

(((SOUND IDEAS

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By the Year 2000, all children with hearing loss should be identified before 12 months of age

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The Benefits of Earlier Identification

A frequently asked question when people are considering the implementation of a universal newborn hearing screening program is whether there are significant advantages associated with identifying and providing children with intervention at an early age versus a later age. Such questions about the advantages of a particular medical procedure are often addressed using results of prospective, randomized, clinical trials in which patients with a particular condition are identified; those patients are randomly assigned to a group which receives the experimental treatment and one which does not; a sufficient period of time elapses; and outcomes are measured for patients in each group. For obvious reasons, it does not make sense to identify hearing impaired children within a few weeks of birth and randomly assign them to a group which receives amplification and early intervention or to a group which waits until they are three years old to receive such services. Thus, there are no prospective clinical trials which can be used to address this question.

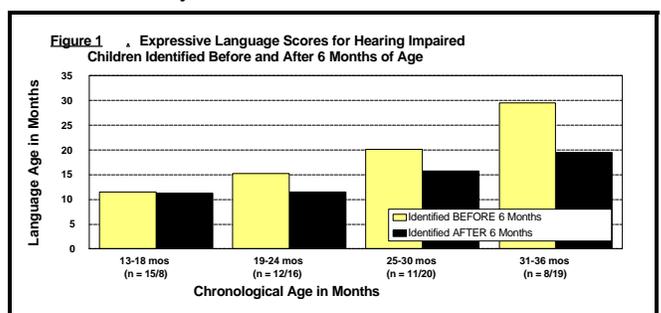
However, there is substantial evidence about the advantages of earlier identification of hearing loss from a number of retrospective studies in which children have been categorized into groups who were identified early or identified later, matched on relevant variables that may affect outcomes, and assessed on various developmental outcomes and success in school-related areas. Although each of these studies is based on relatively small sample sizes, they consistently show that children with hearing loss who are identified early and provided with amplification, auditory training, speech-language therapy, and family support make substantially more progress than similar children who are identified and provided with intervention at later ages.

For example, Yoshinaga-Itano and her colleagues compared the language abilities of 46 hearing impaired children identified before six months of age with 63 similar children who were identified after

six months of age. All of the children had bilateral hearing losses ranging from mild to profound. Language comprehension, expressive ability, and vocabulary were measured by parent report. As shown in Figures 1 and 2, cross-sectional data for children when they were at different ages show a substantial advantage for children identified before six

months of age compared with those identified after six months of age. It is particularly impressive that the advantage for the early identified group becomes more pronounced as children become older. In other words, for the children assessed between 13 and 18 months of age, there is only a very slight advantage for the early group versus the late group. For the children in the 19-24 month-old category, children identified early have a three-month developmental advantage; for children in the 25-30 month-old category, the early identified children have a four-month advantage; and for children in the 31-36 month category, children identified early have a ten-month developmental advantage.

In another study of "earlier versus later," Watkins examined



a total of 69 children with hearing loss (23 in each of three groups) who were matched or statistically equated on severity of hearing loss (pure tone averages were approximately 85 dB in the better ear), presence of other handicapping conditions, age at post-test, age of mother, socio-economic status of the family, and frequency of childhood middle ear infections. Children in each of the three groups had received

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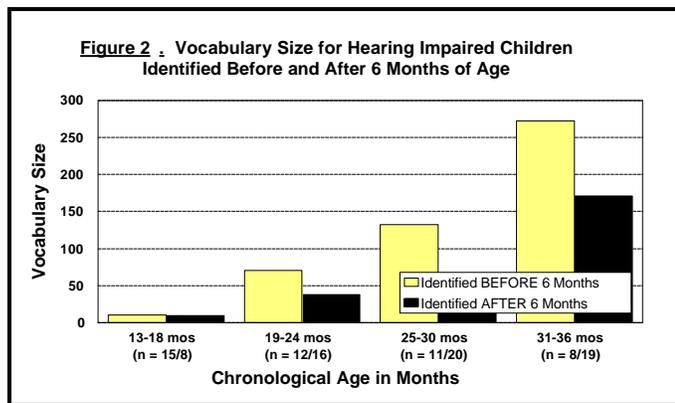
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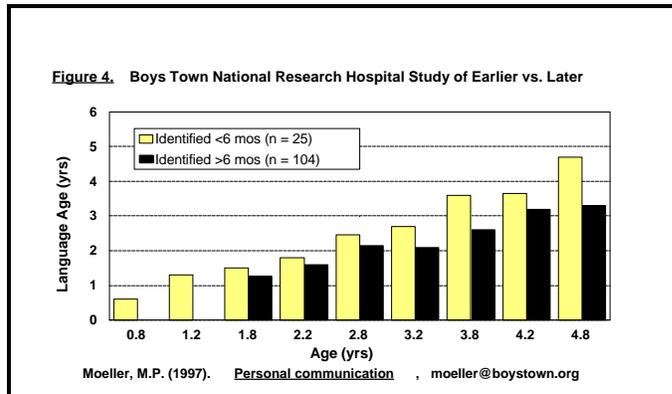
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early intervention at different times as described below:

- Group 1 received an average of 9 months of home intervention before 30 months of age, followed by preschool intervention.
- Group 2 attended preschool beginning at an average of 36 months of age.
- Group 3 did not receive intervention until they began school at approximately 60 months of age.

When children were 10 years old, trained examiners who were unaware of the purpose of the study or to which group children belonged, collected data on a variety of developmental outcomes as shown in Figure 3. For all of the variables assessed, children who received the most and the earliest intervention did the best. For example, the average child who received early intervention and preschool performed better than 75%-92% of the children in the group which received no early intervention or preschool, depending on the outcome measure.

A third study currently underway at Boys Town National Research Hospital under the direction of Mary Pat Moeller shows similar results. The study consists of 129 deaf and hard of hearing children who are assessed two



of the three studies because each child is being assessed repeatedly by trained diagnosticians who are unaware that the data are being used to evaluate the effects of earlier versus later identification and intervention. As shown in Figure 4, the advantage for the earlier identified group is small when children are under two years of age, but becomes consistently larger. By the time children are almost five, there is more than 18 months difference in the language developmental age of children who are identified before six months of age compared to those identified after six months of age. Taken together, data from these and other studies provide convincing evidence that earlier identification and intervention have significant and long-lasting benefits for children with congenital hearing loss.

Apuzzo, M. L., & Yoshinaga-Itano, C. (1995). Early identification of Infants with Significant Hearing Loss and the Minnesota Child Development Inventory. *Seminars in Hearing*, 16(2), 124-139.

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Yoshinaga-Itano, C., Sedey, A., Apuzzo, M., Carey, A., Day, D., & Coulter, D. (July 1996). *The effect of early identification on the development of deaf and hard-of-hearing infants and toddlers*. Paper presented at the Joint Committee on Infant Hearing Meeting, Austin, TX.

Figure 3. Standardized Mean Difference Effect Sizes for Group Comparisons from Watkins, 1987

	EI & Preschool vs. Preschool	EI & Preschool vs. Nothing
Woodcock-Johnson Reading	0.64	0.99
Woodcock-Johnson Calculation	0.83	1.09
Peabody Picture Vocabulary Test	0.70	0.76
Arizona Articulation	0.26	0.78
% of Child's Communication Understood by Non-Family	0.92	1.23
% of Non-Family Communication Understood by Child	0.71	1.12
Meadow-Kendall Social Adjustment	0.74	0.94
Child Behavior Policy	0.61	0.96

times each year as a part of an ongoing early intervention program. Twenty-five of the children in this group were identified and enrolled in early intervention before six months of age, and 104 were identified and enrolled after six months of age. Methodologically, this is the strongest

The Prevalence of Permanent Childhood Hearing Loss

As more and more hospitals implement universal newborn hearing screening programs, a frequently asked question is, "How many children with permanent congenital hearing loss can we expect to identify?" Prior to 1990 when there were very few universal newborn hearing screening programs in operation, it was frequently said that one child per thousand was born deaf and another one or two children per thousand would acquire hearing loss prior to the time they began school.

However, universal newborn hearing screening programs that have been operating for a substantial time are finding many more children.

As shown in Figure 1, programs in Rhode Island, Hawaii, Utah, Colorado, and New Jersey are identifying 2-4 children per thousand with congenital hearing loss. Most of these children are fit with hearing aids and enrolled in early intervention programs before six months of age. Thus, the number of children in families who are benefitting from universal newborn hearing screening programs is substantially higher than what many had expected.

Are these numbers consistent with what we know from large-scale epidemiological studies? As shown in Figure 2, it is clear that the prevalence of hearing loss depends on the definition used to define normal hearing. Figure 2 summarizes data from 11 epidemiological studies in which large cohorts of children were evaluated for hearing loss. Children were only counted as having a hearing loss if the pure tone average in the better ear exceeded the value shown in the figure. Not surprisingly, when hearing loss is defined as a bilateral loss of at least 50 dB, the prevalence is much lower than when children with pure tone average of 25 or 30 in the better ear are included. Given the fact that approximately 30% of all congenital hearing losses are unilateral and consequently were not included in the prevalences reported here, it is clear that the estimate of approximately three per thousand being reported by operational screening programs is what should be expected.

It is, of course, relevant to ask how many of the children in these epidemiological studies had acquired instead of congenital hearing losses. Interestingly, universal newborn hearing screening programs who have been operational for five to seven years and who have tracked children into the school-age years are finding extremely few children with acquired losses. When data from Hawaii, Rhode Island, and Colorado are combined, hundreds of children with congenital hearing loss have been identified since 1990, but only a handful of children with acquired loss have been reported, even though many of the children screened as babies in these states are now enrolled in school programs where we would expect hearing loss to be discovered

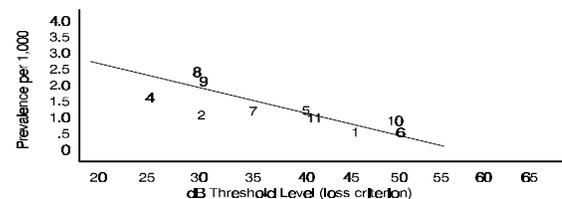
if it were present. If acquired hearing loss were as frequent as has historically been assumed, we would expect dozens, if not hundreds, of children with acquired hearing loss to be turning up in these states.

Figure 1. Rate Per 1000 of Permanent Childhood Hearing Loss in UNHS Programs

Site	Sample Size	Prevalence Per 1000	% of Refers with Diagnosis
Rhode Island (8/90 - 12/91)	3,300	3.98	73%
Colorado (1/92 - 12/96)	41,976	2.56	48%
Utah (7/93 - 12/94)	4,012	2.99	73%
Hawaii (1/96 - 12/96)	9,605	4.15	98%
New Jersey (1/93 - 12/95)	15,749	3.30	?

In summary, it is clear that many more children and families will be identified and helped as a result of universal newborn hearing screening programs than was expected when these programs began to be implemented in the early 1990's. The fact that approximately three children per thousand are being identified makes congenital hearing loss more frequent than any birth defect and emphasizes the importance of establishing universal newborn hearing screening as the standard of care for all children born in this country.

Figure 2. Reported Prevalence Rates of Bilateral Permanent Childhood Hearing Loss (PCHL) in Population-based Studies



1. Barr (1980), n = 65,000
2. Downs (1978), n = 10,726
3. Felthous et al. (1986), n = 62,000
4. Filzland (1986), n = 30,690
5. Kankkunen (1982), n = 31,280
6. Martin (1982), n = 4,126,268
7. Parving (1985), n = 62,265
8. Seftin et al. (1980), n = 63,463
9. Sorri & Ranskallo (1983), n = 11,780
10. Davis & Wood (1982), n = 29,317
11. Fortnum et al. (1986), n = 562,558

Program Spotlight : Greater Staples Hospital - Staples, Minnesota

On February 1, 1997, Greater Staples Hospital implemented a newborn hearing screening program for all babies born at the facility using TEOAE screening technology. Greater Staples Hospital is the first hospital in Minnesota to provide screening on a routine basis as part of their standard of care.

Aware that early identification of even a minimal hearing loss is critical to a child's development, the Greater Staples Hospital will be working with school districts and the Lakewood Clinic to provide education and appropriate intervention if needed. Educational pamphlets are part of the parental packet distributed by Lakewood Clinic at the first prenatal visit. In March of 1998, the newborn hearing screening program will also be working together with the school district and a local audiologist to provide free hearing screening to all children who were born at the hospital between January of 1996 and February of 1997.

This past October, the Minnesota Hospital and Health Care Partnership honored the Greater Staples Newborn Hearing Screening Program with the "Innovation of the Year Award for Patient Care Enhancement" for pioneering newborn hearing screening in the state of Minnesota. An appropriation of \$ 25,000 was awarded to GSH by the Minnesota Legislature to further develop newborn hearing screening in small hospitals throughout Minnesota by utilizing a "Newborn Hearing Screening Mobile Unit".



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Product Review

Editors Note: The product review section of this newsletter is not intended as a product endorsement. For further information, please contact the company directly.

Natus Medical Inc.
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The **ALGO-2** by Natus Medical Inc. is an automated auditory brainstem response (AABR) system designed to allow individuals without audiological training to successfully conduct infant hearing screening. Community volunteers, graduate students and nursing staff may be easily trained to screen newborns for hearing loss. The initial training time required is approximately four hours.

The ALGO-2 permits simultaneous screening of both ears and generates an objective pass or refer result without requiring user interpretation. Results are automatically printed on labels for permanent attachment to the infant's medical chart.

Screening parameters:

Intensity: 35 dBnHL

Acoustic Frequency Spectrum: 700 - 5000 Hz

Sweep Rate: 37 pulses/sec in the right ear

34 pulses/sec in the left ear

Test time: 15 to 20 minutes for simultaneous presentation, including preparation time for attaching/removing electrodes.

BETWEEN A ROCK AND A HARD PLACE: WHAT TO DO WITH THOSE "REFERS"?

Arkansas Children’s Hospital has been involved in the screening of infants for hearing loss since 1980. Currently, we utilize TEOAE technology to screen all of our infants. Because we are not a birthing hospital and serve as the regional tertiary care center for critically ill newborns, our patient population may differ dramatically from other sites that universally screen for hearing loss. Communication with other screening hospitals has taught us that regardless of technology used, size of hospital, screening personnel and program design, all screening programs are confronted with how best to handle follow-up. Of particular concern is the baby who is discharged home and labeled as a “refer”.

Based on our experience at ACH, we wanted to share some ideas that have proven beneficial for us as we search for the definitive protocol that will identify which children truly have hearing impairment in the most efficient, least stressful manner. When an infant comes to our clinic, either having been referred from our NICU or another screening hospital, one of three scenarios is generally played out.

SCENARIO ONE

Baby Jasmine came to our clinic following failure to pass a hearing screening prior to discharge from her birthing hospital. She was screened at our facility using TEOAEs (we have “dabbled” with other technologies and any that meet the criterion of accurate, inexpensive and quick could be used). Baby Jasmine successfully passed the rescreen. In this scenario, parents are “quizzed” regarding possible risk factors to determine need for follow-up and then given information about how to stimulate language development in newborns, as well as communication milestones. Another appointment is not scheduled unless risk indicators warrant it.

SCENARIO TWO

Baby Keon, an ex-28 weeker, returned to our hospital for rescreen. Although he initially failed bilaterally, TEOAE rescreening indicated a normal response in the right ear and a repeat “fail” in the left. He was seen by an ENT physician on-site and noted to have a retracted tympanic membrane in the left ear. While we could have pursued conclusive diagnostic testing to determine actual hearing level in the left ear, we are opting to defer further testing for 6-8 weeks. Our experience has been that in all but a rare exception, the influence of the middle ear status on the TEOAE will resolve and the infant will then “pass”. While it does leave the family wondering about the status of the affected ear, they are saved the expense involved in further diagnostic evaluation and report that they were

not significantly concerned because they knew hearing in at least one ear was normal. On occasion, we have identified a unilateral sensorineural loss at the return visit — still a dramatic improvement over the national age of identification for unilateral loss.

SCENARIO THREE

Baby Taylor came to our clinic and did not pass the rescreen bilaterally. The status of the infant’s middle ears was then determined by the ENT physician and ABR testing was completed. In this scenario, if thresholds are elevated, the family is counseled regarding results and the need for amplification. Impressions are taken for earmolds and the habilitation process begins. Incorporating the ability to go quickly from the screening mode into a diagnostic evaluation within the same visit has proved ideal for our families. They report that even if the results prove stressful, they would rather have answers at this visit than live with the fear of the unknown until the diagnostic appointment can be made. Also, it shortens the timelag from a failed screening to identification, thereby supporting the ultimate goal of early intervention.

Although we are pleased with the progress we have made in decreasing the time between screening, identification and intervention, we continue to refine our protocols to determine which infants are “true positives” and to promote services that are family-centered.

Unfortunately, we have seen several infants for whom hearing aids were recommended by another provider based on elevated ABR testing and an inaccurate diagnosis of normal middle ear status (either by the pediatrician or a general ENT). Following treatment for middle ear dysfunction, all test results were normal. While these families were pleased that their infants would not need amplification, the unnecessary stress placed on them could have been avoided. The most experienced Pediatric Otolaryngologists in our hospital confirm that the evaluation of the middle ear in very young infants may not be a routine task to many physicians and indeed, remains a difficult assessment situation. With the rise in UNHS, physicians experience and expertise should increase and will hopefully eradicate this occasional problem.

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