Mawhinney & McTeague, 2004). The participants in Group 1 completed all sessions in their home, while participants in Group 2 completed a combination of sessions in their home and through telepractice.

During face-to-face sessions, the early intervention provider traveled to the participants' homes. For telepractice sessions, the early intervention provider was located at the University of Mississippi's South Oxford Center Telepractice Lab, and the child and parent were located in their home. For both groups, the Rossetti Infant Toddler Language Scale (RITLS; Rossetti, 2006) was used during the initial evaluation and following the completion of the 20th session to assess and compare the effectiveness of both types of early intervention services. Following the conclusion of services, a CEA was performed. In order to meet the needs of the present study, measures of effectiveness and costs were identified, and cost-effectiveness ratios (i.e., cost/ effectiveness) were completed to determine the cost-effectiveness of providing early intervention (Levin et al., 2017).

## *Unexpected Occurrences*

During the 12-month duration of the study, the COVID-19 (Coronavirus disease) pandemic led to national stay-at-home orders (Moreland et al., 2020). Fortunately, participants in group 1 completed early intervention services prior to the implementation of any regulations. However,

services for participants in group 2 were halted, as the early intervention provider was unable to access the Telepractice Lab or travel to their homes. During this time, the early intervention provider connected with the parents of participants in group 2 through phone calls for follow-up and maintenance sessions until services were able to resume. Unfortunately, COVID-19 resulted in varying number of sessions for each type of service delivery for participants in group 2. This was caused by (1) the varying number of sessions that were completed before COVID-19 and (2) the inability to travel to homes due to public safety issues after the stay-at-home orders were lifted. Nonetheless, because of the telepractice component of hybrid service delivery, participants in group 2 were still able to receive services despite national shutdown. For each participant (group 2), the number of sessions completed for each service delivery type are displayed in Table 6 (see appendix).

### *Measures*

*Costs:* Costs were identified as the value of resources used by the service provider in order to implement early intervention services, such as costs to provide services (i.e. personnel costs), materials and equipment, and travel reimbursement (Levin et al., 2017). Travel costs included only those incurred traveling to the face-to-face sessions. Additionally, telepractice equipment costs were included for the hybrid service delivery, such as HIPPA compliant software and headsets. The costs of providing early intervention services (i.e. face-to-face and hybrid) were measured using a researcher-developed reporting form that included service delivery rates (\$60 per hour) and travel costs (Levin et al., 2017). The early intervention provider reported monthly costs throughout the study, which spanned a duration of 12 months.

*Effectiveness:* Effectiveness of early intervention services was based on IDEA Part C reporting indicator ‘Improved Outcomes,’ in which state systems must report children who improved in developmental functioning to reach a level comparable to same-aged peers in the acquisition and use of knowledge and skills (U.S. Department of Education, n.d.). For the purpose of the present study, the primary measure of developmental functioning was the RITLS. The RITLS is a criterion referenced instrument, used to assess preverbal and verbal aspects of communication and interaction, which is normed for children from birth through 36 months of age (Rossetti, 2006). Scores on the RITLS corresponded to a developmental age level (i.e., 0-36 months). The RITLS has six subtests: (1) interaction-attachment, which assesses the reciprocal relationship between the parent and child; (2) pragmatics, which evaluates language in a social manner; (3) gesture, which assesses use of gestures to express thought and intent; (4) play, which evaluates play that reflects development of representational thought; (5) language comprehension, which determines understanding of verbal language; and (6) language expression, which assesses use of preverbal and verbal behaviors of communication (Rossetti, 2006).

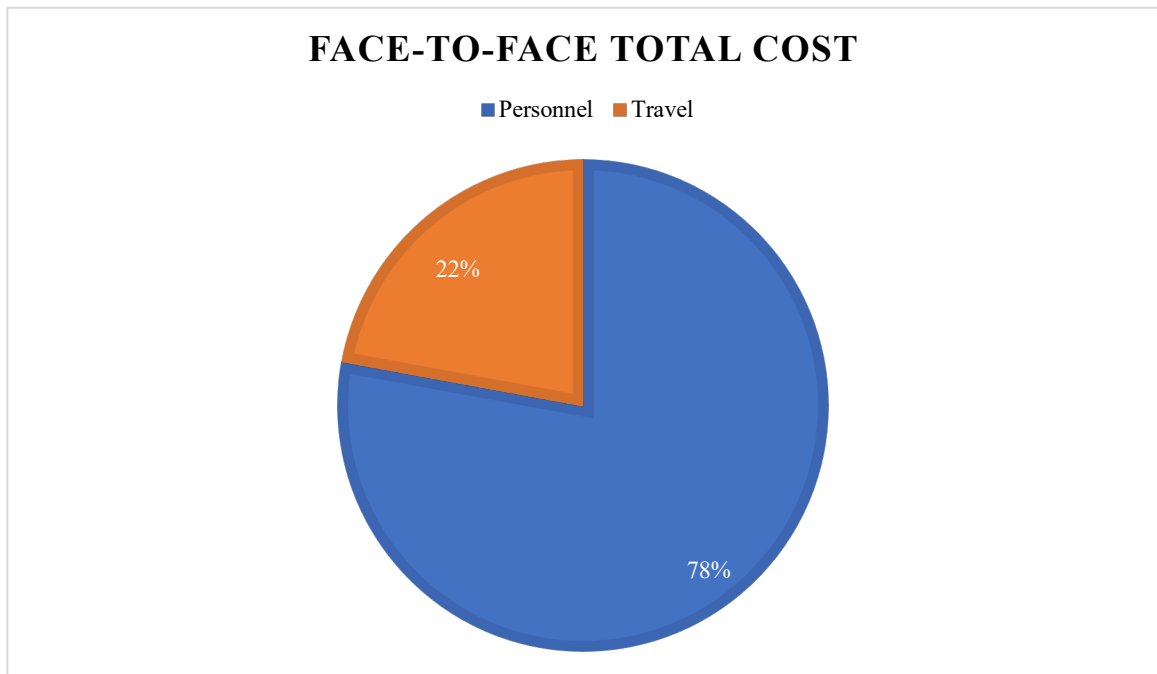
### *Reliability*

Inter-rater reliability was used to ensure the effectiveness results obtained the RITLS. The RITLS was scored by the principal investigator and by two secondary researchers. Any discrepancies in scores were discussed until a consensus was reached.

## RESULTS

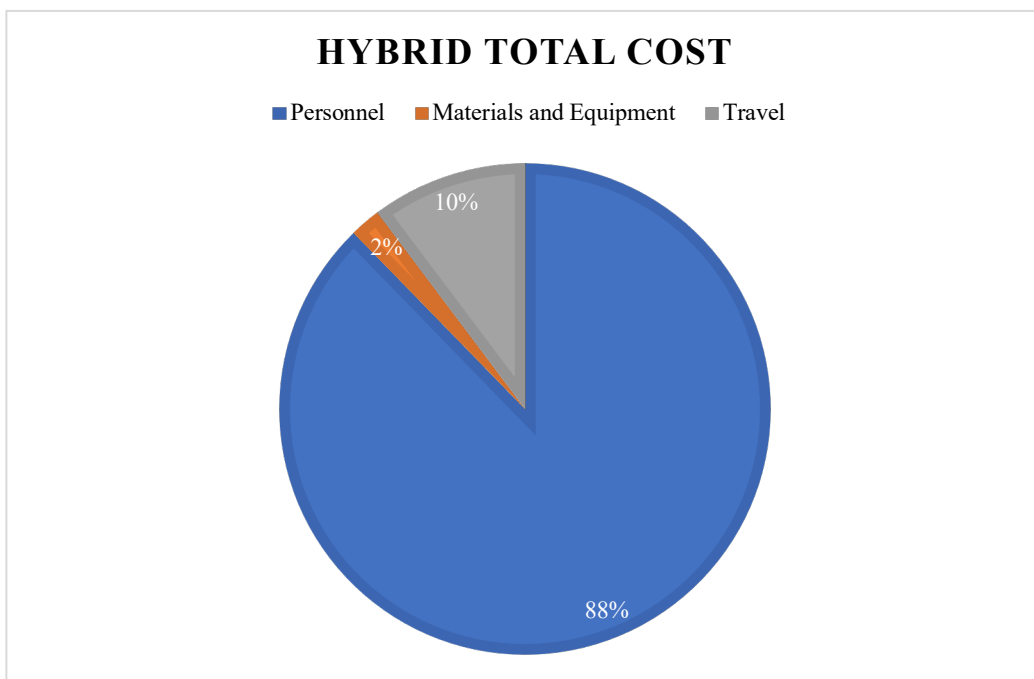
*Research Question 1:* How does the cost of a hybrid model of early intervention service delivery compare to a traditional face-to-face model?

The total cost for face-to-face service delivery of early intervention was \$5,778.32. It was calculated as follows: Personnel = \$4,500 and Travel = \$1,278.32. Personnel costs made up 78% of total costs for face-to-face service delivery. The total cost for face-to-face service delivery of early intervention is displayed in Figure 2, and the complete list of costs can be found in the appendix (see Table 7 Face-to-Face Service Delivery Costs).



**Figure 1.** Face-to-Face Total Cost

The total cost for hybrid service delivery of early intervention was \$5,129.89. It was calculated as follows: Personnel = \$4,500; Materials and Equipment = \$104.99 (i.e., telepractice equipment); Travel = \$524.90. Personnel costs made up 88% of total costs for hybrid service delivery. The total cost for hybrid service delivery of early intervention is displayed in Figure 3, and the complete list of costs can be found in the appendix (see Table 8 Hybrid Service Delivery Costs).



**Figure 2.** Hybrid Total Cost

The total miles traveled for the two service delivery types varied, with face-to-face service delivery requiring 2,204 miles of travel and hybrid service delivery requiring 905 miles of travel. The travel rate was based off the Mississippi State Department of Health travel reimbursement rate per mile. The travel costs incurred for both service delivery types are shown in Table 1.

**Table 1.** Travel Costs

<b>Service Delivery</b>	<b>Miles</b>	<b>Rate</b>	<b>Travel Cost</b>
Face-to-Face	2,204	.58	\$1,278.32
Hybrid	905	.58	\$524.90

The average total cost per participant was \$1,155.60 for participants receiving face-to-face service delivery and \$1,025.98 for participants receiving hybrid service delivery. The average total cost per participant calculation is shown in Table 2.

**Table 2.** Average Total Cost Per Participant

<b>Service Delivery</b>	<b>Cost</b>	<b>Participants</b>	<b>Average Cost</b>
Face-to-Face	\$5,778.32	5	\$1,155.66
Hybrid	\$5,129.89	5	\$1,025.98

*Research Question 2:* Is a hybrid early intervention delivery model as cost- effective, more cost-effective, or less cost- effective than traditional face-to-face model?

The overall effectiveness of face-to-face service delivery of early intervention was 63%, while the overall effectiveness of hybrid service delivery of early intervention was 53%. All participants reached a level of developmental functioning comparable to same-aged peers in acquisition and use of knowledge and skills in at least two of the six subtests (i.e., Interaction-Attachment and Gesture). Table 3 displays the effectiveness for each participant based on the RITLS.

**Table 3. Effectiveness**

Participant	End Age	RITLS Subtests							Levels Reached	% Effective
		Interaction-Attachment*	Pragmatics**	Gesture***	Play	Language Comprehension	Language Expression			
Group 1										
1	34	18	21	27	36	36	30	5	83%	
2	31	18	21	27	30	30	30	3	50%	
3	36	18	18	27	33	18	18	2	33%	
4	30	18	21	27	30	15	12	4	66%	
5	33	18	21	27	33	33	21	5	83%	
<b>Total</b>								<b>19</b>	<b>63%</b>	
Group 2										
6	32	18	21	27	27	24	18	3	50%	
7	33	18	21	27	30	33	24	4	66%	
8	31	18	21	27	27	24	24	3	50%	
9	27	18	21	27	27	24	21	4	66%	
10	24	18	18	27	18	12	15	2	33%	
<b>Total</b>								<b>16</b>	<b>53%</b>	

*Note.* Shading indicates developmental functioning improved to levels comparable to same-aged peers. Scored by age in months: Interaction- Attachment, Pragmatics, Gesture, Play, Language Comprehension, and Language Expression. Ceiling level 36 months for RITLS subtest unless noted.

\*Interaction-Attachment ceiling level 18 months.

\*\*Pragmatics ceiling level 21 months

\*\*\*Gesture ceiling level 27 months.



Finally, the CEA was calculated by dividing the overall costs required to provide services by the overall amount of developmental functioning levels reached for each service delivery type. The CEA revealed the cost-effectiveness ratio of face-to-face service delivery of early intervention was \$304.12 per developmental functioning level reached, while the cost-effectiveness ratio of hybrid service delivery of early intervention was \$320.62 per developmental functioning level reached. The cost-effectiveness ratios for both service delivery types are shown in Table 5.

**Table 4.** Cost-Effectiveness

<b>Service Delivery</b>	<b>Cost</b>	<b>Effect</b>	<b>Cost-Effectiveness Ratio</b>
Face-to-Face	\$5,778.32	19	\$304.12
Hybrid	\$5,129.89	16	\$320.62

## DISCUSSION

The aim of the present study was to determine the cost-effectiveness of two models of service delivery for early intervention in Mississippi: (1) face-to-face therapy in the home environment and (2) a hybrid model combining telepractice and face-to-face therapy in the home environment. In addition, this research aimed to compare the cost of a hybrid service delivery model to the traditional, face-to-face service delivery model.

First, costs were identified and compared in order to establish the cost-effectiveness of the two service delivery models. Face-to-face service delivery of early intervention cost approximately \$129.68 more to conduct per participant than hybrid service delivery. These results indicate that the utilization of telepractice equipment through the hybrid model of early intervention provides cost-minimizations, which are in line with previous research (Agha et al., 2002; Blaiser et al., 2013; Morland et al., 2013). The use of telepractice may allow for less costs associated with early intervention service provision, which could potentially be reallocated to solve early intervention personnel shortages in Mississippi. In addition, the percentage of travel costs for face-to-face service delivery was 22%, while the percentage of travel costs for hybrid service delivery was 10%. As previous research indicates, the amount of travel and costs associated with providing early intervention services were reduced in the hybrid model of service delivery (Cason, 2009).

In contrast to the increased cost associated with face-to-face service delivery, this model was 10% more effective than hybrid service delivery. However, this result may be explained by

the unexpected occurrences that took place during the time of the study that directly impacted the participants in group 2 (i.e., hybrid service delivery). Due to the COVID-19 pandemic, there was a varying number of sessions for both types of service delivery for participants in group 2 (i.e., some participants received more/less in-person sessions while others received more/less telepractice sessions). Furthermore, the participants and their parents may have experienced additional stress and anxiety related to the COVID-19 pandemic (Russell et al., 2020), which may have negatively affected the hybrid service delivery of early intervention services as this group was still receiving services. Another explanation may be the acceptance and familiarity of a new type of service delivery. Previous research established acceptance as a main barrier to the implementation of telepractice (Molini-Avejonas et al., 2015). Accepting and becoming familiar with the new telepractice delivery of early intervention, as an alternative to face-to-face service delivery, may take additional time than the 12-month period the present study could allow.

Lastly, when interpreting the effectiveness results, it is necessary to consider the length of the current study. Each participant received early intervention services for a 5-month period. However, most children receive early interventions services for an average of 17.2 months (Hebbeler et al., 2012). Due to this short duration and the lack of previous research on this topic, the generalizability of the effectiveness data gathered for hybrid service delivery are beyond the scope of this study. Nevertheless, all participants showed improvement and reached developmental functioning levels comparable to same-aged peers in at least two of the six subtests of the RITLS. Therefore, early intervention provided through hybrid service delivery is still beneficial for children who otherwise do not have direct access to services, for example those who reside in rural areas. However, children who participate in hybrid service delivery of early intervention might need more sessions to achieve the same results as children who receive face-to-face services.

Therefore, future research is needed to determine how or if the improvements observed in the present study persist across time.

In conclusion, based on the current findings, face-to-face service delivery of early intervention may be more cost-effective than hybrid service delivery. Cost-effectiveness ratios identified face-to-face service delivery of early intervention was \$304.12 per developmental functioning reached, while hybrid service delivery of early intervention was \$320.62 per developmental functioning level reached. Thus, our results indicate that face-to-face service delivery maximizes quality and quantity, and is therefore the most efficient way to maximize funds.

#### *Limitations & Future Research*

While the present study provides valuable information on the cost-effectiveness in early intervention, there are several limitations that need to be considered. The main limitation was the timing of the study, due to the unexpected occurrence of COVID-19. This limitation caused delayed services and additional stress and anxiety for participants in group 2 (Russell et al., 2020). Taken together, these results may have affected the effectiveness of hybrid service delivery. This was unavoidable due to the national stay-at-home orders (Moreland et al., 2020), and the majority of participants in the hybrid group did receive more telepractice sessions than face-to-face sessions. Therefore, a more balanced session delivery during less stressful times may have yielded different results. Another limitation is the small sample size. Each group was constrained to five participants each due to the nature of the preliminary pilot study and difficulties with participant recruitment, both of which were likely due to concerns related to COVID-19. However, small samples are often seen in pilot studies of a similar nature (Cason, 2009). Finally, there is a limited

amount of research specifically on the cost-effectiveness of early intervention services, making it difficult to draw comparisons between the present study and previous research. The present study was able to gather information from previous research in speech-language pathology in general that supports the cost-minimization aspect of telepractice (Agha et al., 2002; Blaiser et al., 2013; Cason, 2009; Lindgren et al., 2016; Morland et al., 2013) and effectiveness of hybrid service delivery (Cassel, 2016; Goldberg et al. 2012; Valentine 2014; Mashima et al., 2003). However, this gap in literature should continue to be addressed in future research.

The lower level of effectiveness of hybrid service delivery cannot be overlooked. To expand upon the current study, future research should aim to determine a more effective provision of hybrid service delivery. For example, future research should control for the amount of telepractice and face-to-face sessions each participant receives, providing a more systematic model for implementation of hybrid service delivery. Identifying a more effective way to provide hybrid service delivery may reduce the barriers to the provision of early intervention services, which in turn may translate into improved child outcomes. Further research on the cost-effectiveness of a hybrid service delivery model will be conducted when the effects of the COVID-19 pandemic have subsided. This research will aim to implement a more equal provision of face-to-face and hybrid sessions within the hybrid service delivery model. In addition, future research could also examine the time early intervention personnel may save by providing hybrid services.

### *Conclusion*

The Mississippi First Steps Early Intervention Program experiences barriers to the provision of services, which are likely due to rural health disparities. The current study provides a critical first step in understanding the cost-effectiveness of early intervention service delivery types

in Mississippi in order to overcome these barriers. Based on these preliminary findings, hybrid service delivery offers cost-minimization; however, traditional face-to-face service delivery is more cost-effective due to a higher rate of effectiveness. Therefore, face-to-face service delivery seems to be the most efficient way to provide early intervention speech-language therapy services.

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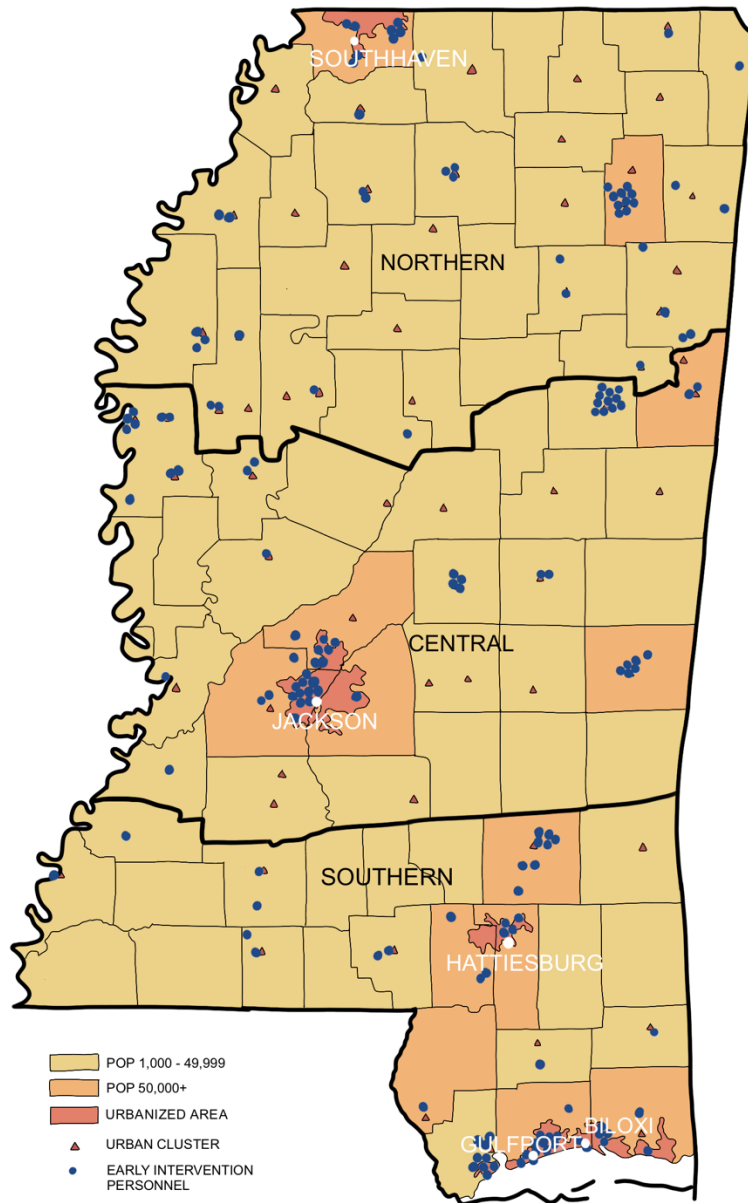
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## APPENDIX



**Figure 3.** Mississippi First Steps Early Intervention Program

*Note.* Urbanized area = 50,000+ people, urban clusters = 2,500 - 50,000 people (Urban Area Criteria for the 2010 Census, 2011). Adapted from “Mississippi: 2010,” By U.S. Department of Commerce, 2012. <https://www.census.gov/prod/cen2010/cph-2-26.pdf> and “Directory of Early Intervention Providers,” By Mississippi First Steps Early Intervention Program, n.d. [https://msdh.ms.gov/msdhsite/\\_static/resources/4444.pdf](https://msdh.ms.gov/msdhsite/_static/resources/4444.pdf) and “Mississippi State Department of Health Public Health Regions,” By Mississippi State Department of Health, n.d. [https://msdh.ms.gov/msdhsite/\\_static/resources/7322.pdf](https://msdh.ms.gov/msdhsite/_static/resources/7322.pdf)

**Table 5.** Participant Age in Months

<b>Participant</b>	<b>Beginning Age</b>	<b>End Age</b>
Group 1 (i.e., face-to-face)		
1	29	34
2	26	31
3	31	36
4	26	30
5	28	33
Group 2 (i.e., hybrid)		
6	26	32
7	27	33
8	25	31
9	22	27
10	19	24

**Table 6.** Group 2 Service Delivery

<b>Participant</b>	<b>Face-to-Face</b>	<b>Telepractice</b>
6	5	15
7	9	11
8	9	11
9	1	19
10	10	10

**Table 7.** Face-to-Face Service Delivery Costs

	<b>Description</b>	<b>Quantity</b>	<b>Price</b>	<b>Cost</b>
<b>Personnel</b>	Early Intervention Personnel	75 hours	\$60 per hour	<b>\$4,500</b>
<b>Materials and Equipment</b>				-
<b>Travel</b>	Travel Costs Incurred	2,204 miles	\$0.58 per mile	<b>\$1,278.32</b>
<b>Total Cost</b>				<b>\$5,778.32</b>
Number of Participants				5
Average Cost per Participant				\$1,155.66

**Table 8.** Hybrid Service Delivery Costs

	<b>Description</b>	<b>Quantity</b>	<b>Price</b>	<b>Cost</b>
<b>Personnel</b>	Early Intervention Personnel	75 hours	\$60 per hour*	<b>\$4,500</b>
<b>Materials and Equipment</b>				<b>\$104.99</b>
Zoom HIPAA Compliant License	Telepractice Equipment	1	\$75.00	
HIPAA Compliant Headset	Telepractice Equipment	1	\$29.99	
<b>Travel</b>	Travel Costs Incurred	905 miles	\$0.58 per mile	<b>\$524.90</b>
<b>Total Cost</b>				<b>\$5,129.89</b>
Number of Participants				5
Average Cost per Participant				\$1,025.98

*\*Note. Personnel was reimbursed \$50 for 3 out of the 12 months. For subsequent therapy and analysis, \$60 was used as the personnel reimbursement rate.*