

# Home Visiting Programs for Families of Children who are Deaf or Hard of Hearing: A Systematic Review

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## Abstract

Prelingual hearing loss greatly restricts a child's language development, hindering his or her behavioral, cognitive, and social functioning. Although technology such as hearing aids and cochlear implants provide access to sound, infants and children also need habilitation to develop skills. These skills include learning to listen, or attend, to process language (whether visual or spoken), and to produce language and communicate. Home visiting is widely recognized as a cost-effective intervention service delivery model. Home visiting programs for promoting language development in children who are diagnosed as deaf or hard of hearing have been in existence for over 50 years, yet there is limited evidence of their effectiveness. This review was undertaken to assess the evidence of effectiveness of home visiting in children with prelingual hearing loss. While many studies have examined early intervention for children who are deaf or hard of hearing, few are published from specific home visiting programs meeting the criteria for inclusion in this review. Studies from specific home visiting program models designed to meet the needs of the target population are needed to examine the effectiveness of promoting language development within the context of a home visiting program for children who are deaf or hard of hearing and their families.

**Keywords:** deaf, hearing loss, hard of hearing, home visiting, home visits, home visitors, home visitation, in-home, family counseling, family health, early intervention, early interventions, language development, literacy development, evidence based, evidence of effectiveness, evidence-based practice, systematic review.

**Acronyms:** AHQR = Agency of Healthcare Quality and Research, CDI = Child Development Inventory, CHIP = Colorado Home Intervention Program, CHTP = Counseling and Home Training Program, DHHS = Department of Health and Human Services, EAS = Emotional Availability Scales, ECHI = Early Childhood Home Instruction Program, EHD = Early Hearing Detection and Intervention, EOWPVT4 = Expressive One-Word Picture Vocabulary Test, HomVEE = Home Visiting Evidence of Effectiveness Program, JCIH = Joint Committee on Infant Hearing, MCDI – EV = MacArthur Communication Development Inventory: Expressive Vocabulary, MCDI – RV = MacArthur Communication Development Inventory: Receptive Vocabulary, PICO = participants or population, interventions, comparisons, and outcomes, PRISMA = preferred reporting items for systematic reviews and meta-analyses, Project ASPIRE = Achieving Superior Parental Involvement for Rehabilitative Excellence, SKI\*HI, TAHL4 = Test of Auditory Comprehension of Language

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## Introduction

### Background

Use of evidence-based practices in health and education as the basis for quality improvement and accountability are at the forefront of federal policy in the United States. Without early intervention, children with congenital or early childhood hearing loss, are at risk for social, emotional, cognitive, and other developmental delays impacting language, literacy, learning, and overall academic performance (Joint Committee on Infant Hearing [JCIH], 2007; JCIH, 2013; Moeller, Tomblin, Yoshinaga-Itano, Connor, & Jerger, 2007; Yoshinaga-Itano & Apuzzo, 1998). Estimates of the lifetime educational costs for prelingual hearing loss are very high (Keren, Helfand, Homer, McPhillips, & Lieu, 2002; Schroeder, 2006); thus even modest models estimate a cost/benefit ratio for newborn hearing screening programs of more than 25:1 (Gorga & Neely, 2003; Porter, Neely, & Gorga, 2009). The World Health Organization (2010) identifies cost-effective newborn and early childhood screening programs as the first step in the process leading to diagnosis and treatment.

### Early Hearing Detection and Intervention (EHDI) Initiative

Implicit in the terminology used to describe the EHDI initiative promoted by JCIH is the notion that hearing screening programs are linked to effective diagnostic and treatment programs (White, 2016). This continuum of care from early detection to intervention for children who are diagnosed as deaf or hard of hearing is multifaceted and requires a multidisciplinary approach to intervention (JCIH, 2013). The origins of EHDI programs share this multidisciplinary approach to family-centered early intervention programs, recognizing the importance of the family as a system on outcomes of intervention services (JCIH, 2007, 2013; White, 2016). The current challenge of EHDI programs is the implementation of existing evidence-based policies and practices in ways that will enable and empower families by increasing individual family and child capabilities and strengths (White, Forsman, Eichwald, & Munoz, 2010). Home visiting is one of the early intervention options available to families of young children with hearing loss (Adirim & Supplee, 2013; Doggett, 2013; Duggan et al., 2013; Korfmacher, Laszewski, Sparr, & Hammel, 2012; Sacks et al., 2003).

### Home Visiting

Home visiting is grounded as an early intervention approach to service delivery in a number of disciplines. It is based on the notion that early intervention makes a difference in child and family outcomes (Division for Early Childhood & National Association for Education of Young Children, 2009). As a result of this philosophy, numerous home visiting programs have been developed including prenatal care, parenting support, child maltreatment prevention, and early intervention for children with disabilities. The origins of home visiting programs can be traced back to three main movements that began

in the 1800s: (a) early childhood education, (b) public health nursing, and (c) social advocacy and prevention efforts (Boller, Strong, & Daro, 2010). Evidence-based home visiting programs embrace the concept that family and child outcomes are improved when family-centered principles are embedded within program activities (Bailey, Raspa, Humphreys, & Sam, 2011; Llewellyn, McConnell, Honey, Mayes, & Russo, 2003). Family-centered principles are evidence-based and form the foundation of federal legislation for the Part C (birth to three) services specified in the Individuals with Disabilities Education Act (IDEA, 2004). These guidelines are based on family-centered values and include a shared philosophy of families as partners, a focus on family strengths, family choice of goals and services, collaboration and coordination of services, effective communication, and flexibility (JCIH, 2007, 2013; IDEA, 2004).

The Maternal and Child Health Bureau's (MCHB) Home Visiting Program builds upon decades of research demonstrating that home visits by nurse, social worker, or early childhood educators during pregnancy and in the first years of life improves child and family outcomes (Adirim & Supplee, 2013). By equipping parents with the skills needed to support the cognitive, socio-emotional, and physical health development of their children, the MCHB Home Visiting Program works with other parts of the early learning initiative to optimize outcomes for children and families and to help each attain their full potential (Adirim & Supplee, 2013). These goals are closely aligned with best practices promoted by JCIH (2007, 2013). The Home Visiting Evidence of Effectiveness Program (HomVEE) was developed by MCHB to conduct rigorous ongoing systematic reviews to evaluate the evidence of effectiveness of home visiting programs with published outcomes demonstrating positive outcomes for children and families (Avellar et al., 2016; Paulsell, Boller, Hallgren, & Esposito, 2010). The results of the systematic reviews conducted annually by HomVEE are published on their website (<http://homvee.acf.hhs.gov/>).

Over the past few years, HomVEE (2016) has designated 19 named home visiting models as "national models" meeting specific criteria set forth by the U.S. Department of Health and Human Services (DHHS) for their rigorous review process (Avellar et al., 2016). Interestingly, although early intervention home visiting programs for children who are deaf or hard of hearing and their families have existed for decades, none of the national home visiting models designated by HomVEE include those developed specifically for application in EHDI programs (Avellar et al., 2016; Sacks et al., 2003). Therefore, the purpose of this research project was to use the HomVEE research design and inclusion criteria (see Table 1) to identify programs specifically serving children who are deaf or hard of hearing and their families. The research question addressed was: Using the method and criteria employed by HomVEE to evaluate specific home visiting models (i.e., national models), do any home visiting programs specifically serving

<sup>1</sup>Throughout the remainder of this article, "jurisdiction" will be used to refer to states, territories, and other political jurisdictions that operate screening programs such as Washington, D.C., Puerto Rico, the Virgin Islands, etc.

children who are deaf or hard of hearing meet the DHHS criteria for evidence-based or emerging practice?

### **Systematic Review Methodology**

HomVEE employed a systematic review methodology to evaluate the quality and strength of evidence available for named home visiting models which consisted of (a) conducting a broad literature search, (b) screening studies for relevance, (c) critically appraising the studies, (d) comparing the appraisals to predetermined criteria (see methods for this study), and (e) extracting the data to evidence tables. We used the same criteria that HomVEE used for inclusion and exclusion in this study. The quality of each study with an eligible design was rated as high, moderate, or low. The home visiting model was rated as an “evidence-based early childhood home visiting service delivery model” if there was one randomized controlled trial (high quality) or two moderate quality studies with statistically significant findings and demonstrated sustainability over 6 months or more (Avellar et al., 2016, p. 5). If the home visiting model met the criteria without demonstrated sustainability, it was designated as a promising practice.

Similar to HomVEE, the authors used the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011) as a guide for developing the methodology for this project. In accordance with steps outlined in this handbook, the systematic review question specifies the types of population (participants) included in the reviewed studies, types of intervention (and comparisons), and the types of outcomes of interest. The acronym PICO (participants or population, interventions, comparisons, and outcomes) serves as a reminder of these components (Counsell, 1997; O’Connor, Green, & Higgins, 2011). According to these authors, the research question is typically stated as an objective using the PICO framework and includes the question components, which are used to generate search terms and search term strings developed for execution of the systematic review. The components of the question, with the specification of the types of studies included in the review are determined a priori, serving as the basis for the eligibility criteria included in the review.

The target populations of the early intervention home visiting models are children who are deaf or hard of hearing (aged birth to three years or birth to five years) and their parents and/or caregivers. The target intervention is home visiting to promote language, listening, and literacy development for infants and young children who are diagnosed, or at risk for prelingual childhood hearing loss. We limited our study to outcome measures in the child development and school readiness domain, which most closely aligns with the JCIH domains of interest. The outcome measures relevant to the target domain included auditory, speech, language, and literacy developmental assessments and/or assessment tools. HomVEE used a similar process in their evaluation of home visiting models, but included eight domains (Avellar et al., 2016). Outcome

domains in the HomVEE review and excluded from our study were: (a) child health; (b) maternal health; (c) reductions in child maltreatment; (d) reductions in juvenile delinquency, family violence, or crime; (e) family economic factors; (f) positive parenting factors; and (g) linkage and referrals.

We used the flow diagram reporting method recommended by Higgins and Green (2011) known as PRISMA, the acronym for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Liberati et al., 2009; Moher et al., 2009). We used the same criteria that HomVEE used to critically appraise each study. In addition, we used evidence summary tables to present the findings of the study as recommended in the Cochrane Handbook.

### **Objectives**

The objective of this systematic review was to assess the effects of home visiting for children who are deaf or hard of hearing and their families in the child development and school readiness domain.

### **Method**

This study was submitted to and approved by the Institutional Review Board (IRB) at the University of Arkansas for Medical Sciences with exempt status (Protocol #205394).

### **Criteria for Considering Studies for this Review Types of Studies**

Eligible study designs were prospective randomized controlled trials or quasi-experimental studies. Retrospective quasi-experimental research designs were also eligible for inclusion.

### **Types of Participants**

Children from birth to five years of age with congenital or early acquired (before age five years of age) deafness. Type, degree, configuration, and laterality of hearing loss were not considerations. Children with known cognitive, social-emotional, or behavioral disorders were not excluded.

### **Types of Interventions**

We included specific, named home visiting programs (i.e., national models designed for children who are deaf or hard of hearing and their families). We did not require a minimum period of intervention. We did not expect to find studies using treatment-as-usual control groups, different dose control groups, or adverse effects from intervention.

### **Types of Outcome Measures**

Child outcomes were considered primary and parent report measures were considered secondary. Outcome measures included receptive language, expressive language, developmental language, auditory development, pre-literacy language development, listening development, social-emotional development, and other developmental

**Table 1. Summary of Inclusion and Exclusion Criteria**

Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> <li>• Randomized controlled trials (RCTs), quasi-experimental, and retrospective quasi-experimental research designs (with or without a comparison group).</li> <li>• Children from birth to five years of age with congenital or early acquired (before age five years of age) deafness regardless of type, degree, configuration, and laterality of hearing loss, and known cognitive, social-emotional, or behavioral disorders.</li> <li>• Home visiting programs designed for children who are deaf or hard of hearing and their families with no consideration of minimum period of intervention, treatment-as-usual control groups or different dose control groups, and adverse effects from intervention.</li> <li>• Outcome measures included receptive language, expressive language, developmental language, auditory development, pre-literacy language development, listening development, social-emotional development and other developmental outcome measures indicative of child development and school readiness with no limit to these developmental outcome measures.</li> <li>• Studies published in English and available electronically.</li> </ul>	<ul style="list-style-type: none"> <li>• No eligible study design.</li> <li>• The primary service delivery strategy was not home visiting.</li> <li>• No inclusion of an eligible target population (families with children from birth to age five served in a developed-world context).</li> <li>• No outcomes relevant to the child development and school readiness outcome domain.</li> <li>• No examination of any of the 19 national home visiting models.</li> </ul>

outcome measures indicative of child development and school readiness. We did not limit inclusion of the study based on the developmental outcome measure. Table 1 summarizes the inclusion and exclusion criteria that were used for considering studies for this systematic review.

**Criteria for Rating Studies**

We used the HomVEE criteria for rating the quality and impact of studies (HomVEE, 2016). Study rating options included high, moderate, or low.

1. High—random assignment studies with low attrition of sample members and no reassignment of sample members after the original random assignments.
2. Moderate—random assignment studies that, due to flaws in the study design, execution, or analysis, do not meet all the criteria for the high rating; matched comparison group designs that establish baseline equivalence on selected measures; and single case and regression discontinuity designs.
3. Low—other studies that do not meet the criteria for high or moderate.

**Criteria for Designation as an Evidence-Based Early Intervention Home Visiting Model or as Promising Practice**

To meet the criteria for an evidence-based early childhood

home visiting service delivery model, program models must meet at least one of the following criteria (HomVEE, 2016):

1. At least one high- or moderate-quality impact study of the model finds favorable, statistically significant impacts in the outcome domain of child development and school readiness.
2. At least two high- or moderate-quality impact studies of the model using non-overlapping analytic study samples with one or more favorable, statistically significant impacts in the target domain.

Home visiting models with at least one moderate-quality impact analytic study sample with one favorable statistically significant impact that had not yet demonstrated sustainability were designated as promising practices.

**Search Methods for Identification of Studies**

**Electronic Searches**

Databases available through the University of Arkansas for Medical Sciences (UAMS) and the University of Arkansas at Little Rock (UALR) searched for this systematic review using the search terms generated from the PICO framework are shown in Appendix A.

**Table 2. Search Terms and Filters**

Concept	Terms	Notes
P = Hearing Loss	All databases: deaf, deafness, “hearing impaired”, “hearing loss” MeSH terms Deafness and Persons With Hearing Impairments also used in PubMed	Combined with OR
P = Age Groups	Terms used in resources without age filters: preschool OR infant OR infants OR baby OR babies	Age filters used in CINAHL, PsycINFO, and PubMed to limit to birth to 5 years old
I = Home Visits	All databases: “home visit”, “home visits”, “home visitors”, “home visitation”, “in-home”, “family counseling” MeSH term Family Health also used in PubMed	Combined with OR
I = Intervention	All databases: “early intervention”, “early interventions”	Combined with OR

*Note.* P = Participant or Population search terms (children who are deaf or hard of hearing aged birth to five and their families) or variables; I = Intervention search terms (home visiting intervention) or variables; CINAHL = Cumulative Index of Nursing and Allied Health Literature; MeSH = Medical Subject Headings.

### Search Strategy

Table 2 summarizes the search terms and filters that were used to retrieve relevant items from the databases. Searches were limited to English language items; no publication date limits were used in any database.

### Other Searches

In addition to the database search, the literature search for this study included two additional activities:

1. Search results were compared against the bibliographies of recent literature reviews and meta-analyses of home visiting models for children who are deaf or hard of hearing, and relevant missing citations were added to our search results.
2. Google was used to search relevant government, state, university, research, and nonprofit websites for unpublished reports and papers.

### Data Collection and Analysis

We identified studies by employing a systematic search strategy in electronic databases, screened identified studies for relevance, compared each study to the eligibility criteria for program models and research design, and summarized data from included publications into evidence tables (see Results and Figure 1). One member of the research team designed and executed the systematic search. Two of the authors screened the titles and abstracts for relevance. Three members of the research team served as reviewers and critically appraised the research design, assessing the evidence for each model. One author summarized the findings in evidence tables. All members of the research team contributed to writing and editing the final manuscript.

### Selection of Studies

After removal of duplicates, two review authors independently screened titles and abstracts of studies identified in the searches and selected all potentially relevant studies. The titles and abstracts were reviewed for relevancy. Those deemed irrelevant were eliminated from further consideration. Studies that examined variables not integral to the home intervention (i.e., demographic report), conducted in underdeveloped countries (i.e., some countries in Africa), and unpublished demonstration project reports were excluded. We obtained copies of relevant articles, which were then evaluated independently by the same review authors against the inclusion criteria. Review authors were not blinded to author names or institutions nor to journals of publication of potential studies.

Full-text electronic versions of the studies qualifying for inclusion were downloaded, printed, and organized with a study review data extraction form that was created by authors and attached to each study (see Appendix B). Three copies of each article and review form were made available to the review authors. Three review authors independently reviewed the articles to determine if they met inclusion criteria, and then met to resolve differences of opinion. For example, if one author indicated the study met the inclusion criteria and two authors excluded it based on the exclusion criteria, the characteristics of the study were discussed at length prior to making a decision. Exclusion criteria for this study were consistent with the HomVEE criteria (see Table 1).

## Data Extraction and Management

One review author performed data extraction using standardized forms, which was checked by two additional review authors. We extracted data on study characteristics (i.e., study design, number of patients enrolled in the study, number of patients fulfilling the review's inclusion criteria), participant characteristics (i.e., age, sex, hearing loss, groups), interventions (i.e., information, resources, indirect services, direct services), outcome measures (i.e., names of receptive language, expressive language, etc. including designation as primary or secondary outcome measure), compliance, number of visits, and length of follow-up. We resolved discrepancies between authors by discussion.

At the top of each form, the full citation for the study was recorded. The program model name, target program population, and a brief program description were recorded. Each study was identified and categorized as a randomized control trial or a quasi-experimental study design and examined for validity and reliability of outcome measure choice. Key features of each program model were extracted from each study and recorded. Key features extracted were consistent with those identified in the HomVEE reviews: education requirement for home visitors, minimum number of visits, outcomes (favorable or unfavorable), and demonstrated sustainability for six months or more. Authors used the standardized form when completing critical appraisals and assessing the impact of the evidence (see Appendix B).

## Critical Appraisal

Three review authors independently rated each study as high, moderate, or low based on the HomVEE criteria. Each review author independently synthesized the information, identified named program models, and determined if the

program model met the criteria for designation as an evidence-based home visiting model or as a promising practice. Critical appraisal ratings were compared at a face-to-face meeting and differences of opinion were resolved through discussion. One review author organized the data into evidence summary tables.

## Results

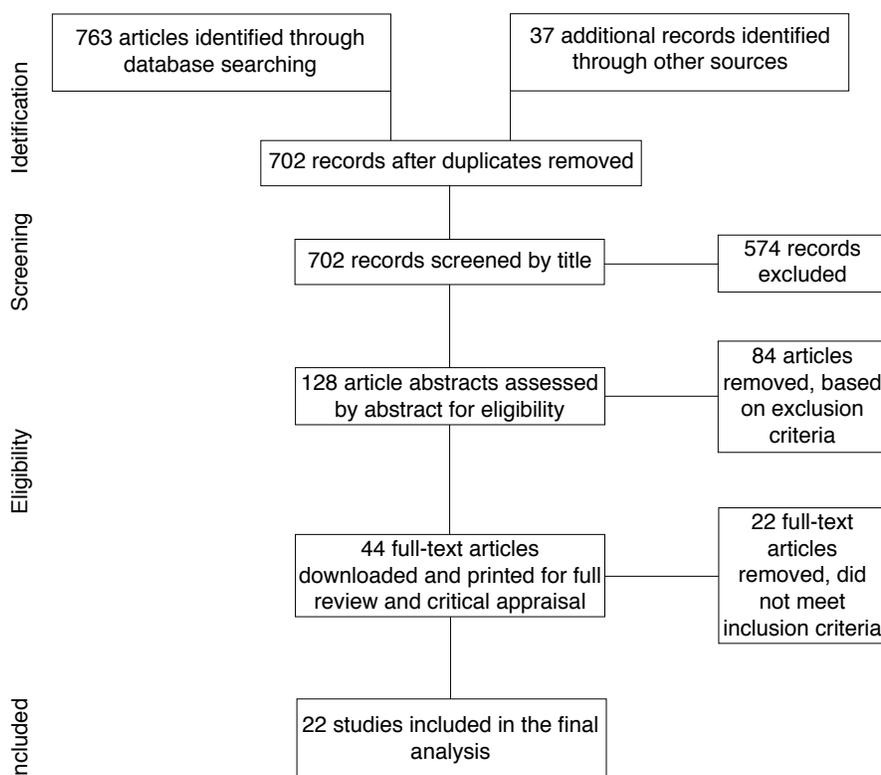
### Literature Search Results

Results of the literature search are shown in Figure 1. The number of studies identified, screened for relevance, eligible for inclusion, and included in the final analysis are shown in the PRISMA flowchart. Seven hundred and sixty-three peer-reviewed articles were identified in electronic database searches. An additional 37 articles were identified by other means (checking reference lists, website searches, etc.). Seven hundred and two articles remained after removing duplicates. A total of 127 articles remained after the title screen. Eighty-seven studies were deemed irrelevant based on the abstract review, and 44 studies were identified as viable options for full review. Twenty-two studies were excluded on the basis of the exclusion criteria, leaving 22 publications for inclusion in the final analysis.

### Home Visiting Models

Twenty-two publications met the inclusion criteria for systematic review. Within those publications, five ( $n = 5$ ) home visiting intervention models, designed for children who were deaf or hard of hearing and their families, targeting an outcome in the child development and school readiness domain were identified.

1. Colorado Home Intervention Program (1969; CHIP)



**Figure 1. The search process consisted of identification, screening, eligibility checks, and inclusion in the systematic review of home visiting models for children who are deaf or hard of hearing.**

2. Counseling and Home Training Program (CHTP)
3. Early Childhood Home Instruction Program (ECHI)
4. Project ASPIRE
5. SKI\*HI

### Evidence Tables

We assessed the effectiveness of each home visiting model and the outcome domain as well as each model's implementation guidelines, if available. This section provides a summary of evidence of effectiveness by model and outcomes. Evidence tables (3, 4, & 5) show summary data for the five identified home visiting program models specific to children who are deaf or hard of hearing and their families. Table 3 shows the ECHI program model name, target population for the program, and brief published program model description. Table 4 shows a summary of the key features of the three remaining home visiting models from children who are deaf or hard of hearing and their families. Table 5 shows the program model name, the number of studies for each early intervention home visiting model, critical appraisal rating (i.e., high, moderate, low), outcome domain measure used, and full reference citation by program model for each of the publications.

### Home Visiting Model Program Descriptions

The home visiting program name, target population for the program, and brief published program model description are shown alphabetically in Table 3. Five program models specific to children who are deaf or hard of hearing and their families were identified: CHIP (Yoshinaga-Itano, Coulter, & Thomson, 2000), CHTP (Greenberg, Calderon, & Kusche, 1984), ECHI (Calderon, Bargones, & Sidman; 1998; Calderon & Low, 1998; Calderon & Naidu, 2000), Project Aspire (Suskind, et al., 2013; Sacks et al., 2014), and SKI\*HI (Gatty, 1995). With more than 47 years, CHIP is the longest operating program and has published 14 high quality quasi-experimental studies over the past 20 years that received a critical appraisal rating of moderate. Because CHTP and ECHI are no longer operating under the program model names, they were excluded from the remaining summary tables. There was one published study for the CHTP program in 1984 with the quality and strength of evidence rated as low and three quasi-experimental studies for the ECHI program in 1998, each rated as low impact. Both programs targeted children aged birth to three. Project ASPIRE is a relatively new home-visiting program, still in the developmental stages. This program model has 1 high quality quasi-experimental study and

**Table 3. Program Model, Target Population, and Brief Descriptions of Home Visiting Programs for Children who are Deaf or Hard of Hearing and Their Families in the Child Development and School Readiness Outcome Domain**

Program Model	Target Population (in months)	Program Description
Colorado Home Intervention Program (CHIP)	Birth-11; 12-23; 24-35; 36-47; 48+	The Colorado Home Intervention Program (CHIP) started in 1969 was established through the U.S. Department of Education demonstration grant awarded through the University of Denver. The program is now administered through the Colorado Department of Education. The early intervention providers are trained professionals, deaf educators, speech/language pathologists, audiologists, early childhood special educators, bilingual educators, and social workers/psychologists who typically have earned graduate degrees in their field of expertise. Information (e.g., resources, strategies, development, methods of communication) is provided to parents through 1 or 1.5 hour sessions each week. Direct services to the child are not provided (Yoshinaga-Itano, 2003).
Counseling and Home Training Program (CHTP)	Birth-11; 12-23; 24-35	The goals of the family-focused Counseling and Home Training Program (CHTP) were to: (a) encourage rich and natural communication between children who are deaf and their families by using all possible modes of communication; (b) support the families' realistic adaptation to deafness through counseling and supportive contacts with other parents and people who are deaf; and (c) to build a sense of competence and esteem for children who are deaf by developing an understanding and secure family context. This home-visiting model used a total communication philosophy and included six specific program components including services provided by a multidisciplinary team. At the time of publication, this program was offered through the Vancouver Children's Hospital and served families in the Lower Mainland of British Columbia (Greenberg, 1984).
Early Childhood Home Instruction Program (ECHI)	Birth-11; 12-23; 24-35	The Early Childhood Home Instruction program emphasized the child's language and communication development using auditory and speech training and manual communication within a family, home-based intervention model. ECHI used a total communication approach with Signing Exact English as the manual mode of communication. The intervention program also made available a parent support group and a center-based playgroup to promote language development in play environments and interaction among toddlers who are deaf. At this time of publication, this program was operated out of Children's Hospital and Regional Medical Center, Seattle, WA (Calderon & Low, 1998; Calderon & Naidu, 2000).

Project ASPIRE	Birth-11; 12-23; 24-35	Project ASPIRE (Achieving Superior Parental Involvement for Rehabilitative Excellence) is a behavior-change intervention program seeking to address habilitation outcomes by supporting parent creation and maintenance of a developmentally supportive language learning environment for their children with hearing loss. The foundational behavior-change strategy of the Project ASPIRE intervention combines an education session and ongoing "quantitative linguistic feedback" to motivate an increase in parental language input and parent-child interaction. The full Project ASPIRE program is conceptualized as a 10-module Early Intervention (EI) curriculum intended for implementation by a developmental therapist (hearing or speech pathologist) in the traditional, one-on-one EI therapy session (Suskind, et al., 2013; Sacks et al., 2014).
SKI*HI	Birth-11; 12-23; 24-35; 36-47; 48+	The SKI*HI program began in 1972 in Utah as a state-based demonstration model of early intervention for children who are deaf or hard of hearing. In 1975, it became the national model of the United States Office of Education as an Outreach Model and has been adopted and used by 250 agencies in the U.S. and Canada. The program consists of a comprehensive, home-based, support model designed for use with children and families through interagency coordination. The model has three components: (a) direct services to the child and family, (b) administrative, and (c) support services. Direct service to the child and family is provided by a parent advisor and includes a specific curriculum. SKI*HI is a planned, systematic approach to meeting the needs of hearing impaired infants and their families through training, published curricula, and development of evaluation materials (Gatty, 1995).

2 randomized control trials. The critical appraisals are 1 moderate and 2 high ratings. SKI\*HI, the fifth model identified, has been in operation for 44 years and has one publication critically appraised as a low rating.

administrative records); number of research studies reporting favorable secondary outcomes (parent report); and sustainable outcomes, replication, and number of unfavorable outcomes reported by program model.

**Key Features by Program Model**

Table 4 shows a summary of the key features of three EHDI home visiting models: CHIP, Project ASPIRE, and SKI\*HI. Key features include the target population in months; minimum required education for home visiting personnel; minimum required reported visit frequency; number of research studies reporting favorable primary outcomes (direct observation, direct assessment,

The review process revealed 14 publications meeting criteria for the CHIP program, 3 for Project ASPIRE, and 1 for SKI\*HI. Project ASPIRE targets the birth to three population through parent education while CHIP and SKI\*HI target children aged birth to five. CHIP and Project ASPIRE report a training requirement for home visiting personnel, SKI\*HI does not. Favorable outcomes are reported in all 14 publications for CHIP, in 3 publications

**Table 4. Key Features of Three Named Home Visiting Program Models for Children who are Deaf or Hard of Hearing for the Outcome Domain of Child Development and School Readiness**

Program Model	Targeted Population (in months)	Minimum HV Staff Education Required	Minimum Required Visit Frequency	Number Favorable Primary Outcomes	Number Favorable Secondary Outcomes	Favorable Outcome Sustained	Favorable Impact/ Replicated	Number of Unfavorable Outcomes
Colorado Home Visiting Program (CHIP)	Birth-11; 12-23; 24-35; 36-47; 48+	Yes	Yes	14	14	Yes	Yes	0
Project ASPIRE	Birth-11; 12-23; 24-35	Yes	Yes	3	3	Not Reported	No	0
SKI*HI	Birth-11; 12-23; 24-35; 36-47; 48+	Not Reported	Not Reported	1	1	Not Reported	No	0

for Project ASPIRE and in 1 publication for SKI\*HI, with no unfavorable outcomes. CHIP studies demonstrated replication and sustainability for 6 months or more. Replication and sustainability was not reported for Project ASPIRE or for SKI\*HI.

### Evidence-Based Home Visiting Model or Promising Practice

Three program models were assessed to determine if they met the HomVEE criteria for designation as an evidence-based model or a promising practice. One program model met the criteria for designation as an EHDI evidence-based home visiting model and one program model met the criteria for designation as an EHDI promising practice. One program model did not meet the designation criteria for either category.

The program model name, the number of studies for each EHDI home visiting model, critical appraisal rating (i.e., high, moderate, low), outcome domain measure used, and full reference citation by program model for each of the publications are shown in Table 5. References are organized chronologically. The outcome domain measure is the instrument or test tool that was used to collect data relevant to auditory, speech, language, listening, literacy, and other developmental outcomes relevant to the outcome domain of child development and school readiness.

The CHIP model meets the HomVEE criteria as an evidence-based home visiting model. Data for CHIP showed 14 published impact studies over the past 20 years, each with a critical appraisal rating of moderate for

evidence of effectiveness. All studies were high quality quasi-experimental research designs with no randomization or comparison group. Outcome measures used in these studies were standardized, reliable, valid instruments and included the Emotional Availability Scales (EAS; Biringen, Robinson, & Emde, 1998), Expressive One-Word Picture Vocabulary Test (EOWPVT4; Martin & Brownell, 2010), Child Development Inventory (CDI; Ireton, 1992), MacArthur Communication Development Inventory: Expressive Vocabulary (MCDI – EV) and Receptive Vocabulary (MCDI – RV) subtests (Fenson et al., 1993), and the Test of Auditory Comprehension of Language (TACL4; Carrow-Woolfolk, 2013).

Project ASPIRE meets the HomVEE criteria as a promising practice. Data showed three published studies over the past five years. One study was a high quality quasi-experimental study with a critical appraisal rating of moderate. The other two studies employed a randomized control design and received a high critical appraisal rating. Outcome measures included a developmental questionnaire, video language sample analysis, and sub-analyses of the Language ENvironment Analysis (LENA) system. This program model is considered a “promising practice” until evidence of sustainability has been demonstrated.

The SKI\*HI model did not meet the HomVEE criteria as either a promising practice or as an evidence-based model. Data showed one publication that did not meet the critical appraisal criteria rating as high (randomized control trial) or moderate (high quality quasi-experimental study design),

**Table 5. Critical Appraisal, Outcome Measure and Full Reference By Program Model for the Child Development and School Readiness Outcome Domain for Families of Children who are Deaf or Hard of Hearing**

Program Model	Number of Studies	Study Rating	Outcome Assessment Measure	Reference
Colorado Home Visiting Program (CHIP)	14	Mod	Minnesota Child Development Inventory	Apuzzo, M., & Yoshinaga-Itano, C. (1995). Early identification of infants with significant hearing loss and the Minnesota Child Development Inventory. <i>Seminars in Hearing</i> , 16, 124–139.
		Mod	Minnesota Child Development Inventory	Yoshinaga-Itano, C., Sedey, A. L., Coulter, D. K., & Mehl, A. L. (1998). The language of early- and later-identified children with hearing loss. <i>Pediatrics</i> , 102, 1161–1171.
		Mod	MacArthur Communication Development Inventory: Expressive Vocabulary	Yoshinaga-Itano, C., & Snyder, L. (1998). The relationship of language and symbolic play in deaf and hard-of-hearing children. <i>Volta Review</i> , 100, 135–164.
		Mod	MacArthur Communication Development Inventory: Expressive Vocabulary	Snyder, L., & Yoshinaga-Itano, C. (1998). Specific play behaviors and the development of communication in children with hearing loss. <i>Volta Review</i> , 100, 165–185.
		Mod	MacArthur Communication Development Inventory: Expressive Vocabulary	Mayne, A. (1998a). Expressive vocabulary development of infants and toddlers who are deaf or hard of hearing. In C. Yoshinaga-Itano & A. L. Sedey (Eds), <i>Language, speech and social-emotional development of children who are deaf and hard of hearing: The early years</i> . <i>Volta Review</i> , 100, 29–52.
		Mod	MacArthur Communication Development Inventory: Receptive Vocabulary	Mayne, A. (1998b). Receptive vocabulary development of infants and toddlers who are deaf or hard of hearing. In C. Yoshinaga-Itano & A. L. Sedey (Eds), <i>Language, speech and social-emotional development of children who are deaf and hard of hearing: The early years</i> . <i>Volta Review</i> , 100(5), 1–28.
		Mod	Emotional Availability Scales; MacArthur Communication Development Inventory	Pressman, L., Pipp-Siegel, S., Yoshinaga-Itano, C., Kubicek, L., & Emde, R. (1998). A comparison of the links between emotional availability and language gains in young children with and without hearing loss. <i>Volta Review</i> , 100(5), 251–277.
		Mod	Emotional Availability Scales; MacArthur Communication Development Inventory	Pipp-Siegel, S., Blair, N. L., Deas, A. M., Pressman, L., & Yoshinaga-Itano, C. (1998). Touch and emotional availability in hearing and deaf or hard of hearing toddlers and their hearing mothers. <i>Volta Review</i> , 100, 279–298.

		Mod	Emotional Availability Scales; MacArthur Communication Development Inventory	Pressman, L., Pipp-Siegel, S., Yoshinaga-Itano, C., & Deas, A. M. (1999). Maternal sensitivity predicts language gain in preschool children who are deaf and hard of hearing. <i>Journal of Deaf Studies and Deaf Education</i> , 4(4), 294–304.
		Mod	MacArthur Communication Development Inventory: Expressive Vocabulary	Yoshinaga-Itano, C., Coulter, D., & Thomson, V. (2001). Developmental outcomes of children born in Colorado hospitals with universal newborn hearing screening programs. <i>Seminars in Neonatology</i> , 6, 521–529.
		Mod	Minnesota Child Development Inventory	Pipp-Siegel, S., Sedey, A. L., Van Leeuwen, A., & Yoshinaga-Itano, C. (2002). Mastery motivation predicts expressive language in children with hearing loss. <i>Journal of Deaf Studies and Deaf Education</i> , 8(2), 133–145.
		Mod	Minnesota Child Development Inventory; Expressive One Word Picture Vocabulary Test – 3; Test of Auditory Comprehension of Language - 3	Yoshinaga-Itano, C., Baca, R., & Sedey, A. (2010). Describing the trajectory of language development in the presence of severe to profound hearing loss: A closer look at children with cochlear implants versus hearing aids. <i>Otology &amp; Neurotology</i> , 31(8), 1268–1274.
		Mod	Logical International Phonetics Program (LIPP)	Wiggin, M., Sedey, A. L., Awad, R., Bogle, J. M., Yoshinaga-Itano, C. (2013). Emergence of Consonants in Young Children with Hearing Loss. <i>Volta Review</i> , 113(2), 127–148.
		Mod	Expressive One-Word Picture Vocabulary Test – 3; MacArthur Communication Development Inventory: Expressive Vocabulary	Han, M. K., Storkel, H. L., Hoon-Lee, J., & Yoshinaga-Itano, C. (2015). The influence of word characteristics on the vocabulary of children with cochlear implants. <i>Journal of Deaf Studies and Deaf Education</i> , 20, 242–251.
Project ASPIRE	3	Mod	Language ENvironment Analysis (LENA) system	Suskind, D., Leffel, K. R., Hernandez, M. W., Sapolich, S. G., Suskind, E., Kirkham, E., & Meehan, P. (2013). An exploratory study of “quantitative linguistic feedback”: Effect of LENA feedback on adult language production. <i>Communication Disorders Quarterly</i> , 34(2), 1–11.
		High	Language ENvironment Analysis (LENA) system	Sacks, C., Shay, S., Repplinger, L., Leffel, K., Sapolich, S., Suskind, E., Tannenbaum, S., & Suskind, D. (2014). Pilot testing of a parent-directed intervention (Project ASPIRE) for underserved children who are deaf or hard of hearing. <i>Child Language, Teaching and Therapy</i> , 30(1), 91–102.
		High	Developmental Questionnaire; Video Analysis; Language ENvironment Analysis (LENA) system	Suskind, D. L., Graf, E., Leffel, K. R., Hernandez, M. W., Suskind, E., Webber, R., Tannenbaum, S., & Nevins, M. E. (2016). Project ASPIRE: Spoken language intervention curriculum for parents of low-socioeconomic status and their deaf and hard-of-hearing children. <i>Otology &amp; Neurotology</i> , 37(2), e110–e117.
SKI*HI	1	Low	SKI*HI Language Development Scale	Meinzen-Derr, J., Wiley, S., & Choo, D. I. (2011). Impact of early intervention on expressive and receptive language development among young children with permanent hearing loss. <i>Volta Review</i> , 155(5), 580–591.

Note. Mod = Moderate

and was therefore rated as low. The SKI\*HI Language Development Scale was used as the outcome measure. This scale is standardized or normed on children who are deaf and hard of hearing, and not on their typically hearing peers, thus – would not be valid as a language assessment tool for children using spoken language.

## Summary and Conclusions

### Summary

Results of our study revealed 22 publications from which five EHDI home visiting programs were identified. CHIP met the criteria for designation as an EHDI Evidence Based Home Visiting Model and Project ASPIRE was identified as an EHDI Promising Practice. These results are important and demonstrate consistency with the purpose of EHDI articulated by JCIH (2013). Implications of these results are provided for practice, policy, and future research efforts.

EI services represent the purpose and goal of the entire EHDI process. Screening and confirmation that a child is DHH [deaf or hard of hearing] are largely meaningless without appropriate, individualized, targeted, and high-quality intervention. For the infant or young child who is DHH to reach his or her full potential, carefully designed individualized intervention must be implemented promptly, utilizing service providers with optimal knowledge and skill levels and providing services on the basis of research, best practices, and proven models (JCIH, 2013, p. e1324).

### Overall Completeness and Applicability of Evidence

One issue that HomVEE does not differentiate or comment on in their studies is the difference between a home visiting program model and a home visiting curriculum model. This is a very important distinction that we want to draw attention to as it has very different implications for practicing EHDI professionals. The two EHDI home visiting models identified in this study are very different types of home visiting models.

Project ASPIRE is a home intervention curriculum program model currently in development that is not yet commercially available. It has a specific set of objectives related to listening and spoken language, specific materials for use in parent training sessions, and a specific goal of facilitating listening and spoken language. Therefore, it is most appropriate for hearing parents choosing the aggressive use of technology to access auditory sounds. It is an innovative, well-designed, technology-based, culturally sensitive, active engagement curriculum targeting the needs of adult learners developed by a multidisciplinary team. For practicing professionals, this is a curriculum that one might choose to provide indirect services in the form of parent education. It is also the only curriculum developed specifically for children who are deaf or hard of hearing and their families with a rigorous and robust research agenda guiding the development. It is the only curriculum the authors are aware of in which prospective research with randomized group treatment has demonstrated

evidence of effectiveness. This is very similar in structure and philosophy to one of the national home visiting models designated by HomVEE known as PALS (Play and Learn Strategies; Landry et al., 2012; Landry, Smith, & Swank, 2006; Roggman & Cardia, 2014). This program is a curriculum developed to facilitate language development through parent training. It is supported by rigorous and robust research following a focused research agenda appropriate to the target population and target audience.

In contrast, CHIP is part of a multidisciplinary integrated statewide EHDI system designed to meet the needs of a diverse population in a geographically diverse state. As such, CHIP does not subscribe to one specific curriculum with targeted communication goals, but instead, offers a continuum of services from which families can choose to best meet their individual needs. Statewide data is warehoused at the University of Colorado, Boulder and serves as a rich repository from which retrospective analyses can be done. Prospective randomized controlled trials are not part of this system and probably never will be. However, the components of this early intervention home visiting program are consistent with the JCIH (2007, 2013) guidelines. It is the only statewide EHDI home visiting program with published outcome data and serves as the standard for program development and implementation.

Another important consideration in the completeness and applicability of our study is telepractice. HomVEE does not address this issue and did not include telepractice services in their definition of home visiting programs. Although by nature, telepractice is a home-based service, we chose to follow the HomVEE definition and did not include studies using telepractice as a service delivery method in this systematic review.

### **Quality of Evidence**

The quality of the studies included in this systematic review was high overall. Randomized controlled trials were well designed and rated as high impact, and despite the moderate impact rating for the Colorado studies, they employed a repeatable and replicable methodology to facilitate developmental outcomes. These Colorado outcome studies were well-designed quasi-experimental studies using matched designs, multi-variate analyses, and covariance statistic designs and multiple regression techniques using both step-wise and block designs (Yoshinaga-Itano, 2004). The internal validity of the studies was high with little selection, attrition, or detection bias. Confounding variables were limited or controlled by research design. In addition, external validity was high with well-described participant populations in all studies.

### **Potential Biases in the Review Process**

This systematic review used a very broad search strategy for identifying eligible studies, although it is unlikely that eligible studies were missed, it is never possible to rule out reporting bias.

### **Conclusions of Evidence-Based Review**

The CHIP EHDI model should be submitted to HomVEE for consideration as a designated national evidence-based home visiting model specific to children who are deaf or hard of hearing and their families. The Project ASPIRE home visiting curriculum model should be submitted to HomVEE for consideration of designation as a promising practice for facilitating listening and spoken language development. Studies of the SKI\*HI program are insufficient to recommend inclusion as an evidence-based model at this time.

### **Implications for Practice**

High-quality, cost-effective services resulting in the best possible patient outcomes are at the heart of the national conversation regarding health care and education reform (Nicholson, Shapley, & Martin, 2012). Although the concept of healthcare and service quality assessment has been around for most of a century, it has been a hot topic in the healthcare and education arena for the past decade. Quality in healthcare has been defined by the Agency of Healthcare Quality and Research (AHQR, 2003) as safe, timely, patient-centered, efficient, and equitable service delivery with full consideration of a patient's preference and values. This definition can be viewed in a broad sense, encompassing intervention services provided by audiologists, speech pathologists, early interventionists, etc. No one would deny that the ultimate goal for any diagnostic and/or intervention service in the field of communication disorders is to achieve the best possible results or outcomes by providing the right services, at the right time, in the right way (Nicholson et al., 2012). Although home visiting services have been provided as a service model for decades to children who are deaf or hard of hearing and their families, there is little high quality outcome data to support this practice, and the data that exists, is largely from one state. Child developmental outcomes (social emotions, language, and literacy) are the foundation for school readiness and school success, and the literature supports the use of home visiting as one cost-effective method of achieving these goals.

This article serves as a wake-up call to clinicians and researchers practicing in the field of deafness and early intervention to reach beyond disciplinary knowledge and skills and to continue to work together to achieve better parent and child outcomes, and to recognize the value of using evidence-based clinical protocols implemented systematically with outcome data collected, documented, databased, and studied at the group level. Increased awareness, cooperation with, collaboration among, partnerships between, and integration of systems in early intervention, medicine, public health, and education are one potential solution to the complex challenges posed by the families in need of these services.

Home visiting is one of the services on the continuum that should be available in every state as an option to meet the needs of the families of children who are deaf or hard of hearing. Home visiting and medical home initiatives share

goals of promoting the health and development of children, often through trusting longitudinal relationships (Tschudy, Toomey, & Cheng, 2013). Both provide children and their families with social support and anticipatory guidance (e.g., development, safety), and linkage to community resources and services. To fully capitalize on these synergies, the systems should be integrated, whenever possible prioritizing the particular strengths of each service and needs of the family (IDEA, 2004). State systems are challenged to do more than play together nicely in the sandbox, and instead to dig deep and join forces through thoughtful efforts in joint consideration, communication, cooperation, and collaboration to solve problems and to publish meaningful outcome data. These aspirations are not new, however, practitioners are challenged to come up with new and innovative solutions to help reduce barriers to high quality services which generate outcome data in a retrievable format. This is the approach taken by Suskind and colleagues in the conceptualization and development of Project ASPIRE (2014, 2016).

The decision for a parent to choose home visiting intervention should balance the benefits and downsides and integrate the parent/child's values and preferences (Haynes, Devereaux, & Guyatt, 2002; JCIH 2007, 2013). Parents with a high preference for home based services may find that the advantages with regard to costs associated with time, travel, and transportation far outweigh the disadvantages. What authors found missing from the home visiting outcome literature was the parent perspective. Surprisingly, secondary outcomes were not considered that may have related not only to increased knowledge and skills on the part of the parent, but also to confidence, self-efficacy, and satisfaction with services. In addition, parent preferences about choice of the preferred method of learning (reading, watching video, listening, etc.) were not available in the studies reviewed. These aspects of home visiting intervention are data that could be collected by home visitors or at the program level to use in the development of programming and in quality improvement efforts.

### **Implications for Research**

Results of this systematic review highlight the need for a systematic interdisciplinary outcomes-based approach to program evaluation to support and/or inform best practices. The current state of evidence for home visiting models for children who are deaf or hard of hearing and their families has been described. This is the right time to join the conversation of the Home Visiting Research Network (Duggan et al., 2013). This network was established in July 2012 to meet 3 objectives, (a) develop a national home visiting research agenda, (b) advance the use of innovative research methods to carry out this agenda, and (c) provide a research environment supportive of the professional development of emerging home visiting researchers (Duggan et al., 2013). The stated overarching goal of this organization is to promote the translation of research into policy and practice. They have developed a conceptual model of home visiting service delivery and outcomes,

characteristics of families and providers, variables relevant to family and home visitor relationships and demographic variables such as psycho-social well-being; cognitive capacity and attitudes; and perceived norms, personal agency, knowledge, skills, and dispositions (Duggan et al., 2013). The National Home Visiting Research Network (2013) priorities, a multidisciplinary collaboration, include the following:

1. Strengthen and broaden home visiting effectiveness
2. Identify core elements of home visiting
3. Promote successful adoption of home visiting innovations
4. Promote successful adaptation of home visiting innovations
5. Promote fidelity in implementing home visiting innovations
6. Build a stable, competent home visiting workforce
7. Promote family engagement in home visiting
8. Promote home visiting coordination with other services for families
9. Promote the sustainment of effective home visiting

Contributions that researchers can make, specific to children who are deaf or hard of hearing include child population variables (e.g., age of diagnosis, age of enrollment in early intervention), intervention variables (frequency of intervention, dose per week, number of visits, home versus clinic, qualifications of providers, etc.), comparison groups (prospective or retrospective, randomized or matched), and outcome variables (auditory development, listening skills, etc.). It is incumbent upon current and future researchers in the fields of communication sciences and disorders, deafness, and early intervention to design, implement, and study voluntary home visiting programs for children who are deaf or hard of hearing, and participate in longitudinal interdisciplinary data collection.

Furthermore, collaborative efforts in tracking child and family outcomes, and adherence to robust program evaluation designs are needed and provide an adequate level and quality of evidence for effectiveness (Korfmacher et al., 2012). These authors provide an invaluable practical tool for use in the cross disciplinary assessment of home visiting with common components of quality programming and specific operational anchors for measurement across multiple program models. Program evidence like this, coupled with primary (child) and secondary (parent) outcome data, can be used to guide program development, design decisions in EHDI programs, plan quality improvement initiatives, and influence policy.

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**Appendix A**  
**Systematic Review Databases, Vendor, and Support**

Databases Available for Systematic Review Search		
	Vendor	Supported by
CINAHL® Plus with full text	EBSCO	UAMS
Cochrane EBM databases (EBM Reviews - Cochrane Database of Systematic Reviews 2005 to October 2014, EBM Reviews - ACP Journal Club 1991 to November 2014, EBM Reviews - Database of Abstracts of Reviews of Effects 4th Quarter 2014, EBM Reviews - Cochrane Central Register of Controlled Trials October 2014, EBM Reviews - Cochrane Methodology Register 3rd Quarter 2012, EBM Reviews - Health Technology Assessment 4th Quarter 2014, EBM Reviews - NHS Economic Evaluation Database 4th Quarter 2014)	Ovid	UAMS
Education Research Complete	EBSCO	UALR
Education Resources Information Center	EBSCO	UAMS
JSTOR®	ITHAKA	UALR
PsycINFO®	EBSCO	UAMS
Psychology and Behavioral Sciences Collection	EBSCO	UAMS
PubMed (MEDLINE)	National Library of Medicine	UAMS
SocINDEX™	EBSCO	UAMS
Web of Science™	Thomson Reuters	UAMS

*Note.* CINAHL = Cumulative Index to Nursing and Allied Health Literature; EBM = Evidence-based Medicine; UALR = University of Arkansas at Little Rock; UAMS = University of Arkansas for Medical Sciences

**Appendix B**  
**Home Visiting Study Systematic Review Form**

Study Full Citation: \_\_\_\_\_

Database: \_\_\_\_\_ Reviewer: \_\_\_\_\_

**(1) Study Screen Details**

Screening Decision			Screening Conclusion		
Study Passes Screens	Yes	No	Eligible for Review	Yes	No

**(2) Study Design Details (Circle Appropriate Indicator)**

Rating	Study Design	Outcomes	Threats to Validity	Outcome Effect
High	Randomized Control Trial (RCT)	Primary Child Outcomes	Number of Subjects Number of Groups	Favorable No Effect
Mod	Quasi Experimental Cross Sectional Cohort	Secondary	Instrumentation	Unfavorable
Low		Parent Report Parent Outcomes	Differences between participants	Not Measured

**(3) Study Characteristics**

**Population**                      Child who is deaf or hard of hearing age birth to five and parent/caregiver

**Intervention**                      Home Visiting Program  
Name: \_\_\_\_\_

**Outcomes Targeted**      Child Development and School Readiness

Outcome Measures  
(specify title of test measurement for assessment)

- Receptive Language (spoken or sign)
- Expressive Language (spoken or sign)
- Auditory Skill Development
- Listening Skills
- Literacy Development
- Speech Development