

# COMMUNITY EAR AND HEARING HEALTH

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## SCREENING FOR HEARING IMPAIRMENT

**Valerie E Newton**  
MD FRCPCH

*Emeritus Professor of Audiological  
Medicine  
University of Manchester  
Manchester M13 3PL  
United Kingdom*

Hearing impairment is a major public health problem. In 2005, the World Health Organization (WHO) estimated that 278 million people in the world have a disabling hearing impairment. Disabling hearing loss was defined as an average pure tone threshold of 31 db HL or more in the better ear at four frequencies 0.5, 1, 2 and 4 kHz for children, and 41db or more at the same frequencies for adults. Some children and adults would, however, be disadvantaged with an average hearing loss less than these intensities.<sup>1</sup>

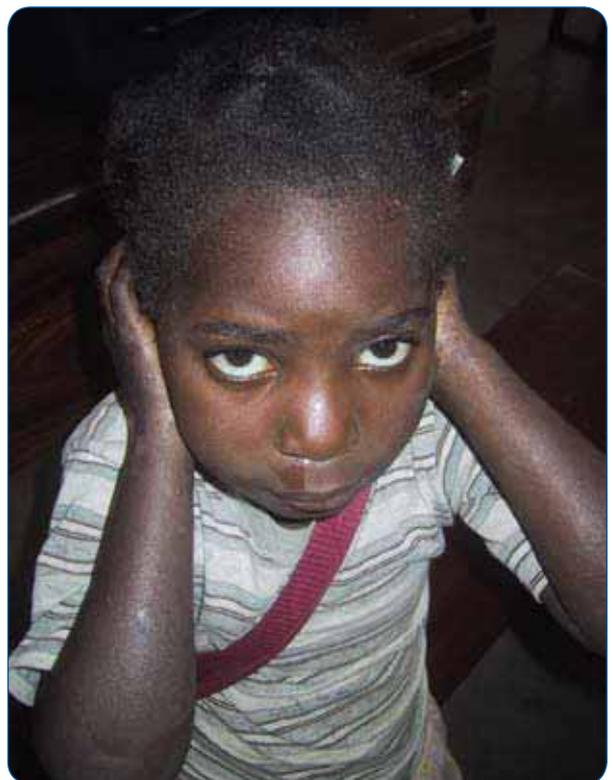
### Consequences of Hearing Impairment

A hearing impairment of a disabling degree affects language development and education in children; it has social and employment implications for older indi-

viduals; there is an economic impact upon society as a whole. The longer a hearing loss remains undetected the greater the adverse effects can be. For children who have a hearing loss of congenital or perinatal causation, the earlier the habilitation process can commence the greater the benefit in terms of language development. The benefit is particularly pronounced if effective habilitation is introduced in the first six months of life.<sup>2</sup>

### Screening

Screening can be defined as detecting in a population those likely to have or develop a particular condition. It divides the population into two groups – those with the condition, or its antecedents, and those without. It enables a condition to be identified in a population in which



*A very cautious and fearful 6-year old child with severe sensorineural hearing loss who was identified through the program in Mozambique - subsequently receiving a hearing aid with accessories*

*Photo: Jackie Clark*

### CONTENTS

*Community Ear and Hearing Health 2008; 5:1-16*

*Issue No.7*

#### EDITORIAL

*Screening for Hearing Impairment*

*Valerie E Newton*

*1*

#### LEAD ARTICLES

*A Two Year Study of Factors Contributing to Hearing Loss in Mozambique*

*Jackie L Clark*

*3*

*Screening for Hearing Impairment in Oman*

*Mazin Jawad J Al Khabori*

*6*

*National Newborn Hearing Screening in Mexico*

*Pedro Berruecos*

*8*

*Hearing Impairment and Newborn Screening in Costa Rica*

*Juan J Madriz*

*11*

#### BOOK REVIEW

*Tinnitus Retraining Therapy: Clinical Guidelines (Review by Afaf Bamanie)*

*James A Henry, Dennis R Trune, Michael J A Robb, Pawel J Jastreboff*

*13*

#### ABSTRACTS

*14*

it would otherwise not be detected, and then treated, habilitated or monitored. The criteria for screening most generally accepted were an initiative of the World Health Organization and current concepts are discussed in an article by Strong et al.<sup>3</sup>

Screening programmes to detect hearing loss have mainly targeted infants and children. Hearing screening in adults has tended to be confined to occupations in which there is noise exposure or where normal hearing is considered to be particularly important for performing the tasks involved. Screening of an older population is not generally performed. However, due to the high prevalence of hearing impairment and the benefit rehabilitation has been shown to provide, screening could be acceptable and cost-effective in the age group 55-74 years, where hearing loss in the better ear is at least 35dB HL.<sup>4</sup>

The ideal screening test would have a high sensitivity and a high specificity. A high sensitivity is important as a 'pass' when a child has a significant hearing impairment, i.e., a false negative result, may result in the hearing loss not being detected until later, as there would not, therefore, be a diagnostic test performed. These children would not receive appropriate habilitation at an optimal time. Not only could this affect speech and language development but may result in behaviour problems, and isolation from their normal hearing peers. They may also be sent to see several different medical specialists as parents seek another explanation for the child's communication problems. A high specificity is required as a 'fail' in a hearing screening test when a child is normal hearing, i.e., a false positive result, could result in undue parental anxiety whilst awaiting the follow-up diagnostic tests and so these should not be unduly delayed.

## Screening Tests and Equipment

Whereas, at one time, screening of hearing in infants could not be carried out until the infant was developmentally old enough (7-8 months), the discovery of otoacoustic emissions and the development of equipment for screening with transient or distortion product otoacoustic emissions, has facilitated hearing screening in newborns. Otoacoustic emissions and auditory brainstem response equipment, manually operated or automatic, are now used

regularly in newborn hearing screening programmes. Many programmes use a two stage protocol with OAEs used at the initial stage and ABR tests at the second stage; others use both tests initially to avoid missing the small proportion of infants with an auditory neuropathy.

Where the trained personnel and equipment are not available for newborn screening, then tests such as distraction testing or visual reinforcement audiometry can be employed in infancy.<sup>5</sup> Training is also required to perform these tests but the equipment requirements are considerably reduced.

## Screening Programmes

Newborn hearing screening programmes were initially targeted towards those newborns with 'at risk' factors such as being admitted to special care, a family history of permanent hearing loss of childhood onset, congenital abnormalities involving the head and neck. These programmes resulted in around 50% of hearing loss of congenital or perinatal origin being undetected. Subsequently, many countries have adopted programmes aimed at universal newborn hearing screening. This has been shown to be feasible in a developing country as well as in developed countries.<sup>6</sup>

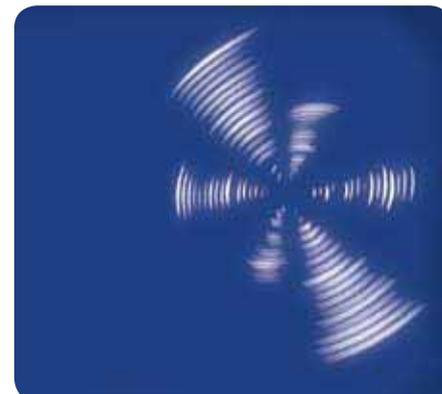
Countries introducing newborn/infant hearing screening programmes need a second method of detecting hearing loss developed subsequently. The prevalence of hearing loss increases with age as children develop infections such as meningitis and measles, genetic hearing loss becomes apparent, and trauma and other less common causes occur.<sup>7</sup> Hearing loss which develops after the newborn screen or infant behavioural tests can be detected using surveillance procedures and, at school age, by school screening. Most school screening programmes involve pure tone audiometry but some researchers have advocated the use of otoacoustic emissions for screening at this age.<sup>8</sup>

Whichever screening programmes are employed these need to be part of the government health service provision in the country concerned, this is to ensure their continuation. There will be ongoing needs for staff training, the provision and maintenance of equipment and management aids, and established links with education, social and other support agencies.

In this issue we read about screening programmes in Mozambique, Oman, Mexico and Costa Rica.

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## A TWO YEAR STUDY OF FACTORS CONTRIBUTING TO HEARING LOSS IN MOZAMBIQUE

Jackie L Clark

PhD F-AAA CCC-A

U.T. Dallas - Callier Center

U. Witwatersrand

Johannesburg

South Africa

Assistant Clinical Professor

School of Behavioral & Brain Sciences

University of Texas at Dallas

Callier Center

1966 Inwood Road

Dallas, Texas 75235

USA

Email: jclark@utdallas.edu

### Background to the Present Study

As a developing country recuperating from a lengthy civil war, documenting incidence of hearing loss has remained a low priority in Mozambique. Though an epidemiological study was conducted some thirteen years ago in the capital city of Maputo, the ensuing report provided limited data about factors contributing to hearing loss within the country of Mozambique. Results of hearing evaluation of 1000 primary school-aged children (5 – 16 years old), conducted in 1995 in the capital city of Maputo, were reported. Of the 1000 children evaluated, 18.6% presented with otitis media, and a total of 5% of the children exhibited otitis media accompanied with hearing impairment. Unfortunately, the report fell short of providing more in depth details of any other findings, nor was there any mention regarding excessive cerumen or debris as a contributing factor for hearing loss.



Jackie Clark conditioning a young child who was eventually identified with profound hearing loss

Photo: Jackie Clark

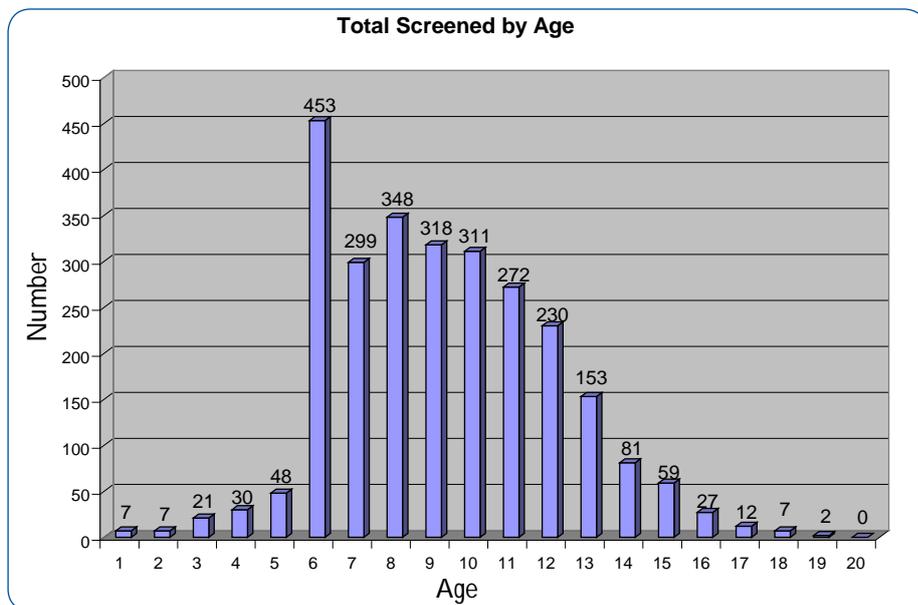


Fig. 1: Total number of students screened by age

It is important to note that, in preparation for a large scale hearing screening program to take place in 2005 and 2006, 1518 primary school students' ears (ages 8-14 years) were viewed otoscopically by trained individuals in 2004. The findings of the initial survey by the author suggested at least 39% of the ears viewed had significant occlusion and, as a consequence, appropriate logistical preparation could be made.

### Study

Beginning in 1997, the Mozambique Audiology Philanthropic Program from the University of Texas at Dallas, Callier Center, was created in partnership with the Chicupe Rural Hospital and Maxixe Primary School in Mozambique. The

primary purpose was to implement a number of ear and hearing health programs - through free hearing clinics; training local medical technicals; large scale hearing screenings at the primary school; and interacting with the local deaf school program. One of the many results of the program was obtaining much needed and valuable data on incidence and potential causation of hearing loss from conditions, such as ear canal obstruction and restricted tympanic membrane (TM) mobility.

### Hearing Screening Program

Beginning in 2005, this portion of the hearing screening program was implemented over a two year period at one of two primary schools for all 1st, 3rd and

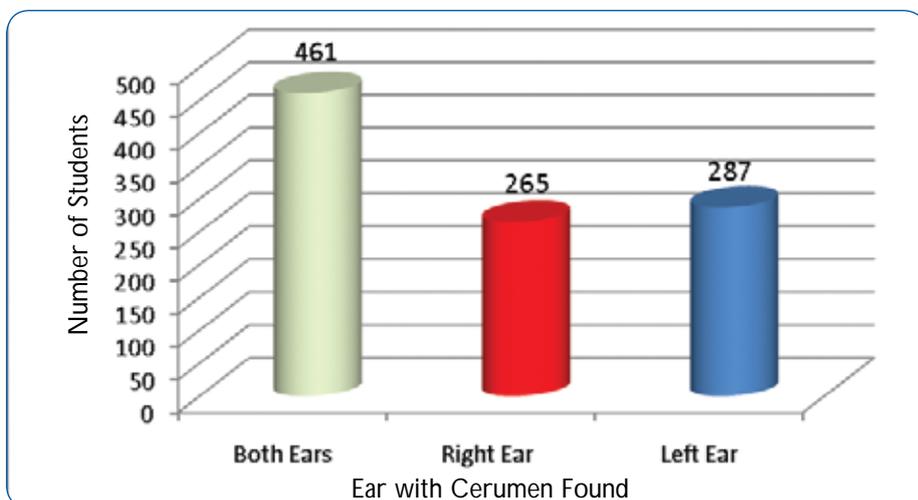


Fig. 2: Number of students with an initial finding of excessive cerumen or debris in external auditory canal via otoscopy

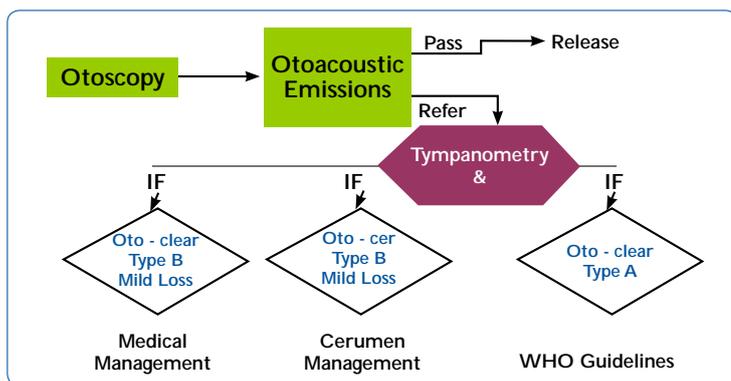


Fig. 3: Program Protocol Workflow

5th grade students (ranging in ages, 6 – 20 years old) in Maxixe, Mozambique and one pre-school (0 – 5 years old) in a neighboring community, Chicuque, Mozambique. Of the total 2685 students screened over the two year period, during an abbreviated time period in the winter season, there were 2384 children, ages 5 through 13 years of age from the primary school (Figure 1). Demographic information (i.e., student name, age, sex and grade) was provided by the classroom teachers, and screening and test results were recorded on the screening forms which the students carried through all required stations. Once concluded, the completed form was turned in by the student for programmatic data management purposes.

## Otoscopy

An initial otoscopic inspection was attempted on all students by audiologists and/or trained upper level graduate students, with notation entries made on the screening form. These entries indicated unremarkable external auditory canal (EAC) with no more than 80% occlusion ('Clear'); 80% or greater occlusion with cerumen and/or debris in EAC ('Cerumen'); and any condition that would require medical intervention, such as evidence of active drainage, abnormal EAC or tympanic membrane (TM) discoloration ('Med Tx'). Consistency and agreement of otoscopy findings were confirmed for all of the initial 50 students screened and all of the 10% random checks completed by the author. Otoscopic questions always pertained to the type of debris causing occlusion or type of potential pathology leading to medical referral. These questions had no bearing on the determination of notation category (i.e., 'Clear', 'Cerumen' or 'Med Tx').

At the initial otoscopic inspection, 1013 of the 2685 students (37.7%) were found to

have 'Cerumen' (no less than 80% occlusion) in one or both EAC (Figure 2). Almost half of the students affected with 'Cerumen', and the other half of students had nearly equal right versus left

ear affected. A total of 85 students (i.e., 3% of the total number of students screened) had notations 'Med Tx'; this is significantly less than those found with 'Cerumen' at the initial otoscopic inspection.

## Further Procedures

As shown in the protocol flow chart (Figure 3), after visual otoscopy, the number of procedures each participant would undergo was dependent upon results beginning with otoacoustic emission testing, tympanometry measures, pure tone 4 frequency air conduction hearing screening and, potentially, a diagnostic pure tone air and bone conduction threshold test.

Of interest are those students whose otoscopic evaluation notations indicated 'Med Tx'. Almost half of those students whose otoscopic evaluation resulted in 'Med Tx' were affected in the right ear only, while the other half of students had nearly equal distribution between left ear and both ears affected.

## Otoacoustic Emission (OAE) 4 Frequency Screening

Regardless of the otoscopic findings, all participants then underwent otoacoustic emission (OAE) 4 frequency screening. All participants that passed OAE for both ears handed in their screening forms and were dismissed with a clear 'pass' for the hearing screening. Those participants who twice failed the OAE screen in either ear were re-screened by a different examiner and instrument to achieve confirmation of OAE status. If a failed OAE screen ultimately occurred in either ear, a tympanogram was obtained, followed by a subsequent behavioural pure tone 4 frequency audiometric screening for both ears. Those who passed the behavioural audiometric screening at 25 dB or 40 dB HL, in at least 3 out of 4 frequencies, were dismissed and the screening form handed in with a recommendation to have their hearing checked in one year. Those who did not pass pure tone behavioural screening at 40 dB underwent a diagnostic pure tone audiological air and bone conduction threshold evaluation.

When comparing the number of students who initially failed the screening with those whose hearing loss was validated through behavioural pure tone diagnostic audiometry, it is not surprising that there was a significant decrease in numbers from the initial to the eventual final 'fail' figure (Figure 4). In fact, a total of 432 (16%) of the 2685 students failed the initial first stage OAE screening. There were 232 students who had some condition that could be attributed to their initial screening failure (Figure 5).

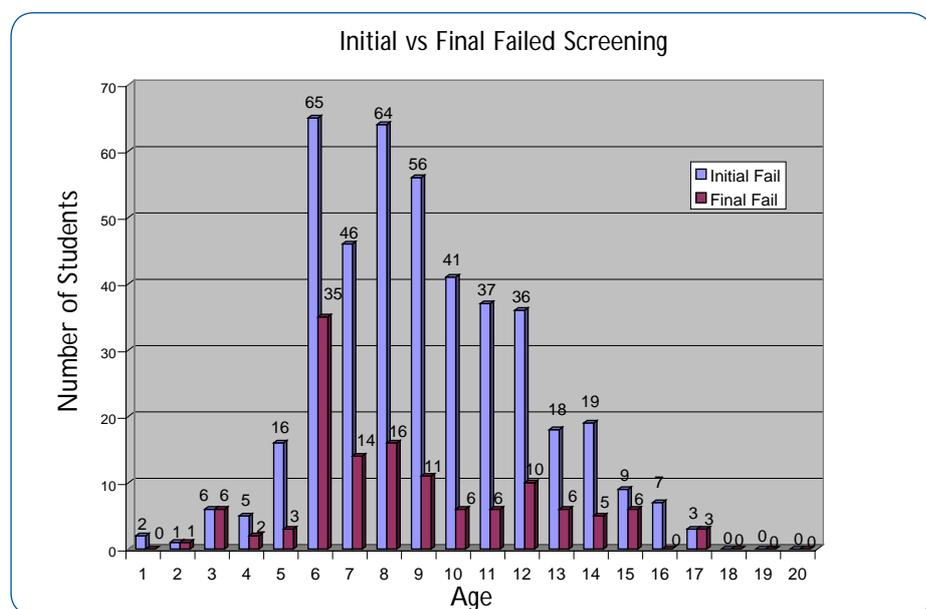


Fig. 4: Number of students with initial hearing screening failure compared to those with identified hearing loss during final testing

The most prevalent condition reported, regardless of age, was excessive cerumen, found in 154 students. A distant second was the severely restricted TM (i.e., flat tympanogram), in the absence of EAC obstruction, found in 61 students - followed by the other less prevalent active drainage condition in 23 students.

All students who failed the initial screen, in conjunction with 'Cerumen' otoscopy notation and tympanometry findings consistent with occlusion, underwent cerumen management followed by an OAE re-screening. If they passed the second screening, following cerumen management, they were dismissed. Confidence in program findings of type and degree of hearing loss increased, because the protocol allowed the pairing of otoscopic notations with tympanometric results for all students who failed the diagnostic hearing. Ultimately, 131 (5%) of the students were found to have greater than 40 dB in the better ear with varying degrees and types of hearing loss.

## Discussion

These findings are not in complete agreement with the data reported in the 1995 (WHO) report by Mozambique Health Representatives - which stated that the two most prominent causes of hearing loss in Maputo were otitis media and ototoxicity. Nor are the data in agreement with what one would find in developed countries.<sup>1,2</sup> Clearly, the most prominent factors leading to hearing loss in this current program were:

- Excessive cerumen - followed distantly by
- Severely restricted TM mobility in the absence of ear canal obstructions - and lastly
- Aural drainage.

Not only is there disparity in reports between the 1995 WHO report and this program regarding those prominent causes of hearing loss, the incidence data are likewise conflicted. The 1995 Mozambique report detailed 18.6% incidence of otitis media and 0.9% otitis media with hearing loss in a group of 1000 (5 - 16 year olds) primary school students in the capital of Mozambique (Maputo). Yet, our findings which defined middle ear deficits (i.e., restricted TM mobility or drainage) would suggest that 61 (2%) of all students exhibited hearing loss due to

restricted TM mobility and 23 (0.8%) of all students exhibited active aural drainage. When combined, 84 (3%) of all students had either active aural drainage or restricted TM mobility; these particular students were initially identified as 'Med Tx' via initial otoscopic inspection. Unfortunately, the 1995 WHO data<sup>3</sup> was not accompanied with methodological procedures and details. Nor is there any indication of whether 1995 WHO Mozambique data had any seasonal or geographic influences on student screening outcomes.

Excessive cerumen was not reported in the 1995 WHO report, however, our initial otoscopic findings of 38% 'Cerumen' in students is significantly greater than the 10% expected in a developed country paediatric context. Yet, in this program, 154 students ultimately experienced a negative impact on hearing status from the cerumen. Countless other students underwent cerumen management procedures and quite often their hearing was easily improved. Regardless of the disparity in findings in Mozambique, there is a real need to identify if there are any regional differences within the country.

As mentioned earlier, one of the Mozambique Audiology Program components aims to provide hearing and ear health care. Consequently, the necessary medical follow-up, hearing aid recommendations, and cerumen management procedures were conducted within stringent adherence to the WHO guidelines.<sup>3</sup> In fact, hearing aids were dispensed according to the WHO guidelines as

well, and the information providing the incidence of hearing loss (by degree and type) in Mozambique is detailed in an earlier report.<sup>4</sup>

## Summary

WHO guidelines<sup>3</sup> suggest that one of the purposes of any hearing health project should be to increase community awareness about hearing loss and hearing health. Some of the benefits of conducting prevalence studies include raising awareness within the community so that they seek ear and hearing health assistance. Hearing screenings can be viewed as an initial process by which groups of people are separated into those who manifest some defined trait, or those who do not. The key to prevention of hearing loss is knowledge of accurate epidemiological information on prevalence, risk factors and costs of hearing loss in the population. When launching any initiative, it is wise not only to understand the local culture but, also, become acquainted with local resource limitations and strengths. Further, any aetiologies which may be prominent contributing factors for hearing loss, such as genetic traits, otitis media, excessive cerumen, exostoses, ototoxicity, etc., should be recognised. In fact, some programs will implement an initial survey visit for logistical planning in the community, to see first-hand those challenges or resources immediately available. This means that proper equipment, personnel and instruments are brought for the actual 'identification and remediation' program which may ensue, weeks or months later, with the needs of the region incorporated.

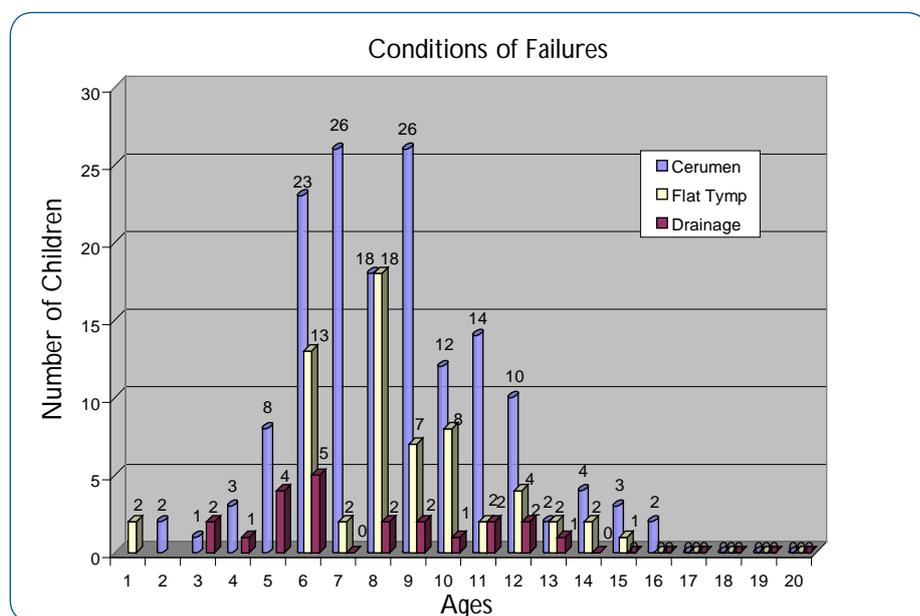


Fig. 5: Conditions affecting the hearing screening failures

# Hearing Loss in Mozambique

Results from this project confirm an ongoing need for establishing National Hearing Healthcare Programs which integrate cerumen management procedures and promote good hearing health practices – to educate individuals on the potential complications which can occur from otitis media. As discovered, the greatest contribution to hearing loss in the specific region of Maxixe Mozambique is obstruction in the external auditory canal, followed, a distant second, with medical pathology and, lastly, with sensorineural hearing loss. Knowledge of which aetiologies are particularly prevalent in a specific region or country can only be beneficial to national administrators in their plans to identify, prioritise health programs and select/monitor preventive strategies.

## Acknowledgments

Tremendous gratitude goes to Ms Rachel Wood and Dr Stephanie Cox for their invaluable diligence in accurately and methodically entering these data – and those Mozambique Audiology Team members for their such enthusiastic and willing attitudes while working on-site in ‘interesting and challenging conditions’. Many thanks are also owed to academic and industry supporters: U.T.Dallas/Callier Center; U. Witwatersrand Oak-Tree Products; Widex; Hal-Hen Company; BioLogic Corporation; GSI Viasy HealthCare; Siemens; Phonak; Starkey Foundation; Insta-Mold Products; Kessler Renata Batteries.

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## Screening for Hearing Impairment: Oman

# SCREENING FOR HEARING IMPAIRMENT IN OMAN

**Mazin Jawad J Al Khabori**  
**MBBCh FRCS (Glasgow)**

*Al-Nahda Hospital*

*ENT Services*

*Ministry of Health*

*PO Box 937, PC 112*

*Muscat*

*Oman*

Email: [nadiamaz@omantel.net.om](mailto:nadiamaz@omantel.net.om)

Oman is a country with a population of 2.44 million of which 1.77 million are Omani and the rest are people from other countries.<sup>1</sup> Oman is situated in the southern part of the Gulf peninsula and has an area of 309,500 square kilometres. It is a member country of the Eastern Mediterranean Region of the World Health Organization.

Rapid socio-economic developments from 1970 placed Oman among group ‘B’ countries in the WHO classification, based on mortality data.<sup>2</sup> Health strategies, such as an emphasis on the primary health care approach, optimum utilisation of health services, community participation, easy access to health services, etc., placed Oman among the top five countries of the WHO member countries for health service utilisation.<sup>3</sup>

### Health Care of Children

High coverage of immunisation of children, antenatal care and a special

emphasis on an organised approach to the control of diseases have resulted in a marked decline in communicable diseases in Oman.<sup>4</sup> Health information regarding the newborn is compiled and recorded in the child health register. The reporting of childbirth is mandatory in Oman. More than 95% of the births take place in hospitals. To achieve the objective of improving quality of life, the national health program stressed early detection and care of children with special needs.

Hearing loss is one of the priority health problems in Oman since 1995.<sup>5</sup> This health care emphasis was justified in 2000, when hearing impairment was found to be one of the leading causes of disease burden in Oman.<sup>6</sup> A community based prevalence study on blindness and deafness, conducted in 1996, suggested that the national prevalence of hearing impairment was 5.5%, of which 2% was of a disabling grade.<sup>7</sup> Unfortunately, information regarding hearing impairment among less than one year old children was not possible in the survey. Since 1995, the ear health care program introduced standard procedures for common diseases causing deafness.<sup>8</sup>



*ENT examination in the deafness clinic*

*Photo: Mazin Jawad J Al Khabori*

In 2001, the ear health care program in Oman introduced hearing screening for the newborn,<sup>9</sup> as a policy in the sixth Five Year Health Plan.

The Ministry of Health is divided administratively into nine regions. Al-Nahdha Hospital is the only tertiary centre with advanced diagnostic audiology services. Health staff in the maternity or paediatric wards, and the ENT department of the Ministry of Health, are trained in screening. Further periodic training is carried out by the ENT specialists of the regional hospitals. A protocol outlining the screening, referring and defaulter retrieval procedures is prepared and distributed to all regions. The regional ear care health managers

supervise the implementation in their respective regions.

## Screening for Hearing Impairment

Hearing screening is performed in two stages. In Stage One, the nurse of the maternity or paediatric department uses the equipment to test hearing, usually between 24 to 48 hours from the time of birth of the baby. Those with failed test results are tested again before mother and infant leave the maternity ward. If hearing impairment is suspected, the newborn child is referred to the ENT staff of the same hospital. The ENT surgeons examine the infant for ear malformations. The ENT doctors repeat the second level screening test after six weeks. Those who fail the second level screening test are referred to the audiology unit at Al-Nahdha Hospital in Muscat for Stage Two. Appointments are arranged online through the medical records of the regional hospitals and the medical records at Al-Nahdha Hospital. The parents take their child to the tertiary centre where the hearing screening test is repeated and, in case of failure, the newborns are given an Auditory Brainstem Response (ABR) test. If the child is found to have a sensorineural hearing loss, an appropriate hearing aid or cochlear implant is prescribed.

The monthly progress of the screening and the list of neonates suspected of having hearing impairment are reported through the health information system. The data are cross-checked at regional and national levels by the ear care managers. The regional ear care team monitors the coverage, defaulter retrieval and feedback system from the rehabilitation centre. The data on the coverage of screening at different levels, equipment malfunction and care of neonates with hearing impairment are presented annually by regions at national ear care meetings.

The types of devices used are variable but all are internationally available on the market. As mentioned, the staff is given training on the use of equipment and the local agent is always available, if any technical assistance is required.

Theoretically, the program should run smoothly but there are various practical problems which we have had - some of which we are still facing. This results in less than 95% universal coverage.

The health services, mentioned earlier, are delivered by regional authorities. Local health authorities have to run various other health programs and hearing impairment is not always at the top of priority lists. Therefore, purchase of an adequate number of machines is delayed. Further, repair and procurements of disposable parts (tips, etc.) goes through a long process, full of bureaucracy - and many babies are missed.

The ownership of the machine was initially given to the maternity wards. However, some staff initially refused to cooperate, quoting, 'not our job', but were finally persuaded - only after the obstetricians were absolved of responsibility. In some hospitals, the neonatologist took over the machine and carried out screening according to their own criteria, saying, 'they know better'. Usually, they would only screen targeted, high risk babies.

Some regional health directors had to be given a special presentation on the efficacy and importance of Universal Newborn Hearing Screening, as they had been told that it is inefficient and costly.

Recently, the Mother and Child Care program was given the responsibility of conducting the screening program in collaboration with the Ear Care program.

Regions which have taken on Universal Newborn Hearing Screening (UNHS) report more than 95% yearly coverage (actually one region, Musundam, reported 110% coverage as some families

from the adjacent United Arab Emirates came for the screening), but others can report less than 50% coverage. However, the trend is improving after intensive discussions and involvement of the authorities at central level in the Ministry of Health. The target for all health authorities for the coming seventh Five Year Plan for UNHS is 100%.

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Speech therapy

Photo: Mazin Jawad J Al Khabori

## NATIONAL NEWBORN HEARING SCREENING PROGRAM IN MEXICO

**Pedro Berruecos MD**

Head, Audiology and  
Phoniatrics Department  
Coordinator of the National  
NHSP in Mexico  
General Hospital of Mexico  
Ministry of Health  
National University of Mexico

Email: kefasmex@yahoo.com

### Historical Background

From the pre-hispanic period (before 1521), we can find references to hearing, deafness and muteness in the *náhuatl* literature.<sup>1</sup> The word 'Tlacaquiliztli' means the action of hearing and correlates sounds with mind, sense, imagination, behaviour or ethical disposition. 'Nontli' was muteness and language and was so important that the word 'náhuatl' means 'skilled' or 'astute' but, also, 'everything that sounds good'.

In the colonial period (1521-1810), many laws were issued about the civic rights of deaf people, but these were limited because of their lack of language. In the independent period, President Juarez founded the National School for the Deaf (1861). In the 20th Century, only eight years after the word 'Audiology' was coined in 1945 by Carhart and Canfield, the Ministry of Health founded



Learning the use of portable equipment  
Photos: Pedro Berruecos

the National Institute of Audiology in 1953. In spite of this important historical fact, and the development of the specialty, nowadays recognised as one of the postgraduate medical residencies in our National University, there was no government policy for a National Newborn Hearing Screening (NHS) program in Mexico - until now.

### The First Steps

A survey of more than 2000 parents of deaf children all over Mexico<sup>2</sup> showed significant delay in early identification, diagnosis and intervention, where hearing impairment was concerned. The results of another survey directed at General Practitioners and MDs, in the process of specialisation,<sup>3,4</sup> clearly demonstrated the lack of knowledge and commitment and, also, inappropriate attitudes of medical personnel in relation to the three prevention levels of hearing impairment.

The first real attempt to carry out a NHS program started in the General Hospital of Mexico (GHM) in 1999, but only in 2003 was it formally established with the acquisition of portable screening equipment. Later, the Health Department of the State of Nayarit started a NHS protocol in several hospitals of the State but, in the country as a whole, we know that there are isolated attempts to start a program in no more than 10-15 hospitals.

After much lobbying and persuasion, it was possible to achieve an important change in the Federal Law of Health.<sup>5</sup> Taking advantage of relevant arguments, including the fact that Neonatal Metabolic Screening, but not the NHS, was established in a federal program, named 'Equality at the Beginning of Life'. Article 61 was modified in February, 2005. The actual text emphasises the



Teaching the use of portable NHS equipment  
Photo: Pedro Berruecos

priority of the '...early identification and treatment of deafness in all its degrees since the first days after birth...'

### Actual Situation

A new government administration started in Mexico in December, 2006. One of its main publicised programs is the so-called, 'Universal Insurance for a New Generation', included in the National Health Plan, 2007-2012. This includes the National Program of Hearing Health, which comprises the NHS, the screening and diagnosis of school-aged children and elderly persons, the provision of hearing aids and cochlear implants and the training of specialised personnel in the medical and the auditory-verbal therapy fields.

### Challenges for the NHS Program in the Five-year Period, 2007-2012

Around 1.8 million children are born in Mexico each year and so, at least 1,800-2,700 are hearing impaired. Accordingly, in the mentioned period it will be necessary to perform NHS on 9 million babies,

**Table 1: No. of Births in Medical Units of the Ministry of Health**

Medical Birthing Units (Ministry of Health)	No. of Births (2005)	%
1-100	425,987	62.94
1-150	520,551	76.91
1-200	584,139	86.31
1-250	628,120	92.80
<b>Total of 404</b>	<b>676,781</b>	<b>100.00</b>

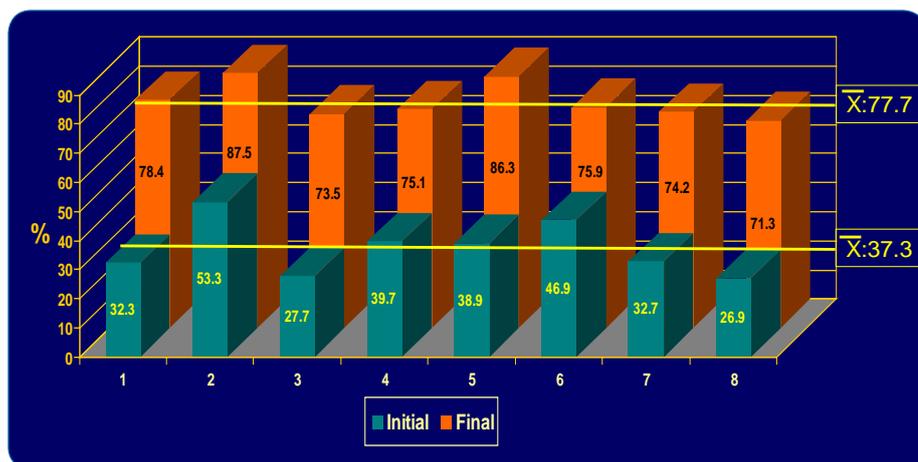


Fig. 1: Average of right answers. Comparison of initial and final tests. Training groups 1-8

18,000-27,000 specialised diagnostic procedures on the NHS positive cases, the provision of 30,000 hearing aids and 1,800-3,600 cochlear implants to bilateral and profoundly hearing impaired children. Auditory-verbal therapy will be required for 18,000 children.

To face the challenge, the Ministry of Health decided to start a comprehensive program, limited at the beginning to the hospitals belonging to the federal administration, i.e., around 35-40% of the total number forming the health coverage in the country. The rest are served by the social security system and private institutions.

## Operational Considerations

The Ministry of Health is in charge of more than 20,000 health units. There are 1,200 second and third level units and 404 birthing hospitals all over the country. Table I shows the number of births in the units with the highest number of deliveries: the first 100, 150, 200 and 250 from the total of 404.<sup>6</sup>

Based on these figures and cost/benefit considerations, it was decided:

- To train 3 persons (MDs, paediatricians or paediatric nurses) from each one of the first 200 hospitals (600 persons) that cover almost 90% of newborns. We underline that these 200 hospitals are located in all the 32 States of Mexico.
- To put the acquisition of 200 NHS and 60 items of equipment for diagnosis out to tender.
- To increase the training of personnel to carry out hearing aid fitting, cochlear implant and auditory-verbal therapy programs.

- To acquire the software to follow-up the identified, diagnosed and treated children until their inclusion into normal education systems.
- To refine reference-contra reference systems by State, to cover the children born outside the hospitals with NHS programs.

## National Program for Training of NHS Personnel

The last four programs stated above are in their first steps. Meanwhile, the training of personnel for the NHS began in March 2008 and has made great progress. The General Hospital of Mexico was appointed as the host hospital, because it is one of the first ten by number of births in Mexico and, also, because of its well-known NHS program that covers nearly 95% of the neonates. The neighbouring Children's Hospital collaborates in the practical activities.

Around 75% of the personnel sent by the hospitals are paediatric nurses. The two day training course starts with an initial assessment, using the 30 Lickert Scale open or multiple-choice questions, about the subjects that will be presented in the course. Then, the importance of hearing; prevalence, causes, types, and degrees of hearing impairment and impact of deafness; a NHS protocol model; the statements of the NHS Mexican Consensus; the simplicity, non-invasiveness, quickness, reliability and cost-efficiency characteristics of NHS and the widely available possibilities for an early and integral diagnosis and intervention - are emphasised.

About 75% of the course is practical. We use our own equipment and the ones provided by Gradson-Stadler and



Screening of babies during the training program

Photos: Pedro Berruecos

Madsen representatives, with a total of eleven items of equipment. That is, one for each 2-3 participants. Firstly, we teach how to operate the equipment, then, the trainees practice OAE (oto-acoustic emissions) and AABR (automated auditory brainstem response) tests among

**Table 2: Summary; Eight Groups Trained, 3 March to 20 May 2008**

Participant States	No. of Hospitals	No. of Trainees
Aguascalientes	2	5
Baja California Sur	1	4
Colima	3	8
Chiapas	4	10
Chihuahua	12	24
D. F. (HNH, GEA, HJM, ABC)	4	21
Estado de México	1	4
Guanajuato	12	30
Guerrero	5	11
Jalisco	12	25
Michoacán	5	5
Morelos	3	9
Nuevo León	2	4
Oaxaca	1	2
Querétaro	4	12
San Luis Potosí	4	11
Sinaloa	1	3
Tabasco	1	1
Tlaxcala	5	15
Veracruz	2	5
Zacatecas	2	7
<b>21 States</b>	<b>86</b>	<b>216</b>

themselves. They observe the NHS in the Audiology/Neonatology Departments, carry out the NHS with babies and learn how to manage the obtained data. A discussion on the NHS protocol and the Mexican Consensus statements precedes the final examination, with the same test used as before (the Lickert scale), which allows us to evaluate the improvement of knowledge and attitudes towards the hearing impaired and NHS.

Table 2 lists the States and hospitals represented and the number of people trained, until May 20, 2008. The preliminary analysis of the results in the initial and final examinations, shows an important performance improvement by the participants. The average of the 8 groups, already trained, is around 40%, in spite of the fact that in Figure 1 we show the high rate of right answers in percentage terms for certain questions in the initial test. In addition, it was interesting that comparing the physicians' and nurses' performances there are no significant differences and that, in some questions, nurses perform better than physicians. If we take into account that, without doubt, nurses are always nearer to mothers and babies and their continuance in the hospital setting, it was seriously

planned to provide them with a role in the National NHS Program.

## Conclusion

Besides this training program, considered as the NHS National Program cornerstone, we are working in other important prevention areas: genetics and deafness and the 'Weeks of Hearing Health'. This includes wide information, screening, diagnosis and intervention in school-aged and elderly hearing impaired people. In addition, our proposal to add a one-week educational module, centred on hearing impairment and deafness, to the study program of the medical curriculum was recently approved by the Technical Council of the Faculty of Medicine<sup>7</sup> and already started with 120 pre-graduate, internship students in the General Hospital of Mexico.

We are optimistic because after many years of placing particular emphasis on the importance of NHS, there are now well conceived, real and supported national programs. This initial step by the Ministry of Health will be followed, in the short term, by the Social Security institutions and so we hope to be

ready soon to convey important achievements to the audiological community. We are convinced that, in this way, we are contributing to the decrease or elimination of the consequences of hearing impairment in terms of damage, dysfunction, impairment or disability, and taking steps to achieve, more effectively, the aims of the three prevention levels in our field.

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*Learning the use of portable equipment*

*Photo: Pedro Berruecos*

## HEARING IMPAIRMENT AND NEWBORN HEARING SCREENING IN COSTA RICA

Juan J Madriz MD (Costa Rica)

ORL-Audiology Department  
National Children's Hospital  
Costa Rican Social Security  
San Jose  
Costa Rica

### Background

Costa Rica is a small country located in Central America, west of Panama, with a population of 4 million people and land area of only 52,000km<sup>2</sup>. This description certainly suggests an ideal and concentrated scenario for any kind of pilot program, health care orientated initiative or epidemiology research project, considering also the country's unusual characteristics for a Latin American and a 'Third World' country.

Believe it or not, we are talking here of a nation with no army – the Costa Rican Army was banned by Constitution in 1949 – and with the longest history of democratic and institutional governance among all Latin American countries in the last 100 years.

Costa Rica indicators show a life expectancy at birth of 79 years,<sup>1</sup> an infant mortality rate of 9 per every 1000 live births, a literacy rate of 95%,<sup>2</sup> a GDP per capita income of \$6,700 USD<sup>3</sup> – compared with \$44,000 for the USA and \$35,600 for Canada – and 99% of births in the country are attended by medical staff in hospitals.<sup>2</sup> The country serves its citizens with a broad coverage in health care services provided by the Costa Rican Social Security and the Ministry of Health, involving almost 95% of the entire population. Medical facilities exist at a reasonable distance from most population centres, and acceptable roads and communications ensure that people have medical and educational services, preventive programs and other government services within reach.

Without military expenditure, Costa Rica has been able, over the years, to invest in health and education, and the results are supported by the health indicators we just reviewed. Costa Rica's health system is a model for the region and Costa Ricans are proud of their achievement in human and social development.



Costa Rica delegation at St. Louis, Missouri, USA

Photo: Juan Madriz

### Audiology in Costa Rica

Unfortunately, the world of hearing and deafness has not been able to evolve at the same pace as other medical developments in this 'wonder' nation... and many problems and flaws hamper excellence and quality of services in the audiological scenario.

To begin with, ENT doctors do not have a strong component of audiology in their ORL Specialty training. Audiology testing, in general, is performed by modestly trained technicians in audiometry and all efforts to improve and professionalise audiology in the past years have been limited. Currently, in the hands of profit-orientated and not necessarily academically driven 'private' universities, the preparation of human resources in audiology is poor and, unfortunately, in the hands of hearing aid dealers.

Due to the lack of medical leadership and of committed interest by the institutions involved, the situation requires some organisation. For a country that provides hearing aids free to patients, involving a very high yearly cost for Social Security, it is sad to realise, as an example, that the lack of controls makes it possible for the same patient to receive two or three pairs of hearing aids, prescribed in different medical centres, without any awareness of what is happening at the central institutional level. Paediatric audiological testing is limited, mostly

to very young babies and difficult-to-test or multi-handicapped children. The recent Cochlear Implant Program has been challenged by the absence of teachers for the deaf, who know how to teach a deaf child to speak. Sign language has totally taken over the education of the deaf in Costa Rica in the last 20 years, and the Ministry of Education does not have any professionals in speech therapy and deaf education who know how to teach language to a deaf child, by auditory-verbal means. Limitations and lack of operational norms are common.

### Prevalence of Hearing Impairment in Children in Costa Rica

The previously described conditions facilitated the conduction of the First National Prevalence of Hearing Impairment in Children in 1995-1997.<sup>4</sup> The study was sponsored by the Ministry of Health and the University of Costa Rica, and enjoyed the support of international institutions like the Hearing Research Council (HRC) at the University of Nottingham (UK), the National Institute on Deafness and Hearing Impairment from the National Institutes of Health of the USA (NIDCD-NIH), Dalhousie University from Canada, the Ethymotic Foundation, the Starkey Foundation and the physical presence, as co-investigator, of Professor George T Mencher, Director of the Nova Scotia Hearing and Speech Clinic in Halifax (Canada)

and Professor of Audiology at Dalhousie. This research became the first ever, true 'national' investigation on epidemiology of sensorineural hearing impairment in the developing world and showed interesting conclusions, which might be extrapolated to other countries in the region. The study included a sample of 12,500 primary school children (second graders – approximately 8 years of age) from 250 elementary schools throughout the country. A questionnaire was applied to all deaf children (700+) enrolled in the country's Schools for the Deaf and known by the Ministry of Education of Costa Rica. The database generated from this research provided many interesting findings.

The literature has always expressed the view that hearing impairment in developing nations can be expected to be anywhere between 2 to 6 profoundly deaf per 1000 live births.<sup>5</sup> The estimated prevalence of profound deafness from our study suggested 1.5 profoundly deaf children per 1000 live births, a much lower figure than the prediction for a developing nation like Costa Rica. In 2002, a study of incidence of hearing impairment, concentrated on those Costa Ricans born in 1988 – a peak of hearing impairment detected in the original study, showed 2/1000 live births, corresponding to an outbreak of rubella in that particular year. The causes of diagnosed deafness in 1996 showed that rubella, meningitis and perinatal complications were prevalent. A new review done at the National Children's Hospital of Costa Rica, in 2006, showed a significant change in the aetiology profile. In this study, unknown aetiology (40%) and

perinatal complications (33%) accounted for the majority of cases. The remaining 33% included familial/congenital deafness (8%), syndromes and genetic conditions (10%) and cytomegalovirus (CMV) accounting for the most frequent ToRCHS\* infection, instead of rubella. The assessment of the epidemiology of hearing impairment in Costa Rica has been a valuable achievement, in a country where research is a luxury very difficult to fund.

## Newborn Hearing Screening: A Pilot Program

In 2006, as an initiative from the newly appointed Minister of Health, Dr. Maria Luisa Avila, political will and resources were allocated to establish a national program of early identification of hearing disorders in the newborn (DITS: Detection and Early Intervention on Newborn Deafness). The visit to Costa Rica, in February of that year, of a team of consultants: Dr Karl R White, Director of the U.S. National Center for Hearing Assessment and Management, Dr Louis Z Cooper, Professor Emeritus of Pediatrics from Columbia University and Dr Karen Munoz, Assistant Director of The Speech-Language-Hearing Clinic from Northern Illinois University, sparked the initiative to develop a pilot program in the country. The enthusiastic and hard-working role of a young ENT doctor, Dr Sebastian Malek, must be commended and, after several exploratory meetings, a project document was conceived and drafted. A program of observation and study visits started in early 2007, when a delegation of Costa Rican ENT Specialists, Physicians in Audiology and Physician Neonatologists, visited the city of St. Louis, Missouri, and had the opportunity of seeing how the U.S. program worked. Visits to the School for the Deaf and to the Central Institute for the Deaf complemented the tour, allowing the delegates to consider the needs of the project and the appropriate speech rehabilitation personnel who should be trained.

The pilot program involves the different known and well-identified components of such initiatives, and will be started in 2009 in two maternity wards, in two of

the largest hospitals in the San Jose, the capital city. Two Diagnostic Reference Centers will be involved for final referral of those children identified by the program, namely the National Children's Hospital and the Mexico Hospital, and a complex timetable of step-by-step referral has already started. The provisions contained in the 2007 Principles and Guidelines for Early Hearing Detection and Intervention Programs<sup>6</sup> were taken into consideration for the draft. The training of the audiology personnel, who will carry out screening will take place in the month of November 2008.

The program will involve a conventional flowchart of two screening sessions, followed by confirmation of the medical-audiology-otology conditions in those identified by diagnostic testing, and referred to management and intervention. Screening, depending on the Center, will be made by otoacoustic emission or Auditory Brainstem Response (ABR) screening. The data management within the DITS program will be adapted to a HITRACK 4 Windows Data Management System, with the technical support and guidance of the International Consulting Team. With the intention of obtaining non-governmental support for the program, a NGO (ADIS: Association for Detection and Intervention in Deafness) was created, with the hope of managing private funding and initiatives that may otherwise encounter bureaucratic processing interference or delay. The program has created high expectation, although it is clear that much still needs to be achieved before it can be expanded to a nation-wide level. But an important step has been taken.

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\*ToRCHS = toxoplasmosis: rubella: cytomegalic inclusion disease (CID, EMV): herpes: syphilis



Screening of infants in San Jose, Costa Rica

Photo: Juan Madriz

# TINNITUS RETRAINING THERAPY: CLINICAL GUIDELINES

**James A Henry, Dennis R Trune,  
Michael J A Robb,  
Pawel J Jastreboff**

*San Diego, Plural  
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*Plural Publishing Inc.  
5521 Ruffin Road  
San Diego  
CA 92123  
USA*

**Email:**  
[information@pluralpublishing.com](mailto:information@pluralpublishing.com)

I have found this book to be an excellent resource for teaching clinicians and therapists wishing to practice **tinnitus retraining therapy** (TRT). The book is in three parts.

In Part 1 of the book, the authors have addressed the concepts of the neurophysiological model of tinnitus, consciousness and directed attention, the emotional responses that can be produced by subconscious processes, as explained by conditioned reflexes and non-conscious learning. These principles are important for the proper implementation of TRT, which is based upon shifting brain focus away from the tinnitus neural signal and processing it as an irrelevant auditory signal. The objectives of TRT are to reduce the amount of tinnitus annoyance to the patient ('habituation of tinnitus reaction') and to reduce attention to tinnitus perception ('habituation of tinnitus perception').

In Part 2 of the book, the authors discuss the causes behind the poor management of tinnitus patients in practice. It is the diversity of different health care professions that are involved in dealing with tinnitus patients which leads to an absence of consensus concerning management in tinnitus cases, and in standardised guidelines. Otolaryngology, Otolology, Neurotology, Audiology, Psychiatry and Psychology are examples of the different specialties that manage tinnitus patients - with Otolaryngology/ Otolology, Psychology and Audiology being the most common professions involved. Accordingly, all referrals of tinnitus patients seem largely to reflect

the profession's views. The authors suggest that, instead, the referral guidelines must address the needs of the tinnitus patient.

Although there is a debate between the different professions commonly involved in managing tinnitus on the question of which profession should provide health care for tinnitus patients, the authors consider that it should be a 'true multidisciplinary approach that enables tinnitus patients to undergo appropriate medical, psychological and audiological evaluations'. So treatment will be by a mixture of these different professions. A qualified audiologist can provide the primary clinical services to the tinnitus patient, independently or together, with a psychologist or psychiatrist. The physician must learn to differentiate between the two types of tinnitus, a sensory-neural tinnitus, most commonly of neurophysiological origin and not correctable surgically nor life threatening, and somatic sounds that are generated from vascular, muscular or respiratory sources and are correctable surgically. In each instance, questionnaires are available to identify the patients who need help. Post-traumatic stress disorder, that can be present in any patient, must not be ignored when treating a tinnitus patient as, if it goes unrecognised, it may impair the results of treatment.

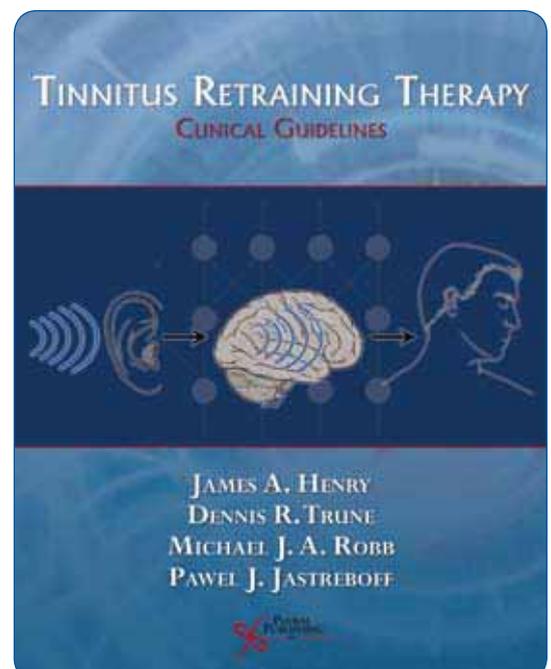
Part 2 of this book provides the clinicians with thorough detailed information on appropriate counseling and assessment of tinnitus patients. The authors recommend the Tinnitus Handicap Inventory (THI) questionnaire, as a self-report to reveal the severity of the condition. The THI has some limitations that over or under estimate the effect of tinnitus on patients' lives. To overcome these limitations, the authors add rating subscales that cover depression, anxiety, sleep disorder and life quality. Treatment with TRT includes the initial interview, audiological assessment and then the assignment of patients to one of the five categories (0, 1, 2, 3, 4),

that are used as a general guide for treatment.

Part 3 discusses the guidelines for TRT 'directive and non-directive counseling and treatments'. It includes treatment of decreased sound tolerance. The Directive Counseling Protocol includes fitting of ear-level devices (sound generators or combination instruments) for a patient's categories (1-4) and presents extensive information in the form of graphics and written scripts. All this information and illustrations are contained in the book (Tinnitus Retraining Therapy: Patient Counseling Guide) that is a supplement to the present book. The second book is a double sided resource with information one-on-one for the patient and clinician. When anxiety or depression is present in tinnitus patients, then treatment must be provided by a mental health provider. Insomnia may present in patients with severe tinnitus and might require referral to a sleep disorders clinic.

I recommend this academic training book for clinicians who need a compassionate, unhurried way of managing tinnitus patients successfully.

**Afaf Bamanie**  
*King Abdulaziz University  
Jeddah  
Saudi Arabia*



## Causes of childhood deafness in Pukhtoonkhwa Province of Pakistan and the role of consanguinity

Sajjad M, Khattak AA, Bunn JE, Mackenzie I

Child and Reproductive Health Group  
Liverpool School of Tropical Medicine  
UK

**Background:** Deafness is the hidden disability of childhood, and leads to poor educational and employment prospects. There is little published information on deafness in Pakistan. Profound hearing impairment is more prevalent in countries where consanguineous marriages are common, such as Pakistan. This study aimed to assess causes of childhood deafness and association with parental consanguinity, within deaf and hearing children in the Peshawar district of Pukhtoonkhwa Province, Pakistan.

**Methods:** One hundred and forty deaf children were identified from two schools for deaf children within the Peshawar district. These children were assessed

via audiology, otoscopic examination, case note review and parental history, in order to attempt to ascertain the cause of their deafness. Two hundred and twenty-one attendees at a local immunisation clinic (taken as representative of the local childhood population) were also screened for hearing impairment. Parents of both groups of children were assessed by interview and questionnaire in order to ascertain the mother and father's family relationship (i.e., whether cousins or unrelated).

**Results:** Of the 140 deaf school pupils, 92.1 per cent were profoundly hearing impaired and 7.9 per cent were severely hearing impaired. All these children had bilateral sensorineural hearing loss. A possible cause of deafness was identified in only six of these children. Parental consanguinity (i.e., first or second cousins) was established for 86.4 per cent of deaf school pupils and 59.7 per cent of

immunisation clinic attendees. None of the control children were identified as having a hearing problem.

**Conclusion:** The prevalence of parental consanguinity was significantly higher in deaf children compared with non-hearing impaired children. However, the study also confirmed a high rate of consanguinity within the general Peshawar community. In this setting, prevention of consanguineous unions is the only means of reducing levels of congenital hearing impairment. The current levels of hearing disability represent both a prominent public health problem and an important, potentially preventable childhood disability.

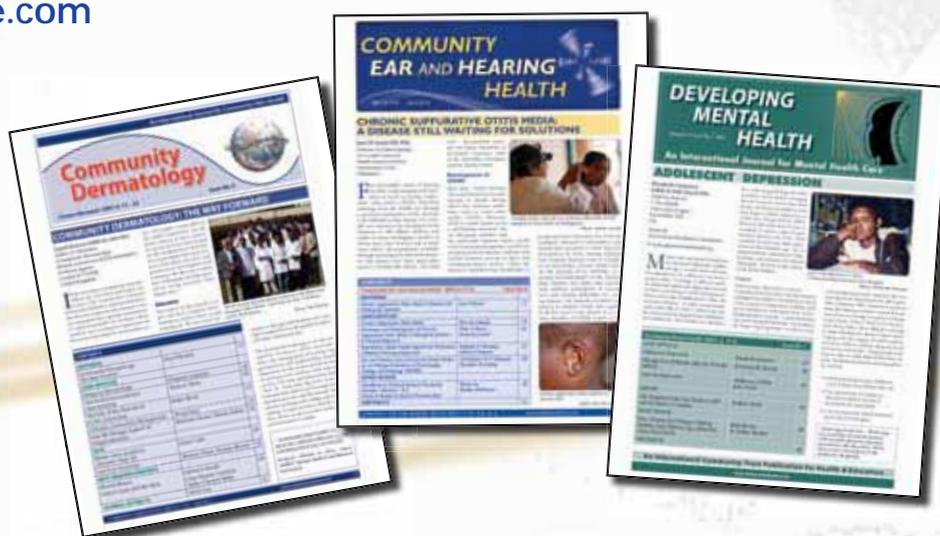
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**Tel:** +44 (0)141 332 1707  
**E-mail:** [info@icthesworldcare.com](mailto:info@icthesworldcare.com)

**Please state:** Name, Full Postal Address, E-mail Address & Occupation

- *Community Ear and Hearing Health*
  - *Developing Mental Health*
  - *Community Dermatology*

## Which children would benefit most from tympanostomy tubes (grommets)? A personal evidence-based review

Lous J

Department of General Practice  
Institute of Public Health  
University of Southern  
J.B. Winslows Vej 9A  
5000 Odense C  
Denmark

Otitis media with effusion (OME) is a common condition in young children. OME causes some hearing loss, and can cause permanent changes in the tympanic membrane as well as other symptoms. In most cases, OME is of short duration. As long-lasting bilateral OME for decades has been associated with delayed cognitive and language development, parents

and ENT specialists have a positive attitude towards treatment with tympanostomy tubes (TT).

**Method:** This personal evidence-based review is built on own observations and research combined with newer studies and guidelines.

**Results:** The review argues for a relatively restrictive treatment policy concerning the use of TT in children with OME without signs or symptoms of impaired social or linguistic function.

**Conclusion:** Six months with bilateral OME and significant hearing loss should be present before treatment with TT in otherwise healthy children. At the

moment we have no evidence for the subgroups of children excluded from the RCTs, i.e., children with speech/language delays, behaviour and learning problems, or syndromes. Clinicians will need to make their own decisions regarding treatment of such children. The situation just now is that some children are over-treated and some are under-treated. There is an urgent need for prospective cohort studies and randomised studies on children with long-lasting OME in an attempt to characterise the children who would benefit most from TT.

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## A systematic review of the interventions to promote the wearing of hearing protection

El Dib RP, Atallah AN, Andriolo RB, Soares BG, Verbeek J

Universidade Federal de Sao Paulo  
Sao Paulo  
Brazil

Email: re.lucci@terra.com.br

**Context and Objective:** Noise-induced hearing loss can only be prevented by eliminating or lowering noise exposure levels. When the source of the noise cannot be eliminated, workers have to rely on hearing protection equipment. The aim here was to summarize the evidence for the effectiveness of interventions to enhance the wearing of hearing protection among workers exposed to noise in the workplace.

**Data Source:** Studies with random assignment were identified by an electronic search of the medical literature up to 2005. Data were double-entered into the Review Manager software, version 4.2.5.

**Data Synthesis:** Two studies were found. A computer-based intervention tailored to individual workers risks and lasting 30 minutes was not found to be more effective than a video providing general information for workers. A second randomized controlled trial evaluated the effect of a four-year school-based hearing loss prevention program among schoolchildren working on their parents farms. The intervention group was twice as likely to wear some kind of hearing protection as was the control group

(which received only minimal intervention).

**Reviewers' Conclusions:** The limited evidence does not show whether tailored interventions are more or less effective than general interventions among workers, 80% of whom already use hearing protection. Long-lasting school-based interventions may increase the use of hearing protection substantially. Better interventions to enhance the use of hearing protection need to be developed and evaluated in order to increase the prevention of noise-induced hearing loss among workers.

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## Clinical features of benign paroxysmal positional vertigo in Western Turkey

Celebisoy N, Polat F, Akyurekli O

Department of Neurology  
Ege University Medical School  
Bornova  
Turkey

Email: nese.celebisoy@ege.edu.tr

**Background:** It was the aim of this study to analyze the clinical manifestations, the incidence of each variant and the co-morbid conditions of benign paroxysmal positional vertigo (BPPV) as well as the response to treatment.

**Methods:** One hundred and fifty-seven patients with BPPV were reviewed

prospectively. An extensive neurotologic examination was performed. All patients were treated with an appropriate canalith repositioning maneuver (CRM).

**Results:** In 138 patients, the posterior canal (PC) was involved, in 14 patients, the horizontal canal (HC), in 2 patients, the anterior canal (AC), and in 3 patients, both the PC and HC. A history of head trauma was identified in 17 patients. In 1 patient, sensorineural hearing loss on the affected side and, in another, bilateral peripheral vestibular loss was present. A history of migraine was reported in 21 cases. A resolution attributable to the

first CRM was achieved in 132 patients.

**Conclusions:** PC involvement was the most frequent type, constituting 87.9% of all BPPV cases. HC, AC and mixed canal types were relatively rare constituting 8.9, 1.3 and 1.9% of the cases, respectively. Response to the first CRM was recorded in 84.1%. Association with migraine was recorded in 13.4% of the patients.

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[fastplate@cytanet.com.cy](mailto:fastplate@cytanet.com.cy)

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**Hearing impairment - technological advances and insights**

O'Leary S, Chang A

Melbourne University Department of  
Otolaryngology  
Royal Victorian Eye and Ear Hospital  
East Melbourne  
Victoria  
AustraliaEmail: [sjoleary@unimelb.edu.au](mailto:sjoleary@unimelb.edu.au)**Background:** The treatment of hearing impairment is rapidly evolving. Despite this, a significant number of adults with hearing impairment receive inadequate treatment or rehabilitation, resulting in functional impairment and social isolation.**Objective:** This article outlines the available options and recent advances in the treatment of hearing impairment.**Discussion:** Severe to profoundly hearing impaired individuals of any age, including infants and geriatric patients,

are now considered as candidates for cochlear implant surgery, rather than only the profoundly hearing impaired. Until recently, cochlear implant surgery led to the loss of all natural hearing in the implanted ear, but emerging technology now provides the potential for combining natural hearing and cochlear implant function within the same ear. There is now recognition of the need to treat both ears, combining two cochlear implants and/or hearing aids. Treatment options for conductive and less severe sensorineural hearing loss have expanded, with the osseointegrated hearing prosthesis providing new alternatives for individuals with microtia and canal atresia, single sided deafness, or when corrective surgery or a hearing aid are problematic.

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- To promote ear and hearing health in developing countries

**Objectives**

- To facilitate continuing education for all levels of health worker, particularly in developing countries
- To provide a forum for the exchange of ideas, experience and information in order to encourage improvements in the delivery of ear and hearing health care and rehabilitation.

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ICTHES World Care, PO BOX 4101, Glasgow G4 7BX, Scotland, UK

Tel: +44 (0)141 332 1707

E-mail: [m.mcgavin@ictesworldcare.com](mailto:m.mcgavin@ictesworldcare.com) or [andrew.smith@lshtm.ac.uk](mailto:andrew.smith@lshtm.ac.uk)© *Community Ear and Hearing Health*

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