Measures of Follow-Up in Early Hearing Detection and Intervention Programs: A Need for Standardization

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Purpose: To demonstrate the need for standardized data definitions and reporting for early hearing detection and intervention (EHDI) programs collecting information on newborn hearing screening and follow-up, and types of information best collected in a standardized manner.

Method: A hypothetical birth cohort was used to show the potential effects of nonstandardized definitions and data classifications on rates of hearing screening, audiologic follow-up, and hearing loss.

Results: The true screening rate in this cohort was 92.4%. The calculated rate was between 90.0% and 96.5%, depending on the measure used. Among children documented as screened and referred for follow-up, 61.0% received this testing. Only 49.0% were documented to have been tested. Despite a true prevalence of 3.7 per 1,000 births, only 1.5 per 1,000 children were documented with a hearing loss.

Conclusion: Ensuring that children receive recommended follow-up is challenging. Without complete reporting by audiologists to EHDI programs, accurate calculation of performance measures is impossible. Lack of documentation can lead to the overstatement of "loss to follow-up." Also, standardization of measures is essential for programs to evaluate how many children receive recommended service an assess progress toward national goals. A new survey has been implemented to collect more detailed and standardized information about recommended services.

Key Words: infant hearing loss, hearing rescreening, audiologic diagnostic testing

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Evidence indicates that children with hearing loss who are identified and provided intervention services by 6 months of age have significantly better language development than do other children with hearing loss (Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998). The long-term benefits of universal newborn hearing screening (UNHS) have also been demonstrated through the findings of a controlled trial and pilot screening program in England (Kennedy et al., 2006). Thanks largely to the implementation of UNHS and early hearing detection and intervention (EHDI) programs within the United States, more than 90% of U.S. newborns are now screened for hearing loss (Green, Gaffney, Devine, & Grosse, 2007). The potential benefits of screening are reduced, however, when children with abnormal results do not obtain the recommended follow-up tests needed to confirm a hearing loss. Therefore, a key part in evaluating the success of UNHS and EHDI is accurately measuring the number of children not passing a newborn hearing screen who subsequently receive recommended follow-up tests, such as a diagnostic evaluation.

Despite the importance of follow-up testing and the efforts of public health programs and health care providers, many children fall through the cracks. In 2004, fewer than half (48%) of infants referred for diagnostic evaluation across the country were documented by state EHDI programs to have received recommended follow-up testing (Directors of Speech and Hearing Programs in State Health and Welfare Agencies, 2004). Similarly, according to one study, the majority of children who fail a hearing screen in a pediatrician's office do not receive a follow-up evaluation (Halloran, Wall, Evans, Hardin, & Woolley, 2005). Infants and children who are referred for follow-up but are not documented as having received these tests are commonly, although often inaccurately, referred to as "lost to follow-up" or LFU (Centers for Disease Control and Prevention [CDC], 2003; Connolly, Carron, & Roark, 2005; Todd, 2006; White, 2003). In fact, only a fraction of such children are truly "lost" to follow-up; most are known to follow-up programs, but evaluation results are not available for a variety of reasons, such as the reporting of results not being required in some states.

The percentage of children reported to have received recommended diagnostic evaluations in 2004 varied between 10% and 88% among states screening at least 10,000 infants (Directors of Speech and Hearing Programs in State Health and Welfare Agencies, 2004). Although some of this variation is due to actual differences in follow-up evaluation, variability in estimates can also be due in part to at least three other issues. First, state programs, federal agencies, and other organizations have adopted different definitions of LFU. Some groups refer to any infant who fails to return for further testing as LFU, regardless of reason. Others, such as the Utah Department of Health, define LFU as infants who have not completed the screening and referral process and who cannot be identified by tracking (Utah Administrative Code, 2001). This definition excludes infants whose parents either refused follow-up testing or did not make or keep an appointment. Second, programs differ as to the definition of referral. The broadest definition of referral includes all children who do not pass an initial hearing screen, plus those who were missed or had incomplete screens. The most restrictive definition includes only children who completed the screening process, including rescreens if needed, and were referred for a formal diagnostic evaluation after failing all screens. Third, an unknown number of infants may have received follow-up evaluation, but their results were never documented and reported to the appropriate entity (e.g., the state EHDI program). These infants could be considered lost to documentation (LTD). However, it is unlikely that an EHDI program would be able to distinguish between cases that were LFU and those that were LTD. In certain jurisdictions, the reporting of results from hearing screening and follow-up tests to an EHDI program is voluntary or incomplete.

The need for standardization of definitions and reporting has been recognized by the Joint Committee on Infant Hearing (JCIH), which recommended "the development of uniform state registries and national information databases incorporating standardized methodology, reporting and system evaluation" (JCIH, 2000, p. 811). The JCIH also expressed the need for federal and state agencies to standardize data definitions to ensure the value of state registries and federal data sets and prevent misleading or unreliable information. The adoption of standardized data definitions and reporting practices can help public health officials to better evaluate the delivery of recommended hearing-

related services and to generate more accurate data.

In this article, the potential effects of using nonstandardized definitions and data classifications on rates of hearing screening, LFU, and confirmed hearing loss are illustrated, based on a hypothetical birth cohort of 200,000. A model to classify and analyze this hypothetical birth cohort in the hearing screening and diagnostic stages of the EHDI process is presented. Although early intervention is not addressed, the general principles outlined here should apply there as well. This model is intended as an aid to illustrate how a lack of standardization in definitions and reporting can affect reported screening and LFU rates, and the impact that lack of documentation can have on these estimates. An overview of recent efforts by the CDC to help standardize the reporting and calculation of LFU data is also provided.

Documentation Subgroups

The information that programs collect influences how children are classified in relation to receiving EHDI services and affects estimates of screening, referral, and diagnostic evaluation rates. Different classifications and the resulting effects on LFU rates are illustrated through three tables that contain a theoretical breakdown of children. The numbers included in these tables are based on a simulated birth cohort of 200,000. In reality, a state program would never have some of the information provided in the tables. For example, a program would not know the number of children without documentation who were actually screened. However, this detail is provided here to illustrate the impact of various types of missing or incomplete data.

Table 1 outlines a typology for classifying children with respect to hearing screening status and follow-up. The first distinction is whether documentation exists for a child who was screened and, if so, what the results of the screening test were. In addition to identifying children who did not “pass” their screen, documentation should exist identifying those who did pass. A lack of documentation can occur if hospitals and/or providers do not report screening results to the state EHDI program. The existence—or lack—of documentation is independent of the results of a screen.

Among children for whom documentation of screening results exists, two categorizations are possible: those with a complete screen and those not screened or whose screening was incomplete. Incomplete screens would include documented cases in which the child should have received the screening but was missed or in which the child received an incomplete screening (e.g., tested in only one ear). This group would also include children for whom screening was not possible (e.g., due to an infant’s death or relocation before the screening was available) and for whom there is documentation that the family refused screening. While these different situations could be examined separately, they are combined into a single group in this article for clarity. Finally, while by definition, a program would not have screening information for those children with no documentation, it is likely that, in reality, some of these children would have been screened. As such, this group consists of children who received a complete hearing screen or a follow-up rescreening and those children who had an incomplete screen (e.g., missed, parents refused, screened in one ear). For these cases, the EHDI program does not have documentation.

Gaps in documentation can significantly affect screening and other estimates and can make evaluating a program’s effectiveness more difficult. Furthermore, documentation needs to be complete. Simply flagging individuals who do not pass a screen is insufficient. It is important that both children who pass their screen and those who do not are identified. It may be tempting to believe that LTD can be used as evidence of a pass. For example, requiring hospitals to report only children who did not pass may be viewed as a means of increasing efficiency and privacy. However, assuming that LTD indicates a pass is fundamentally problematic as it removes the distinctions between the categories presented in Table 1 and can blur the underlying differences in estimates.

Estimating Screening Rates

By using the categorization exemplified in Table 1, a state EHDI program could estimate the proportion of infants screened in at least three ways. First, the apparent overall screening rate in Table 1 equals 90.0% (Equation 1); however, this estimate excludes children whose

screening occurred but was not documented, leading to an underestimate of the true proportion of children screened, which is 92.4% (Equation 2). Second, a program could estimate the screening rate using the number of births with documentation as the denominator, which in this simulated population is 94.7% (Equation 3). This finding suggests that if a state assumes that the screening rate among births without documentation is equal to the rate among those with a documented screen, the true screening rate may be overestimated. Third, a program could estimate the screening rate by excluding children whose parents refused to have their child screened, children for whom documentation exists that a screening was not possible, or children for whom there is no documentation. This approach results in an estimate of 96.5% children screened (Equation 4), which is again greater than the true value of 92.4%. Restricting screening rate calculations to children with documentation is likely to result in upwardly biased estimates of the overall screening rate.

Screening to Diagnostic Evaluation

Table 2 summarizes diagnostic evaluation information for a subset of the hypothetical cohort of 200,000 births for whom there is documentation that the child was screened and did not pass.[1] For ease of calculations, we assumed that 2.0% (3,600) of the 180,000 infants with documented screenings were referred. This figure is similar to national data from 2004, which indicated that, on average, 1.8% of infants with completed screenings were referred for diagnostic evaluations (Directors of Speech and Hearing Programs in State Health and Welfare Agencies, 2004). Children who were not screened or had incomplete screening should also be referred for evaluation, but for the sake of brevity, we excluded this group from our analysis. It should be noted that if this group were included, the percentage of children classified as LFU could be considerably higher.

Lack of documentation also affects estimates of follow-up evaluation. Although in Table 2, 61% of children received a complete diagnostic evaluation (Equation 5), the state program could only document that 49% had been evaluated (Equation 6). The other 12% were evaluated, but this was unknown to the state program. Thirty-nine percent of children with documentation that they did not pass their screenings did not receive a diagnostic evaluation; of them, 21% had some form of documentation that a follow-up evaluation was not completed (Equation 7) and 18% had no such documentation (Equation 8).

Following Table 2, the state program could calculate the LFU rate in a variety of ways. First, it could classify any child not documented to have a follow-up evaluation as LFU, which would result in an estimate of 51.0% LFU (Equation 9). Second, the state program could exclude from the LFU category children with documentation that an evaluation was not possible or for whom the parents refused evaluation. This scenario would reduce the estimated LFU rate to 47.8% (Equation 10). Both measures misclassify as “LFU” 432 children who actually received an evaluation but whose documentation was not available to the EHDI program. Neither measure is satisfactory, but in the absence of full reporting of audiologic examination results, state programs cannot accurately assess the effectiveness of the EHDI process. Alternatively, one could focus on those for whom there is no documentation about an evaluation (LTD), which in this simulated sample is 30.0% (Equation 11), indicating that diagnostic evaluation status is unknown for 30% of the children who did not pass the screens.

Universal Diagnostic Evaluation Data

The prior section focused on the 3,600 children who were identified by newborn screening as needing further diagnostic evaluation. If a newborn screening program is effective, this group will likely constitute most children who receive a diagnostic evaluation. However, there will be additional children seen for a diagnostic evaluation who were not tracked, including those missed by the screening program or born out of state. Ideally, an EHDI tracking and surveillance program would obtain information on all children who receive a diagnostic evaluation. By obtaining information on all infants receiving diagnostic evaluations, a

[1]While a program may include in its tracking systems children documented as having missed their hearing screen or where the hearing screen is incomplete, we simplify in this illustration.

program can estimate the overall rate of hearing loss in the population and the number of cases involving late onset.
Of course, information on children who were born out of state or in another country should not be included in an estimate using the number of occurrent births as the denominator.

Infants who receive a diagnostic evaluation can be grouped on the basis of screening status. Table 3 extends the simulated example to include diagnostic data for all children in the original sample of 200,000 births, including those with documented hearing screens and those with no documented screens. If the screening program has been effective, the largest group should consist of children known to have not passed their screen who are being actively tracked. Diagnostic evaluation reports may also include other infants for whom an EHDI program has screening documentation, such as those who passed a newborn screen or who were not screened at all (e.g., refusals or documented missed newborns). In addition, diagnostic evaluations may involve infants for whom an EHDI program has no screening documentation, such as those newborns who did not pass their screen but whose information was not reported to the EHDI program. Given that the number of children who will obtain a diagnostic evaluation in a timely manner likely varies across these groups, the extent to which such data are obtained will be important in subsequent estimates.

Newborn Hearing Loss

Based on Table 3, 731 children have hearing loss, yielding a true but unknown prevalence of 3.7 per 1,000 children out of the total cohort of 200,000 births (Equation 12). However, programs do not have all the data needed to calculate this value. One approach that a program may adopt is to focus on the 180,000 children with documented hearing screens by following those children known to have not passed their screen. Given that 264 children with a documented “not pass” on their screen were also documented to have a hearing loss, this finding would result in an estimated prevalence of hearing loss of 1.5 per 1,000 (Equation 13). Alternatively, a program may seek to obtain results of diagnostic evaluations on any child in the entire 200,000 birth cohort who goes on to receive an evaluation, rather than only those who had documented screens. In this case, 311 children out of the 200,000 births were later documented to have hearing loss, resulting in a slightly higher prevalence estimate of 1.6 per 1,000 (Equation 14).

Better estimates of the frequency of hearing loss could potentially be obtained through more aggressive and successful tracking. If an EHDI program obtained diagnostic evaluation information for all children in the birth cohort with a complete evaluation, the estimated prevalence of hearing loss would increase to 2.8 per 1,000 (Equation 15). While more accurate, this figure still underestimates the true prevalence of 3.7 per 1,000. The remaining 0.9 per 1,000 children with hearing loss figure represents those with incomplete evaluations, those for whom an evaluation may not have been possible, or those for whom the family may have refused an evaluation or refused to have the results released (Equation 16).

Late Onset or Progressive Hearing Loss and False Negatives

Children with risk indicators, such as cytomegalovirus infections, have an elevated risk of a late onset or progressive hearing loss (Nance, Lim, & Dodson, 2006). Obtaining information on all children receiving a diagnostic evaluation also allows one to calculate a crude estimate of the proportion of children who develop late onset or progressive hearing loss. Such a calculation can be done using the number of children who “pass” their initial screen but who are later identified as having a hearing loss. In Table 3, 29 children were documented as having hearing loss despite passing their hearing screen. Referring to the 180,000 children with completed screens, this provides an estimate of 0.2 per 1,000 of children with late onset or progressive hearing loss. This is likely an underestimate because it excludes children for whom there is no diagnostic evaluation documentation as well as some children who were documented as having a hearing loss without a completed hearing screen. On the other hand, this does not take into account false negative screening results—screens that a child passed, even though he or she had a hearing loss at the time—which may lead to an inflated estimate of late onset. Consequently, additional diagnostic information differentiating false negative screens from true cases of late onset hearing loss would be needed to further refine this estimate.

Case Example: Michigan 1998–2002

A “real world” case example of this issue can be seen in a reanalysis of previously reported data on screening and diagnostic rates for Michigan for the 1998–2002 birth cohorts (El Reda, Grigorescu, & Jarrett, 2005). The Michigan EHDI program is to be commended for analyzing and publishing data tracking the performance of the program over time. Table 4 shows reorganized data from that article to demonstrate how estimates of hearing loss or LFU will vary based on the inclusion or exclusion of different groups from calculations. A total of 1,025 children in these birth cohorts were diagnosed with hearing loss, 568 of whom were referred for diagnostic evaluation based on completed hearing screenings. The remaining 457 children with diagnosed hearing loss either had incomplete screens (n = 261), were not referred (n = 167), or had no record of being screened (n = 29). Depending on the denominator, the prevalence of hearing loss varies. Among infants with completed hearing screens (n = 410,554), the prevalence is 1.8 per 1,000 (Equation 17). If infants with incomplete initial screens are also included (n = 437,779), the prevalence increases to 2.3 per 1,000 (Equation 18). If an EHDI program only had information on hearing loss among infants who failed their initial screen and were referred for diagnostic evaluation (13,535), the prevalence of confirmed hearing loss would be estimated as 1.4 per 1,000 (Equation 19). If all cases of documented hearing loss were divided by the entire birth cohort, the prevalence of hearing loss would be 1.5 per 1,000 (Equation 20).

The Michigan data in Table 4 also indicate the challenges in calculating how many children are LFU, as well as the potential impact of lack of documentation on estimates. By focusing on infants with completed screens, LFU might be defined as the proportion of all referrals where no follow-up information was obtained, resulting in an LFU of 58.2% (Equation 21). On the other hand, the inclusion of infants with incomplete screens results in a much larger LFU estimate of 72.4% (Equation 22). Furthermore, among children with incomplete screens for whom diagnostic documentation was ultimately obtained, 4.7% were identified as having hearing loss (Equation 23). Among children with completed screens who were referred for evaluation, 10.0% of those with documented diagnostic results were found to have a hearing loss (Equation 24). That diagnostic documentation was unavailable for the majority of children who either were referred for diagnostic testing or had an incomplete screen suggests that the actual number of children with hearing loss may be substantially higher than reported.

Discussion

Ensuring that infants and children receive recommended follow-up tests for hearing loss is a key challenge for EHDI programs. When infants and children do not receive recommended follow-up care, the potential benefits of UNHS, such as early intervention, can be reduced or even eliminated.
This article demonstrates the need for standardization in calculating and reporting data on newborn hearing screening and follow-up. It also reflects the JCIH 2000 position statement, which indicated standardized reporting as a crucial element in meeting follow-up goals. The JCIH recommended that programs document efforts to obtain follow-up on a minimum of 95% of infants who do not pass the hearing screening and achieve a minimum return-for-follow-up rate of 70% of infants.

Monitoring the LFU rate is required for federal agencies that provide funding to state EHDI programs, and improvements over time in this area could be crucial for continued appropriations by the U.S. Congress. Specifically, CDC is held accountable to meet the Government Performance and Results Act (GPRA) goal that states, “By 2010, decrease to 10 the percentage of newborns that screen positive for hearing loss but are lost to follow-up” (Department of Health and Human Services, 2007). GPRA goals were established in 1993 to help government programs become more results-oriented and to help evaluate the effectiveness of government-funded programs.

Assessing progress toward these JCIH and GPRA goals is challenging because it is impossible to validly compare data reported using different calculations. As noted, this is attributable at least in part to the variations in how LFU is defined and how related statistics are calculated. Such variations make it difficult to assess the number of infants and children who are not receiving follow-up services and to determine the reason(s) for this. As a result, existing LFU data may be misleading in that they

underestimate the number of children receiving follow-up services, which leads some people to question the merits of EHDI activities.

To increase standardization in the reporting and calculation of LFU data, the CDC and its partners developed a new survey to gather data from states and territories in a more consistent manner than had been accomplished previously. This voluntary, Web-based survey, referred to as the CDC Hearing Screening and Follow-up Survey (HSFS), was implemented in 2007 and is intended to serve as the primary national source of EHDI-related data. The survey is focused on collecting data related to outcomes rather than just process measures, like the number screened, and addresses many of the issues discussed in this article. In order to allow one to calculate accurate estimates of LFU and hearing loss, the HSFS has been designed to account for the screening, diagnostic, and intervention outcomes of every birth reported on the survey. Fields for unknown data are included so that respondents can report the numbers of infants for whom it is unknown whether they were screened, received a diagnosis, or enrolled in intervention. In order to accurately evaluate LFU or LTD, additional detail is collected regarding cases with missing or incomplete screenings or diagnostic evaluations.
For example, the HSFS asks respondents to report the numbers of infants not passing the final hearing screening and their diagnostic status: “normal hearing,” “hearing loss,” or “no diagnosis/undetermined.” The last category is further divided into subcategories indicating “audiologic diagnosis in process (awaiting diagnosis),” “infant died/parents declined services,” “nonresident or moved out of jurisdiction,” and “unable to contact/ unresponsive/unknown.” If the numbers reported in the categories “normal hearing,” “hearing loss,” and “no diagnosis/undetermined” do not sum to the total reported as not passing the final hearing screening, the respondent receives an error message and is unable to submit the online survey until the numbers sum correctly.

Conclusions

Standardizing how LFU is defined and calculated can help programs better assess how many infants and children are receiving follow-up services. Standardized data should address program performance indicators more completely and take into account the impact of LTD. As illustrated by the theoretical model discussed in this article, a lack of standardization can lead to unreliable and unrepresentative LFU data. Through strategies such as the HSFS, it is hoped that increased awareness about the need for standardization and accurate documentation of services will lead to LFU/LTD data that better reflect how many infants and children are and are not receiving recommended services. This in turn will help CDC and its partners to better assess progress toward national EHDI goals as well as to determine needs for technical assistance.

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Table 1. Newborn Screenings

			N	Percent
Screening Documented	Completed Screening		**180,000**	**90.0%**
	Screening Not Completed	Missed Cases (e.g., LFU)	**4,375**	**2.2%**
		Incomplete Screen or no Rescreen (e.g., LFU)	**2,188**	**1.1%**
		Documented that Screening Not Possible	**1,875**	**0.9%**
		Documented Refusal of Screening	**1,562**	**0.8%**
Screening Not Documented (LTD)	Screening Did in Fact Occur		**4,750**	**2.4%**
	Screening Did Not in Fact Occur		**5,250**	**2.6%**
		Total	**200,000**	

Percentage of children with documented screens: 90.0% or 180,000 / 200,000 **[Eq. 1]**

Total percentage of children screened: 92.4% or (180,000 + 4,750) / 200,000 **[Eq. 2]**

Percentage of documented children screened: 94.7% or 180,000 / (180,000 + 4,375 + 2,188 + 1,875 + 1,562) **[Eq. 3]**

Percentage of documented "participating" children screened: 96.5% or 180,000 / (180,000 + 4,375 + 2,188) **[Eq. 4]**

Note "Screening Did Not in Fact Occur": Includes cases of missed screens, parental refusal, incomplete screens

Table 2. Tracking "Not Pass" Screens to Diagnostic Evaluation

Diagnostic Results for the 3,600 Documented "Not Pass" Screens			Hearing Loss	No Hearing Loss	TOTAL
Diagnostic Evaluation Documented	Diag Evaluation Completed		264	1,500	1,764
	Diagnostic Evaluation Not Completed	Missed Cases (e.g., LFU)	116	410	526
		Incomplete Diagnostic Evaluation (e.g., LFU)	26	90	116
		Documented that Evaluation Not Possible	6	32	38
		Documented Refusal of Evaluation	17	59	76
Diagnostic Evaluation Not Documented (LTD)	Evaluation Did in Fact Occur		71	361	432
	Evaluation Did Not in Fact Occur		138	510	648
		TOTAL	**638**	**2,962**	**3,600**

Percentage of infants with documented "not pass" screening…

Who received a complete diagnostic evaluation: 61.0% or (1,764 + 432) / 3,600

For whom there is documentation of the results of a complete diagnostic: 49.0% or (1,764 / 3,600)

With documention that a complete diagnostic evaluation was not performed: 21.0% or (526 + 116 + 38 + 76) / 3,600

Without documention that a complete diagnostic evaluation was not performed: 18.0% or 648 / 3,600

LFU Estimates

Any child not documented to have a follow-up evaluation classified as LFU: 51.0% or (526 + 116 + 38 + 76 + 432 + 648) / 3,600

No documented evaluation, excluding not possible and refusals: 47.8% or (526 + 116 + 432 + 648) / 3,600

Where there is no documentation of a diagnostic evaluation (i.e., LTD): 30.0% or (432 + 648) / 3,600

Table 3. Results for All Diagnostic Evaluations

Diagnostic Evaluation Documented	Hearing Loss	264	29	9	9	**311**	**311**
	Incomplete Evaluation (e.g., LFU)	116	15	4	10	**145**	**33**
	Doc Eval Not Done (e.g., LFU)/Not Possible/Refuse	640				**640**	**139**
Diagnostic Evaluation Not Documented (LTD)	Normal Hearing	871	29	29	28	**957**	**0**
	Hearing Loss	209	14	7	18	**248**	**248**
	TOTAL	**3,600**	**145**	**100**	**102**	**3,947**	**731**

Hearing Loss Estimate Based On…..

True, Unknown Proportion of Infants with Hearing Loss: 3.7 per 1,000 or (731 / 200,000) **[Eq. 12]**

Documented Evals for Infants with Documented "Not Pass" Screen: 1.5 per 1,000 or (264 / 180,000) **[Eq. 13]**

All Documented Evals: 1.6 per 1,000 or (311 / 200,000) **[Eq. 14]**

All Infants with Hearing Loss Identified (including undocumented evals): 2.8 per 1,000 or ([311 + 248] / 200,000) **[Eq. 15]**

Evaluation incomplete, not performed, not possible, or refused by parent: 0.9 per 1,000 or ([33 + 139] / 200,000) **[Eq. 16]**

Table 4. Screening and Diagnostic Rates for Michigan, 1998–2002

TOTAL BIRTHS: 665,891									
Incomplete Screens: 27,225			Completed Screens: 410,554					No Documented Screen: 228,112	
			Referred: 13,535			Not Referred: 397,019			
Documented Hearing Loss	Documented No Hearing Loss	No Rescreen/ Follow-Up	Documented Hearing Loss	Documented No Hearing Loss	No Follow-Up	Documented Hearing Loss	Not Being Actively Tracked	Documented Hearing Loss	Not Being Actively Tracked
261	5,324	21,640	568	5,095	7,872	167	396,852	29	228,083

Hearing Loss Estimate Based On…

Infants with Completed Screens: 1.8 per 1,000 or ([568 + 167] / 410,554) **[Eq. 17]**

Infants with Complete and Incomplete Screens: 2.3 per 1,000 or ([261 + 568 + 167] / [27,225 + 410,554]) **[Eq. 18]**

Infants with Completed Screens, Based Soley on Refered Screens: 1.4 per 1,000 or (568 / 410,554) **[Eq. 19]**

All Known Hearing Loss, Based on Entire Birth Cohort: 1.5 per 1,000 or ([261 + 568 + 167+ 29] / 665,891) **[Eq. 20]**

LFU Estimates Based On…

Referals with No Follow-Up: 58.2% or (7,872 / 13,535) **[Eq. 21]**

Referals and Incomplete Screens with No Follow-Up: 72.4% or ([21,640 + 7,872] / [27,225 + 13,535]) **[Eq. 22]**

Hearing Loss Among Sub-Groups…

Hearing Loss Among Incomplete Screens with Documented Diagnostic Info: 4.7% or (261 / [261 + 5,324]) **[Eq. 23]**

Hearing Loss Among Referals with Documented Diagnostic Info: 10.0% or (568 / [568 + 5,095]) **[Eq. 24]**