

# Time Trend and Factors Associated with Late Enrollment in Early Intervention among Children with Permanent Hearing Loss in Louisiana 2008-2013

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## Abstract

This study aimed to identify the time trend of and factors associated with late enrollment in early intervention (EI) services among children with permanent hearing loss (HL) born between 2008 and 2013 in Louisiana. 2008-2013 linked Louisiana Early Hearing Detection and Intervention, birth records, EarlySteps (IDEA, Part C), Parent-Pupil Education Program, and Medicaid data were analyzed. Logistic regression models were used to evaluate the trend and associations of mother and child's demographic and hearing loss characteristics with late EI enrollment. Results of data analyses did not show any trend of late enrollment in EI services from 2008 to 2013. Delayed diagnosis and mild or unilateral HL were strongly associated with late enrollment. Appropriate strategies to resolve problems relating to missed diagnosis during newborn hearing screening and to convince parents of children with HL to enroll soon after diagnosis of HL will contribute to success of early EI enrollment in the state.

**Key Words:** Early Hearing Detection and Intervention, newborn hearing screening, early intervention, hearing loss

**Acronyms:** EI = Early Intervention, HL = Hearing Loss, IDEA = Individuals with Disabilities Education Act, JCIH = Joint Committee on Infant Hearing, D/HH = Deaf and Hard of Hearing, CDC = Centers for Disease Control and Prevention, EHDI – IS = Early Hearing Detection and Intervention – Information System, PPEP = Parent – Pupil Education Program, DSHPSHWA = Directors of Speech and Hearing Programs in State Health and Welfare Agencies, CI = Confidence Interval, UHL = Unilateral Hearing Loss, MBHL = Mild Bilateral Hearing Loss, NHS = Newborn Hearing Screening

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## Introduction

It is known that hearing loss is strongly associated with delayed development of speech, language, and cognition in early childhood (Holt & Svirsky 2008; Kennedy et al., 2006; Moeller, 2000; Nicholas & Geers, 2006). Previous researchers have suggested the significant value of receiving early intervention services before six months of age for improved academic achievement as well as language and social-emotional development among children with permanent hearing loss (Pipp-Siegel, Sedey, VanLeeuwen, & Yoshinaga-Itano, 2003; Yoshinaga-Itano, 2003, 2004; Yoshinaga-Itano, Coulter, & Thomson, 2000). Although the Joint Committee on Infant Hearing (JCIH) recommends that all newborns diagnosed with hearing loss receive early intervention services no later than six months of age (JCIH, 2007), many deaf and hard of hearing (DHH) children still do not enroll or enroll late in early intervention programs in the United States. Based on 2013 National Centers for Disease Control and Prevention's (CDC) Early Hearing Detection and Intervention (EHDI) Summary Data Report, only 63.9% of children diagnosed with permanent hearing loss are enrolled in early intervention programs. Of children who enrolled in early intervention programs, 68.8% enrolled before six months of age (CDC, 2013). Recent studies have identified risks factors related to discrepancies in early intervention enrollment timing and/or service provision among DHH children such as rural residential area (Bush, Burton, Loan, & Shinn, 2013), low socioeconomic status (Boss, Niparko, Gaskin, & Levinson, 2011), a shortage of healthcare insurance (Sommers, 2005), missed newborn hearing screening, lack of parent and primary care provider education on the importance of early intervention (Lester, Dawson, Gantz, & Hansen, 2011), lack of family involvement (Harrison et al., 2016), and late age at diagnosis of hearing loss (Alyami, Soer, Swanepoel, & Pottas, 2016; Walker et al., 2014).

Although the Louisiana (LA) EHDI Program has seen an increase in the number of children reported with hearing loss since 2002 when universal newborn hearing screening began, enrollment in early intervention services among children with hearing loss has never been evaluated. Using Louisiana Newborn Hearing Screening, birth records, EarlySteps (IDEA, Part C), Parent-Pupil Education Program, and Medicaid data, we aimed to identify the time trend of late enrollment in early intervention services and associated factors among children ages 0–3 years with permanent hearing loss born between 2008 and 2013. Research factors included mother and child's demographic and geographic characteristics, time of diagnosis of hearing loss, and characteristics of hearing loss (i.e., type, degree, and laterality). The findings of the study may facilitate improvements in EHDI program implementation and policy making to ensure all affected children have equal access to and benefit from the early intervention services in Louisiana and other states.

## Method

### Study Population, Data Sources and Linkages

The study included children ages 0–3 years who were born in Louisiana between 2008 and 2013 and were diagnosed with permanent hearing loss. The following children were excluded from the study: children whose mothers were not Louisiana residents at birth; who moved out of state after birth; or who died after diagnosis of hearing loss regardless of receiving any early intervention services.

Four datasets were used for data analyses including birth certificates, LA EHDI-Information System (IS), EarlySteps (i.e., the state's IDEA, Part C early intervention program), and Medicaid. LA EHDI-IS consisted of newborn hearing screening, diagnosis, and audiological and early intervention data. Only records of children diagnosed with permanent hearing loss were selected and used for data linkages and analyses. The early intervention data in LA EHDI-IS were provided directly from the LA Parent-Pupil Education Program (PPEP), a statewide outreach program provided by the Louisiana School for the Deaf at no cost to families with children ages 0–3 who are deaf or hard of hearing. The LA EHDI Tracking Specialist received data from the PPEP and entered it into the LA EHDI-IS monthly. Louisiana Bureau of Health Statistics and Vital Records provided birth certificate data. Medicaid data included only records with Current Procedural Terminology (CPT) codes of 92507 and 92508 (treatment of speech, language, voice, communication, and/or auditory processing disorder; 92507 for individual, and 92508 for group). The project was deemed exempt by Louisiana State University Institutional Review Board because it did not meet the federal definition of human subjects research.

SAS 9.4 and LinkPro 3.0 were used for data linkages. First, LA EHDI-IS data including only children with hearing loss were linked to birth certificates. Only records matched with birth records were kept and used in the next linkage (552 matched records in total 559 records with hearing loss). Second, matched LA EHDI-IS and birth data were linked to EarlySteps data; and last, matched LA EHDI-IS, birth, and EarlySteps data were linked to Medicaid data. The linking variables included child's date of birth, first name, and last name with soundex codes (i.e., codes of names based on the phonetic spelling of the name). In each stage of linkages, linked records were reviewed manually to define true matches using linking variables and some of the following variables when available: mother's last name, first name, maiden name; address of residence at birth or most updated address of residence; and birthing hospital. Of 552 records of children with hearing loss matched with birth certificates, 351 (63.5%) records contained PPEP data, 412 matched with EarlySteps data (74.5%), and 240 (43.5%) matched with Medicaid data. Thus, EarlySteps contributed the most data of documented enrollment in EI in this study. A total of 492 (89.1%) records of children in the final matched data were included in PPEP, and/or EarlySteps, and/or Medicaid data. Those children were defined as enrolled in early intervention programs and used for data analysis.

## Analysis Variables-Outcome Variables.

### Enrollment in early intervention (EI)

As mentioned above, only children found in PPEP, EarlySteps, or Medicaid data were defined as enrolled in early intervention programs. Children who enrolled in intervention programs may have received services (i.e., PPEP, EarlySteps, or Medicaid) or were monitored by audiologists (PPEP). Intervention services included any type of habilitative, rehabilitative, or educational service provided to children with hearing loss (JCIH, 2007).

### Late/early enrollment in early intervention

Of those who enrolled in early intervention programs, children who began services or were monitored before six months of age were classified as enrolled early in early intervention; otherwise they were classified as enrolled late. The earliest date of enrollment in the three programs was used to estimate the time of enrollment.

### Independent variables

Factors used to evaluate associations with late enrollment in EI included mother and child's demographic and geographic characteristics, time of diagnosis of hearing loss, and characteristics of hearing loss (i.e., type, severity degree, and laterality).

All demographic and geographic variables were derived from birth certificate data and defined as categorical variables. They included birth weight (i.e., low birth weight, < 2,500 grams vs. normal weight, > 2,500 grams), race (i.e., white, black, and other), ethnicity (i.e., Hispanic vs. non-Hispanic), geographic area of residence (i.e., urban vs. rural), maternal age (i.e., < 20, 20-34, and 35+ years old), maternal education (i.e., not completed, completed high school, and completed some college), number previous live births (i.e., none, one, and two or more), and sex (i.e., male vs. female).

Hearing loss (HL) was classified into different levels of severity, types, and laterality. The Directors of Speech and Hearing Programs in State Health and Welfare Agencies system for degree of hearing loss was used to categorize severity of hearing loss as follows: mild (21–40 decibels hearing level [dBHL]), moderate (41–40 dBHL), severe (71–90 dBHL), and profound (> 91 dBHL; Curry & Gaffney, 2010). For bilateral HL, the ear with more severity was used to categorize severity degree. Laterality of hearing was categorized as unilateral versus bilateral. Four types of hearing loss were defined as sensorineural, conductive, mixed, and auditory neuropathy/dyssynchrony. Age at diagnosis of HL was calculated using date of birth and date when hearing loss was diagnosed and confirmed by an audiologist, and categorized as 0–2, 3–5, and 6+ months of age.

### Data analysis

Rate of late enrollment in EI was calculated using the following formula: (Number of children with hearing loss who enrolled in EI at six months of age or older/total

children with hearing loss who enrolled in EI)\*100. Trend of late enrollment in EI was analyzed from the 2008 to 2013 birth years. Both unadjusted and adjusted annual percent change of odds of late enrollment was estimated by using logistic regression models. Birth year was treated as a continuous variable when estimating the trend of late enrollment in regression models. Multiple regression models used to estimate adjusted annual percent change of odds of late enrollment included birth year and all study factor variables.

To identify associations of independent variables with late enrollment in EI, only data including children with hearing loss diagnosed before six months of age were analyzed (267 of total 492 children defined as enrolled in EI). Logistic regression models were used to analyze data, and adjusted models included all independent variables. All final models included only variables with p value < 0.05. Data analyses were conducted in SAS 9.4.

## Results

### Study population description

The study included 492 children ages 0–3 years old who were born between 2008 and 2013 in Louisiana, were diagnosed with permanent hearing loss, and enrolled in EI. Approximately 54% of children were white, 96% non-Hispanic, 55% male, and 27% low birth weight (< 2,500

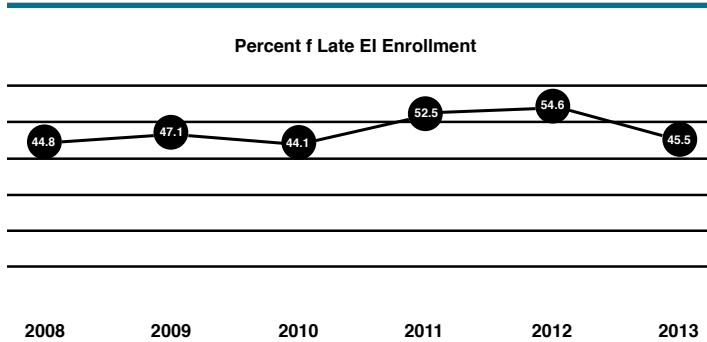
**Table 1: Late Enrollment in Early Intervention (%) among Children with Hearing Loss Born between 2008 and 2013, Louisiana (N = 492)**

Demographic and hearing loss characteristics		Percent (CI95%)
<b>Total</b>		<b>48.8, 44.4 – 53.2</b>
Race	White (54%)	43.3, 37.1 - 49.4
	Black (41%)	55.7, 48.7 - 62.8
	Other (5%)	50.0, 30.0 - 70.0
Ethnicity	Non-Hispanic (96%)	48.5, 43.9 - 53.2
	Hispanic (4%)	52.4, 31.0 - 73.7
Geographic area at birth	Rural (47%)	48.2, 41.6 - 54.8
	Urban (53%)	49.2, 42.9 - 55.4
Maternal age	<20 (11%)	56.9, 43.3 - 70.5
	20-34 (78%)	48.6, 43.5 - 53.8
	35+ (11%)	41.2, 27.7 - 54.7
Maternal Education	< High school (19%)	57.3, 47.0 - 67.6
	High school (33%)	51.7, 43.7 - 59.6
	>High school (48%)	43.4, 37.0 - 49.9
# Previous live births	None (41%)	45.1, 38.1 - 52.1
	One (33%)	49.7, 41.8 - 57.6
	Two+ (26%)	53.3, 44.4 - 62.1
Birth weight	<2,500 grams (27%)	51.2, 2.4 - 60.0
	2,500+ grams (73%)	47.8, 42.5 - 53.1
Sex	Male (55%)	51.0, 44.9 - 57.1
	Female (45%)	46.0, 39.2 - 52.7
Type of HL	Conductive (6%)	44.4, 25.7 - 63.2
	Serorineural (81%)	51.3, 46.3 - 56.4
	Mixed (5%)	38.5, 19.8 - 57.2
	Auditory Neuropathy (8%)	32.5, 18.0 - 47.0
Severity of HL	Mild (18%)	55.0, 44.1 - 65.9
	Moderate (30%)	44.7, 36.2 - 53.2
	Severe (18%)	53.8, 42.8 - 64.7
	Profound (34%)	50.0, 42.0 - 58.0
Laterality of HL	Bilateral (75%)	44.9, 35.9 - 53.9
	Unilateral (25%)	50.1, 45.0 - 55.3
Age at diagnosis of HL (months)	0-2 (40%)	21.1, 15.3 - 26.8
	3-5 (15%)	29.0, 18.3 - 39.7
	6+ (45%)	100.0

grams). Most children were diagnosed with sensorineural (81%) and bilateral (75%) HL. Percent of mild HL was 18%, moderate 30%, severe 18%, and profound 34%. About 55% of children with HL were diagnosed before six months of age (0–2 months: 40%; 3–5 months: 15%). Table 1 presents characteristic distributions of the study population and percent of late EI enrollment in detail.

### Trend and Associations of Independent Variables with Late Intervention Enrollment in EI

Between 2008 and 2013, the overall rate of documented enrollment in early intervention (EI) programs was 89.1%. Of those who enrolled in EI, 48.8% enrolled late. The rate



**Figure 1. Time Trend of Late Enrollment in Early Intervention (EI) among Children with Hearing Loss Born Between 2008 and 2013, Louisiana**

**Table 2. Rate (%) and Odds Ratio (OR) of Late Enrollment in Early Intervention among Children with Hearing Loss (HL) Diagnosed Before Six Months of Age (N = 267) Born between 2008 and 2013, Louisiana**

Demographic and hearing loss characteristics		Percent (CI95%)	Unadjusted OR, CI95%	P Value	Adjusted* OR, CI95%
<b>Total</b>		<b>48.8, 44.4 – 53.2</b>			
Race	White	43.3, 37.1 – 49.4	1.0		Not significant
	Black	55.7, 48.7 – 62.8	1.7, 0.9 – 3.3	0.1006	
	Other	50.0, 30.0 – 70.0	1.7, 0.5 – 5.9	0.4023	
Ethnicity	Non-Hispanic	48.5, 43.9 – 53.2	1.0		Not significant
	Hispanic	52.4, 31.0 – 73.7	1.2, 0.3 – 4.9	0.7528	
Geographic area at birth	Rural	48.2, 41.6 – 54.8	1.0		
	Urban	49.2, 42.9 – 55.4	1.0, 0.6 – 1.9	0.9460	
Maternal age	<20	56.9, 43.3 – 70.5	1.0		Not significant
	20-34	48.6, 43.5 – 53.8	1.4, 0.5 – 4.5	0.5411	
	35+	41.2, 27.7 – 54.7	0.8, 0.2 – 3.5	0.7851	
Maternal Education	< High school	57.3, 47.0 – 67.6	1.0		Not significant
	> High school	51.7, 43.7 – 59.6	1.5, 0.6 – 3.4	0.3826	
	High school	43.4, 37.0 – 49.9	1.2, 0.6 – 2.3	0.6936	
# Previous live births	None	45.1, 38.1 – 52.1	1.0		Not significant
	One	49.7, 41.8 – 57.6	1.4, 0.7 – 2.9	0.3816	
	Two+	53.3, 44.4 – 62.1	1.4, 0.6 – 3.0	0.3986	
Birth weight	2,500+ grams	51.2, 2.4 – 60.0	1.0		Not significant
	<2,500 grams	47.8, 42.5 – 53.1	1.5, 0.8 – 3.1	0.2468	
Sex	Male	51.0, 44.9 – 57.1	1.0		Not significant
	Female	46.0, 39.2 – 52.7	1.1, 0.6 – 2.1	0.7183	
Type of HL	Serorineural	44.4, 25.7 – 63.2	1.0		Not significant
	Conductive	51.3, 46.3 – 56.4	1.6, 0.5 – 5.6	0.4520	
	Mixed	38.5, 19.8 – 57.2	1.3, 0.4 – 4.3	0.6786	
	Auditory Neuropathy	32.5, 18.0 – 47.0	0.2, 0.0 – 1.8	0.1620	
Severity of HL	Profound	55.0, 44.1 – 65.9	1.0		1.0
	Mild	44.7, 36.2 – 53.2	7.6, 2.7 – 21.3	0.0001	12.2, 3.9 – 38.6
	Moderate	53.8, 42.8 – 64.7	3.5, 1.3 – 9.4	0.0127	4.4, 1.5 – 12.6
	Severe	50.0, 42.0 – 58.0	3.6, 1.2 – 10.9	0.0223	5.4, 1.6 – 18.0
Laterality of HL	Bilateral	44.9, 35.9 – 53.9	1.0		1.0
	Unilateral	50.1, 45.0 – 55.3	1.6, 0.8 – 3.2	0.0801	2.5, 1.1 – 5.7
Age at diagnosis of HL (months)	0-2	21.1, 15.3 – 26.8	1.0		1.0
	3-5	29.0, 18.3 – 39.7	2.0, 1.1 – 3.9	0.0350	3.2, 1.5 – 7.0

\*All demographic and hearing loss characteristics were initially included in the adjusted model and only severity, laterality, and age diagnosis of hearing loss were significant in the final model.

was fairly stable during the study time period with the rate of 44.8% in 2008 and 45.5% in 2013 (Figure 1). Unadjusted annual percent change of odds of late enrollment was 10.0% (Odds Ratio [OR]: 1.1, CI: 0.9-1.2, p = 0.1967). Adjusted logistic regression models did not show any trend of late enrollment from 2008 to 2013 (p > .05). Birth year was not statistically significant and excluded from the final model; therefore, the value of the odds ratio was not shown.

One of the main reasons for late enrollment in EI was diagnosis made at six months of age or older. Of children who enrolled late in EI programs (240), 74.5% of them were diagnosed with HL at six months of age or older. Limited to children diagnosed with hearing loss before six months of age (267), the rate of late enrollment was 19.5%. The final adjusted regression model showed odds of late enrollment were statistically higher in children with mild HL (Mild: OR: 12.2, CI: 3.9-38.6; Moderate: 4.4, CI: 1.5-12.6; Severe: 5.4, CI: 1.6-18.0), unilateral HL (OR: 2.5, CI: 1.1-5.7), or those with HL diagnosed after two months of age (OR: 3.2, CI: 1.5-7.0). There was no statistically significant association of late enrollment with birth weight, race, ethnicity, geographic area of residence, maternal age, maternal education, number previous live births, or sex (Table 2).

### Discussion

Results of data analyses indicated that of those who enrolled in EI, the rate of late enrollment (after six months of age) was 48.8%. The rate of late enrollment was steady and a trend was not found during 2008–2013. One of the main reasons for late enrollment was late diagnosis, made at six months of age or older. It contributed 74.5% of total late enrollment. Among those whose HL were diagnosed before six months of age, children with mild HL had the highest risk of late enrollment. In addition, children with unilateral HL or diagnosis after two months of age were more likely to enroll late.

Based on results of the study, children with mild or unilateral HL were potentially at risk for late enrollment in EI programs. Findings from previous studies indicated that unilateral or mild HL can adversely affect a child's development. Bess and Tharpe (1984, 1986) found that approximately one-third of children with permanent unilateral HL experienced significant language and academic delays. Madell and Flexer (2008) showed that children with unilateral HL or mild bilateral HL can be at risk for academic, speech-language, and social-emotional difficulties. Tharpe (2008) also found children with mild HL were not performing at expected academic levels. Thus, late EI enrollment can negatively impact developmental outcomes for children with unilateral or mild HL. Some researchers have indicated one of the main reasons leading to late enrollment was difficulty in obtaining EI services, wherein children with unilateral hearing loss and mild bilateral hearing loss were not qualifying for the EI services (Holstrum, Gaffney, Gravel, Oyler, & Ross, 2008; JCIH 2007). However, this reason was not applicable to



Louisiana where all children with any degree of unilateral or bilateral HL are eligible for both EarlySteps (IDEA, Part C) and PPEP. Parents of children with unilateral or mild HL often declined services and those children often enrolled in EI programs later when developmental delays, specifically language delay, were evidenced. The study data showed that of children diagnosed with HL before six months of age, those with unilateral-mild HL had the highest rate of late enrollment (40.0%), followed by bilateral-mild HL (31.4%), and other laterality-severity HL (< 25%). In fact, children with unilateral or mild HL may appear to have “normal” hearing, making it difficult to convince parents of the necessity of enrolling early in early intervention programs (Haggard & Primus, 1999). Thus, it is very important to help parents understand difficulties of hearing for children with unilateral and/or mild HL. To do so, audiologists may educate parents to use hearing loss simulation, via software such as NIOSH Hearing Loss Simulator (CDC, 2002), which is useful to help parents listen to what the hearing loss sounds like, and also to demonstrate the challenges of distance and noise in speech recognition for a hearing loss child.

The findings of this study also indicated that delayed diagnosis as a strong factor related to late EI enrollment. Delayed diagnosis could be caused by no newborn hearing screening (NHS) or missed diagnosis through NHS. The study data indicated 33 (6.0%) children with HL were not screened with NHS. Of those, 5 (4.8%) and 21 children (63.6%) were diagnosed with HL after three months and six months of age, respectively. The data also found that 104 children (18.8%) passed NHS but were diagnosed with HL later. Of those, 9 (8.7%) and 77 (74.0%) were diagnosed with HL after three months and six months of age, correspondingly. Missed diagnosis may be due to some forms of HL (mild, auditory neuropathy, or delayed-onset HL) or quality of NHS services so that HL could not be detected through NHS. Studies by Cone-Wesson and Johnson et al. have indicated that current NHS technologies fail to detect some infants with mild hearing loss (Cone-Wesson et al., 2000; Johnson et al., 2005). Other studies also showed that newborns with auditory neuropathy HL may not be detected through NHS when otoacoustic emission (OAE) method is used alone (D’Agostino & Austin, 2004). In our study, among 104 newborns who passed NHS but had HL later, 35 (33.7%) of those were diagnosed with mild and/or auditory neuropathy HL. Thus, 69 (66.3%) of children with other levels and types of HL were still not detected through NHS. Delayed onset HL or quality of screening services may relate to missed diagnosis among those children. Closely monitoring passed-NHS newborns with risk factors of mild, auditory neuropathy, and delayed onset HL is recommended by the JCIH to capture HL missed through NHS. The JCIH developed a list of risk factors and time frames to monitor children with increased risk of these forms of HL. However, with the current recommended time frames of monitoring for delayed onset HL with an audiological evaluation at least once by 24 to 30 months of age, early detection of this form of HL is challenging. In order to improve missed diagnosis of auditory neuropathy HL, the JCIH

recommends using automated auditory brainstem response to screen newborns who require NICU care and who are at high risk for this type of HL (JCIH, 2007). More research is needed regarding problems related to the quality of NHS services that cause missed diagnosis.

The findings from this study were consistent with previous studies which indicated that earlier diagnosis was effective in decreasing the age at entry into EI (Alyami et al., 2016; Harrison, Roush, & Wallace, 2003). Although data analysis in our study showed children with mild HL were inversely related to early enrollment in EI programs, this finding was contrary to earlier studies. For instance, Walker et al. (2014) did not find any association between the severity of HL and age at entry into early intervention. Note that the analysis of Walker et al. was conducted with a very small sample size of only 20 children who enrolled in early intervention following HL confirmation, which may attenuate the power of the statistical tests. Recent studies have found that socioeconomic status is an important effect on enrollment timing of EI (Boss et al., 2011). However, this information was not well captured in the study data. Although Medicaid coverage can be used as a proxy of low family income, and linkage with Medicaid data was conducted in the study, the definition of Medicaid children may be underestimated because Medicaid data did not include children who may have been qualified for Medicaid but only enrolled in EarlySteps and/or PPEP, not Medicaid.

### **Strengths and Limitations**

This study had two major strengths. First, the study used three data sources (EarlySteps, PPEP, and Medicaid) that covered nearly all early intervention services in the state. About 90% of total children with hearing loss reported by LA EHDI were found in these data sources. Use of all three data sources improved both quality of LA EHDI program reports and research in EI enrollment. Second, high accuracy of the data linkages was ensured by using multiple identifiers for both child and mother for the linkages and matched case review.

The findings in this study were subject to three limitations. First, the study did not capture data of early intervention services provided through other data sources such as private health insurance. However, with an estimate of 10% of children with HL from those data sources, bias in results of data analyses was not expected. Second, some other factors (study independent variables) that may be significant were excluded from the final adjusted regression model when data analyses were limited to the small sample of children with a HL diagnosis before six months after birth (267). Last, the study did not include newborns who failed the newborn hearing screening and were lost to follow-up (about 32%) meaning their diagnosis of HL and enrollment in EI are unknown. Exclusion of those newborns from the study may affect both data validity and reliability of analyzed results.

## Conclusions

Among birth cohorts from 2008 to 2013, about 90% of HL children were found enrolled in EI programs in Louisiana. Of those, approximately 50% enrolled late, and this rate was not seen to improve during the study time period. Efforts targeted on high-risk populations defined in the study may enhance early enrollment in EI services. Delayed diagnosis and mild or unilateral HL were strongly associated with late enrollment. Appropriate strategies to resolve problems relating to missed diagnosis during NHS and to encourage parents of children with HL to enroll soon after diagnosis of HL will contribute to success of early EI enrollment in the state.

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