

What Are Others Publishing about Early Hearing Detection and Intervention?

The aim of the Journal of Early Hearing Detection and Intervention (JEHDI) is to promote access to evidence-based practice, standards of care, and research focused on all aspects of Early Hearing Detection and Intervention. Taking a broad systems perspective, JEHDI publishes peer-reviewed articles that describe current research, evidence-based practice, and standards of care specifically focused on newborn and early childhood hearing screening, diagnosis, family support, early intervention, the medical home, information management, financing, quality improvement and other issues that contribute to improving EHD systems.

Whereas JEHDI is the only journal that focuses specifically on improving EHD systems, many other journals publish relevant articles as a part their journal's broader focus. To help JEHDI readers stay up-to-date about recently published material, we provide titles and abstracts of what has been published in the last 12 months that JEHDI editors think are most relevant to improving EHD programs. Titles of all articles are hyperlinked to the source.

1. Antoni M, Rouillon I, Denoyelle F, Garabédian EN, Loundon N.

Newborn hearing screening: Prevalence and medical and paramedical treatment of bilateral hearing loss in a neonatal series in the Île-de-France region of France. *Eur Ann Otorhinolaryngol Head Neck Dis.* 2015 Oct 28. pii: S1879-7296(15)00153-2. doi: 10.1016/j.anorl.2015.10.001

Objectives: We report results for newborn hearing screening in a cohort of children born in the Île-de-France region of France, as part of a national screening program set up by the French national health insurance agency.

Materials and Methods: A prospective study was performed on neonates undergoing hearing screening by automated auditory brainstem response at 35dB in maternity departments between 2005 and 2011. In case of positive findings, a further check was performed; if this was also positive in one or both ears, the child was referred to the diagnostic center.

Results: The study recruited 27,885 births; 96% of neonates were tested. Retest was positive in 0.84% of cases. Bilateral hearing loss was diagnosed in 0.63% of infants. Fifty-nine percent of these had ≥ 1 risk factor. Hearing normalized by end of follow-up in 25% of cases. Hearing loss was moderate in 59% of hearing-impaired children, severe in 12% and profound in 29%. Mean age at hearing aid fitting ranged from 4months in profound hearing loss to 11.4months in moderate hearing loss. In children receiving a cochlear implant, mean age at implantation was 14 months.

Conclusion: Newborn hearing screening is now public policy. It is effective in terms of exhaustiveness, age at diagnosis and early management. Caution is appropriate in the treatment of moderate hearing loss. In case of moderate hearing loss associated with otitis media serosa, transtympanic aerators should be suggested as of the age of 6months to enable hearing threshold measurement. Hearing aid fitting can then be considered around 9months of age if hearing has not improved.

2. Avison J & Jactett R.

Traceability in newborn hearing screening via an auditory-evoked response simulator. *International Journal of Audiology* 2015; 54: 559–561

More than 0.75 million babies are born each year in the UK and each is offered hearing screening within the first few days of life through newborn hearing screening programmes (NHSPs). Similar practices are also adopted in many other countries. With the wellbeing of so many infants riding on the efficacy of each screening programme, it's essential that quality assurance measures are in place for every part of the screening process. The technology and techniques used in hearing screening have developed at a rapid rate and a wide variety of screening devices are in use. Standardization and calibration methods inevitably lag behind any new technology and as a consequence there are some traceability gaps that need to be filled (Durrant et al, 2007). The authors propose the use of an auditory-evoked response simulator to provide a traceability route for hearing screening devices.

For any measurement to be meaningful, it must be traceable to some reference standard. In pure-tone audiometry, for example, traceability of the acoustic stimulus is achieved through the use of ear simulators (BS EN 60318-1:2009) which are in turn calibrated using calibrated reference microphones. This method of reference standard dissemination ensures that all pure-tone audiometry measurements are of well-defined accuracy and are directly comparable. This is not currently the case for evoked response measurements. Here, both the acoustic stimulus and the response must be considered. Calibration methods for the stimulus already exist (BS EN 60645-3:2007; BS EN 60645-6:2010; BS EN 60645-7:2010), and a current European project, EARS (EMRP 2014), is attempting to further improve their accuracy for neonatal ears. However, there are no objective methods that provide measurement traceability or interpretation of the response, whether acoustical as in the case of OAE, or electrophysiological as in the case of ABR.

As it stands, the efficacy of any NHSP relies on proprietary algorithms and hardware and is without a mechanism for independent or ongoing verification. The auditory-evoked response simulator is proposed as an objective and independent solution to that problem. It could be used in a variety of ways: not only for providing traceability during annual maintenance but also for detecting equipment faults in situ on a daily basis; for demonstrating the equivalence of different models of screening device; and as a tool to aid the training and competency assessment of newborn hearing screeners.

The authors anticipate that the primary application of the auditory-evoked response simulator would be the verification of automated hearing screening devices. These devices make decisions with minimal human input, and their operators will not necessarily have the time, tools, or technical expertise to identify when faults have occurred. The simulator could additionally be applied to audiological assessment, providing realistic and repeatable signals for testing, hardware development, demonstrations, and training.

3. Caluraud S, Marcolla-Bouchetemplé A, de Barros A, Moreau-Lenoir F, de Sevin E, Rerolle S, Charrière E, Lecler-Scarcella V, Billet F, Obstoy MF, Amstutz-Montadert I, Marie JP, Lerosey Y.

Newborn hearing screening: analysis and outcomes after 100,000 births in Upper-Normandy French region. *Int J Pediatr Otorhinolaryngol.* 2015 Jun;79(6):829-33. doi: 10.1016/j.ijporl.2015.03.012

Objectives: Neonatal hearing impairment is a common disorder with a prevalence of 1 to 2‰ worldwide, with significant consequences on overall development when rehabilitated too late. New-born hearing screening has been implemented in the 1990s in most European countries and the USA. The Upper-Normandy region of France has been conducting a pilot program since 1999. The aim of this prospective study was to evaluate and critically analyse it.

Methods: The Upper-Normandy universal new-born hearing screening program is performed in two steps. Between 1999 and 2004, first, we administered a Transient Evoked Oto Acoustic Emission (TEOAE) test was administered a few days after birth for healthy newborns without risk factors. For newborns admitted to a neonatal intensive care unit (NICU) or presenting risk factors, was administered an automated auditory brainstem response (AABR) test prior to discharge. Second, newborns who failed the initial hearing screening were retested as outpatients using TEOAE. Since 2004, infants who failed the initial screen were tested with AABR 3 to 4 weeks later as outpatients, providing an opportunity to compare the two protocols.

Results: Overall screening coverage in the Upper-Normandy region is 99.8%. First step coverage is 99.58% in well-infant nurseries and 97.09% in the NICU. The test-retest procedure during the first step and the use of AABR for the second resulted in higher follow-up rates and lower false positive rates.

Conclusion: The Upper-Normandy region universal newborn hearing screening program facilitated diagnosis and rehabilitation of infants before age of 9 months, most notably when severe to profound hearing impairment was found.

4. Chan KT, Wong EC, Law CW, Chong HM, McPherson B.

Improving newborn hearing screening: Are automated auditory brainstem response ear inserts an effective option? *Int J Pediatr Otorhinolaryngol.* 2015 Nov;79(11):1920-5. doi: 10.1016/j.ijporl.2015.09.008

Objective: Universal newborn hearing screening is an established practice among Hong Kong public hospitals using a 2-stage automated auditory brainstem response (AABR) screening protocol. To enhance overall efficiency without sacrificing program accuracy, cost reduction in terms of replacing the initial ear coupler-based screening with a more economical ear insert-based screening procedure was considered. This study examined the utility of an insert-based AABR initial screening approach and the projected cost-effectiveness of a combined probe-based plus follow-up ear coupler AABR screening procedure.

Methods: Following prenatal maternal consent, newborn hearing screening was conducted with 167 healthy neonates using a cross-sectional, repeated measures study design. The neonates were screened with AABR sequentially; using ear coupler and ear probe (insert) procedures, in both ears, with two different but comparable AABR instruments. Testing took place in the antenatal ward of a department of obstetrics and gynaecology, at a large public hospital.

Results: With the specific combination of instruments deployed for this study insert-based AABR screening generated a five-fold higher rescreen rate and took an additional 50% screening time compared to coupler-based AABR screening. Although the cost of consumables used in a 2-stage AABR screening protocol would reduce by 9.87% if the combined procedure was implemented, the findings indicated AABR screening when conducted with an ear probe has reduced utility compared with conventional ear coupler screening.

Conclusion: Significant differences may occur in screening outcomes when changes are made to coupler method. Initiating a 2-stage AABR screening protocol with an ear insert technique may be impracticable in newborn nurseries given the greater number of false positive cases generated by this approach in the present study and the increased time required to carry out an insert-based procedure.

5. Chen JL.

Newborn hearing screening may predict Eustachian tube dysfunction. *Int J Pediatr Otorhinolaryngol.* 2015 Sep 28. pii: S0165-5876(15)00468-1. doi: 10.1016/j.ijporl.2015.09.021.

Introduction: There is evidence for temporary hearing loss in neonates immediately after birth because of residual liquid derived from amniotic fluid in the ME cavity. This study examines whether a referred newborn hearing screen (NBHS) with subsequent testing confirming normal hearing can be attributed to persistence of middle ear effusion and predict poor Eustachian tube function manifested as recurrent otitis media or otitis media with effusion in the first year of life. The aims of the present study are to investigate the following: (1) whether infants who fail a neonatal hearing screen and subsequently pass are more likely to experience recurrent otitis media or otitis media with effusion, (2) whether these infants are more likely to obtain tympanostomy tubes.

Methods: This retrospective cohort study examined newborns who referred their NBHS and were subsequently noted to have normal hearing and a control group comprised of newborns who passed their NBHS. Univariate and multivariate analysis was performed on the data collected as well as generation mean cumulative function plots.

Results: The baseline characteristics of the case and control groups are not statistically significant with regards to gender, number of otitis media (OM), delivery mode, or the need for tubes in the follow up period. Within the refer group, those with bilateral refers were twice as likely to have otitis media than those with a unilateral refer ($p=0.012$). The logistic regression model for odds of subsequent otitis media was not statistically significant for bilateral or unilateral refer though the logistic regression model for odds of tubes demonstrated a statistically significant increased risk in bilateral refer patients. With time to event analysis, it was seen that bilateral refer patients are more likely to have OM than control and unilateral refer patients.

Conclusion: There is no difference in the incidence of subsequent OM between those infants who passed the NBHS versus those who initially referred and then passed subsequent audiology examination. However there was a difference in the number of otitis media between those infants who referred bilaterally versus those who referred unilaterally.

6. Elpers J, Lester C, Shinn JB, Bush ML.

Rural Family Perspectives and Experiences with Early Infant Hearing Detection and Intervention: A Qualitative Study. *J Community Health.* 2015 Aug 28.

Infant hearing loss has the potential to cause significant communication impairment. Timely diagnosis and intervention is essential to preventing permanent deficits. Many infants from rural regions are delayed in diagnosis and treatment of hearing loss. The purpose of this study is to characterize the barriers in timely infant hearing healthcare for rural families following newborn hearing screening (NHS) testing. Using stratified purposeful sampling, the study design involved semi-structured phone interviews with parents/guardians of children who failed NHS testing in the Appalachian region of Kentucky between 2012 and 2014 to describe their experiences with early hearing detection and intervention program. Thematic qualitative analysis was performed on interview transcripts to identify common recurring themes in content. 40 parents/guardians participated in the study and consisted primarily of mothers. Demographic data revealed limited educational levels of the participants and 70 % had

state-funded insurance coverage. Participants reported barriers in timely infant hearing healthcare that included poor communication of hearing screening results, difficulty in obtaining outpatient testing, inconsistencies in healthcare information from primary care providers, lack of local resources, insurance-related healthcare delays, and conflict with family and work responsibilities. Most participants expressed a great desire to obtain timely hearing healthcare for their children and expressed a willingness to use resources such as telemedicine to obtain that care. There are multiple barriers to timely rural infant hearing healthcare. Minimizing misinformation and improving access to care are priorities to prevent delayed diagnosis and treatment of hearing loss.

7. Fitzpatrick E, Hamel C, Stevens A, Pratt M, Moher D, Doucet S, Neuss D, Bernstein A, Na E.

Sign Language and Spoken Language for Children with Hearing Loss: A Systematic Review.

Pediatrics. 2015 Dec 18.

Children with mild bilateral and unilateral hearing loss are now commonly identified early through newborn hearing screening initiatives. There remains considerable uncertainty about how to support parents and about which services to provide for children with mild bilateral and unilateral hearing loss. The goal of this study was to learn about parents' experiences and understand, from their perspectives, the impact of hearing loss in the mild range on the child's functioning. Parents of 20 children in Ontario, Canada, participated in the study. The median age of identification of hearing loss was 4.6 months (interquartile range: 3.6, 10.8). Parents appreciated learning early about hearing loss, but their experiences with the early process were mixed. Parents felt that professionals minimized the importance of milder hearing loss. There was substantial uncertainty about the need for hearing aids and the findings suggest that parents need specific guidance. Parents expressed concerns about the potential impact of hearing loss on their child's development, particularly at later ages.

8. Fitzpatrick E, Grandpierre V, Durieux-Smith A, Gaboury I, Coyle D, Na E, Sallam N.

Children With Mild Bilateral and Unilateral Hearing Loss: Parents' Reflections on Experiences and Outcomes. J

Deaf Stud Deaf Educ. 2015 Oct 3. pii: env047.

Children with mild bilateral and unilateral hearing loss are now commonly identified early through newborn hearing screening initiatives. There remains considerable uncertainty about how to support parents and about which services to provide for children with mild bilateral and unilateral hearing loss. The goal of this study was to learn about parents' experiences and understand, from their perspectives, the impact of hearing loss in the mild range on the child's functioning. Parents of 20 children in Ontario, Canada, participated in the study. The median age of identification of hearing loss was 4.6 months (interquartile range: 3.6, 10.8). Parents appreciated learning early about hearing loss, but their experiences with the early process were mixed. Parents felt that professionals minimized the importance of milder hearing loss. There was substantial uncertainty about the need for hearing aids and the findings suggest that parents need specific guidance. Parents expressed concerns about the potential impact of hearing loss on their child's development, particularly at later ages.

9. Giordano T, Marchegiani AM, Germiller JA.

Children With Sensorineural Hearing Loss And Referral To Early Intervention.

ORL Head Neck Nurs. 2015 Summer;33(3):10-4.

Objective: Sensorineural hearing loss (SNHL) is identified at a rate of 1-3 per 1,000 newborns in the United States. Timely referral to Early Intervention (EI) services is critical, as early EI referral has been shown to improve outcomes, including speech and language development, social and emotional development, and academic performance. The objective of this study was to determine the rate at which children diagnosed with SNHL at a large tertiary referral center were referred to EI, and, if so, by whom. In addition, we sought to determine the time from the diagnosis of SNHL to the completion of the referral, and what services were received.

Design: Prospective observational study

Methods: Data were collected by telephone survey and review of the electronic medical record

Results: Children with SNHL were referred to and participated in EI at a high rate. All children in this study (100%) were referred to EI. Most (92%) of the children were referred by 6 months of age, and almost all (98%) participated in EI.

Conclusion: At our institution, children with SNHL are being consistently referred to EI, meeting the goals of the Early Hearing Detection and Intervention program. Future outcomes research can now be designed to determine whether achieving these benchmark goals improves children's academic performance, expressive and receptive language skills, and development as compared to age-matched, normal hearing peers.

10. Harrop-Griffiths K.

The impact of universal newborn hearing screening. Arch Dis Child doi:10.1136/archdischild-2014-307867.

About 1 in 1000 children are born each year with hearing impairment sufficiently severe to compromise speech and language development and communication. There has been much work in recent years to reduce the age of diagnosis and intervention for these children. The paper by Pimperton et al,¹ provides important evidence to support the observations of those working clinically with these children, that early identification and habilitation of significant hearing impairment in children pays dividends in terms of education. The cohort of children on whom this paper is based was identified by universal newborn hearing screening before the establishment of NHSP, the national newborn hearing screening programme. The same cohort was studied earlier at an average age of 7.9 years² when significant benefit in language development was shown in those diagnosed before 9 months of age compared with those identified when older than 9 months. The particular value of this paper is that it has looked at performance in the second decade as well as the first, and there is a paucity of work in this age group. Pimperton et al have highlighted the value of early diagnosis and intervention in establishing good language skills, which underpin later reading comprehension.

11. Januário GC, Lemos SM, Friche AA, Alves CR.

Quality indicators in a newborn hearing screening service. Braz J Otorhinolaryngol. 2015 May-Jun;81(3):255-63. doi:

10.1016/j.bjorl.2014.08.008.

Introduction: Newborn hearing screening (NHS) programs are implemented across the globe to detect early hearing impairment. In order to meet this objective, the quality of these programs should be monitored using internationally recognized indicators.

Objective: To evaluate a newborn hearing screening service (NHSS) using international quality indicators.

Methods: A retrospective cohort study on the NHSS of Minas Gerais was conducted, analyzing the services performed between 2010 and 2011. Results were analyzed according to criteria from the American Academy of Pediatrics and the Joint Committee on Infant Hearing.

Results: This study assessed 6987 children. The proportions of cases that were referred for a retest, that followed through with retest, and that were referred for diagnosis were 8.0%, 71.9%, and 2.1%, respectively. The proportion of assessed newborn children in the first 30 days of life in this study was 65%. The median age of those children who failed both the NHS and the retest was significantly higher than the other children. The chance of a

child with a hearing impairment risk indicator to fail the NHS was 2.4 times higher than of those without a risk indicator.
Conclusion: NHSS achieved three of four evaluated indicators. Despite this, it is still necessary to perform NHS earlier and to ensure that the subsequent steps are followed.

12. Kemaloğlu YK, Gökdoğan Ç, Gündüz B, Önal EE, Türkyılmaz C, Atalay Y.

Newborn hearing screening outcomes during the first decade of the program in a reference hospital from Turkey.

Eur Arch Otorhinolaryngol. 2015 Jun 3.

In this study, the authors report the results of a three-stage newborn hearing screening (NHS) program for well babies at the Gazi University Hospital (GUH) in Ankara between 2003 and 2013. GUH-NHS was performed by automated transient evoked otoacoustic emission (a-TEOAE) at the first and second steps and by automated brainstem audiometry (a-ABR) at the third step. The data were analysed to assess not only rate of congenital permanent hearing loss (CPHL), but also the effectiveness of the program during the years. A total of 18,470 well babies were tested. The data showed that coverage ratio for the GUH-born babies was increased and more outside-born babies (OBB) were admitted by time (means 84.31 and 11.28 %, respectively). Mean CPHL was found to be 0.26 %. Mean referral rate was decreased to 0.81 % by a-ABR from 2.16 % by a-TEOAE. Mean of missed cases in any stage of GUH-NHS was 4.88 %. It was seen that neither CPHL nor referral rate, but only ratio of missed ones presented increase in parallel to increment in OBB. This paper first presents that clinically acceptable screening procedures developed in GUH by time, and secondly higher rate of CPHL in Turkey than in the Western countries, and benefits of third stage screening by a-ABR because it prevented referral of 251 children (1.29 %) to the clinical tests. We think that this number is reasonably important regarding not only economical point of view, but also waiting lists in the audiology departments in a developing country, in which audiological service is still limited.

13. Khoza-Shangase K, Harbinson S.

Evaluation of universal newborn hearing screening in South African primary care. *Afr J Prim Health Care Fam Med.*

2015 May 21;7(1). doi: 10.4102/phcfm.v7i1.769.

Background: Universal Newborn Hearing Screening (UNHS) is the gold standard toward early hearing detection and intervention, hence the importance of its deliberation within the South African context.

Aim: To determine the feasibility of screening in low-risk neonates, using Otoacoustic Emissions (OAEs), within the Midwife Obstetric Unit (MOU) three-day assessment clinic at a Community Health Centre (CHC), at various test times following birth.

Method: Within a quantitative, prospective design, 272 neonates were included. Case history interviews, otoscopic examinations and Distortion Product OAEs (DPOAEs) screening were conducted at two sessions (within six hours and approximately three days after birth). Data were analysed via descriptive statistics.

Results: Based on current staffing profile and practice, efficient and comprehensive screening is not successful within hours of birth, but is more so at the MOU three-day assessment clinic. Significantly higher numbers of infants were screened at session 2, with significantly less false-positive results. At session 1, only 38.1% of the neonates were screened, as opposed to more than 100% at session 2. Session 1 yielded an 82.1% rate of false positive findings, a rate that not only has important implications for the emotional well-being of the parents; but also for resource-stricken environments where expenditure has to be accounted for carefully.

Conclusion: Current findings highlight the importance of studying methodologies to ensure effective reach for hearing screening within the South African context. These findings argue for UNHS initiatives to include the MOU three-day assessment to ensure that a higher number of neonates are reached and confounding variables such as vernix have been eliminated.

14. Lammers MJ, Jansen TT, Grolman W, Lenarz T, Versnel H, van Zanten GA, Topsakal V, Lesinski-Schiedat A.

The influence of newborn hearing screening on the age at cochlear implantation in children. *Laryngoscope.* 2015

Apr;125(4):985-90. doi: 10.1002/lary.25045.

Objective/Hypothesis: To evaluate the influence of the introduction of newborn hearing screening programs on the age at cochlear implantation in children.

Study Design: Retrospective, multicenter cohort study.

Methods: All 1,299 pediatric cochlear implant users who received their implants before the age of 5 years between 1995 and 2011 in the Medical University Hannover, Germany and University Medical Center Utrecht, the Netherlands were enrolled in this study. Age at implantation and the number of children implanted within the first year of life was assessed for each center.

Results: Age at cochlear implantation gradually declined over the years in both centers. The introduction of the screening resulted in significant decline in the age at implantation in the Netherlands; simultaneously, the number of children implanted within their first year of life increased significantly. Comparing 4-year epochs immediately before and after introduction of the screening, the mean age decreased from 2.4 to 1.2 years, and the percentage of early implanted children increased from 9% to 37%. In the German population, a similar effect of the introduction of the hearing screening program was absent.

Conclusion: The introduction of the national newborn hearing screening program has reduced the age at cochlear implantation in young children in the Netherlands but not in Germany. Correspondingly, it resulted in an increase in the number of children implanted early in life. The difference between the Dutch and German population might be due to differences in the follow-up and referral after the hearing screening.

15. Lima MC, Rossi TR, Françoze MF, Collela-Santos MF, Correa CR.

Analysis of neonatal hearing screening program performed on an outpatient basis: Analysis of an outpatient hearing screening program. *Int J Pediatr Otorhinolaryngol.* 2015 Oct 27. pii: S0165-5876(15)00516-9. doi: 10.1016/j.ijporl.2015.10.009. [Epub ahead of print]

Objective: The aims of the present study were to analyze the coverage of an outpatient hearing screening program in a public hospital for healthy newborns, to describe the social and demographic profile of the mothers and to identify the prevalence of infants with severe or profound hearing losses.

Methods: The method was descriptive and retrospective. In 2002 and 2003, the newborn hearing screening program was initiated in the maternity ward. Due to many logistic problems, in 2004, we implemented screening on an outpatient basis. Thus, upon discharge from the hospital, the mothers received a printed schedule referring the baby to an outpatient clinic. A two-stage screening protocol was implemented. The screening results were presented from 2004 to 2013.

Results: The program was initiated on an outpatient basis in 2004. From 2004 to 2013, 14,882 infants were screened but the complete data for 14,205 cases were obtained. The adherence of the families was 32% in 2004 and increased to 85% in 2013. The mean age of the screened newborns was 48.66 days in 2005 and 24.53 days in 2013. The number of newborns who failed the test and were referred for diagnosis decreased from 12.3% in 2004 to 3% in 2013. The majority of the mothers were young, 69.77% of them aged up to 29 years old and 74.86% had completed basic education.

Seventy infants showed hearing loss, totaling 0.49% or approximately 5 cases in 1000, with eight individuals diagnosed with severe or profound sensorineural hearing loss, totaling 0.06% or approximately six cases in 10,000.

Conclusions: The newborn hearing screening program offered by a public hospital in Brazil, over the years, has increased the coverage from 32% to 85%, and so, can be performed on an outpatient basis as an alternative to overcome the operating limitations that might occur in hospital hearing screening. The mothers of the newborns were young and had complete basic education; the prevalence was similar to international studies as hearing loss is concerned.

16. Moeller, Mary Pat; Tomblin, J. Bruce

An Introduction to the Outcomes of Children with Hearing Loss Study *Ear & Hearing: November/December 2015 - Volume 36 - Issue - p 4S–13S. doi: 10.1097/AUD.0000000000000210*

The landscape of service provision for young children with hearing loss has shifted in recent years as a result of newborn hearing screening and the early provision of interventions, including hearing technologies. It is expected that early service provision will minimize or prevent linguistic delays that typically accompany untreated permanent childhood hearing loss. The post-newborn hearing screening era has seen a resurgence of interest in empirically examining the outcomes of children with hearing loss to determine if service innovations have resulted in expected improvements in children's functioning. The Outcomes of Children with Hearing Loss (OCHL) project was among these recent research efforts, and this introductory article provides background in the form of literature review and theoretical discussion to support the goals of the study. The Outcomes of Children with Hearing Loss project was designed to examine the language and auditory outcomes of infants and preschool-age children with permanent, bilateral, mild-to-severe hearing loss, and to identify factors that moderate the relationship between hearing loss and longitudinal outcomes. The authors propose that children who are hard of hearing experience limitations in access to linguistic input, which lead to a decrease in uptake of language exposure and an overall reduction in linguistic experience. The authors explore this hypothesis in relation to three primary factors that are proposed to influence children's access to linguistic input: aided audibility, duration and consistency of hearing aid use, and characteristics of caregiver input

17. Müller J, Fechner H, Köhn A, Reißmann A.

Newborn Hearing Screening - Results of a Parental Survey in Saxony-Anhalt.

Gesundheitswesen. 2015 Jun 25.

Background: In recent years quality assurance has become an essential part of today's health-care system in the wake of the modern patient-oriented quality management. With the statutory introduction of newborn hearing screening (NHS) in 2009, a quality assurance of these early detection methods has become necessary. The aim of the study was to determine patient satisfaction in relation to the NHS in Saxony-Anhalt.

Patients/Methods: During the period from November 2013 to April 2014, 394 parents were retrospectively interviewed about their experiences and expectations in relation to the NHS, using a standardised questionnaire. In total, 21 child care centres and 6 paediatric primary care centres from all over Saxony-Anhalt were involved.

Results: It turns out that the majority of parents are satisfied with the NHS and 97.7% are in favour of the offer of an NHS. Of the surveyed parents, 69.3% felt the information as sufficient. However, only 66.2% of parents took a closer look at the leaflet issued by the G-BA. In addition, 17.7% of respondents are dissatisfied with the professional competence of the examining staff.

Conclusion: The study shows that the general attitude among parents towards newborn hearing screening was very positive. They felt reassured by it although there are some aspects still open to criticism.

18. Muñoz, Karen; Olson, Whitney A.; Twohig, Michael P.; Preston, Elizabeth; Blaiser, Kristina; White, Karl R.

Pediatric Hearing Aid Use: Parent-Reported Challenges

Ear & Hearing: March/April 2015 - Volume 36 - Issue 2 - p 279–287 doi: 10.1097/AUD.0000000000000111

Objectives: The aim of this study was to investigate parent-reported challenges related to hearing aid management and parental psychosocial characteristics during the first 3 years of the child's life.

Design: Using a cross-sectional survey design, surveys were distributed to parents of children with hearing loss via state Early Intervention programs in Utah and Indiana. Packets contained one family demographic form and two sets of three questionnaires to obtain responses from mothers and fathers separately: the Parent Hearing Aid Management Inventory explored parent access to information, parent confidence in performing skills, expectations, communication with the audiologist, and hearing aid use challenges. The Acceptance and Action Questionnaire measured psychological flexibility, experiential avoidance, and internal thought processes that can affect problem-solving ability and decrease an individual's ability to take value-based actions. The Patient Health Questionnaire identified symptoms of depression. Thirty-seven families completed questionnaires (35 mothers and 20 fathers).

Results: Most responses were parents of toddlers (M = 22 months) who had been wearing binaural hearing aids for an average of 15 months. Both mothers and fathers reported that even though the amount of information they received was overwhelming, most (84%) preferred to have all the information at the beginning, rather than to receive it over an extended time period. Parents reported an array of challenges related to hearing aid management, with the majority related to daily management, hearing aid use, and emotional adjustment. Sixty-six percent of parents reported an audiologist taught them how to complete a listening check using a stethoscope, however, only one-third reported doing a daily hearing aid listening check. Both mothers and fathers reported a wide range of variability in their confidence in performing activities related to hearing aid management, and most reported minimal confidence in their ability to troubleshoot hearing aid problems. More than half of the parents reported child behavior and activities, such as playing outside, as a major hearing aid use challenge. Parents reported hearing aids were worn all waking hours by 35% of children and less than 5 hr/day by 31%. Almost half of the parents (47%) did not feel that they had enough time to talk about their emotions when speaking with their audiologist(s), 69% reported the audiologist did not help them know what to expect related to emotions about their child's hearing loss, and 22% reported symptoms of depression.

Conclusions: Parents reported an array of challenges, even after their child had been wearing hearing aids for a prolonged time, revealing critical implications for how to provide audiological care. Audiologists have an important role in partnering with parents to identify and jointly problem-solving challenges related to their child's hearing aid use. Supporting parents includes not only addressing technical aspects of hearing testing and hearing aid function but also addressing parent thoughts, feelings, and emotions.

19. Pitlick MM, Orr K, Momany AM, McDonald EL, Murray JC, Ryckman KK.

Determining the prevalence of cytomegalovirus infection in a cohort of preterm infants. *J Neonatal Perinatal Med. 2015 Jul 31;8(2):137-41. doi: 10.3233/NPM-15814057.*

Background: Preterm birth is a global public health problem that is a significant cause of infant morbidity and mortality. Congenital cytomegalovirus (CMV) infection has been proposed as a risk factor for preterm birth, but the rate of CMV in infants born preterm is unclear. CMV is the leading infectious cause of sensorineural hearing loss, which will affect 15% - 20% of congenitally infected infants later in their childhood. 90% of infected

infants are asymptomatic at birth and are not recognized as at risk for CMV-associated deficits.

Objectives: To determine the prevalence of CMV infection in a large cohort of preterm infants.

Methods: DNA was extracted from cord blood, peripheral blood, saliva, and buccal swab samples collected from preterm infants. A total of 1200 unique DNA samples were tested for CMV using a nested PCR protocol. The proportions of preterm infants with CMV was compared by sample collection type, race, gender, and gestational age.

Results: A total of 37 infants tested positive for CMV (3.08%). After excluding twins, siblings, and infants older than two weeks at the time of sample collection, two out of 589 infants were CMV positive (0.3%), which was lower than the proportion of CMV observed in the general population. All positive samples came from buccal swabs.

Conclusion: Our work suggests that while CMV infection may not be greater in preterm infants than in the general population, given the neurologic consequences of CMV in preterm infants, screening of this population may still be warranted. If so, our results suggest buccal swabs, collected at pregnancy or at birth, may be an ideal method for such a program.

20. Silva DP, Lopez PS, Ribeiro GE, Luna MO, Lyra JC, Montovani JC.

The importance of retesting the hearing screening as an indicator of the real early hearing disorder. *Braz J*

Otorhinolaryngol. 2015 Jul-Aug;81(4):363-7. doi: 10.1016/j.bjorl.2014.07.019.

Introduction: Early diagnosis of hearing loss minimizes its impact on child development. We studied factors that influence the effectiveness of screening programs.

Objectives: To investigate the relationship between gender, weight at birth, gestational age, risk factors for hearing loss, venue for newborn hearing screening and "pass" and "fail" results in the retest.

Methods: Prospective cohort study was carried out in a tertiary referral hospital. The screening was performed in 565 newborns through transient evoked otoacoustic emissions in three admission units before hospital discharge and retest in the outpatient clinic. Gender, weight at birth, gestational age, presence of risk indicators for hearing loss and venue for newborn hearing screening were considered.

Results: Full-term infants comprised 86% of the cases, preterm 14%, and risk factors for hearing loss were identified in 11%. Considering the 165 newborns retested, only the venue for screening, Intermediate Care Unit, was related to "fail" result in the retest.

Conclusion: Gender, weight at birth, gestational age and presence of risk factors for hearing loss were not related to "pass" and/or "fail" results in the retest. The screening performed in intermediate care units increases the chance of continued "fail" result in the Transient Otoacoustic Evoked Emissions test.

21. Sugaya A, Fukushima K, Kasai N, Kataoka Y, Maeda Y, Nagayasu R, Toida N, Ohmori S, Fujiyoshi A, Taguchi T, Omichi R, Nishizaki K.

Impact of early intervention on comprehensive language and academic achievement in Japanese hearing-

impaired children with cochlear implants. *Int J Pediatr Otorhinolaryngol.* 2015 Oct 8. pii: S0165-5876(15)00497-8. doi: 10.1016/j.ijporl.2015.09.036.

Objectives: Early hearing detection and intervention (EHDI) is critical for achievement of age-appropriate speech perception and language development in hearing-impaired children. It has been 15 years since newborn hearing screening (NHS) was introduced in Japan, and its effectiveness for language development in hearing-impaired children has been extensively studied. Moreover, after over 20 years of cochlear implantation in Japan, many of the prelingual cochlear implant (CI) users have reached school age, and the effect of CI on language development have also been assessed. To identify prognostic factors for language development, audiological/language test scores and demographic factors were compared among prelingual severe-to-profound hearing-impaired children with CI divided into subgroups according to age at first hearing aid (HA) use and whether they received NHS.

Methods: Prelingual severe-to-profound deafened children from the Research on Sensory and Communicative Disorders (RSCD) project who met the inclusion criteria were divided into groups according to the age (in months) of HA commencement (before 6 months: group A, after 7 months: group B), and the presence or absence of NHS (groups C and D). Language development and socio-economic data were obtained from audiological/language tests and a questionnaire completed by caregivers, respectively.

Results: In total, 210 children from the RSCD project participated in this study. Group A (n=49) showed significantly higher scores on comprehensive vocabulary and academic achievement (p<0.05) than group B (n=161), with no difference in demographics except for significantly older age in group B. No differences in language scores were observed between group C (n=71) and group D (n=129), although participants of group D was significantly older and had used CIs longer (p<0.05).

Conclusion: Early use of HAs until the CI operation may result in better language perception and academic achievement among CI users with prelingual deafness. A long-term follow-up is required to assess the usefulness of NHS for language development.

22. Song CI, Kang HS, Ahn JH.

Analysis of audiological results of patients referred from newborn hearing screening program. *Acta Otolaryngol.*

2015 Nov;135(11):1113-8. doi: 10.3109/00016489.2015.1063785.

Conclusion: As tools of confirmation of sensorineural hearing loss in neonates who are 'referred' from a newborn hearing screening program, both ASSR and DPOAE have high sensitivity and specificity. In addition, ASSR can be used as a substitute for ABR.

Objectives: To analyze the confirmative audiological results of patients referred from a newborn hearing screening program.

Patients and Methods: From January 2007 to December 2013, hearing tests were performed on 474 babies (804 ears) who were 'referred' from the hospital or other maternity centers. Auditory brainstem response (ABR), auditory steady-state response (ASSR), and distortion product otoacoustic emissions (DPOAE) were used for hearing evaluation.

Results: Of 474 babies (804 ears), 232 had normal hearing, while 242 babies (358 ears) had over 30 dB nHL threshold from ABR. Among the 156 babies (312 ears) who underwent both ABR and ASSR, the mean ASSR threshold had a strong correlation with ABR threshold ($r = 0.942$, $p < 0.001$). Assuming that ABR results were the yardstick of abnormal hearing, sensitivity and specificity of ASSR to ABR were 90.6% and 95%. DPOAE tests were performed on 180 babies (360 ears), with sensitivity of 85.9% and specificity of 84.4%.

23. Unlu I, Guclu E, Yaman H.

When should automatic Auditory Brainstem Response test be used for newborn hearing screening? *Auris Nasus*

Larynx. 2015 Jun;42(3):199-202. doi: 10.1016/j.anl.2014.10.005

Objectives: The aim of this study was to investigate the referral rate and when automatic Auditory Brainstem Response (aABR) should be used for newborn hearing screening.

Methods: The present study enrolled 2933 healthy full-term infants and 176 infants with perinatal risk factors. Hearing screening using Transient Evoked Otoacoustic Emissions (TEOAEs) was performed in newborns for the first time 5 days after birth except perinatal risk factors infants. The TEOAE was repeated to neonates failing to pass at the 15th day after birth. Neonates failing to pass the second TEOAE, repeated the test again at the 30th day after birth. Neonates failing to pass the third TEOAE were referred for the second stage screening using aABR. In addition, neonates with risk factors were tested with aABR directly.

Results: In this research, 85 (2.9%) infants who could not pass the TEOAE and 176 infants exposed to perinatal risk factors, underwent the aABR test. In the aABR, 14 (7.9%) of 176 infants exposed to perinatal risk factors and 10 (11.7%) of 85 infants who could not pass the TEOAE failed to pass. As a result, hearing loss was detected in only 10 (0.34%) of 2933 healthy full-term infants.

Conclusion: TEOAE should be performed at least twice in healthy full-term infants before aABR, because aABR is to be performed by specially trained personnel and takes a long time. In view of these results, it is our opinion that infants without perinatal risk factors should undergo TEOAE screening test and infants who did not pass control screening tests and have perinatal risk factors should absolutely undergo aABR test. But it should be remembered that TEOAE can cause a problem to miss auditory neuropathy in infants without perinatal risk factors.

24. Van Dyk M, Swanepoel de W, Hall JW 3rd.

Outcomes with OAE and AABR screening in the first 48 h--Implications for newborn hearing screening in developing countries. *Int J Pediatr Otorhinolaryngol.* 2015 Jul;79(7):1034-40. doi: 10.1016/j.ijporl.2015.04.021

Objective: Early discharge of newborns (<24h after birth) from birthing centres is an important barrier to successful newborn hearing screening (NHS) in developing countries. This study evaluated the outcome of NHS within the first 48 h using an automated auditory brainstem response (AABR) device without the need for costly disposables typically required, and transient evoked otoacoustic emissions (TEOAE).

Methods: NHS was performed on 150 healthy newborns (300 ears) with TEOAE and AABR techniques before discharge at a hospital. A three-stage screening protocol was implemented consisting of an initial screen with TEOAE (GSI AUDIOscreeener+) and AABR (BERAphone®) MB 11). Infants were screened at several time points as early as possible after birth. Infants were only re-screened if either screening technique (TEOAE or AABR) initially yielded a refer outcome. The same audiologist performed all TEOAE and AABR screenings.

Results: Over the three-stage screen AABR had a significantly lower refer rate of 16.7% (24/144 subjects) compared to TEOAE (37.9%; 55/145 subjects). Screening refer rate showed a progressive decrease with increasing age. For both TEOAE and AABR, refer rate per ear screened 24h post birth was significantly lower than for those screened before 24h. For infants screened before 12h post birth, the AABR refer rate per ear (51.1%) was significantly lower than the TEOAE refer rate (68.9%). Overall AABR refer rate per ear was similar for infants screened between 24 to 36 h (20.2%) and 36 to 48 h (18.9%) but significantly lower than for TEOAE (40.7% and 41.9%, respectively). Lowest initial refer rates per ear (TEOAE 25.8%, AABR 3.2%) were obtained after 48 h post birth.

Conclusion: In light of the early post birth discharge typical in developing countries like South Africa, in-hospital screening with AABR technology is significantly more effective than TEOAEs. AABR screening with a device like the MB 11 is particularly appropriate because disposable costs are negligible.

25. Vos B, Senterre C, Lagasse R; SurdiScreen Group, Levêque A.

Newborn hearing screening programme in Belgium: a consensus recommendation on risk factors. *BMC Pediatr.* 2015 Oct 16;15(1):160. doi: 10.1186/s12887-015-0479-4.

Background: Understanding the risk factors for hearing loss is essential for designing the Belgian newborn hearing screening programme.

Accordingly, they needed to be updated in accordance with current scientific knowledge. This study aimed to update the recommendations for the clinical management and follow-up of newborns with neonatal risk factors of hearing loss for the newborn screening programme in Belgium.

Methods: A literature review was performed, and the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system assessment method was used to determine the level of evidence quality and strength of the recommendation for each risk factor. The state of scientific knowledge, levels of evidence quality, and graded recommendations were subsequently assessed using a three-round Delphi consensus process (two online questionnaires and one face-to-face meeting).

Results: Congenital infections (i.e., cytomegalovirus, toxoplasmosis, and syphilis), a family history of hearing loss, consanguinity in (grand)parents, malformation syndromes, and foetal alcohol syndrome presented a 'high' level of evidence quality as neonatal risk factors for hearing loss. Because of the sensitivity of auditory function to bilirubin toxicity, hyperbilirubinaemia was assessed as a 'moderate' level of evidence quality. In contrast, a very low birth weight, low Apgar score, and hospitalisation in the neonatal intensive care unit ranged from 'very low' to 'low' levels, and ototoxic drugs were evidenced as 'very low'. Possible explanations for these 'very low' and 'low' levels include the improved management of these health conditions or treatments, and methodological weaknesses such as confounding effects, which make it difficult to conclude on individual risk factors. In the recommendation statements, the experts emphasised avoiding unidentified neonatal hearing loss and opted to include risk factors for hearing loss even in cases with weak evidence. The panel also highlighted the cumulative effect of risk factors for hearing loss.

Conclusion: We revised the recommendations for the clinical management and follow-up of newborns exhibiting neonatal risk factors for hearing loss on the basis of the aforementioned evidence-based approach and clinical experience from experts. The next step is the implementation of these findings in the Belgian screening programme.

26. Wood SA, Sutton GJ, Davis AC.

Performance and characteristics of the Newborn Hearing Screening Programme in England: The first seven years. *Int J Audiol.* 2015 Jun;54(6):353-8. doi: 10.3109/14992027.2014.989548

Objective: To assess the performance of the universal newborn hearing screen in England.

Design: Retrospective analysis of population screening records.

Study Sample: A total of 4 645 823 children born 1 April 2004 to 31 March 2013.

Results: 97.5% of the eligible population complete screening by 4/5 weeks of age and 98.9% complete screening by three months of age. The refer rate for the 12/13 birth cohort is 2.6%. The percentage of screen positive (i.e. referred) babies commencing follow up by four weeks of age and six months of age is 82.5% and 95.8% respectively. The yield of bilateral PCHL from the screen is around 1/1000. For bilateral PCHL in the 12/13 birth cohort the median age is nine days at screen completion, 30 days at entry into follow up, 49 days at confirmation, 50 days at referral to early intervention, and 82 days at hearing-aid fitting.

Conclusion: The performance of the newborn hearing screening programme has improved continuously. The yield of bilateral PCHL from the screen is about 1/1000 as expected. The age of identification and management is well within the first six months of life, although there remains scope for further improvement with respect to timely entry into follow up.

27. Xiao H, Li W, Ma R, Gong Z, Shi H, Li H, Chen B, Jiang Y, Dai C.

Study on the factors impacting on early cochlear implantation between the eastern and western region of China.

Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi. 2015 Jun;29(12):1111-4.

Objective: To describe the regional different factors which impact on early cochlear implantation in prelingual deaf children between eastern and western regions of China.

Method: The charts of 113 children who received the cochlear implantation after 24 months old were reviewed and analyzed. Forty-five of them came from the eastern region (Jiangsu, Zhejiang or Shanghai) while 68 of them came from the western region (Ningxia or Guizhou). Parental interviews were conducted to collect information regarding the factors that impact on early cochlear implantation.

Result: Based on the univariate logistic regression analysis, the odds ratio (OR) value of universal newborn hearing screening (UNHS) was 5.481, which indicated the correlation of UNHS with early cochlear implantation is significant. There was statistical difference between the 2 groups ($P < 0.01$). For the financial burden, the OR value was 3.521 (strong correlation) and there was statistical difference between the 2 groups ($P < 0.01$). For the communication barriers and community location, the OR value was 0.566 and 1.128 respectively, and there was no statistical difference between the 2 groups ($P > 0.05$). The multivariate analysis indicated that the UNHS and financial burden are statistically different between the eastern and western regions ($P = 0.00$ and 0.040 respectively).

Conclusion: The UNHS and financial burden are statistically different between the eastern reinforced in the western region. In addition, the government and society should provide powerful policy and more financial support in the western region of China. The innovation of management system is also helpful to the early cochlear implantation.