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Universal newborn hearing screening in Zefat, Israel: The first two years

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ABSTRACT

Objective: Unidentified hearing loss at birth can adversely affect speech and language development as well as academic achievement and social-emotional development. Historically, moderate-to-severe hearing loss in young children was not detected until well beyond the newborn period. Around 0.5 to 5 in every 1000 neonates and infants have congenital or early childhood onset sensorineural hearing impairment. When identification and intervention occur at no later than 6 months of age, the infants perform much higher on school-related measures. Therefore, early detection is vitally important. Toward the end of 2009, the Israeli ministry of health issued a directive establishing a universal newborn hearing screening program in all hospitals in the country from 01.01.10. The objectives of this study are to evaluate a newly established universal newborn hearing screening program, to assess performance and to compare measurements of performance to performance benchmarks representing a consensus of expert opinion. The benchmarks are the minimal requirements that should be attained by high-quality early hearing detection programs.

Methods: As specified by the ministry of health, a two-stage screening protocol was implemented using otoacoustic emissions and automated auditory brainstem response. Screening results of all neonates born from the initiation of the program on 15th March 2010 until the end of 2011 were reviewed.

Results: The total number of live births during the study period was 5496. Of these, 5334 (97%) started screening for hearing loss but only 5212 completed the screening process, giving a screening coverage of 94.8%. Of the 5212 neonates completing the screening process, 270 (5.18%) were referred for full diagnostic testing.

Conclusions: The newly established universal newborn hearing screening program at the Ziv Medical Center in Zefat closely approaches, but does not yet meet the minimal requirements that should be attained by high-quality early hearing detection programs. Every effort should be made to complete the screening tests before discharge from hospital. Screening staff should actively encourage parents to participate in all stages of early detection.

1. Introduction

It has long been recognized that unidentified hearing loss at birth can adversely affect speech and language development as well as academic achievement and social-emotional development [1,2]. Historically, moderate-to severe hearing loss in young children was not detected until well beyond the newborn period, and it was not unusual for diagnosis of milder hearing loss and unilateral hearing loss to be delayed until children reached school age [3,4]. According to a range of studies and surveys conducted in different countries, around 0.5 to 5 in every 1000 neonates and infants have congenital or early childhood onset sensorineural (SN) deafness or severe-to-profound hearing impairment [5–7]. Between 1995 and 2005 the population of persons with disabling hearing loss has been reported to have grown from 120 million people to at least 278 million, with two-thirds of this population residing in developing countries [8]. High-risk target populations include infants in the neonatal intensive care unit (NICU), because research data have indicated that this population is at the highest risk of having neural hearing loss [3]. Following the adoption of universal newborn hearing screening, diagnosis of hearing loss can be made as early as at the mean age of 3.5 months [9]. There is a growing body of literature indicating that when identification and intervention occur at no later than 6 months of age for newborn infants who are deaf or hard of hearing, the infants perform as much as 20–40 percentile points higher on school-related

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measures (vocabulary, articulation, intelligibility, social adjustment, and behavior) [3,6,8,10–12].

Hearing impairment may affect the auditory neuropathway of children at a later developmental stage if appropriate and optimal interventions are not provided within the critical period of central auditory pathway development [4,13]. Therefore, early detection is a vitally important element in providing appropriate support for deaf and hearing-impaired babies that will help them enjoy equal opportunities in society alongside all other children [5]. The United States Preventive Services Task Force (USPSTF) recommended in 2008 that all neonates be screened for hearing loss. The Joint Committee on Infant Hearing (JCIH) 2000 position statement recommends universal screening of hearing loss before hospital discharge and identifies principles and guidelines for hospital programs. By 2005, approximately 95% of newborn infants in the United States were screened for hearing loss before hospital discharge. Despite this fact, almost half of newborn infants who do not pass the initial screening do not have appropriate follow-up to either confirm the presence of a hearing loss and/or initiate appropriate early intervention services [3]. Toward the end of 2009, the Israeli Ministry of Health issued a directive establishing a universal newborn hearing screening program in all hospitals in the country from 01.01.10 [14]. The objectives of this study are to evaluate a newly established universal newborn hearing screening program, to assess performance and to compare measurements of performance to performance benchmarks representing a consensus of expert opinion in the field of newborn hearing screening and intervention. The benchmarks are the minimal requirements that should be attained by high-quality early hearing detection programs [3].

2. Materials and methods

This study was conducted at the Ziv Medical Center in Zefat, Israel. It is a government-owned hospital serving the population of the upper Galilee and the Golan heights. The average annual birth rate is approximately 3000. The outcome measures used to assess program performance were:

1. Percentage of all newborn infants who complete screening by 1 month of age; the recommended benchmark is more than 95%.
2. Percentage of all newborn infants who fail initial screening and fail any subsequent rescreening before comprehensive audiological evaluation; the recommended benchmark is less than 4%.
3. For infants who fail initial screening and any subsequent rescreening, the percentage who complete a comprehensive audiological evaluation by 3 months of age; the recommended benchmark is 90%.

An audiology unit offering comprehensive diagnostic services is located within the hospital and has been performing behavioral and neurophysiological testing for many years. 3 part-time members of staff were recruited specifically for screening. Two of these are qualified audiologists and one is a biomedical technician. All staff members were trained in the use of the screening equipment and were made aware of the screening protocol. Meetings were conducted with the neonatal ward and NICU staff in order to clarify the significance and purpose of the screening program. Parents were informed of the benefits of early detection and of the safety of the screening tests with the aid of an information leaflet. As specified by the Israeli Ministry of Health, a two-stage screening protocol was implemented. All neonates were initially tested using transient evoked otoacoustic emissions (TEOAE). Failure to detect TEOAE in one or both ears was considered a "refer" result. If a refer result was received, the test was repeated a day later. Neonates failing to pass the repeat TEOAE were referred for second stage screening using automated auditory brainstem response (A-ABR). Neonates with risk factors for hearing loss (Table 1) were screened using both TEOAE and A-ABR in all cases. The combination of both tests is designed to reduce the number of false negative test results, especially in cases of Auditory Neuropathy/Auditory Dyssynchrony). Neonates failing to pass A-ABR testing in one or both ears were referred for full diagnostic evaluation. All screening tests were performed in a quiet room in the neonatal ward, isolated and dedicated to the program. Screening results were communicated immediately to parents, noted in the medical records and specified in the neonate's discharge letter. Screening results of all neonates born from the initiation of the program on 15th March 2010 until the end of 2011 were reviewed. Demographic data, screening results and, if available, information regarding definitive diagnostic testing were recorded. Screening results were transferred to a spreadsheet (Microsoft Excel) and afterwards were exported to SPSS for windows for statistical analysis. Values at $p < 0.05$ are considered statistically significant. Ethical approval for the study was obtained from the hospital review board.

3. Results

The total number of live births during the study period was 5496. Of these, 5334 (97%) started screening for hearing loss but only 5212 completed the screening process, giving a screening coverage of 94.8%. For demographic data of neonates starting the screening process see Table 2. Of the 5212 neonates completing the screening process, 270 (5.18%) were referred for full diagnostic testing. The vast majority of the neonates was screened prior to discharge from the hospital. All neonates discharged without completing screening were invited to complete the screening process on an outpatient basis at no extra charge to the family or the medical insurer. Of these, 76.6% completed screening. The number and percentage of neonates passed or referred at the various stages of screening is presented in Table 3. All in all, over the study period, 162 families refused to take part in the screening program. 97.5% of non-participating neonates due to parental refusal were from the not at-risk group. 10.5% of the neonates not screened were from the non-Jewish population. Of the 100 non-participating neonates during 2010, 51 (51%) were male, 96 (96%) were from the not at-risk group and 95 (95%) were Jews. Of the 62 non-participating neonates during 2011, 36 (58.1%) were male, 100% were from the not at-risk group and 50 (80.6%) were Jews. 57 neonates who did not pass the first TEOAE were referred for the second TEOAE but did not perform the test. 43 of these were in 2010 (of them, 77% Jews), and 14 of these were in 2011 (of them, 64% Jews). 65 neonates who were referred for A-ABR testing did not perform the test. 51 of these were in 2010 (of them, 74.5% Jews), and 14 of these were in 2011 (of them, 86% Jews). The differences in test results between 2010, the first year of the screening program, and 2011, the second year of the screening program are demonstrated in Table 4. At first, the 270 neonates referred for full diagnostic evaluation were invited to undergo ABR testing by air conduction (AC) only during natural sleep. 220 neonates (81.5%) performed the test and 50 failed to meet their scheduled appointments (18.5%). 153 of the tests (69.5%) showed

Table 1
Risk factors for hearing loss mandating screening using both TEOAE and A-ABR.

1.	Family history of permanent childhood hearing loss
2.	Genetic syndrome in neonate associated with congenital hearing loss
3.	Hospitalization in the NICU for 5 days or more
4.	Hyperbilirubinemia requiring plasmapheresis