NOVA SCOTIA CONFERENCE ON THE EARLY IDENTIFICATION OF HEARING LOSS: A REVIEW

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RESUME

Une conférence concernant l'identification hâtive de la perte de l'ouië à eu lieu en Nova Scotia au mois de septembre, 1974. Cette revue résume les délibérations de la conférence et présente en forme modifée les recommendations consequentes .

ABSTRACT

An international conference on the early identification of hearing loss was held in Nova Scotia in September, 1974. This review summarizes the proceedings of the conference and presents a modified form of the resulting recommendations.

Although systems for the earliest possible identification of those with a hearing loss have been considered for many years, the major emphasis began with an article by Downs and Sterritt (1964) which described a method for screening based on observing behavioral changes in the newborn in response to a 90 or 100 dB signal (White Noise and/or Narrow Band Noise). While the techniques described were sound in principle, the specific testing procedures were not as clearly refined. As a result, those who did not understand the preliminary nature of the Downs and Sterritt report instituted newborn hearing

screening programs and then found themselves passing some hard of hearing children (false negatives) and failing a significant number of normal children (false positives). To combat a proliferation of these improperly controlled testing programs, the American Speech and Hearing Association asked the American Academy of Ophthalmology and Otorhinolaryngology and the American Academy of Pediatrics to join in forming a committee to study infant hearing screening programs. The National Joint Committee on Infant Hearing Screening was charged with the evaluation of any newborn testing systems reported in the literature, and with making specific recommendations regarding their acceptance and implementation. Marion Downs was appointed Chairperson. The committee immediately published a statement designed to halt the spread of uncontrolled neonatal hearing screening programs (Figure 1) and has continued its work by publishing a supplementary statement (Figure 2), meeting in constant review, and joining us at the Nova Scotia Conference on Early Identification of Hearing Loss, Halifax, September, 1974.

Figure 1
JOINT COMMITTEE STATEMENT
ON INFANT HEARING SCREENING

STATEMENT ON NEONATAL SCREENING
FOR HEARING IMPAIRMENT

In recognition of the need to identify hearing impairment as early in life as possible, auditory screening programs have been implemented in newborn nurseries throughout the country. Review of data from the limited number of controlled studies which have been reported to date has convinced us that results of mass screening programs are inconsistent and misleading.

To determine whether mass screening programs for new born infants should indeed be instituted, intensive study of a number of variables is essential. These should include stimuli, response patterns, environmental factors, status at the time of testing, and behavior of observers. Furthermore, confirmation of results obtained in the nursery must await data derived from extended follow-up studies which involve quantitative assessment of hearing status.

In view of the above considerations and despite our recognition of the urgent need for early detection of hearing impairment, we urge increased research efforts, but cannot recommend routine screening of newborn infants for hearing impairment.

November 1970

American Academy of Ophthalomology and Otolaryngology
American Academy of Pediatrics
American Speech and Hearing Association

Figure 2
SUPPLEMENTARY STATEMENT OF
JOINT COMMITTEE ON INFANT HEARING SCREENING*
JULY 1, 1972

In light of the urgent need to detect hearing impairment as early as possible, a 1970 statement of the Joint Committee urged further investigation of screening methods but discouraged routine hearing screening which is not research oriented. In consonance with that statement, and in view of the information that application of high risk data can increase the detectability of congenital hearing impairment perhaps as much as tenfold, the Committee considers it appropriate to make additions to the 1970 statement.

The Committee recommends that, since no satisfactory technique is yet established that will permit hearing screening of all newborns, infants AT RISK for hearing impairment should be identified by means of history and physical examination. These children should be tested and followed-up as hereafter described:

I. The criterion for identifying a newborn as AT RISK for hearing impairment is the presence of one or more of the following:
   A. History of hereditary childhood hearing impairment.
   B. Rubella or other nonbacterial intrauterine fetal infection (e.g., cytomegalovirus infections, Herpes infection).
   C. Defects of ear, nose, or throat. Malformed, low-set or absent pinnae; cleft lip or palate (including submucous cleft); any residual abnormaility of the otorhinolaryngeal system.
   D. Birthweight less than 1500 grams.
   E. Bilirubin level greater than 20 mg/100 ml serum.

II. Infants falling in this category should be referred for an in-depth audiological evaluation of hearing during their first two months of life and, even if hearing appears to be normal, should receive regular hearing evaluations thereafter at office or well-baby clinics. Regular evaluation is important since familial hearing impairment is not necessarily present at birth but may develop at an uncertain period of time later.

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* The Joint Committee on Infant Hearing Screening was formed in November of 1970, with representatives from three national organizations:

American Academy of Pediatrics (through the Committee on Fetus & Newborn)
Sheldon Korones, M.D.
James E. Drorbaugh, M.D.
David Weintraub, M.D. (term expired 1971)

American Academy of Ophthalmology and Otolaryngology (through the Committee on Conservation of Hearing)
Aram Glorig, M.D. (term expired 1971)
Ralph Naunton, M.D.

American Speech and Hearing Association
A. J. Derbyshire, Ph.D.
Marion P. Downs, M.A., Chairman
Sanford Gerber, Ph.D.
George Mencher, Ph.D.
Irving Shapiro, Ph.D. (term expired 1971)

At the same time the Joint Committee was providing structure for the direction of research programs, the United States Government, the Elks Purple Cross Deaf Detection and Development Fund in Canada, and other governments and private foundations were investing significant amounts of money into the controlled, longitudinal projects necessary to research and develop acceptable testing techniques. While the results of the various research efforts were evantually finding their way into the literature, much was lost in the limitations of printing space, translation from one language to another, lack of clarity in data presentation, lack of time to prepare materials for publication and the normal time lags involved in publication. More significantly, there was no opportunity for one author to meet another and for them to have a face to face dialogue about their results. It is only from such a dialogue that there is real understanding of the work that has been done — and perhaps even more importantly — what it means.

The Benevolent and Protective Order of the Elks and their Auxiliary, the Order of the Royal Purple, have established the Elks Purple Cross Deaf Detection and Development Program in Canada. Because of their past work in neonatal projects, and their continued effort in a 10,000 baby longitudinal study involving three provinces in Canada, they were contacted through the offices of the Chairman of the Program, Mr. Robert Coulling. They were asked for funds to bring together for the first time — at one table — those people from all around the world who had demonstrated continued research and commitment to the problem of early identification. It was only through the generosity of the Elks that the Nova Scotia Conference was possible.

The conference brought together representatives from six countries. The delegates traveled a combined total of nearly 200,000 miles to attend the meetings. They came to Nova Scotia from as far west as British Columbia; as far east as Jerusalem; as far north as Stockholm; and as far south as San Juan, Puerto Rico. Many of them had never met in person, but they knew of each other's work. The group met for four days, first presenting a series of papers describing their work, highlighting similarities and differences in results, and then meeting behind closed doors to share interdisciplinary expertise, to combine data, to explore new ideas, to reaffirm areas of agreement and of course, to resolve areas of conflict. The ultimate goal was to arrive at a set of recommendations to be submitted to the respective governments represented, the National Joint Committee, and the World Health Organization.

The keynote address by Marion Downs highlighted the urgency of developing and defining early identification programs. Citing Eric Lenneberg's model of language as a "biological time — locked function," she stressed the need for the earliest possible identification so as to avoid the devastating effects of hearing loss during the language learning periods. Pointing to some very specific economic, educational, social, psychological, medical, and emotional factors,

Downs laid out the facts and figures of deafness. Reporting statistics indicating that only 3% of the children from six months to eleven years had been given hearing screening tests at their primary health care source, and that only 1% of the United States newborn population is actually being screened through the high risk register recommended by the Joint Committee, Mrs. Downs charged the conference participants with not only designing testing systems, but perhaps even more importantly, with offering direction for delivery of the programs recommended.

The first set of conference papers centered around physiological methods of early identification. First, Peltzman reviewed his work in intrauterine monitoring of the fetus; then he illustrated systems for inter-hospital transmission of data from children in a longitudinal study involving averaged evoked auditory and visual EEG potentials with monitored normal infants and infants suspected of fetal distress. Next, Derbyshire discussed acoustically evoked potentials and the auditory process, concluding that the early evoked responses appear to reflect acoustic behavior better than the late responses. Gerber then presented an extremely comprehensive overview of past work in the analysis of the cardiovascular responses of human neonates to sound. He indicated that he has found that responses are idosyncratic in magnitude, direction, and pattern of rate change. He suggested that the "absolute" response may be more meaningful than its components. Next, an excellent film on electrocochleography developed by Naunton and Zerlin was shown, and followed by discussion of the technique. Clearly, the procedure is not useful in screening programs. As a conclusion to the session, Keith discussed his work with impedance measurements in the newborn. He reported that, with the exception of stapedius reflex testing, results are similar to that found in older children. The requirements of the test procedure, however, dictated that impedance audiometry is not practical for mass screening of newborns.

The next day, Dr. George Fraser, whom Mrs. Downs called "the Dean of Genetics on three continents," outlined some of the results of the extensive retrospective studies he has conducted with patients with a hearing loss. Dr. Fraser pointed to the genetic bases of deafness, stressing the role the elements of the case history can play in diagnostic evaluation and prevention. Then followed an extensive review of each of the various international behavioral research programs represented by the authors at the conference. Between the studies of Downs (United States), Rossi (Italy), Feinmesser and Tell (Israel), Coulling (Canada), Borkowska-Gaertig (Poland), Stensland-Junker (Sweden), and McCulloch, Stick and Mencher (United States), over 75,000 babies had been evaluated for hearing loss and followed longitudinally. Follow-up procedures, use of the High Risk Register, behavioral testing protocols, identification of associated communication disorders, and national hearing health care delivery systems were considered. Suffice it to say, the results of the work is seen in the conference recommendations.

In the afternoon, reviews of research gave way to more practical matters as Dr. Aram Glorig and Gary Curtis outlined the Texas Plan for Identification and Evaluation of Deaf Children; and G. David Zink described a British Columbia design for the same function. Those two very comprehensive models for identification and management of the hard of hearing population are based on regionalization, with coordination of the overall networks centralized. Thus, there is some assurance of uniformity in the delivery of the hearing care services.

In the late afternoon Drs. Altman and Simmons described their separate work on equipment and procedures for the automated screening of hearing in the neonate. Dr. Altman's "Accelerometer" is still in the design stage. He has tested nearly 300 babies. His results are promising and quite similar to those reported by Simmons, however, much work needs to be done before the instrumentation can be mass tested. Dr. Simmons' "Crib-O-Gram" is operational in both single bed and group testing units. His data re: high occurance of hearing test failures in the intensive care nursery were quite revealing, and lent great support to the definitive use of the High Risk Register. The entire group of conference participants felt that the Crib-O-Gram deserves special support and recognition, as it appears to be extremely promising for the future.

Dr. Bess reported results of a survey which indicated that most pediatricians are confused about or unaware of newborn testing procedures. Such an attitude may explain why only 1% of the United States newborns are now evaluated along the lines of the High Risk Register. Dr. Cancel from Puerto Rico presented the conference with some startling evidence regarding incubator noise and its possible effects on the hearing of high risk children. She reported that, at her hospital, ironically, the older incubators are less noisy and traumatizing than the new units. She urged that sound level readings be taken in all incubators before they are put into use, and that the sound levels within them be measured periodically so as to avoid exposing newborns to excessive noise.

Finally, the formal papers were concluded with a review by Mencher of the MAST, a screening protocol for auditory perceptual disorders. Methods for using the test were presented and some information concerning its standardization was offered.

In the concluding remarks for the day, the participants were challenged to integrate their knowledge, segregate their preconceived ideas, eliminate their prejudices, and to postulate a logical system for the identification of hearing loss. The actual proceedings of the conference will be available shortly as a complete text. However, the recommendations of the conference are of such a significant nature, they cannot wait for book form to be disseminated, and thus are presented here in a slightly modified form. They have been presented to and accepted by the National Joint Committee as policy. That committee has set as its goal the implementation of the recommendations throughout the United

States. The recommendations have been carried to several other national governments, and are included in a program for the total development of hearing care in Nova Scotia. They have been presented to representatives of the World Health Organization, and are under review by that group.

There is no doubt that it would be an awesome responsibility to spearhead a program from the implementation of these recommendations. But, a conquest of the devastating effects of deafness requires that we, as specialists in communication disorders, accept that responsibility. The participants in the conference, the medical community, parents and educators of deaf children, are looking to audiologists to provide the impetus for initiating these kinds of programs. Even if you must do it step by step — a little at a time — do it in your community. That is the challenge of our profession.

MODIFIED RECOMMENDATIONS FROM THE NOVA SCOTIA CONFERENCE ON THE EARLY IDENTIFICATION OF HEARING LOSS *

We are biologically programmed to develop certain skills in response to certain inputs. Language learning is one such skill which must be gained very early in life. Hearing is the most expedient basis for normal language acquisition and language is the keystone of modern society. Hearing loss must be identified as early as possible in the first two years of life so that its effects may be diminished to a point where the hearing impaired child may mature to a full role in society.

The subtleties of hearing impairment require esoteric and intensive assessment. This conference was convened to evaluate the methods of assessment and to make recommendations for their realization and implementation by making guidelines which lead to practical results. To these purposes the conference adopts the following resolutions.

1) **RESOLVED:**
A HIGH RISK REGISTER OR FILE SHOULD BE UNIVERSALLY IMPLEMENTED ON THE BASIS OF THE FIVE POINTS OF THE 1972 SUPPLEMENTARY STATEMENT OF THE JOINT COMMITTEE ON INFANT HEARING SCREENING, AND THE FOLLOW-UP PROCEDURES OF THAT STATEMENT SHOULD ALSO BE UNIVERSALLY IMPLEMENTED. WE RECOMMEND THAT THE WORLD HEALTH ORGANIZATION, NATIONAL AND LOCAL GOVERNMENTS AND HEALTH AGENCIES ADOPT THIS PROGRAM BY LEGAL MANDATE.

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* Modified for this article by the author.

THIS CONFERENCE ALSO RECOGNIZES THAT CHILDREN WHO FALL INTO THE DESIGNATED HIGH RISK CATEGORIES DELINEATED BY THE JOINT COMMITTEE ON INFANT HEARING SCREENING OFTEN SUFFER FROM OTHER COMMUNICATION DISORDERS.

2) **RESOLVED:**
AS A SUPPLEMENT TO THE HIGH RISK REGISTER AN AGENCY MAY EMPLOY BEHAVIORAL SCREENING TESTS AS IN THE APPENDED MODEL.

Any tests recommended in the future must also satisfy the requirements contained in the 1970 Statement of the Joint Committee on Infant Hearing Screening with respect to stimuli, response patterns environmental factors, status at the time of testing, and behavior of observers.

We believe the reasons for the intensive studies of these variables are:

a) Different stimuli may activate different components of the auditory system;

b) Different response criteria may be selectively sensitive to different aspects of hearing disturbance;

c) Different observers bring special sensitivities to the test procedures; and

d) Different infants in different psycho-physiological states offer varying types of responses, each with different clinical meaning.

We believe that to control these variables the acoustic stimulus must be carefully specified as to its intensity and frequency (energy content), duration, rise and fall time (shape), interstimulus interval (pattern of presentation) and informational content. Criteria must specify changes of behavior accepted as response differentiated from behavioral changes during control periods. The psycho-physiological states of the infant must be operationally defined and determined in relation to the test procedure. Finally, the physical and physiological factors of the infants environment must be described, and where possible, stabilized.

In light of the resolutions made here, and in view of the guidelines that we have and will recommend, we encourage field trials of automated techniques, such as the crib-o-gram, since it meets the criteria set down previously.

3) **RESOLVED:**
BECAUSE THE HIGH RISK REGISTER OR OTHER SCREENING PROGRAM CANNOT BE EXPECTED TO DETECT ALL HEARING IMPAIRMENT, A PROVISION WITHIN THE HEALTH CARE SYSTEM SHOULD BE MADE FOR HEARING TESTING LATER IN INFANCY AS PART OF ANY PUBLIC HEALTH — WELL BABY CARE PROGRAM. IN ORDER TO IDENTIFY **BOTH** EAR DISEASE AND HEARING LOSS, THE FOLLOWING PROCEDURES ARE RECOMMENDED:

a) In order to determine if ear disease is present some examination of the status of the middle ear should be employed at every health visit.

b) A system should be designed in each country to distribute and evaluate a questionnaire provided to the parents to ascertain the child's reaction to sound, at least twice in each of the first two years of life.

c) At approximately seven months of age behavioral hearing tests should be employed universally. The kinds of tests that are recommended should employ stimuli that have been measured on appropriate instrumentation for frequency and intensity content. Signals consisting of no greater than 45 dB (C scale) measured at the ear canal, and at least one stimulus centered at high frequencies (2000 - 4000 Hz), and one at low frequencies (500 - 1000 Hz) should be employed.

d) We recognize the impracticality, at the present time, of implementing the specifications presented above in all testing situations involving the seven month old child, and therefore suggest as interim procedures which are also acceptable, the documented protocol attached.

e) At the time of regular health visits close to the age of twelve and eighteen months, additional screening tests are desirable.

4) **RESOLVED:**
AT TWO YEARS OF AGE A CHILD SHOULD BE EVALUATED FOR HEARING, SPEECH, AND LANGUAGE FUNCTION. DELIVERY SYSTEMS MUST BE DESIGNED BY EACH COUNTRY.

5) **RESOLVED:**
IN VIEW OF THE FACT THAT HEARING LOSS MAY DEVELOP AT OLDER AGES, AND ALTHOUGH WE ARE DEALING WITH THE CHILD 0 - 2 YEARS, WE URGE THAT PERIODIC SCREENING FOR HEARING SHOULD BE MANDATED BEYOND THE AGE OF TWO, AND THAT COMPLETE ASSESSMENT OF COMMUNICATION SKILLS BE REQUIRED FOR ENTRANCE TO SCHOOL.

6) **RESOLVED:**
PERSONS WHO IMPLEMENT THE RECOMMENDATIONS OF THIS CONFERENCE SHOULD BE GIVEN SPECIAL TRAINING IN THE PROCEDURES THAT HAVE BEEN SPECIFIED: AND THE WORLD HEALTH ORGANIZATION AND OTHER HEALTH AGENCIES OFFER INTERDISCIPLINARY TRAINING COURSES TO THIS EFFECT. THESE COURSES SHOULD BE DESIGNED AND OUTLINED BY RESPONSIBLE INTERNATIONAL GROUPS SUCH AS REPRESENTED BY THIS CONFERENCE.

7) **RESOLVED:**
CONTINUED RESEARCH INTO THE CAUSES, PREVENTION, AND EARLY DETECTION OF HEARING LOSS IS ESSENTIAL.

We specifically recommend continued research in the following areas:

a) Comprehensive studies of genetic and other kinds of hearing impairment, with special emphasis on longitudinal audiologic studies concerning the natural history and time of onset;

b) Continued exploration of procedures for the early differential diagnosis of all forms of auditory disorders in children;

c) Automated hearing testing units be studied with age levels beyond the newborn period;

d) The relationships between prenatal environment and hearing loss be studied.

SUGGESTED PROTOCOL FOR A BEHAVIORAL HEARING SCREENING TEST

1. **TEST STIMULUS:**
A random noise having a low frequency attenuation of 30 dB or more per octave below 750 Hz; a maximum of 90 dB sound pressure level at the pinna; a rise-decay time of five (5) milliseconds or more; a duration of 0.5 to two (2) seconds; an interest interval minimum of fifteen (15) seconds.

2. **INFANT RESPONSE:**
Any generalized body movement which involves more than one limb and which is accompanied by some form of eye movement.

3. **SCORING CRITERIA:**
Controlled by one of two methods:

a) Scorer does not known when a stimulus is actually present, or

b) Two observers score an infant's responses independent of one another.

Furthermore, two (of eight maximum) stimulus responses should be positive to score as a "pass" and a "failure" should be retested at least once (with a cummulative positive response score of more than 20%) before being considered a true test "failure".

4. **PRETEST STATE:**
The pre-test behavioral state of an infant is an important determinant in governing the initiation of a response and must be controlled or described in specific terms. This protocol calls for a sleeping infant (eyes closed, no observable body movement for at least fifteen (15) seconds prior to stimulation).

5. **TEST ENVIRONMENT:**
The ambient noise level at the time of the typical test should be measured and reported.

SUGGESTED PROTOCOL FOR EVALUATION OF HEARING IN INFANTS (FIVE - TWELVE MONTHS OF AGE) *

Date of Test_____ Birthdate_____ Sex _____

Surname_____ First Name_____ Father's Name _____

Address _____

Marks:
Clear Response (+); Delayed Response (D); Doubtful Response (S);
No Response (-)

Auditory Screening Tests

Kind of Examination		Frequency in c/s	Intensity in dB From Distance of 30 cm.	Responses L.E.R.E.
Test 1				
Localization Response	1. First rattle	2000-16000	35	___ ___
	2. Second rattle	4000-16000	40	___ ___
	3. Cup, spoon	2000-10000	40	___ ___
	4. Rustling of tissue paper	62.5 - 8000	40	___ ___
Test 2				
Localization and auriculo-palpebral reflexes	1. Toy drum	64 - 500	65	___ ___
	2. Rattle	2000-16000	55	___ ___
	3. Rattle	4000-16000	65	___ ___
	4. Whistle	2000	70	___ ___
	5. Trumpet	500-8000	70	___ ___

Details on Child's Health

Had he suffered from ear infection? No _____
Yes (With recurrent discharge) _____
Yes (Without recurrent discharge) _____

Had he suffered from:
a) Meningitis or Encephalistis?
b) Other illnesses such as: (C.P., Polyomelitis, Mumps, Measles, etc.)
c) Was he hospitalized? _____ Cause _____

Place and duration of hospitalization _____
Had severe trauma? No _____ Yes _____
Congenital malformations _____
Remarks _____

Details on Child's Development

	Yes	No	Remarks
Has good head balance			
Sucks and swallows well			
Brings hand to mouth			
Good relationship to environment			
Reacts to noises and voices from the environment			
Babbles			

Summary: 1. Passed
2. Failed
3. To be retested

' Based on forms and materials supplied by Feinmesser and Tell, Jerusalem, Israel and Borkowska-Gaertig and Sobieszezanska-Radoszewska, Warsaw, Poland.

INSTRUCTIONS FOR PROCEDURE
HEARING TEST FOR BABIES — 5 to 12 MONTHS OF AGE

The test described below, may be used in Well Baby Clinics to detect babies whose responses to acoustic stimuli deviate from the normal.

This test is less accurate than an Audiometric procedure.

The frequencies of the devices selected for testing the hearing of babies are similar to these of the Audiometer. (See form).

Preseptation of the acoustic stimuli should be carried out for each ear separately, at the level of the ear, and at the intensities and distances indicated on the test form.

1. Cellophane paper — delicate crumpling.
2. A cup and a teaspoon — a movement of turning the spoon in the cup without knocking at its sides.
3. A rattle — delicate, sharp and short noise.
4. A bell — delicate and short ringing.
5. Spoken voice: — pronouncing the syllable Ps, Ps, Ps, Ps, four times.

The test should be carried out in the quietest room of the Baby-Clinic.

The chair that the mother sits on, should be put in the middle of the room, facing away from any windows, at a distance of 1½ to 2 meters from any walls.

The mother should hold the child in her lap with his back leaning against her, and his limbs free of all clothing.

The test should be carried out by two persons — one producing the sounds behind the back of the baby, and the other observing the responses of the baby from a distance of one meter opposite the baby, but in a diagonal line, so as not to distract the child.

While testing, one should be on guard not to let the child see the movements of the hands or the shadow.

There should be a between stimulus interval of several seconds.

The expected responses:

1. Movement of the head.
2. Blinking of the eyes.
3. Movements of the limbs.
4. Holding of breath.
5. Starting or cessation of crying.
6. Grimacing.

Results to be recorded:

1. If the baby responds clearly and promptly in the manner mentioned above, record "+", which means **Clear response.**
2. If the baby's response, though clear, is somewhat delayed, the mark "D", which means **Delayed response.**
3. If the baby's response is doubtful, the letter "S" is to be marked, which means **doubtful.**
4. No response is to be marked by "-"

The child fails the test when:

1. There is no or doubtful response in **both ears** to two or more identical stimuli out of 5.
2. No or doubtful response to both rattle and bell or other stimuli in one ear only.

   The children who fail the test should be retested in the same manner within a month. (Usually 2 - 4 weeks).
3. Failure at the second test requires immediate referral to an Audiology Center.

The testers are requested to fill in accurately, all the items of the forms with regard to the "hearing test", and other relevant details and to forward those forms with the referral.

The devices should be carefully handled and put into the appropriate boxes after the test is performed.

Personnel in the Baby Clinic are encouraged to call an Audiology Center any time in regard to any problems arising in connection with the work.

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