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PEDIATRIC AUDIOLOGICAL EVALUATION (PART I): GUIDELINES AND PROTOCOLS FOR NEONATAL HEARING SCREENING

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This month's bulletin aims to discuss and present the guidelines and main protocols aimed at pediatric audiological assessment, more specifically, in neonatal hearing screening programs. It is worth noting that this topic will be addressed and elaborated on in future bulletins. Therefore, we invite you to accompany us on this journey within Child Audiological Assessment.

There are different guidelines focused on addressing and providing guidance on early diagnostic and audiological intervention methods in childhood. Among them, the Joint Committee on Infant Hearing (2007; 2019) stands out, with extremely relevant data on hearing demands in different age groups, such as the recommended ages for carrying out hearing screening (1st stage), assessment diagnostic hearing (2nd stage) and auditory intervention processes (3rd stage) in early childhood.

The JCIH guideline (2007) recommended ages of 1 month (1st stage), 3 months (2nd stage) and 6 months (3rd stage), while

the updated guideline in 2019 suggested bringing forward the recommended ages, being 1 month (1st stage), 2 months (2nd stage) and 3 months (3rd stage) (see figure 1).

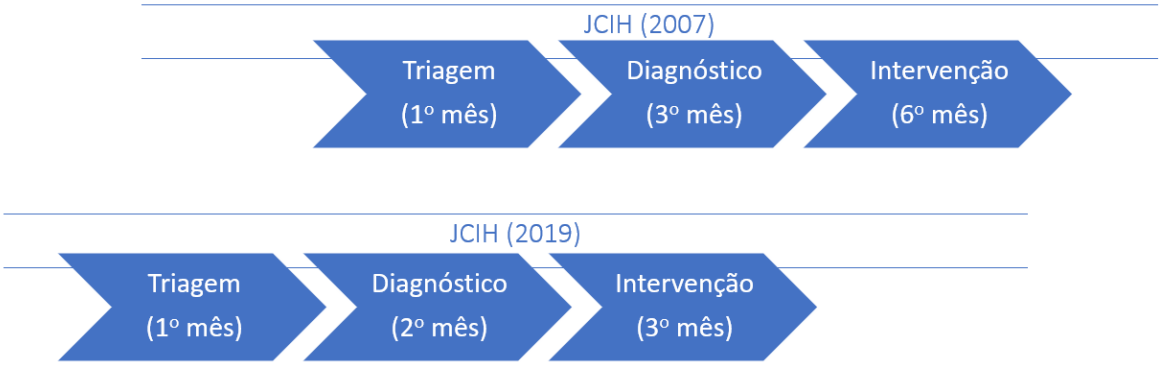

Figure 1: Schematic and representative figure of the age groups recommended by the JCIH (2007; 2019). Image developed by the authors.

The 1st stage aims to carry out hearing screening on a large number of infants with the aim of early detection of hearing loss. There is a difference in the screening method that is recommended between infants without risk indicators for hearing loss (w/IRDA) when compared to infants with risk indicators for hearing loss (c/IRDA) in early childhood. Therefore, it is essential that the evaluator is aware of the list of IRDAs, which will be presented in table 1 (JCIH, 2019).

PERI-NATAL INDICATORS	
1	History of hearing loss in family members
2	Neonatal ICU care for more than 5 days
3	Hyperbilirubinemia due to exchange transfusion
4	Use of aminoglycosides for more than 5 days
5	Asphyxia or Hypoxic Ischemic Encephalopathy
6	Extracorporeal membrane oxygenation (ECMO)
7	Intrauterine infections, such as herpes, rubella, syphilis, toxoplasmosis and cytomegalovirus. Cases of maternal contamination by Zika Virus considering the presence or absence of clinical and laboratory evidence as well as clinical findings
8	•Findings at birth: •craniofacial malformation including microtia and atresia, ear dysplasia, cleft palate, white quiff, microphthalmia.microcefalia congênita, hidrocefalia congênita ou adquirida •Anomalies in the temporal bone
9	+ 400 syndromes that have been identified with altered hearing thresholds
PERI OR POSTNATAL INDICATORS	
10	Infections associated with sensorineural hearing loss, including bacterial and viral infections (especially herpes and chickenpox), meningitis, or encephalitis
11	Events associated with hearing loss, head trauma especially basal skull with temporal bone fractures
12	Concern of the caregiver, parents, or guardians about hearing, speech and language, developmental delay or regression

If the infant has any risk factors, it is recommended that a hearing screening is carried out using automated Brainstem Auditory Evoked Potentials (BAEP-A) (see figure 2) because these cases are associated with a greater risk of impairment. The use of otoacoustic emissions alone to assess this population could hide Auditory Neuropathy Spectrum Disease (ANSD).

Given the high incidence of infants with ANSD who have high auditory thresholds, it is strongly recommended that if there are no BAEP-A responses the infant be referred for retest, and, if the failure remains, they should be immediately referred for a more comprehensive audiological evaluation. The retest should include a BAEP examination involving both click-type stimuli (to probe the integrity of the auditory pathway) and tone-burst or chirp stimuli (to check for thresholds).

For more information about the different techniques, see our October 2023 Bulletin.

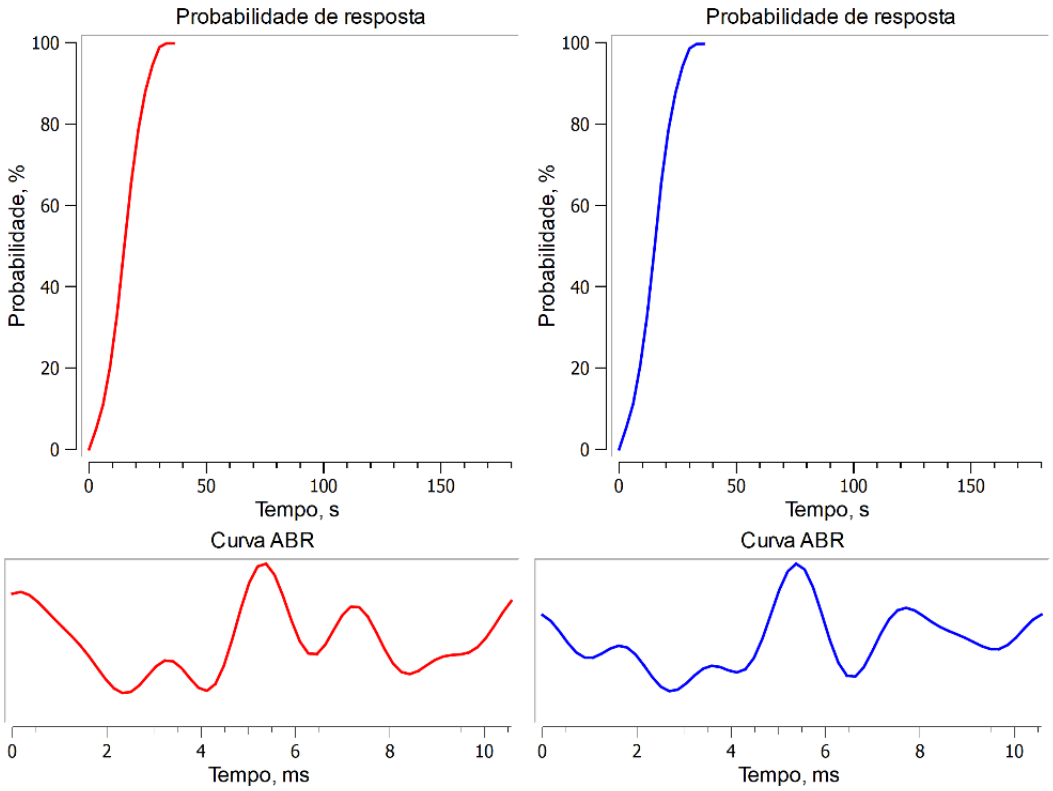

Figure 2: Hearing assessment using BAEP-A. Equipment: Audio-SMART from Neurosoft.

In the case of infants without ANSD, the neonatal hearing screening can be done using assessment procedures such as transient evoked otoacoustic emissions (TEOAEs) and/or distortion product otoacoustic emissions (DPOAEs) (see figure 3), although it is still possible to use BAEP-A.

Both methods are able to detect changes in auditory thresholds. If there no response to any of the methods used, the infant must be retested and, if the failure persists, the child must be immediately referred for more comprehensive audiological testing. The follow-up should include a BAEP test, both using a click (to test the integrity of the auditory pathway) and tone-bursts or chirps (to test electrophysiological thresholds).

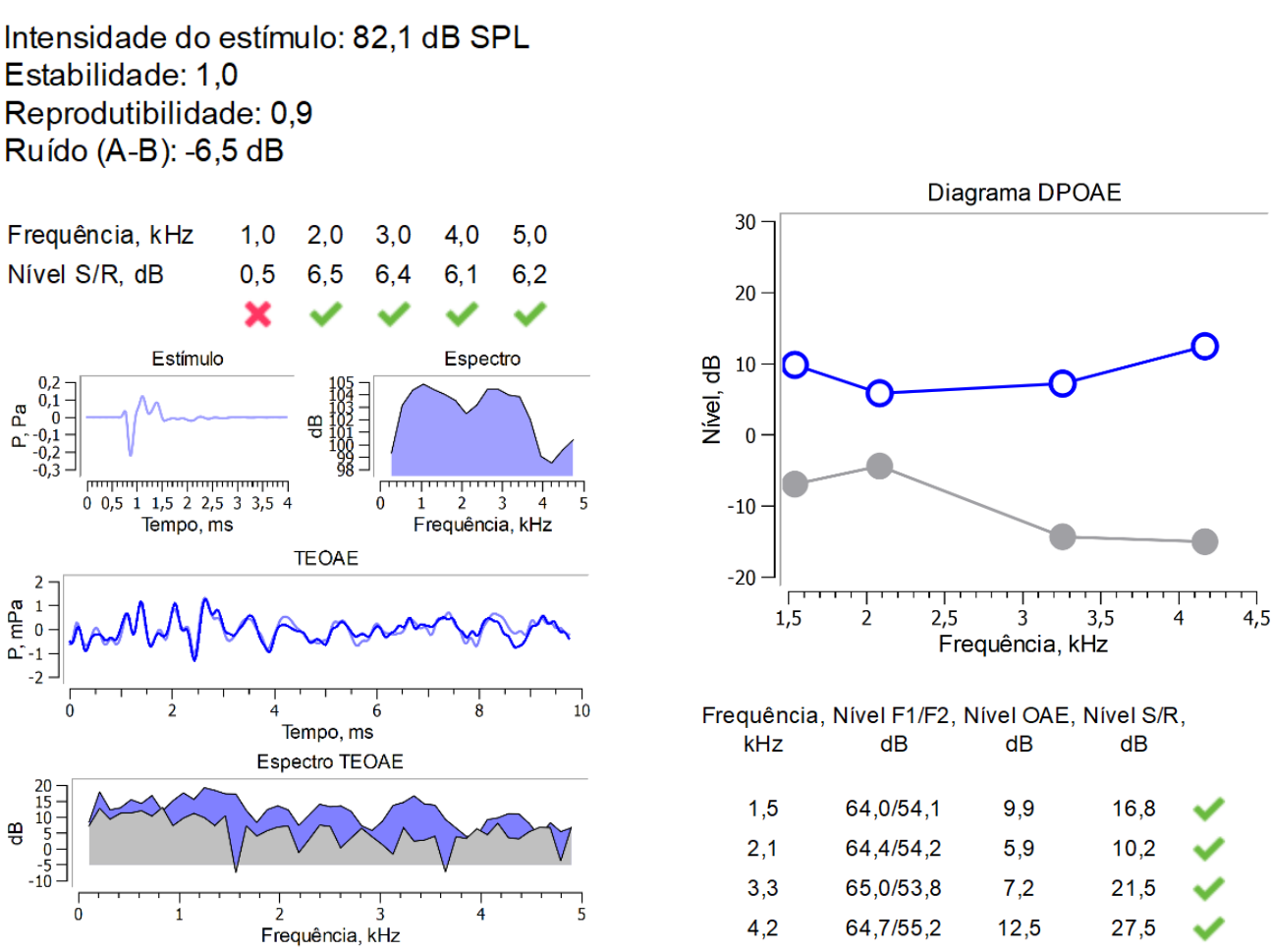

Figure 3: Assessment of hearing using TEOAEs and DPOAEs. Equipment: Audio-SMART (Neurosoft)

The procedures used in NHS programs do not identify all infants with a hearing disorder, as they are not capable of detecting mild hearing loss. For this reason, all children should be monitored for how their listening skills are developing. In terms of hearing monitoring, there are different recommendations as to the time when they should be carried out.

It is important that evaluators be aware of the indications for carrying out hearing monitoring for each age group. Below, a brief summary is presented.

IMMEDIATE MONITORING

If parents, guardians, or caregivers have any suspicion about the integrity of a child's hearing, such as from delay in the development of speech or language, or even regression in development, a diagnostic hearing assessment must be initiated immediately.

MONITORING AT 1 MONTH

Monitoring in this age group is recommended in cases of maternal infection by Zika virus (backed up by laboratory evidence or clinical findings at birth).

MONITORING AT 3 MONTHS

In this age group, evaluators should be aware of special events such as:

- Uterine cytolomegalovirus (CMV) infection,
- Extracorporeal membrane oxygenation (ECMO),
- Culture-positive infections associated with sensorineural hearing loss such as meningitis and encephalitis,
- Events associated with possible hearing loss such as chemotherapy medications or traumatic brain injury (TBI).

MONITORING AT 9 MONTHS

The vast majority of risk indicators for hearing loss fall into the hearing monitoring stage at 9 months after neonatal hearing screening. The indicators are:

- History of hearing loss in family members (early, progressive, late, or permanent);
- Care in the neonatal ICU for more than 5 days;
- Hyperbilirubinemia requiring exchange transfusion;
- Use of aminoglycosides for more than 5 days;
- Asphyxia or hypoxic-ischemic encephalopathy;
- Intrauterine infections, such as herpes, rubella, syphilis, toxoplasmosis;
- Zika virus infection (positive mother and infant without laboratory evidence or clinical findings);
- Certain conditions at birth or findings such as craniofacial malformations, congenital microcephaly, congenital or acquired hydrocephalus; changes in the temporal bone;
- Syndromes that lead to hearing loss.

It is important to highlight that, in this age group, many babies will be evaluated for the second time, after passing NHS testing. The evaluation and monitoring of these infants is important, since, as previously highlighted in this bulletin, there is a percentage of babies who are not identified as having hearing loss through neonatal hearing screening, i.e., they have acquired a late hearing loss.

AT THIS STAGE, IT IS POSSIBLE TO IDENTIFY THOSE INFANTS WHO HAVE HEARING CHANGES THAT WERE NOT PREVIOUSLY IDENTIFIED.

At this stage, pediatricians play an important role, since their advice for guardians or parents will permit their child to undergo a new hearing assessment, even though the child may have previously passed the NHS.

Attention and care from a pediatrician is important and will permit early detection and intervention in the event of hearing loss. It is also important that parents have access to guidance, both oral and written, as it promotes a family-centered approach. If family members and others involved in the baby's care have good health literacy, there will be increased adherence to referrals.

Family members should be informed about when they are to come back to the professional for a follow-up assessment. According to Ribeiro and colleagues (2023), effective communication means conversing in the family's native language and the evaluator should ensure that information is well understood. In this way, the written material will reinforce the verbal information, and it allows family members to refer back to the material if any doubts arise.

Pediatricians as well as speech therapists with expertise in pediatric hearing play an key role in informing parents, guardians, and family members of the importance of fully functioning hearing for optimum child development.

SOUNDS NEED TO BE AUDIBLE SO THAT THEY CAN TRAVEL THROUGH ALL THE STRUCTURES INVOLVED IN PROCESSING AUDITORY INFORMATION AND BE ABLE TO REACH THE BRAIN, WHERE THEY ARE FINALLY DECODED AND UNDERSTOOD.

All professionals should convey the message that hearing integrity, perhaps after an early auditory intervention, will give a child full access to language and learning.

Finally, family members should be told that, regardless of the type and degree of hearing loss, all children with a hearing loss will benefit from a range of available technologies.

With the aid of appropriate hearing devices, and through neural-brain plasticity and neural reprogramming, the structures responsible for different auditory abilities will be stimulated and the child will have access to sound.

Ultimately, an appropriate therapeutic intervention program will enable them to make new neural connections.

We invite you to follow us on this journey of pediatric audiological assessment in our next newsletters!

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Authors:

DR. ANDREA SOARES

- Master in Human Communication Health at Santa Casa de São Paulo;
- Specialist in Audiology by the Federal Council of Speech Therapy;
- Improvement in Child Audiology by APADAS and in hearing aids by CEDIAU;
- Member of the Brazilian Academy of Audiology (ABA);
- Clinical performance in audiology with children and adults regarding audiological diagnosis, adaptation, selection and validation of electronic devices as well as evaluation and intervention in patients with tinnitus disorder.

PROF. DR. DANIELA GIL

-Speech therapist graduated from the Federal University of São Paulo
-Specialist in Audiology by the Federal Council of Speech Therapy
-PhD in Sciences from the Federal University of São Paulo
-Associate Professor of the Department of Speech Therapy at the Federal University of São Paulo, UNIFESP/EPM

PROF. DR. PIOTR HENRYK SKARZYNSKI

- Professor, ENT, Master and Doctorate by Medical University of Warsaw;
- Research, didactic, clinical, and organizational work in World Hearing Center of Institute of Physiology and Pathology of Hearing, Institute of Sensory Organs and Medical University of Warsaw;
- Specialist in ENT, pediatric ENT, audiology and phoniatrics, and public health. Participated in the 3rd Stakeholders Consultation meeting during which the World Hearing Forum of WHO was announced;
- Member of the Roster of Experts on Digital Health of WHO, Vice-President and Institutional Representative of ISfTeH;
- President-elect of International Advisory Board of AAOHNS, member of Congress and Meeting Department of EAONO, Regional Representative of Europe of ISA, Vice-President of HearRing Group, Auditor of EFAS, member of the Facial Nerve Stimulation Steering Committee;
- Board Secretary of the Polish Society of Otorhinolaryngologists, Phoniatrists and Audiologists. Member of Hearing Committee (2018–19);
- Goodwill Ambassador representing Poland at the AAO-HNSF 2021 Annual Meeting & OTO Experience, and since 2021 a member of Implantable Hearing Devices Committee and Otology & Neurotology Education Committee of AAO-HNS;
- Consultant Committee of International Experts of CPAM-VBMS (by special invitation), honorary member of ORL Danube Society, and honorary member of Société Française d'Oto-Rhino-Laryngologie;
- Member of the Council of National Science Center;
- Expert and member of numerous national organizations.

PROF. DR MILAINE DOMINICI SANFINS

- Postdoc at the World Hearing Center, Warsaw, Poland;
- Sandwich Doctorate by School of Medical Sciences, State University of Campinas (FCM-UNICAMP) and by Università degli Studi di Ferrara/Italy;
- Expertise in Audiology by Federal Council of Speech Therapy and Audiology;
- Speech Therapist and Audiologist, Master by Medical School of University of São Paulo (FMUSP);
- Professor of the Post-graduate program in Clinical Audiology at the Albert Einstein Israelite Institute of research and teaching;
- Invited professor in undergraduate, specialization and postgraduate courses;
- Reviewer of scientifi c articles in the area of Neuroaudiology, Neuroscience and Audiology;
- Research group member, Institute of Physiology and Pathology of Hearing, Kajetany, Poland.
- Instagram @dramisanfins / email: msanfins@uol.com.br