HEAL 2014

HEaring Across the Lifespan

June 5-7, 2014
Cernobbio (Lake Como), Italy

Programme
The Como Conferences have become the place where a broad community investigating all components of hearing care across the life course work together to merge contemporary research findings with cutting-edge clinical practice and vice versa. Once again, presentations and Special Sessions this year cover an overall mixture of topics including basic research on mechanisms of hearing and hearing dysfunction, medical issues related to protocols implementation and patient management, psychosocial effects, as well as clinical decision making, quality assurance, and health policies.

The organizers of HEAL 2014 wish all delegates enjoy the opportunity to meet and share their latest research and clinical information, enhancing cooperation and exchange within this multifaceted community, in a truly international and multidisciplinary forum exploring all domains of infant and adult hearing.

To develop the spirit of the meeting, the program schedule is arranged to maximize opportunities for interaction among participants. The program is structured in concurrent sessions, with time for interactive discussions to let delegates follow their own preferences for topics and discussions. Poster presentations are key elements in the Program and are organized in topics and sub-topics in a display area designed to facilitate contacts and exchanges. Ample time will be allowed for all participants to visit the exhibits and speak with exhibit representatives.

Be part of this, and enjoy the warm and relaxed atmosphere of Lake Como.

Ferdi Grandori, Alessia Paglialonga, Deborah Hayes, Larry E. Humes
Chairman
Ferdi Grandori

Scientific Organisers
Ferdi Grandori
Alessia Pagliialonga
Deborah Hayes
Larry E. Humes

Steering Committee
Teresa Ching, Adrian Davis, Louise Hickson, Kathleen Pichora-Fuller, De Wet Swanepoel

Collaborating Institutions
CNR IEIIT - National Research Council of Italy, Institute of Electronics, Computer and Telecommunication Engineering, Milan (Italy)
Bill Daniels Center for Children’s Hearing at The Children’s Hospital – Colorado (USA)
Department of Speech & Hearing Sciences, Indiana University (USA)

Organising secretariat
Meet&Work srl
Abano Terme, Italy

Venue
Villa Erba Congress Center

Delegates are representing the following Countries

Albania  Greece  Qatar
Australia  India  Romania
Austria  Iran  Russia
Belgium  Ireland  Saudi Arabia
Brazil  Israel  Serbia
Bulgaria  Italy  Sierra Leone
Canada  Japan  Singapore
Chile  Kazakhstan  South Africa
China  Malaysia  South Korea
Croatia  Macedonia  Spain
Cuba  Netherlands  Sweden
Cyprus  New Zealand  Switzerland
Czech Republic  Nigeria  Taiwan
Denmark  Norway  Tunisia
Egypt  Pakistan  Turkey
Finland  Palestine  United Kingdom
France  Paraguay  USA
Germany  Portugal

HEAL 2014 - June 5 – 7, 2014 – Cernobbio (Lake Como), Italy
This event has been made possible thanks to the contribution and support of the following Institutions and Organizations:

American Academy of Audiology
Amplivox Ltd
Cochlear
GN Resound
Grason-Stadler
Interacoustics
Inventis Srl
MAICO Diagnostic GmbH
MED-EL
Natus Medical
Northgate Public Services
Oticon
Otodynamics Ltd
Otometrics
Resonance
The Ear Foundation
PROGRAMME
### Thursday, June 5, 2014

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<th>Room Carmen</th>
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<tbody>
<tr>
<td>08:00 - 10:30</td>
<td>registration</td>
<td>Welcome Reception (Villa Erba)</td>
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<tr>
<td>09:15 - 10:30</td>
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<tr>
<td>10:30 - 12:00</td>
<td>Special Session</td>
<td>Sensory Perception in Middle-Aged Adults</td>
<td>Issues on EHDI</td>
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<td></td>
<td>Hearing Screening in Adults</td>
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<tr>
<td>12:00 - 12:30</td>
<td>Special Lecture</td>
<td>Hearing Across the Lifespan from the Public Health Perspective - Adrian Davis</td>
<td>Intervention Strategies for Adults</td>
</tr>
<tr>
<td>12:30 - 13:00</td>
<td>Workshop: Expect the Unexpected: Managing an Incident and Improving Quality in the New Zealand Newborn Hearing Screening Programme</td>
<td>Telepractice</td>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>13:00 - 14:30</td>
<td>Lunch (in the Exhibit and Poster areas)</td>
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<tr>
<td>14:30 - 16:00</td>
<td>Special Session</td>
<td>The brain and hearing aids: Considerations for children, younger and older adults</td>
<td>Special Session</td>
</tr>
<tr>
<td>16:00 - 16:30</td>
<td>Coffee Break (in the Exhibit and Poster areas)</td>
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</tr>
<tr>
<td>16:30 - 18:30</td>
<td>Aging and Higher Level Processing</td>
<td>Communication Outcomes in Children</td>
<td>Hearing Loss and Medical Conditions</td>
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### Friday, June 6, 2014

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<th>Room Aida</th>
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<th>Room Carmen</th>
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<tbody>
<tr>
<td>08:30 - 10:00</td>
<td>Special Session</td>
<td>Intervention and outcomes of children detected with hearing loss</td>
<td>Noise and Other Risk Factors</td>
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<tr>
<td></td>
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<td>Screening in Pre-school and School-age Children</td>
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<td>Epidemiology</td>
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<tr>
<td>10:00 - 10:30</td>
<td>Coffee Break (in the Exhibit and Poster areas)</td>
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</tr>
<tr>
<td>10:30 - 11:30</td>
<td>Speech and Language Development</td>
<td>Education and Training</td>
<td>Issues on Genetics</td>
</tr>
<tr>
<td>11:30 - 12:30</td>
<td>Global Development (part I)</td>
<td>Data Management</td>
<td>Objective Measures - New Techniques (part I)</td>
</tr>
<tr>
<td>12:30 - 13:45</td>
<td>Lunch (in the Exhibit and Poster areas)</td>
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<tr>
<td>13:45 - 14:45</td>
<td>Global Development (part II)</td>
<td>High-Risk Babies</td>
<td>Objective Measures - New Techniques (part II)</td>
</tr>
<tr>
<td>14:45 - 15:45</td>
<td>Beyond Newborn Hearing Screening</td>
<td>Suprathreshold Acuity in Noise</td>
<td>Focus on Technology (part I)</td>
</tr>
<tr>
<td>15:45 - 16:45</td>
<td>Hearing in Pre-school and School-age Children</td>
<td>Patients’ Perspective</td>
<td>Focus on Technology (part II)</td>
</tr>
<tr>
<td>16:45 - 18:00</td>
<td>Poster Session and refreshments</td>
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<td>Social Dinner</td>
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### Saturday, June 7, 2014

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<th>Room Boheme</th>
<th>Room Carmen</th>
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<tbody>
<tr>
<td>09:00 - 10:30</td>
<td>Special Session</td>
<td>Challenges in Hearing Health Care for the Oldest Older Adults</td>
<td>Issues on Auditory Perception and Processing</td>
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<td>Auditory Neuropathy Spectrum Disorder</td>
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<td>Parents’ Perspective</td>
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<tr>
<td>10:30 - 11:00</td>
<td>Coffee Break (in the Exhibit and Poster areas)</td>
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<tr>
<td>11:00 - 12:00</td>
<td>Screening in Remote and Rural Areas</td>
<td>Hearing Aid Fitting</td>
<td>Empowering Parents (part I)</td>
</tr>
<tr>
<td>12:00 - 13:00</td>
<td>Evoked Potentials</td>
<td>Improvements in Implantable Devices</td>
<td>Empowering Parents (part II)</td>
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<td>End of meeting</td>
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</table>
JUNE 5 - ANCIENT VILLA  
09:15 – 10:30  Welcome

JUNE 5 - ROOM AIDA  
10:30 – 12:00  Special Session - Sensory Perception in Middle-Aged Adults  - Moderator: L.E. Humes  
Cognitive and hearing influences on competing speech perception in middle-aged adults - Helfer KS  
Speech recognition across the lifespan: Longitudinal changes from middle age to older adults - Dubno JR  
Listening comprehension in middle-aged and older adults - Sommers MM  
Temporal processing deficits in middle age - Grose JH, Mamo SK, Buss E, Hall III JW  
Are Age-related Changes in Cognitive Function Driven by Age-Related Changes in Sensory Processing? - Humes LE, Busey TA, Craig J, Kewley-Port D

12:00 – 12:30  Special Lecture - Moderator: G. Carr  
Hearing Across the Lifespan from the Public Health Perspective - Davis A

12:30 – 13:00  Workshop - Moderator: A. Davis  
Expect the Unexpected: Managing an Incident and Improving Quality in the New Zealand Newborn Hearing Screening Programme - Tuohy P, McLeod M

13:00 – 14:30  Lunch

14:30 – 16:00  Special Session - The brain and hearing aids: Considerations for children, younger and older adults  - Moderator: K. Pichora - Fuller  
Cortical measures and their potential for the assessment of pediatric hearing needs – Small SA  
The Ear-Brain Connection: Older ears and Older brains – Tremblay K  
Cognitive hearing aids and top-down/bottom-up issues – Lunner T

16.00 – 16.30  Coffee Break

Aging and Higher Level Processing  - Moderator: K. Tremblay  
16:30 - 16:45  Multi-level analysis of age-related declines in auditory temporal processing - Bartlett EL, Parthasarathy A

16:45 - 17:00  Aging differentially affects neural temporal processing at subcortical and cortical levels - Goossens T, Vercammen C, Hofmann M, Wouters J, van Wieringen A

17:00 - 17:15  Semantic effects on dichotic listening in older adults - Lavie L

17:15 - 17:30  Cognitive tests of memory and self-reported memory efficiency are associated with hearing self-reports in a population-representative sample of middle age and older adults - Setti A, Shanahan W, O’Tool M, Kenny RA

17:30 - 17:45  How age and audibility affect memory task performance in normal hearing persons - van Wieringen A, Vercammen C, Goossens T, Wouters J

17:45 - 18:00  Differential effect of aging on Verbal and Visuo-Spatial Working Memory - Vermeire K, De Boom C, Talaveron-Rodriguez M, Knoop A

18:00 - 18:15  How age-related hearing loss and cognitive abilities interact and influence memory performance - DiDonato R, Surprenant AM, Neath I


HEAL 2014 - June 5 – 7, 2014 – Cernobbio (Lake Como), Italy
### JUNE 5 - ROOM BOHEME

#### Issues on EHDI - Moderator: D. Hayes

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<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>10:45 - 11:00</td>
<td>Identifying and addressing ethically important scenarios in newborn hearing screening - <em>Kavanagh G, Delany C, Poulakis Z, Barker M, Hood F, Clarke J</em></td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Rescreening infants in Victoria 2011-2012 - <em>Kavanagh G, Barker M, Poulakis Z, Clarke J</em></td>
</tr>
<tr>
<td>11:15 - 11:30</td>
<td>Introduction to the Knowledge and Implementation in Pediatric Audiology Group and their work - <em>Moodie S, Davidson L, Eiten L, Gordey D, Haluschak M, Lindley G, Littman T, Rall E</em></td>
</tr>
<tr>
<td>11:30 - 11:45</td>
<td>Polish Universal Neonatal Hearing Screening Program – from detection to the diagnosis - <em>Greczka G, Wróbel M, Szyfter W, Dąbrowski P</em></td>
</tr>
<tr>
<td>11:45 – 12:00</td>
<td>Hearing Screening in Neonates in Central Region Denmark - <em>Linnebjerg Busk L, Ekmann Hansen A, Reinholdt Møller T</em></td>
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#### Intervention Strategies for Adults - Moderator: A. Laplante-Lèvesque

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<tr>
<td>12:00 - 12:15</td>
<td>Cognitive training to improve speech understanding in complex communication environments – a framework and methodological aspects - <em>Ortmann M, Kessler J, Kaul T, Arehart KH, Meister H</em></td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Earlier cochlear implantation in adults with severe hearing loss may improve outcomes - <em>Dowell RC, Au A, Rousset A</em></td>
</tr>
<tr>
<td>12:30 - 12:45</td>
<td>Improved word identification performance in auditory training focused on frequent communication partners - <em>Barcroft J, Tye-Murray N, Sommers M, Spehar B</em></td>
</tr>
<tr>
<td>12:45 – 13:00</td>
<td>Conversationally oriented rehabilitation program for acquired hearing loss - <em>Pajo K</em></td>
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<tr>
<td>13:00 – 14:30</td>
<td>Lunch</td>
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<tr>
<td>14:30 – 16:00</td>
<td>Special Session – International Report on EHDI programs - Moderator: L. Sliwa, G. Tognola</td>
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<tr>
<td>16.00 – 16.30</td>
<td>Coffee Break</td>
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# JUNE 5 - ROOM BOHEME

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<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>16:30 - 16:45</td>
<td>Communication outcomes in a large population-based sample of children using cochlear implants - Dettman S, Dowell R, Choo D, Holland J, Leigh J, Hollow R</td>
</tr>
<tr>
<td>16:45 - 17:00</td>
<td>Long-term growth of speech production accuracy in pediatric cochlear implant recipients with prelingual deafness: Vowel Features - Moore JA</td>
</tr>
<tr>
<td>17:00 - 17:15</td>
<td>The effect of hearing aid use on outcomes of children with mild bilateral hearing loss - Walker E, Holte L, McCreery R, Spratford M</td>
</tr>
<tr>
<td>17:15 - 17:30</td>
<td>Potential benefits of music and multi-modal training on perception of emotional prosody in children with cochlear implants - Russo FA, Good A, Nespoli G, Fels DI, Gordon KA</td>
</tr>
<tr>
<td>17:30 - 17:45</td>
<td>Working with Babies with Hearing Impairment: Starting as we mean to go on! - Burden S, Grover A, Richardson R</td>
</tr>
<tr>
<td>17:45 - 18:00</td>
<td>Case Studies of Children With ANSD Who Were Borderline CI Candidates: Outcomes of Cochlear Implantation - MacIver-Lux K</td>
</tr>
<tr>
<td>18:00 - 18:15</td>
<td>Factors Influencing Auditory Based Communication Outcomes in South African Children with Hearing Loss - Booysen S, Bester J</td>
</tr>
<tr>
<td>18:15 - 18:30</td>
<td>Adverse outcome of early cochlear implantation – is the earlier always the better? - Mikic B, Ostojic S, Nikolic M, Miric D, Asanovic M, Arsovic N</td>
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### JUNE 5 - ROOM CARMEN

#### Hearing Screening in Adults - Moderator: M. Lerch

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<tr>
<td>10:30 - 10:45</td>
<td>Benefits of a Hearing Loss Screening and Education Protocol in Primary Care - Wallhagen MI, Strawbridge WJ</td>
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<tr>
<td>10:45 - 11:00</td>
<td>Development of Community-Based Hearing Loss Screening in the Elderly Through A Novel Multidisciplinary Integrated Care Pathway - Ramdoo K, Maden B, Singh A, Tatla T</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Assessment of usefulness of audiometric manual and automated tests to hearing screening in elderly population - Śliwa L, Kochanek K, Kręglicka M, Pilka A</td>
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#### Hearing in the Oldest Older Adults - Moderator: M. Wallhagen

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<tr>
<td>11:15 - 11:30</td>
<td>Is bedside testing for auditive impairment in the elderly feasible? - The earPad trial - Lerch M</td>
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<tr>
<td>11:45 – 12:00</td>
<td>Vocal acoumetry: A valid, easy and reliable tool for detecting, quantifying and following up hearing impairment in the elderly. AcoumAudio, a French institutionalized population study - Leusie S, Perrot X, Renard C, Aubel D, Vergnon L</td>
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#### Telepractice - Moderator: E. Rushbrooke

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<tr>
<td>12:00 - 12:15</td>
<td>Infant diagnostic audiological evaluations by Tele-Practice - Hayes D, Dreith S, Eclavea E</td>
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<tr>
<td>12:15 - 12:30</td>
<td>Time for paradigm change in clinical care - Lehnhardt-Goriany M</td>
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<tr>
<td>12:30 - 12:45</td>
<td>The role of telepractice in cochlear implantation candidacy and habilitation - Gabrielides A, Psarros C, McCarthy M</td>
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<tr>
<td>12:45 – 13:00</td>
<td>Online rehabilitation of adult hearing-aid users - Thorén ES, Öberg M, Wänström G, Andersson G, Lunner T</td>
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#### Psychosocial Effects of Hearing Loss in Adults - Moderator: B.E. Weinstein

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<tr>
<td>14:30 - 14:45</td>
<td>Hearing Aid Use and Perceived Social Isolation Among Older Adults - Weinstein BE, Sirow LW</td>
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<tr>
<td>14:45 - 15:00</td>
<td>Stages of change in adults who have failed an online hearing screening - Laplante-Lévesque A, Brännström KJ, Ingo E, Andersson G, Lunner T</td>
</tr>
<tr>
<td>15:00 - 15:15</td>
<td>Experiences of family members and caregivers of older adults with hearing impairment - Dupuis K, Pichora-Fuller MK</td>
</tr>
<tr>
<td>15:15 - 15:30</td>
<td>The association of self-reported hearing with time spent outside the home among older adults - Mikkola T, Polku H, Rantakokko M, Portegijs E, Tsai L-T, Rantanen T, Viljanen A</td>
</tr>
<tr>
<td>15:30 - 15:45</td>
<td>Needs in hearing health care: Perspectives from patients - Fulton SE</td>
</tr>
<tr>
<td>15:45 - 16:00</td>
<td>Hearing loss: Highly prevalent but underrated among aging adults - Mukari SZ-MS, Ishak WS, Maamor N, Hashim WFW</td>
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16.00 - 16.30 Coffee Break
JUNE 5 - ROOM CARMEN

Hearing Loss and Medical Conditions - **Moderator: B. Lyxell**

16:30 - 16:45  Theory-of Mind in adolescents and young adults with Alström syndrome - Frölander HE, Möller C, Marshall JD, Sundqvist A, Rönnåsen B, Falkensson L, Lyxell B

16:45 - 17:00  Phonological development in Swedish children with otitis-proneness - Stålnacke H, van Doorn J, Czigler PE

17:00 - 17:15  A comparison of auditory brainstem response thresholds in infants born with otitis media with effusion and with or without cleft palate - Sundman H, Flynn T, Lohmander A


17:30 - 17:45  Microtia and Atresia Program at Hear and Say - Rushbrooke E, Cheadle S, Dowell T

17:45 - 18:00  Hearing loss and Cerebral Palsy: Parental perceptions and experience of early intervention services in South Africa - Joubert K, Venter M, Moroe N, Moodley S

18:00 - 18:15  The Role of Auditory Brainstem Response in Diagnosing Auditory Impairments of Dejerine-Sottas - Talebi H, Mazaherytehrani N

18:15 - 18:30  CLEFT Audiology Standards - Mainstone V, Dighe A
## JUNE 6 - ROOM AIDA

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<th>Time</th>
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| 08:30 – 10:00 | **Special Session** - Intervention and outcomes of children detected with hearing loss  
*Moderator: T.Y.C. Ching*  
Outcomes of children with hearing loss: implications for management - *Ching TYC*  
Speech-language development of hearing impaired children identified through universal newborn hearing screening program - *Mukari SZ, Marhaban JA, Kartini A, Asma A*  
Auditory threshold amelioration during the first year of life in a group of severely/profoundly hearing impaired children - *Trevisi P, Bovo R, Ghiselli S, Benatti A, Martini A*  
Communication development in early-identified children with mild bilateral and unilateral hearing loss - *Fitzpatrick EM, Durieux-Smith A, Gabory I, Coyle D* |
| 10:00 – 10:30 | Coffee Break                                                             |
| 10:30 – 11:30 | **Speech and Language Development** - *Moderator: S. Small*                |
| 10:30 - 10:45 | Using receptive vocabulary acquisition to develop a speech perception test for children with hearing loss - *Warner-Czyz A, Uhler K, Yoshinaga-Itano C, Sweeney M* |
| 10:45 - 11:00 | The effect of hearing status on perceptual preferences for canonical syllables in infancy - *von Hapsburg D, Hay JF, Frank MK, Robertson S* |
| 11:15 - 11:30 | Born to Hear: Brain Development for Optimal Listening and Spoken Language Development in Children with Hearing Loss - *Dornan D* |
| 11:30 – 12:30 | **Global Development (part I)** - *Moderator: A. Davis*                   |
| 11:45 - 12:00 | Language, academic outcomes and predictive factors for early-implanted children with bilateral versus unilateral cochlear implants - *Sarant J, Harris D, Sinclair L, Bennet L, Bant S* |
| 12:15 - 12:30 | Benchmarking the social inclusion of children with hearing loss educated using a listening and spoken language approach - *Constantinescu G, Dornan D, Phillips R, Davis A* |
| 12:30 – 13:45 | Lunch                                                                    |
| 13:45 – 14:15 | **Global Development (part II)** - *Moderator: D. Dornan*                 |
| 13:45 - 14:00 | Literacy Achievement of Deaf Learners with Cochlear Implants - *Mayer C, Millett P* |
| 14:00 - 14:15 | Empowering Children & Youth through Peer Support - *Phillips R, Harris C* |
| 14:15 - 14:30 | Vocal singing ability of prelingually-deafened children using hearing aids or cochlear implants - *Xu L, Mao Y, Liu Q, Liu S* |
| 14:30 - 14:45 | School-age educational outcomes of children with significant congenital bilateral sensorineural hearing impairment - *Lam SE, Daniel LM, Hee YM, Yeoh A, Lim SB* |
### Beyond Newborn Hearing Screening - Moderator: HLM van Straaten

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<tr>
<td>14:45 - 15:00</td>
<td>Newborn hearing screening: What have we learned about progressive hearing loss?</td>
<td>Barreira-Nielsen C, Fitzpatrick EM, Hashem S, Whittingham J</td>
</tr>
<tr>
<td>15:00 - 15:15</td>
<td>The role of report-based measures of listening difficulty for understanding auditory processing disorder</td>
<td>Barry JG, Tomlin D, Moore DR, Dillon H</td>
</tr>
<tr>
<td>15:15 - 15:30</td>
<td>The need for screening newborns for congenital CMV referred in the Neonatal Hearing Screening Program</td>
<td>Schornagel F, Soede W, Rusman L, de Vries J, Kroes A, Oudesluys-Murphy AM, Vossen A</td>
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### Hearing in Pre-school and School-age Children - Moderator: K. Munro

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>15:45 - 16:00</td>
<td>Progression of hearing loss in infants and children</td>
<td>McCreery RW, Walker E, Spratford M, Roush P, Fernau K</td>
</tr>
<tr>
<td>16:00 - 16:15</td>
<td>Communication outcomes of pre-school deaf and hard of hearing children identified by the England Newborn Screening Programme (NHSP)</td>
<td>Carr G, Kean M, Bush V</td>
</tr>
<tr>
<td>16:15 - 16:30</td>
<td>Beyond Newborn Screening: Community-based hearing screening programs for infants and toddlers subsequent to the newborn screening and follow-up period</td>
<td>Eiserman W, Hoffman J, Shisler L</td>
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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Presenters</th>
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<tbody>
<tr>
<td>16:45 – 18:00</td>
<td>Poster Session and refreshments</td>
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**JUNE 6 - ROOM BOHEME**

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<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>08:45 – 09:00</td>
<td></td>
<td>Hearing status and auditory evoked potentials in teenagers and young adults who reported exposure to secondhand smoke - Ramkissoon I, Batavia MM</td>
</tr>
<tr>
<td>09:00 – 09:15</td>
<td></td>
<td>Hearing, tinnitus and listening habits in 9 year old children - Båsjö S, Möller C, Widén S, Jutengren G, Kähärä K</td>
</tr>
<tr>
<td>09:15 – 09:30</td>
<td></td>
<td>Screening for NIHL among military personnel in eastern province of Saudi Arabia - Alsaif SS, Ibrahim M</td>
</tr>
<tr>
<td>09:30 – 10:00</td>
<td>Auditory and Visual Information - <em>Moderator: A. Goedegebure</em></td>
<td>Auditory and visual information in speech perception: developmental and rehabilitative perspective - Taitelbaum-Sweed R, Fostick L</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td></td>
<td>Coffee Break</td>
</tr>
<tr>
<td>11:00 – 11:15</td>
<td></td>
<td>Interprofessional Education (IPE) for AuD Students: A Health Sciences Center Model - Jilla AM, Borton B, Johnson C</td>
</tr>
<tr>
<td>12:00 – 12:15</td>
<td></td>
<td>ChildLINK: Integrating Newborn Hearing Screening in an Early Childhood Health Screening Data System - Tu S, Song Q, Liang Q, Bhuvanagiri S, Cobo-Lewis C, Mason C, Wall T</td>
</tr>
<tr>
<td>12:15 – 12:30</td>
<td></td>
<td>Generation Victoria (GenV): building on expertise and systems to transform the health and wellbeing of generations of children - Siero W, Reilly S, Barker M, Poulakis Z</td>
</tr>
<tr>
<td>12:30 – 13:45</td>
<td></td>
<td>Patient Registries Providing Valuable Evidence for Policy Makers - Sanderson G</td>
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</tbody>
</table>

**HEAL 2014 - June 5 – 7, 2014 – Cernobbio (Lake Como), Italy**
JUNE 6 - ROOM BOHEME

High-Risk Babies - Moderator: L. Stappaerts

13:45 - 14:00 Hearing loss by week of gestation and categories of birth weight in very preterm neonates: a population-based study - van Dommelen P, Verkerk PH, van Straaten HLM

14:00 - 14:15 The risk factor profile of children covered by the Polish Universal Neonatal Hearing Screening Program and its impact on hearing loss incidence - Wróbel M, Greczka G, Szyfter W


14:30 - 14:45 Screening infants who are young and too young: an analysis of gestational age at screening in Victoria - Kavanagh G, Poulakis Z, Barker M, Clarke J

Suprathreshold Acuity in Noise - Moderator: A. Paglialonga

14:45 - 15:00 The multinational-multilingual project HD5090 - collecting reference data for Hearing Devices - Coninx F, Hoffmann V

15:00 - 15:15 Development of the SUN (Speech Understanding in Noise) in Portuguese - Vaez N, Pereira L, Paglialonga A

15:15 - 15:30 Repeated testing of speech intelligibility with open-set and closed-set sentence tests - Luts H, Jansen S, Wouters J


Patients’ Perspective - Moderator: C. Thodi

15:45 - 16:00 Health-Related Quality of Life Benefits from Amplification in the Advanced Digital Era - Johnson CE, Danhauer JL, Jilla AM, Howerton KM

16:00 - 16:15 Cochlear implant service delivery – now and in the future - Archbold S, Athalye S, Lutman M, Mulla I

16:15 - 16:30 The experiences of adults assessed for cochlear implantation who did not proceed - Athalye S, Mulla I, Archbold S

16:30 - 16:45 Is the impact of a hearing loss taken seriously? - Best L, Bobeldijk M

16:45 – 18:00 Poster Session and refreshments
**JUNE 6 - ROOM CARMEN**

### Screening in Pre-school and School-age Children - Moderator: W. Eisermann

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>08:30 - 08:45</td>
<td>The Bath (UK) School Entry Hearing Screen (SES): Quality Improvement Outcomes - Dighe A, Mainstone V</td>
</tr>
<tr>
<td>08:45 - 09:00</td>
<td>Community pre-school screening with sequential ultra-short parent questionnaire &amp; tympanometry - Andric Filipovic S, Marchisio P, Williamson IG, Csakanyi Z, Spencer H, Haggard MP</td>
</tr>
<tr>
<td>09:00 - 09:15</td>
<td>Preschool Hearing Detection in Cyprus - Thodi C, Vogazianos M, Vogazianos P</td>
</tr>
<tr>
<td>09:15 - 09:30</td>
<td>Validation of hearing screening procedures in Ecuadorian schools - Muñoz K, Luzuriaga E, White K, Callow-Heusser C, Ortiz E</td>
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</table>

### Epidemiology - Moderator: C. Johnson

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>09:45 – 10:00</td>
<td>Do the ageing baby Boomers hear better than their parents? - von Gablenz P, Holube I</td>
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10:00 – 10:30 Coffee Break

### Issues on Genetics - Moderator: E. Bartlett

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>10:30 - 10:45</td>
<td>Analysis of deaf gene mutations in nonsyndromic hearing loss in children of Shandong province - Lin Q, Nie W, Xiang L, Hou Q, Li Y, Li H</td>
</tr>
<tr>
<td>10:45 - 11:00</td>
<td>Massively Parallel Sequencing Identification of Novel Genes and Mutations for Hereditary Hearing Loss in Inbred Population - Brownstein Z, Rayyan AA, Lee M, King M-C, Walsh T, Avraham KB, Kanaan M</td>
</tr>
<tr>
<td>11:00 - 11:15</td>
<td>Progressive hearing impairment with deletion c.35delG in GJB2 gene despite normal newborn hearing screening - Birkenhäuser R, Prera N, Löhle E</td>
</tr>
<tr>
<td>11:15 - 11:30</td>
<td>A dominant mutation in the stereociliary gene TBC1D24 is a probable cause for nonsyndromic hearing impairment - Zhang L, Wu H, Yang T</td>
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### Objective Measures - New Techniques (part I) - Moderator: F. Coninx

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>11:30 - 11:45</td>
<td>Objective identification of click-evoked auditory brainstem responses using time domain cross-correlations between interleaved responses - Berninger E, Olofsson Å, Leijon A</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Rejection of background acoustic activity in registration of transient evoked otoacoustic emissions - Belov O, Alexeeva N, Tavartkiladze G</td>
</tr>
<tr>
<td>12:00 - 12:15</td>
<td>An application of Pitch-Envelope Analysis for visualization, classification and filtering of transient evoked otoacoustic emissions - Belov O, Alexeeva N, Tavartkiladze G</td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Hearing loss screening with stimulus frequency otoacoustic emissions evoked by swept tones - Chen S, Li X, Li G</td>
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</tbody>
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12:30 – 13:45 Lunch
### JUNE 6 - ROOM CARMEN

**Objective Measures - New Techniques (part II) - Moderator: F. Coninx**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
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<tbody>
<tr>
<td>13:45 - 14:00</td>
<td>Deconvolution of magnetic Acoustic Change Complex (mACC) - Bardy F, McMahon C, Yau SH, Johnson BW</td>
<td></td>
</tr>
<tr>
<td>14:00 - 14:15</td>
<td>Binaural evoked potentials in young normal hearing adults: objective measures of the binaural System - Vercammen C, Wouters J, van Wieringen A, Francart T</td>
<td></td>
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<tr>
<td>14:15 - 14:30</td>
<td>ABRs to Chirp and Click Stimuli in Neonates and Adults - Stuart A, Cobb KM</td>
<td></td>
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<tr>
<td>14:30 - 14:45</td>
<td>40-Hz sinusoidal ASSR and TB-ABR thresholds in detecting mild conductive hearing loss in children with otitis media with effusion - Kaf WA, Mohamed ES, Elshafey H</td>
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</table>

**Focus on Technology (part I) - Moderator: J.M. Sequi Canet**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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<tbody>
<tr>
<td>14:45 - 14:55</td>
<td>Wireless sound transmissions for the hearing impaired in the public space - Bisgaard N</td>
<td></td>
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<tr>
<td>14:55 - 15:05</td>
<td>Call me: Investigating end user benefit with different contemporary phone listening strategies - Jespersen CT</td>
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<tr>
<td>15:05 - 15:15</td>
<td>Independent study identifies method for evaluating hearing instrument sound quality - Jespersen CT</td>
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<tr>
<td>15:15 - 15:25</td>
<td>ReSound Smart app - Personalization and control with 2nd gen. app from ReSound - Ceylan D</td>
<td></td>
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<tr>
<td>15:25 - 15:35</td>
<td>When the brain doesn’t understand what the ears are hearing - presenting a qualitative evaluation of the ReSound Unite Mini Microphone in children and adolescents with APD - Haastrup A</td>
<td></td>
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<tr>
<td>15:35 - 15:45</td>
<td>Use it, don’t lose it: ReSound’s new approach to frequency compression - Haastrup A</td>
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</table>

**Focus on Technology (part II) - Moderator: B. Engdahl**

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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<tbody>
<tr>
<td>15:45 - 15:55</td>
<td>Significant Tinnitus Improvement with Extended Wear Device - Sanford M</td>
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<tr>
<td>15:55 - 16:05</td>
<td>Efficient paediatric hearing assessment - Sanchez C</td>
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<tr>
<td>16:05 - 16:15</td>
<td>The benefits of Roger technology for children with hearing aids and cochlear implants - Rich S</td>
<td></td>
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<tr>
<td>16:15 - 16:25</td>
<td>Experience with the Naida CI Q70 sound processor in cochlear implant users: preliminary outcomes - Mathias N, Brendel M</td>
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<tr>
<td>16:25 - 16:35</td>
<td>My Experience Book – moving towards literacy - Kendrick A</td>
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<td>16:35 - 16:45</td>
<td>Design of novel systems to monitor cochlear implant performance - Tani A, Cambiagli M</td>
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**16:45 – 18:00 Poster Session and refreshments**
### JUNE 7 - ROOM AIDA

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>09:00 – 10:30</td>
<td><strong>Special Session - Challenges in Hearing Health Care for the Oldest Older Adults</strong></td>
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<tr>
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<td><em>Moderator: J. Dubno</em></td>
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<td>Changing the audiology delivery model to meet the needs of the oldest older adults -</td>
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<td><em>Weinstein BE</em></td>
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<td>Hearing Care for Older Adults beyond the Audiology Clinic - <em>Öberg M</em></td>
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<td>Cognitive decline and hearing health care for older adults - <em>Pichora-Fuller MK</em></td>
</tr>
<tr>
<td>10:30 – 11:00</td>
<td>Coffee Break</td>
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<tr>
<td></td>
<td><strong>Screening in Remote and Rural Areas -  <em>Moderator: G. Lightfoot</em></strong></td>
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<tr>
<td>11:00 - 11:15</td>
<td>What Other Countries Can Learn From the Pacific Islands of Micronesia in Establishing a</td>
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<td><em>Sablan VA</em></td>
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<tr>
<td>11:15 - 11:30</td>
<td>Tele-Practice: Delivering early intervention and audiology services to families in rural</td>
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<tr>
<td></td>
<td>and remote areas - <em>Rushbrooke E, Ryan M, Atkinson B, Close L, Constantinescu G</em></td>
</tr>
<tr>
<td>11:30 - 11:45</td>
<td>The Many Roles of Telepractice in EHDI: The Time is Now - <em>McCaslin D, Tharpe AM,</em></td>
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<tr>
<td>11:45 - 12:00</td>
<td>Pilot study to evaluate children with hearing aids through PEACH and TEACH in a rural</td>
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<td>community - <em>Emerson LP</em></td>
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<td><strong>Evoked Potentials -  <em>Moderator: G. Tognola</em></strong></td>
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<tr>
<td>12:00 - 12:15</td>
<td>ABR Peer Review: Benefits and models for best practice - <em>Lightfoot G, Sutton G, Ferm I</em></td>
</tr>
<tr>
<td>12:15 - 12:30</td>
<td>Clinical feasibility of recording sound field obligatory cortical auditory evoked potentials in</td>
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<td></td>
<td>infants: findings from the first 55 infants - *Munro KJ, Nassar R, Purdy S, O’Driscoll M,</td>
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<td></td>
<td><em>Booth R, Bruce I, Uus K</em></td>
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<tr>
<td>12:30 - 12:45</td>
<td>Threshold Changes of ABR results in toddlers and children by the course of time - *Louza J,</td>
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<td></td>
<td><em>Wittlinger N, Zirn S, Helbig B, Scheckinger S, Schuster M</em></td>
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### JUNE 7 - ROOM BOHEME

**Issues on Auditory Perception and Processing - Moderator: M. Sommers**

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>09:00 - 09:15</td>
<td>APD Intervention: Addressing Non-Classical as well as Classical Auditory Pathways - Light LK</td>
</tr>
<tr>
<td>09:15 - 09:30</td>
<td>Auditory hypersensitivity among individuals with Sensory Processing Disorder - Zlotnik S, Engel-Yeger B, Attias J, Pratt H</td>
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<tr>
<td>09:30 - 09:45</td>
<td>Processing consequences of unilateral deafness-implications for screening - Sininger YS, Bhatara A</td>
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<tr>
<td>09:45 - 10:00</td>
<td>Temporal patterning skills: Comparison between tonal and non-tonal language speakers in South Africa - Pottas L</td>
</tr>
<tr>
<td>10:00 - 10:15</td>
<td>Effects of 24 h sleep deprivation on temporal resolution - Pottas L, Soer M</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>Auditory perception evolution in a group of pediatric CI recipients - Vallarino M, Pianesi F, Micardi M, Resca A, Scorpecci A, Marsella P</td>
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**10:30 – 11:00 Coffee Break**

**Hearing Aid Fitting - Moderator: E. Berninger**

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<th>Time</th>
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<tbody>
<tr>
<td>11:00 - 11:15</td>
<td>On the Use of Auditory Spectral Representations for the Comparison of Hearing Compensation Techniques - Tognola G, Chiaramello E, Moriconi S</td>
</tr>
<tr>
<td>11:15 - 11:30</td>
<td>Aided Speech in Noise Testing as a Pre-fitting Measure - Lindley G</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Pilot validity of Oticon’s EasyRECD Measurement Procedure - Moodie KS, Moodie STF, Easwar V</td>
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</table>

**Improvements in Implantable Devices - Moderator: R. Dowell**

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<tbody>
<tr>
<td>12:00 - 12:15</td>
<td>Electric-acoustic stimulation: for whom, in which ear, and how? - Ching TYC, Incerti P, Plant K</td>
</tr>
<tr>
<td>12:45 – 13:00</td>
<td>Variability of Human Cochlea: Implications for Hearing Preservation - Pietsch M, Erfurt P, Lenarz T, Kral A</td>
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### JUNE 7 - ROOM CARMEN

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td><strong>Auditory Neuropathy Spectrum Disorder</strong> - Moderator: D. Hayes</td>
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<tr>
<td>09:00 - 09:15</td>
<td>Audiological management of Children with Auditory Neuropathy Spectrum Disorder - Fitzpatrick EM, Barreira-Nielsen C, Whittingham JA, Ham J</td>
</tr>
<tr>
<td>09:15 - 09:30</td>
<td>Imaging infants with unilateral ANSD (auditory neuropathy spectrum disorder) - Roddick L, Walker P, Oliver J</td>
</tr>
<tr>
<td><strong>Parents' Perspective</strong> - Moderator: J. Cutler</td>
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<tr>
<td>09:30 - 09:45</td>
<td>Quality of Life of Parents and Siblings of Children with Cochlear Implants - Umat C, Ross SC, Wahat NHA, See GB</td>
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<tr>
<td>09:45 - 10:00</td>
<td>The needs of families benefiting from an AVT program, using the “Family Needs Survey” adapted version - Brás da Silva P, Monteiro da Costa I, Correia da Silva V</td>
</tr>
<tr>
<td>10:00 - 10:15</td>
<td>Why parents refuse newborn hearing screening and default on follow-up rescreening – A South African perspective - Scheepers LJ, Swanepoel DW, le Roux T</td>
</tr>
<tr>
<td>10:15 - 10:30</td>
<td>Parents views on the acceptability of recording infant obligatory cortical auditory evoked potentials in the sound field: The only problem was keeping him quiet with all the fun he was having - Munro KJ, Nassar R, Purdy SC, O’Driscoll M, Booth R, Bruce I, Uus K</td>
</tr>
<tr>
<td><strong>Empowering Parents (part I)</strong> - Moderator: M. McCarthy</td>
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<tr>
<td>11:00 - 11:15</td>
<td>Transition into Primary School (TIPS) Project - Moores-Chadwick J, Galloway J</td>
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<tr>
<td>11:15 - 11:30</td>
<td>Supporting Parent Empowerment through Early Education - McNally A, Muhs J</td>
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<tr>
<td>11:30 - 11:45</td>
<td>Educating Parents About Intensive Brain Development for Children with Hearing Loss - Dornan D</td>
</tr>
<tr>
<td>11:45 - 12:00</td>
<td>Measuring parent participation and engagement in family support services for children diagnosed with a permanent hearing loss through Universal Newborn Hearing Screening in Queensland - Harris S</td>
</tr>
<tr>
<td><strong>Empowering Parents (part II)</strong> - Moderator: J. Muhs</td>
<td></td>
</tr>
<tr>
<td>12:00 - 12:15</td>
<td>Social Media and Family Support in Hearing Loss: A Global Collaboration - Cutler JM, Lenzi G, Berrettini S</td>
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<tr>
<td>12:15 - 12:30</td>
<td>Supporting the needs of families of children with unaided mild hearing loss - McCarthy M, Hodgson F, Britton L, Cook G</td>
</tr>
<tr>
<td>12:45 – 13:00</td>
<td>Parent Education for Low Income Families of Children with Hearing Loss - Christie M</td>
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</tbody>
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POSTER SESSION

HEARING SCREENING AND ASSESSMENT IN CHILDREN

1. Further comparisons of ABR response amplitudes, test time and estimation of hearing threshold using frequency specific chirp and tone pip stimuli in newborns - Ferm I, Lightfoot G
2. A comparison of Auditory Evoked Potentials elicited using clicks and frequency specific tones versus broadband and narrowband iChirps - Delgado RE, Savio G
5. Minimum response levels obtained with insert earphones; behavioural observation audiometry protocol for infants aged 2-6 months - Haaksma-Schaafsma SC, Wiersinga-Post JEC, van Dijk P
6. Click and Speech Auditory Brainstem Responses (ABR) in Typically-Developing Children - Ubiali T, Dominici Sanfins M, Reis Borges L, Coellana-Santos MF

SPEECH AND LANGUAGE DEVELOPMENT

10. The Importance of Lipreading to Spelling Accuracy for Children who are Deaf or Hard of Hearing - Schwarz I, McCarthy J, Cannon L
11. Study of speech and language development in bilingually raised children with cochlear implants and/or hearing aid - Fabian A, Fries B, Hoffmann V, Keilmann A
13. Children with hearing loss in a multi-lingual environment - factors influencing mainstream language acquisition - Steiger C
16. Minor hearing impairment and learning to read European Portuguese - Serrano M, Verhaeghe A, Costa MA
17. Lexical and semantic specificity of expression in deaf and hard of hearing students in relation to the type of amplification they use - Nadezda D, Mandaric M, Isakovic L
18. The Development of word categories in hearing impaired children - Nikolic SV, Savić MM, Savic MP, Savic VP
19. Children with damaged hearing and understanding of the read text according to verbal responses - Nikolic SV
20. University of Iowa’s Team Approach to Meeting Aural Habilitation Competencies for Graduate Students in Speech/Language Pathology and Audiology - Wallace A, Kelsay D
REHABILITATION STRATEGIES AND OUTCOMES IN CHILDREN

21. “All inclusive” – Habilitation day for hearing impaired children, age 0-5 years - Steffensen KS


24. The development of auditory and communication skills in early identified toddlers with hearing loss - Ben-Itzhak D, Ringwald-Friemerman D


27. Teaching procedures for improving auditory skills in two adolescent sisters with severe sensorineural hearing loss - Melo Golfeto R, de Souza DdG

RISK FACTORS

28. Music exposure through mp3-players and the risk of music-induced hearing loss among adolescents in the Netherlands - Sheikh Rashid M, Dreschler WA, de Laat JAPM

29. Newborn Hearing Screening and Early Diagnostic confirmation in the NICU and/or Intermediate Care - Colella-Santos MF, Martins PM, Diniz T, Santos I, Libano G, Amaral Mi, Casali R

30. Neonatal hearing screening of preterm neonates using TEOAE in combination with AABR - Galiyeva A, Jaxybayeva A, Bekpan A


32. Newborn hearing screening and audiological diagnosis in NICU infants - Souza GL, Colella dos Santos MF

33. Transient Otoacoustic emissions in neonates leaving the Intensive Care Unit of the IPS Central Hospital, Asunción-Paraguay, 2013. Experience - Báez M, López Olmedo R

34. Perinatal factors that affect otoacoustic emissions in healthy newborns, vaginally delivered, during first 48 hours of life - Sequi Canet JM, Sala Langa MJ, Collar Castillo JI

PRE-SCHOOL AND SCHOOL-AGE CHILDREN

35. The study of the Smart Hearing Screening system for preschool children - Wenjin W, Zhiwu H, Hao W

36. Ear games video game as a hearing screening tool in preschool children - Ostojić S, Nikolić M, Mikić B


38. Assessment of hearing of undergraduates in south western Nigeria - Ajibade IO, Alawode TO
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THURSDAY, JUNE 5, 2014
This presentation will discuss results of two studies examining the ability of middle-aged adults to understand a speech message in the presence of one or two competing speech messages. In the first study we manipulated the number of masking talkers (one or two) as well as the confusability between to-be-attended and to-be-ignored speech streams. The second study focused on examining lexical neighborhood influences in target and masking speech as well as the effect of limiting response time. Participants in both studies also completed a battery of cognitive tests that included working memory, processing speed, and inhibitory ability. In addition, self-perceived hearing difficulty was assessed using selected items from the SSQ. Results of analyses comparing middle-aged listeners to older and younger participants will be discussed (Work supported by NIDCD R01 DC 012057).
recognition in quiet and babble are being measured in a large sample of adults yearly or every 2-3 years. For the current analysis, the subject sample included ~650 adults whose ages ranged from late-30s to 90s at the time of enrolment, with longitudinal data spanning 3-25 years, including >13,000 scores. To account for concurrent changes in pure-tone thresholds over time, each score is converted to an importance-weighted speech-audibility metric to calculate a predicted score. Rates of change in predicted and observed word recognition over time will be reported and associations with gender, age, degree of hearing loss, and auditory and cognitive function will be discussed. [Work supported by NIH/NIDCD]

LISTENING COMPREHENSION IN MIDDLE-AGED AND OLDER ADULTS

Sommers MS

Department of Psychology, Washington University, Saint Louis, Missouri USA

Age-related changes in hearing and spoken word recognition can start as early as the second decade of life and increase systematically across the adult lifespan. However, we know relatively little about how these impairments affect comprehension of passage-length spoken materials across the adult lifespan, especially for middle-aged adults who can have significant reductions in auditory sensitivity. The current study reports the findings from a lifespan investigation of listening comprehension in which 70 participants in each of seven decades (20-29, 30-39…80-89) heard six passages and answered several different types of comprehension questions following each. Of particular interest is the extent to which changes in listening comprehension across the adult lifespan parallel the well-documented declines in absolute sensitivity and word recognition. We also assessed a number of cognitive abilities, including verbal and spatial working memory, processing speed, and executive functions. Results demonstrated that despite systematic and progressive declines in auditory sensitivity across the adult lifespan, listening comprehension is relatively well preserved until at least the seventh decade of life. Structural equation modeling indicated that preserved listening comprehension in middle-aged adults (40-60) is likely due to preservation of verbal working memory abilities in this age group. Results are discussed within the context of both cognitive and sensory abilities contributing to preserved listening comprehension in middle-aged adults.

TEMPORAL PROCESSING DEFICITS IN MIDDLE AGE

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Temporal processing declines with age, independent of peripheral sensitivity loss. Evidence is accumulating that some of these deficits emerge relatively early in the aging process, and can be observed in middle age. Psychophysical studies in our laboratory have focused on temporal processing at both the fine structure level and the envelope level. In terms of temporal fine structure, we have shown that middle-aged listeners (40-57 yrs) with normal hearing are less sensitive to inter-aural phase differences than young listeners (18-27 yrs), particularly for higher frequencies. In terms of temporal envelopes, middle-aged listeners have poorer gap discrimination performance than young listeners and, in some conditions, are more susceptible to task difficulty. Current work is examining age-related effects in masking period patterns as a means of assessing the temporal window. This task requires the detection of a 30-ms burst of speech-shaped noise [SSN] as a
function of its temporal position relative to the modulation cycle of a second SSN that oscillates between 30- and 65-dB SPL at a rate of 5 Hz. Results to date show greater susceptibility to forward and backward masking in older listeners (65-77 yrs) with normal audiograms in comparison to young listeners, with middle-aged listeners performing intermediate with respect to these two groups. [This work supported by NIH NIDCD R03DC012278 and R01DC001507.]

ARE AGE-RELATED CHANGES IN COGNITIVE FUNCTION DRIVEN BY AGE-RELATED CHANGES IN SENSORY PROCESSING?

Humes LE\textsuperscript{1}, Busey TA\textsuperscript{2}, Craig J\textsuperscript{2}, Kewley-Port D\textsuperscript{1}

\textsuperscript{1}Department of Speech & Hearing Sciences; \textsuperscript{2}Department of Psychological & Brain Sciences
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This study examines the associations between aging, sensory processing, and cognitive function. Although there has been a long-standing interest in these associations, previous work did not obtain multiple and rigorous psychophysical measures of sensory processing from several senses and from a large number of young, middle-aged, and older adults. We report the results here from 245 adults, ranging in age from 18-87 years, on an extensive battery of auditory, visual, and tactile sensory-processing measures and a standardized battery of cognitive measures. The 40 sensory-processing measures were reduced to 8 underlying factors, each tied to a common global sensory-processing factor. Likewise, the 15 cognitive measures were reduced to 3 underlying factors, each tied to global cognitive-function factor. The analyses of these data indicate that the long-standing observation of age-related declines in cognitive function in adults may be driven by age-related declines in global sensory processing. Implications for “early intervention” in middle-aged adults will be discussed. (Work supported by NIA R01 AG022334.)
HEARING AND COMMUNICATION ACROSS THE LIFECOURSE – A PUBLIC HEALTH PERSPECTIVE

Davis A

Public Health England, London, UK

The Global Burden of Disease studies show the importance of understanding the population approach to health over the lifecourse. It distinguishes between things that kill us and those that ail us and importantly the trends in these over time. It then tries to partition risk across different sorts of factors so that policy decisions can be made about how to reduce the impact of amenable risks. Hearing is not an underlying cause of death, even though there is emerging evidence that raised hearing thresholds are associated with earlier mortality. Across the lifecourse the key importance of hearing is in being a major channel of communication – to develop language and cognition, to benefit from education, to gain and maintain good employment, form family ties and contribute to and participate in society. The major role of Population Hearing Health in determining and maintaining the good health and wellbeing of the population is unrecognised by society. Over the last 25 years there has been a steady decline in premature mortality in most countries and an increase in life expectancy. However the burden has shifted from mortality to morbidity, with the inevitable costs in managing many more people with morbidity and increasingly multi-morbidity. What do we need to do in terms of creating the best strategy for research, translation and implementation to inform policy makers, clinicians and populations about the crucial role of hearing and communication in creating added healthy years to life? Perhaps, we should look at the success of newborn hearing screening, how it creates the first and best chance to promote population hearing health across the life-course and learn from that about how we can personalise the message and support for those whose need is greatest. A global problem needs a personalised local solution.
WORKSHOP

EXPECT THE UNEXPECTED: MANAGING AN INCIDENT AND IMPROVING QUALITY IN THE NEW ZEALAND NEWBORN HEARING SCREENING PROGRAMME

Tuohy P, McLeod M
Ministry of Health, Wellington, New Zealand

The New Zealand Newborn Hearing Screening and Early Intervention Programme commenced in 2009. This programme is jointly overseen by the Ministries of Health (MoH) and Education (MoE) with the MoH and District Health Boards (DHBs) responsible for newborn hearing screening; diagnosis of hearing loss and medical interventions, and the MoE responsible for early intervention and education services for children with a hearing loss. Similar to many countries, the programme utilises an OAE/AABR protocol for low risk and an AABR/AABR for high risk infants.

Programme quality has been a high priority since inception, and considerable work was done during rollout to ensure that training and resources were available to screeners and management. Regular screener inservice and management oversight has been undertaken.

In July 2012 an audiologist noted a discrepancy in a hearing report for an infant who had apparently passed the OAE screen. This led to the identification of a widespread quality issue in the screening pathway, whereby approximately five thousand babies born between 2009-2012 were not screened according to programme protocols.

The screeners deviated from screening protocol in one or more of three ways, resulting in the baby appearing to have passed the hearing test:

- screening the same ear of a baby twice
- screening one ear of the baby, and then testing one of the screener’s own ears as if it were the baby’s other ear
- testing both of his / her own ears, in place of the baby’s ears.

This workshop will describe the incident and discuss recommendations aimed at improving service provision and strengthening leadership and surveillance of the programme. The ease with which screeners were able to screen outside protocol without being identified may give attendees using an OAE protocol cause to review their results and ensure that this is not a issue within their own programmes.
SPECIAL SESSION

THE BRAIN AND HEARING AIDS: CONSIDERATIONS FOR CHILDREN, YOUNGER AND OLDER ADULTS

CORTICAL MEASURES AND THEIR POTENTIAL FOR THE ASSESSMENT OF PEDIATRIC HEARING NEEDS

Small SA

*University of British Columbia, School of Audiology & Speech Sciences, Vancouver, Canada*

Infants are diagnosed with hearing loss & fitted with amplification at a very young age. Accessibility to spoken language is critical to optimize speech and language development, consequently, confirmation of hearing aid benefit in terms of speech discrimination capacity is a priority. Researchers and clinicians are interested in developing an accurate and objective tool to assess the detection and discrimination of speech sounds in young infants. Cortical auditory evoked potentials, such as the slow cortical response to the onset of a stimulus, and the acoustic change complex (ACC), which elicited to a change within a stimulus, are well suited to these applications.

This presentation will focus on recent studies investigating the ACC in infants with normal hearing and hearing loss. Factors to consider when recording aided & unaided cortical responses will be described and the current challenges faced when interpreting aided cortical response will also be discussed.

THE EAR-BRAIN CONNECTION: OLDER EARS AND OLDER BRAINS

Tremblay K

*University of Washington, Seattle, WA, USA*

Hearing aids help compensate for disorders of the ear, but successful rehabilitation also depends on the integrity of the central auditory system. Here I will describe how the neural representations of frequency and timing cues change with age. I will also review the effects of auditory training and amplification on the human brain and their relevance to clinical rehabilitation. Using information obtained from neuroscience provides new insights into the challenges patients encounter as they age and lose their hearing.

COGNITIVE HEARING AIDS AND TOP-DOWN/BOTTOM-UP ISSUES

Lunner T

*Eriksholm Research Centre Linnaeus Centre HEAD, The Swedish Institute for Disability Research, Department of Behavioural Sciences and Learning, Linköping University, Sweden*

Working memory is important for online language processing in a dialogue. We use it to store, to inhibit or ignore what is not relevant, and to attend to things selectively. It is our way of keeping track...
while taking turns or following the gist of the dialogue. The Ease-of Language Understanding (ELU) model describes the role of working memory capacity (WMC) in sound and speech processing and attempts to explain findings on e.g. the relationship between WMC and speech signal processing and short-term retention and the effects of hearing impairment on memory.

In a given listening situation, the mental/cognitive state may be different in the same acoustic environment if the cognitive tasks differ including e.g. single task versus dual task, time of the day, fatigue, or attention to different sources. Hearing aids include automatics to control signal processing schemes like noise reduction and beamforming/directional microphones. The different mental states during listening indicates that for a hearing aid it might not be enough with just measuring acoustics, it might be necessary to monitor cognitive parameters and make decisions on hearing aid settings, i.e. cognition-driven hearing aids. New technological developments relevant for auditory processing include physiological monitoring via e.g. the electroencephalogram (EEG), and via pupillometry. In the presentation some ideas will be reviewed and some preliminary work will be presented on (a) cognitive load monitoring for hearing aid control, and (b) attention modulation, i.e. which source is attended to?
AGING AND HIGHER LEVEL PROCESSING

MULTI-LEVEL ANALYSIS OF AGE-RELATED DECLINES IN AUDITORY TEMPORAL PROCESSING

Bartlett EL\textsuperscript{1,2}, Parthasarathy A\textsuperscript{1}

\textsuperscript{1}Weldon School of Biomedical Engineering; \textsuperscript{2}Dept. of Biological Sciences

Purdue University, West Lafayette, USA

Human studies of the aging auditory system provide important information regarding perceptual difficulties and use neuroimaging, non-invasive neurophysiological and genetic findings to understand and ameliorate hearing difficulties. Animal studies complement the human studies by being able to link the population neurophysiological data with cellular level physiological and anatomical data to provide mechanistic hypotheses for age-related decline and potential therapeutic avenues. In age-related hearing loss, it is well known and well-studied that cochlear function degrades, producing loss of hearing sensitivity. Less well understood are the changes in the central auditory pathways. A major aspect of age-related hearing loss in central auditory pathways is a deficit in auditory temporal processing, potentially due to compensatory increases in neural excitability, such as a reduction in inhibition. Here, we study changes in temporal processing with age using auditory evoked potentials in F344 rats, which can be easily be bridged to human data using the same techniques and stimuli. Furthermore, we can record local field potentials (LFPs) and single unit activities (SU) from a key integrative auditory nucleus, the inferior colliculus (IC), in the same animals. We then correlate these changes with histological changes to excitatory and inhibitory markers in the IC and use the data from previous studies to create biophysical models of IC neurons. Our results suggest that although SU and population activities in aged animals are comparable to young animals under simple listening conditions or with simple stimuli, reductions in the fidelity of responses are evident in aged animals when temporal modulations are rapid or not as salient. These changes are correlated with reductions in GABAergic markers in IC and can be reproduced qualitatively in biophysical models by such reductions.

AGING DIFFERENTIALLY AFFECTS NEURAL TEMPORAL PROCESSING AT SUBCORTICAL AND CORTICAL LEVELS

Goossens T, Vercammen C, Hofmann M, Wouters J, van Wieringen A

KU Leuven, Department of Neurosciences, Research Group ExpORL, Leuven, Belgium

With advancing age, people experience greater difficulty following a conversation, especially in noisy environments. This is the result of age-related peripheral hearing loss, changes in central temporal processing and/or declining cognition – three factors that are closely intertwined. One temporal feature of speech is particularly crucial for speech perception: the speech envelope, referring to the slow-varying modulations ($\pm$ 2 Hz – 50 Hz) in the amplitude of continuous speech. Very low-frequency amplitude modulations signal the occurrence of syllables ($\pm$ 4 Hz) and phonemes ($\pm$ 20 Hz) and drive speech perception. Coding of envelope modulations requires synchronized neural activity in the auditory system. High- (> 30 Hz) and low-frequency ($\leq$ 20 Hz) modulations respectively have neural generators at subcortical and cortical levels.
Age-related changes in neural synchronization to high-frequency modulations have been demonstrated repeatedly whereas syllabic and phonemic rate modulations have not been investigated in detail yet. Moreover, the boundaries between peripheral, central and cognitive processing were often blurred. To address these limitations, we examine neural temporal processing from brainstem to the cortex by applying both high- and low-frequent, speech-like modulations. By including three age cohorts, while carefully controlling for peripheral hearing and cognition, we are able to examine effects of aging per se.

Three age cohorts are included: 20-30 yrs., 50-60 yrs. and 70-80 yrs. All subjects have audiometric thresholds ≤ 25 dB HL from 125 Hz up to and including 4 kHz and are cognitively screened. Neural synchronization is investigated by means of auditory steady-state responses (ASSRs) which are recorded by a 64-electrode EEG setup in response to octave bands of white noise centred at 1 kHz and amplitude modulated by 80, 40, 20 and 4 Hz.

The results indicate that aging differentially affects neural temporal processing at subcortical and cortical levels, the latter being a novel finding up to now.

SEMANTIC EFFECTS ON DICHOTIC LISTENING IN OLDER ADULTS

Lavie L

University of Haifa, Faculty of Social Welfare & Health Sciences, Department of Communication Sciences and Disorders, Haifa, Israel

Dichotic listening tests demonstrate the age-related changes in the way competing signals are processed. In older adults dichotic listening is characterized by poor scores and large right-ear-advantage (REA) due to large left-ear-deficit. Carter & Wilson (2001) found that when dichotic words differed in their lexical complexity, younger adults better recognized easy words regardless of the ear to which they were presented, while in older adults words presented to the right ear were better recognized regardless of their complexity, hence emphasizing the age-related ear asymmetry.

The aim of the current study was to test whether these patterns will recur in dichotic tests in which the test signals differ in whether they carry semantic meaning.

**Design:** Dichotic listening was evaluated in 17 old normal-hearing participants (mean age: 68.4±9.05). Four combinations of words and nonsense syllables were used: two combinations with identical pairs ((Rt)words-(Lt)words; (Rt)nonsense-(Lt)nonsense), and two with mixed pairs ((Rt)words-(Lt)nonsense; (Rt)nonsense-(Lt)words). The patterns of the results were compared to those of 24 young adults (mean age 22.75±2.32) who were tested similarly in a previous study.

**Results:** In the older adults the expected REA was found in both identical combinations (words-words, nonsense-nonsense). In the mixed combinations, large REA was scored in the (Rt)words-(Lt)nonsense combination and LEA (left-ear-advantage) in the (Rt)nonsense-(Lt)words combination. In the younger group, the pattern of results in the mixed combinations resembled that of the older adults, and in the identical combinations - a slight, insignificant REA was scored.

**Conclusions:** In both younger and older adults, having a semantic meaning was the factor that determined the extent and the direction of ear advantage. Our results suggest that speech is similarly processed in younger and older adults, and that the difficulties faced by elderly individuals in perception of competing stimuli do not origin from deterioration in the perception of meaningful speech.
COGNITIVE TESTS OF MEMORY AND SELF-REPORTED MEMORY EFFICIENCY ARE ASSOCIATED WITH HEARING SELF-REPORTS IN A POPULATION-REPRESENTATIVE SAMPLE OF MIDDLE AGE AND OLDER ADULTS

Setti A1, Shanahan W2, O’Tool M2, Kenny RA2

1School of Applied Psychology, University College Cork, Cork, Ireland; 2School of Medicine, Trinity College Dublin, Ireland

Increasing evidence shows that hearing loss can negatively impact on cognition. While experimental studies have provided some evidence on the specificity of these effects (recall in particular), it is not clear what the mechanisms responsible for these associations are. Epidemiological work has recently shown that on a longitudinal perspective hearing deficit are associated to global cognitive decline and executive functions appear to be the most impacted cognitive skills. Cognitive load has been proposed as a cause of these cross-sectional and longitudinal relationships. However, only few studies at present have included an extensive cognitive battery tapping on different cognitive functions on a large sample of participants. In addition audition is always assessed by audiometric tests, while it is not known whether a simple question relating to self-perceived hearing efficiency is sufficient to highlight these hearing-cognition associations. In the present work we analyzed cognitive performance in relation to self-reported hearing efficiency in a population representative sample of 8000+ individuals aged 50+. Tests included memory (recall, semantic memory, prospective) executive function, processing speed. The results indicated a significant association with recall, fluency and prospective memory as well as self-reported memory efficiency. The results are discussed in relation to current theories on sensory and cognitive efficiency and the limitations of using a self-report measure are considered.

HOW AGE AND AUDIBILITY AFFECT MEMORY TASK PERFORMANCE IN NORMAL HEARING PERSONS

van Wieringen A, Vercammen C, Goossens T, Wouters J

KU Leuven - University of Leuven, Department of Neurosciences, ExpORL, Leuven, Belgium

As people age, they report speech understanding difficulties more frequently, especially in adverse conditions. This can be attributed to age-related changes in factors contributing to speech processing, e.g. auditory sensitivity, central auditory processing and/or cognitive functioning. Several studies document how age affects cognitive tasks, especially the potentially confounding effects of diminished hearing thresholds on performance. The main objective of our study is to investigate whether aging still affects memory tasks performance in persons with very good hearing thresholds, the latter requirement being very exceptional in elderly persons! Participants are 20-30, 50-60 or 70-80 years of age and have normal hearing thresholds (≤ 25 dB HL) in both ears (0.125 – 4kHz). Furthermore, participants have scores within the normal range (≥ 26/30) on MoCA, a cognitive screening tool. In addition to careful subject selection, a subset of the participants were also matched for hearing thresholds in order to evaluate subtle variations in audibility.

Performance is investigated for the WAIS III Digit Span Test forward and backward, and for the Reading Span Test. Results show that the 3 memory tasks are susceptible to age-related changes when comparing subjects between 20-30 years to subjects between 50-60 years old. However, subjects between 70-80 years old perform statistically similarly to subjects of 50-60 years old. This suggests that memory task performance is more robust to age-related changes from middle-age on,
when peripheral hearing is preserved and no indications for cognitive impairments are present. For the Digit Span backward, small variations in audibility rather than age seem to account for the observed performance differences.

**DIFFERENTIAL EFFECT OF AGING ON VERBAL AND VISUO-SPATIAL WORKING MEMORY**

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Working Memory (WM) declines with age. WM is a crucial factor in speech understanding in noise for persons with a hearing impairment. However it is still unclear, whether a decline is more pronounced on verbal WM or on visuo-spatial WM. The present study compares the effect of aging on the verbal and visuo-spatial modality of WM in a group of older adults with age-appropriate hearing.

A group of 20 older healthy adults (age 60 years and above) was included in the study. As a comparison, a group of 20 younger healthy, normal hearing adults (age 18-25 years) was also included. Verbal WM was tested using a Reading Span Test (Van den Noort et al., 2008). A Corsi Block Tapping Test (Milner, 1971) was used to test the Visuo-Spatial modality of the WM.

First results show that there is a slightly bigger effect of age on verbal WM than on visuo-spatial WM but this difference is not significant.

**HOW AGE-RELATED HEARING LOSS AND COGNITIVE ABILITIES INTERACT AND INFLUENCE MEMORY PERFORMANCE**

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This study investigated how age-related-hearing loss (ARHL) might contribute to memory deficits and whether an enhanced auditory message can facilitate memory.

A series of three experiments were conducted to investigate whether decreasing listening effort facilitates memory performance. Recall of complex prescription instructions presented in conversational speech, and clear speech was tested to see if they resulted in better memory performance for two groups of older adults matched for age and hearing loss (quiet and noise). Recall of complex prescription instructions presented in degraded (65% time-compressed speech in babble) and enhanced (120% expanded speech) were compared for older adults with particular configurations of hearing loss to younger adults without hearing loss. Comparing a group of older musicians (‘expert listeners’) to non-‘expert listeners’ (two non-musician groups younger and older adults).

Results demonstrated that enhancements of the auditory message during encoding facilitated memory at retrieval for all groups, more so for the hearing-impaired older adult individuals. The older adult musician group demonstrated additional enhancement in listening so that their memory performance was more similar to the younger non-musician than to a group of older adults matched for age and hearing ability.

The findings from this study support the effortful listening hypothesis. ARHL increases the effort in listening by degrading the message, increasing the distractor effect, and decreasing perceptual learning. These ARHL effects increase the processing load to discern the message for
communication at the perceptual, lexical and cognitive levels. These processing loads result in fewer attentional and cognitive-linguistic resources available for elaborate encoding for later recall. Enhancements to the auditory-verbal message in an ecologically valid task demonstrated that memory performance can be improved in older adults with hearing loss. These findings lend support to ARHL as a potential underlying causal mechanism contributing to declining memory performance in the aging adult population.

OBJECTIVE MEASURES OF SPEECH INTELLIGIBILITY IN SENSORINEURAL HEARING LOSS

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A novel approach based on the use of acoustic simulations of impaired perception and objective measures of perceptual speech quality (PESQ) is proposed and validated to predict speech intelligibility in sensorineural hearing loss. The proposed approach consists of three steps: first, acoustic simulations (based on spectral smearing, expansive nonlinearity, and level scaling) were applied for degrading speech waveform to simulate impaired perception in normal listeners. Second, PESQ have been employed to objectively measure the perceptual quality of the degraded speech waveform obtained from the acoustic simulation. Third, PESQ scores were transformed into predicted intelligibility scores by means of a logistic function.

A set of CV and VC syllables in /a/, /u/, and /i/ contexts was used as reference test material. Subjective measures of intelligibility of the degraded speech were obtained in a group of 10 subjects and were compared to speech intelligibility predicted by the proposed approach.

Overall, results from this study revealed significant effects of speech characteristics (i.e., vowel context) and hearing loss severity on intelligibility of speech waveforms subjected to distortions that simulate sensorineural hearing impairment. Objective PESQ measures showed good correlation with subjective intelligibility scores, as reported by the goodness of fit of the mapping function in terms of correlation coefficient ($R^2=0.7$) and RMSE = 0.14, revealing that the proposed approach is a valuable aid in real clinical applications.
ROOM BOHEME

ISSUES ON EHDI

BENEFITS OF UNIVERSAL NEWBORN HEARING SCREENING TO READING OUTCOMES IN ADOLESCENCE: EARLY CONFIRMATION OF DEAFNESS MATTERS

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Objective: To determine the effect of universal newborn hearing screening (UNHS) and early confirmation of permanent childhood hearing impairment (PCHI) on reading and language in adolescence.

Method: We previously assessed the benefits to language (Kennedy et al., N Engl J Med 2006, 354:2131-41) and reading (McCann et al., Arch Dis Child, 2009, 94:293-297) at primary school age following UNHS and early confirmation of PCHI in a population-based cohort of 120 deaf children. The current study re-assessed participants from this cohort nine years later when they were 13-19 years old. The pre-specified primary outcome variable was reading comprehension z-scores, where the mean (SD) score in the hearing comparison group was 0 (1), adjusted for confounders in a regression model. Receptive and expressive language skills were also assessed.

Results: Reading comprehension z-scores at mean (SD) age of 17.1 (1.45) years were significantly higher in those whose PCHI had been confirmed at age < 9 months than in those with later confirmed PCHI (group means -0.63, -1.74 respectively; adjusted group mean difference = 1.17, 95% CI = 0.36 to 1.97, p = 0.005). Language outcomes showed similar patterns of inter-group differences. The differences seen between early and late-confirmed groups were larger than they had been at primary school age.

Conclusions: The reading ability of the early-confirmed children had increased in line with that of their normally hearing peers as they progressed to the secondary school years whereas the reading ability of children whose PCHI was confirmed later had fallen further behind that of their peers with early confirmed PCHI and their hearing contemporaries. The utility of UNHS programmes that increase the rates of early confirmation of PCHI are likely to have been underestimated by studies at pre-school or primary school age.
IDENTIFYING AND ADDRESSING ETHICALLY IMPORTANT SCENARIOS IN NEWBORN HEARING SCREENING

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The Victorian Infant Hearing Screening Program (VIHSP) is an example of a high quality newborn hearing screening program that meets world wide key performance indicators for the hearing screening pathway. In staff professional development programs, VIHSP have focused on two specific indicators of effective screening programs, recognized by the WHO, but which have received relatively little attention in the literature on screening - ethical acceptability and informed choice for potential participants.

Interpreting and implementing medical ethical principles of (respect for patient autonomy, do no harm, patient benefit and equitable health care) and informed choice in the contexts of newborn hearing screening programs can be complex. Parents, guardians and health care professionals may hold different views and values about conducting hearing screening. It is not always clear who has the moral authority to make decisions about agreeing to hearing screening and whether and how to challenge decisions if they are not in the best interests of the child.

In collaboration with the Royal Children’s Hospital Bioethics Centre (Melbourne, Australia), professional development workshops were conducted with VIHSP staff to canvass the range of ethical issues encountered in everyday screening practice. These included disagreement between parents about their infant’s participation in the program and parents choosing to ignore a screen result that indicates their infant requires further diagnostic testing and possibly early support and intervention.

We present these common ethical dilemmas and a process for analysing and addressing them in the form of ‘ethical guidelines for effective hearing screening’. Feedback from the workshops suggests that increasing ethics competence and literacy has the potential to benefit staff when they liaise with parents and health professionals. The guidelines for ethical practice in hearing screening programs developed from these workshops will have relevance for a range of screening programs, particularly newborn.

RESCREENING INFANTS IN VICTORIA 2011-2012

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Screening programs must be regularly monitored and reviewed to ensure reportable data is of a high quality, patients are not being unnecessarily referred for further testing, staff involved are working to acceptable standards and participants are well informed and receiving the best possible service.

The Victorian Infant Hearing Screening Program (VIHSP) recently undertook a review of data from the financial year 1 July 2011 – 30 June 2012 to investigate the rate of re-screening of newborns. Rates of re-screening are important considerations in the quality of screening provided, minimising false negative results, and resourcing of screening services.

Analysis of data from this period indicated that the VIHSP rescreen rate is approximately 10%. While data were being analysed, a number of interesting subsets of information came to the attention of the monitoring team. VIHSP then undertook an in-depth review of particular sets of this data, focusing primarily on rescreens indicated to have been undertaken within twenty minutes of the
previous screen. This revealed some errors and screening practices specific to some screening sites that were not consistent with the majority of VIHSP services. Practices such as rescreening inpatients immediately following a refer result and data entry errors often related to the screening of multiple birth infants.

Through this analysis VIHSP has been able to create and implement a guideline for rescreening infants. It has also undertaken an education program for all staff delivering screening across Victoria to raise awareness to the importance of following procedures and attending to detail.

INTRODUCTION TO THE KNOWLEDGE AND IMPLEMENTATION IN PEDIATRIC AUDIOMETRY GROUP AND THEIR WORK

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Throughout the world research evidence coupled with clinical expertise establishes the foundation for preferred practice guidelines. The dilemma is that across health care professions evidence-based recommendations exist but are not being consistently implemented in clinical practice. This is also true for the profession of audiology. Professional practice behaviours correlate with the quality of care patient’s receive. Therefore, one approach to ensuring optimal care in the audiology clinic is to support individual audiologists and assist them in modifying their practice behaviours in response to evidence-based guidance. Starting in August 2010, a group of Audiologists met to establish the Knowledge and Implementation in Pediatric Audiology (KIPA) group that continues to meet on a twice-a-year basis. This collaboration of industry partners, researchers and clinical audiologists believe that as a community, pediatric audiologists are willing to critically evaluate research and share that knowledge to facilitate practice change to provide optimal care for their patients. The KIPA group set out to examine the current state of clinical practice in pediatric amplification by focusing on several important essentials¹: (1) determining what needs to be done differently; (2) examining the barriers to practice change and developing solutions to facilitate change; (3) developing implementation interventions and methods of delivery to successfully change practice behaviour; and finally (4) ensuring strategies are in place to sustain practice change. This presentation will introduce the audience to the KIPA collaboration and discuss some of our projects and future thoughts on being facilitators of practice change.


**POLISH UNIVERSAL NEONATAL HEARING SCREENING PROGRAM – FROM DETECTION TO THE DIAGNOSIS**

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Polish Universal Neonatal Hearing Screening Program (PUNHSP) has been running for over 11 years. Throughout this time more than 4 million children have been examined. According to Central Statistics Office 386,257 children were born in 2012 however, central database of PUNHSP registered 370,969 children which represents 96.0% of the population of newborns. The setup of the program separates the screening level, diagnostic level and intervention level. Otoacoustic emission recordings and risk factor questionnaire obtained from the parent on the second day after delivery are the screening tools of the program.

According to the program protocol, 8.9% of screened children requires further diagnosis. This group comprises children that do not meet the pass criteria of the screening (79%) as well as children that skipped the screening due to other reasons (21%). The first group includes children with correct OAE test result and coexisting risk factors for hearing loss (42%), incorrect OAE (32%), incorrect OAE and coexisting risk factors (5%).

Reports from 509 centers participating in PUNHSP, revealed that only 58% of children referred for further diagnosis from the screening level were consulted on the diagnostic level. A telephone survey among parents of children born in 2012, who had left further evaluation was conducted in May 2013 to look for the explanation of such situation.

It is estimated that about 1.5% and 0.8% of data were entered into database as incomplete and incorrect respectively. 8-10% of children requiring further diagnostics, left to centers outside of the PUNHSP. We can assume that the percentage of follow-up visits at the diagnostic level equals approximately 70-75%. The results obtained on the basis of the survey have shown that the PUNHSP works properly, however requires changes encouraging people to fill in of questionnaires on screening level and an increasing in the number of diagnostic centers.

**HEARING SCREENING IN NEONATES IN CENTRAL REGION DENMARK**

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**Introduction:** In 2004/5, hearing screening of all newborns was introduced in Denmark. The purpose was faster identification and diagnosis of children born with hearing loss.

The following guidelines have been determined by the Danish Health and Medicines Authority (DHMA) for hearing screening in Denmark:

- More than 90% of all newborns must go through neonatal screening with OAE and/or aABR.
- The screening programme must be completed no later than 30 days after birth (for healthy newborns) or discharge from a neonatal department.
- A final diagnosis of hearing >30dB must be made within three months after birth or discharge from a neonatal department.
Purpose: The purpose of the study was to evaluate whether Central Region Denmark observes the DHMA guidelines for neonatal hearing screening and to identify factors that may improve screening efforts.

Data and method: We performed a retrospective collection of electronic patient journals data from hearing screening centres in Central Region Denmark between January 2006 and September 2013.

Results: Since 2009, the neonatal screening density in Central Region Denmark has exceeded 90%. Factors with a negative impact on the screening density were a strike among nurses in 2008 and the implementation of electronic patient journals in 2012.

During the study, 133 children were diagnosed with congenital hearing loss. 43% were examined at the Audiology Clinic within 30 days after birth/discharge from the neonatal department. 70% had a diagnostic opinion within 90 days after birth/discharge from the neonatal department.

Conclusion: Central Denmark Region does - to some extent - live up to DHMA guidelines for neonatal hearing screening. In order to improve screening efforts, screening staff has been trained, “birth packages” have been introduced, combining PKU (phenylketonuria) tests and neonatal hearing screening, and close relations have been established between the primary screening clinics and the Audiology Clinic.
INTERVENTION STRATEGIES FOR ADULTS

COGNITIVE TRAINING TO IMPROVE SPEECH UNDERSTANDING IN COMPLEX COMMUNICATION ENVIRONMENTS – A FRAMEWORK AND METHODOLOGICAL ASPECTS

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Hearing loss and cognitive decline are frequently observed in older persons. Auditory training is a common measure to address problems encountered with hearing impairment. In contrast, we propose that cognitive training might also be beneficial with regard to speech understanding in demanding environments. Recent work has shown that distinct cognitive factors contribute to speech understanding in complex communication environments, as for example when confronted with competing talkers (Meister et al. 2013). As a consequence, we compose an interactive, computer-based training program to improve cognitive functions in elderly participants with normal hearing and - in a follow-up study - hearing impaired patients of the same age group, targeting especially the improvement of attention, working memory, processing speed and fluid intelligence.

The main goal of the targeted training program is to stimulate cortical plasticity as a booster of training success (Gauthier et al. 2008) by providing highly motivating exercises that adapt quickly to the performance level of each participant and stepwise increase their difficulty (“shaping”, Uswatte et al. 2006). Each improvement will be mirrored and positive feedback will be provided immediately. Also real world transfer is targeted by introducing behavioral training components. Training sessions will be completed on a computer at home and will be accompanied by an intense counseling program at the research clinic. Training success is assessed by a test battery consisting of neuropsychological and speech perception tests that address the targeted cognitive functions and is administered before and after the training.

The presentation explains the framework of the proposed training program and discusses methodological aspects. Insights into details of the training and evaluation methods are given. If successful the project might open an entirely new perspective in the framework of rehabilitation of age-related hearing loss.

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References:


EARLIER COCHLEAR IMPLANTATION IN ADULTS WITH SEVERE HEARING LOSS MAY IMPROVE OUTCOMES

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Multichannel cochlear implants have become standard treatment for acquired severe and profound bilateral hearing loss. Outcomes have improved with changes in technology, and indications have extended to include older adults, patients with significant residual hearing, and adults with congenital hearing loss. Factors impacting on success include duration of loss, age, onset of hearing loss, surgical result, and cochlea abnormalities. Improvements can be life-changing for many recipients and over 90% show significant benefit. Despite this, there is a disparity between the number of adults who could benefit from implants and the number who receive them. Studies in the UK and Australia estimate the proportion of adults with bilateral severe hearing loss as between 0.5 and 1%, but in Australia, less than 0.05% have received implants. Reasons for this are unclear but some factors may be lack of knowledge, fear of surgery, and a high proportion of elderly patients. If adults are identified with severe bilateral hearing loss earlier, the duration of auditory deprivation prior to implantation will be reduced. Similarly, if identified earlier, adults will be younger when they receive their implant thus mitigating some of the effects of age. A recent study showed that decreased cognitive skills lead to poorer outcomes and more difficult post-implant rehabilitation. There is also evidence that the social isolation of severe hearing loss may accelerate the decline of cognitive skills in elderly patients. This paper will present data supporting the benefits of earlier identification and referral of adults who may benefit from cochlear implantation.

IMPROVED WORD IDENTIFICATION PERFORMANCE IN AUDITORY TRAINING FOCUSED ON FREQUENT COMMUNICATION PARTNERS

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Given limited empirical support for the efficacy of auditory training (AT) (Sweetow & Palmer, 2005), any demonstration of AT benefits should be of interest to the field. However, evidence for efficacy of AT focused on frequent communication partners (FCPs) should be of particular interest given the larger goal of improving day-to-day lives of AT clients. In this light, the present study was designed to assess whether a set of previously observed benefits of AT would extend to AT using stimuli produced by FCPs of the individuals receiving training. The study partially replicated Barcroft et al. (2011), who demonstrated transfer-appropriate gains in word identification based on a 4-choice discrimination task using the AT program I Hear What You Mean. In the previous study, participants heard novel talkers only and experienced gains that depended on the degree of overlap between training and testing based on single- versus multi-talker conditions. In contrast, the present study used stimuli produced by the participants’ FCPs. The results indicated substantially improved mean performance (16.1%) using the stimuli produced by the FCPs. From a practical standpoint, these findings speak to the potential of tailoring AT using stimuli produced by FCPs. Discussion focuses on whether additional focused AT may increase the gains presently observed for FCPs and the extent to which AT can be directed to address specific needs experienced on a daily basis by individuals with hearing loss and their FCPs.
References


**CONVERSATIONALLY ORIENTED REHABILITATION PROGRAM FOR ACQUIRED HEARING LOSS**

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The basic idea that will be developed in this presentation is that a conversationally oriented rehabilitation program of audiologic communication therapy needs to be socially acceptable in a family environment. Accordingly, the repair strategies, which are particularly presented, also need to be based on ecological validity. In addition, the hearing clinician (a speech therapist, audiologist, etc.) should take into consideration the social sensitivity of repair. Based on the evidence from a qualitative conversation analytic PhD-study, the aim is to increase discussion of the counseling program, which deals with repair issues. The data in this PhD-study is video recordings of eight conversational pairs (with five moderately to profoundly HI individuals and their frequent conversational partners). This presentation includes a suggestion that hearing clinicians can empower HI individuals and their frequent conversational partners by increasing their knowledge of their concrete, existing abilities. To answer to this, the presentation addresses, for example, what type of collaborative procedures the HI recipient’s non-vocal, embodied behavior initiate in face-to-face conversation with a frequent conversational partner. The analysis of real-life conversations demonstrates the micro level mechanisms and effects of hearing loss. These effects are not necessarily negative. For example, the recognizable collaboration between the HI individual and the conversational partner can prevent explicit trouble and maintain the conversational flow. A general, concrete and socially acceptable, guideline for communication therapy is presented. This conversationally oriented rehabilitation program offers tools both to secure the conversational flow and also to assist adaption to the disruptions. The hearing clinician should then take an individual approach with each client-pair and extend the information accordingly. One tool in this counseling is a video from real-life conversation, which can be transcribed to emphasize the crucial features of behavior.
SPECIAL SESSION

INTERNATIONAL REPORT ON EHDI PROGRAMS

THE DEVELOPMENT OF THE NEWBORN HEARING SCREENING PROGRAM IN RUSSIA

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The main goal of our study was to investigate the development of the newborn hearing screening program in Russia during the last years (2010-2013).

The comparative analyses included the number of births, screened newborns, children failed the screening, percentage of children who completed diagnostic evaluation and number of children with identified permanent hearing loss.

It is necessary to mention that 100% of maternity hospitals and paediatric outpatient clinics were equipped by 2011.

In 2013 the number of newborns was 1 896 053 (1 901 307 – in 2012), 1 803 352 (94,1%) were screened (the number is about 0,46% higher in comparison with 2012). 2,9% of babies failed screening (50 412 babies) and 78% of them (39366 babies) went through the second stage of screening and diagnostic evaluation. In 5657 babies the hearing loss and deafness were diagnosed: it corresponds to 0,3% of all newborns, 14,4% of babies who went through the diagnostic evaluation and 11,2 % of babies who failed the screening.

The first stage of screening in Russia is conducted in the maternity hospitals as well as in paediatric outpatient clinics. In 2013, 1587 253 of newborns (83,7%) were screened in the maternity hospitals and 216 097 (11,64%) – in outpatients clinics. It was obtained that the percentage of babies who failed the screening was higher in outpatient clinics. Furthermore we could conclude that to confirm the hearing loss in 5657 babies it was necessary to investigate 39366 babies.

Based on the data presented we can conclude that the universal hearing screening program successfully developed in Russia during the last years but its further improvement could be achieved through the development and introduction of data management and quality assurance system.

GOVERNMENT-FUNDED NEWBORN HEARING SCREENING (NHS) OF SOUTH KOREA

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Background: In South Korea, NHS began at private women’s hospitals following the suggestion from businessman who import and distribute the devices since mid-90’s. After that, the Association of Audiology and Otorhinolaryngology Society introduced NHS to the general hospitals and most of
the program were initiated by ENT doctor or Audiologist since 2000 year. South Korea has about 460 thousand neonates every year. We have very low birth rate and our fertility rate is the lowest in the world. Korean Ministry of Health and Welfare (KMHW) has been supported early newborn hearing loss detection from 2007 year. The aim of this study is to explain Korea NHS system and investigate the results of national NHS through 2007 to 2013 (7 years).

**Methods:** In order to launch a nationwide program, a step wise approach was performed. First, we investigate the incidence of newborn hearing loss (HL) via a nationwide sample survey in 2006 year. In 2007 ~ 2008 year, the 1st and 2nd national exhibition NHS project was implemented in 32 regions. The 3rd national NHS project for low income babies have been conducted in all area from 2009 through 2010 year. A major drawback of nationwide program in Korea was poor follow up rate and missing babies during tracking. From 2009, we adopted a coupon system to solve these problems. A free coupon is issued to pregnant women at the public health centre. The coupon consists of two parts, screening test and confirming test with same ID number. The baby born at the small women’s clinic can visit any general hospital within 30 days for screening test. Referred babies from any listed screening clinic also can visit any hospital where confirming test is available within 90 days. Collected coupons from each institute were sent to the Ministry of Health and Welfare to get reimbursement. By analysing coupons, a tracking of baby will be possible. Problems and effectiveness of this system is yet to be determined. In the future, an electric coupon using convenient internet system in South Korea will be considered.

**Results:** The Average hearing loss rate of total babies in this study was about 5 per 1,000 babies (>40dBnHL) and average refer rate was 1.5%. We have been tried for KMHW to support all newborn NHS and organized expert group for NHS, produced clinical guideline of NHS in 2010 and opened on-line education site for screener in 2013.

The average repetition of screening test was two times, but there were some clinic testing even more than 10 times. When we break down the data, the refer rate from private women’s clinic was much lower than that of general hospital. A significant low referral rate (0.36%) raised a serious doubt about the quality of NHS program at private clinic such as false negative cases. During the 2nd national exhibition NHS project in 2008 year, 78.5% of total screening was performed at woman’s clinics, 14.1% at ENT department of general hospitals and 3.0% at children’s clinics.

**Conclusion:** According to Korean CDC data, Korean actual NHS coverage was about 75% but KMHW support only around 8% of the total newborns until 2013 year, but the support coverage will be expanded 2014 due to increasing the budget three times. In Korea, the education of NHS human resources and the quality control of individual program especially in the private clinic are the most important challenging issue. For UNHS and quality control, the computerization of the NHS system is also urgently needed. We anticipate launching a nationwide mandatory UNHS program as soon as possible.

**EARLY HEARING SCREENING AND INTERVENTION IN ISRAEL**

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Each newborn in the well baby nursery passes two stages of hearing screening -distortion product otoacoustic emissions and if repeated fails Automatic ABR. In cases of bilateral failures and before release from hospital, the newborn will pass immediately full detailed diagnostic ABR. In the ICU,
close to release, each newborn pass both OAE and AABR. Each newborn having significant hearing loss is referred to the audiological /ENT department for further evaluation. All cases with persistent hearing loss are referred to hearing rehabilitation centres which are distributed across all areas in Israel. In addition, to the newborn hearing screening, each child is re-tested again, by behavioural distract-tets at age of about 6-9 months in one of 2200 mother-child clinics that are spread out across the country. In this screening station infants with late onset, missed cases or with acquired hearing loss are detected. In general the compliance of attendance in these screening stations is close to 97%. In the rehabilitation centers each child is behaviourally repeatedly tested and carefully provided with hearing aids and other rehabilitation services (speech therapy, family support etc.). The corporation between the hospitals and the rehabilitation centers are very good and tied. In hospital, those new-born that are detected having severe to profound hearing loss are immediately referred to cochlear implant center for staring the preparations and procedure for cochlear implantation. Prevalence data of hearing loss shows that it is strongly dependent on ethnic origin (Israeli Arab & Israeli Jew) most probably due to consanguinity, medical background (ICU & well baby nursery) and time of intervention. In any case, the combination of repeated detection stages and intensive auditory rehabilitation including conventional hearing aids with cochlear implant in early stage of life result in excellent auditory outcomes and full inclusion in education stream.

EARLY HEARING DETECTION AND INTERVENTION NATIONAL PROGRAM IN ROMANIA

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Background: Bilateral prelingual deafness is an invisible handicap which impedes upon future communication skills of the child.

Methods: Our National EHDI Program started in 2006 in three public maternity wards. Now it covers partially the country by means of local effort (19 maternity wards and four audiological centers). UNHS consists of two steps, both in the maternity wards, one month apart:

- Stage 1: ATEOAE for healthy NN and ATEOAE and AABR for NN at risk for hearing loss
- Stage 2 (for REFER NN in first stage): ATEOAE and AABR

Infants with referred result are sent for complete audiological diagnostic.

Results: UNHS is not a mandatory screening test at birth, so the percentage of NN included in EHDI Program varies widely among the maternity wards. More than that, reports to the central unit are inconsistent, as well as follow-up.

For Bucharest, almost 91,87% of NN are included in the UNHS program. 9.6% of them are considered at risk for HL. A significant percentage of them (27,93%) received aminoglycosides for more than 7 days.

After the second UNHS stage, 7,2% of the risk NN had REFER results. Out of them, 60% of them (1.06% of NN at risk for HL) were diagnosed with SNHL in our Institute. 1 infant (0.833‰) was diagnosed with ANSD and 23.07% of REFER NN were lost for follow-up.

Conclusions: After 7 years of UNHS National Program we still struggle with deep commitment of the personnel from the maternity ward which by themselves bought the equipment and very poor database management and follow-up of the screened infants.
Aminoglycosides antibiotics are still first choice of treatment for neonatal sepsis in Romania and we made efforts for implementing better administration protocols in order to minimise the ototoxic effect (one dose/day and no association of more ototoxic antibiotics or loop diuretics).

**BIRTHGRANT AND UNIVERSAL HEARING SCREENING IN LUXEMBOURG (2007-2012)**

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Universal Neonatal Hearing Screening is performed with OAE in our hospital since 1994 and since 2000 in all maternities in Luxembourg. After many years of screening the coverage rate remained insufficient and did not correspond to quality criteria. In 2007 the Ministry of Health decided that the third part of the birthgrant (+/- 600 Euros) was not paid to the parents if neonatal hearing screening tests had not been carried out before. By this way, 98% of the babies could finally be screened. 36303 neonates (97,8% of all birth) were tested by OAE or AABR from 2007 to 2012. A pass could be obtained in 98,1% of cases. In the NICU Department, during the same period, 1310 neonates have been tested out of 1340 admissions: 8,3% of neonates in the NICU had a positive testing and were transferred to ENT doctors for diagnostic tests. In 2012, testing by AABR was introduced in the NICU and the transfer rate decreased to 3,5%. In final, our coverage rate was improved as hearing screening was mandatory for receiving the third part of the birthgrant. As a result of screening by AABR, the number of false positive tests decreased. The study tries also to find out why a number of babies could nevertheless not be tested. Better data exchanges between healthcare providers are necessary for a more effective outcome of our national neonatal screening programme.

**NHS 2014 IN TURKEY : THE WEB ARCHIVE & DATA MANAGEMENT**

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Our aim is presenting the procedures in tracking and monitoring data management of NHS in Turkey. In 1994 NHS started at a university in the big city, Istanbul. Since 2010 it has been implemented in all 81 cities of Turkey. While having 36 screening centers in 2005, we reached 899 screening centers with the 50 reference centers in 2014. The NHS is carried out by Turkish Ministry of Health, Child and Adolescent Health Department of Public Health Institute.

The NHS has 3 different screening centers:

1. First Step Centers; the first and second tests of infants who failed the first screening.
2. Second Step Centers; An ENT Specialist, the AABR, multi-frequency measurements are available for infants referred from the second screening.
3. Reference Centers (Diagnostic Centers); have ENT clinics and Departments of Audiology.

1,300,000 babies are born yearly in Turkey. In December 2013, our screening rate was 89.2%. To provide all these screenings and transfer infants to appropriate centers at the proper time, a web-based software called "TR MOH -NHS Web Application". The demographic information, medical
history, diagnostic and audiological test results are registered on this web page in each three steps 
by the screening centers. Plus, screening data are registered in monthly forms by MCH-FP Branch 
Offices of City’s Health Directorate" then reported by Decision Support Systems (Oracle Business 
Intelligence). So the infant screening stage can be followed by tracking reports, the system warns 
family physician about incomplete screening, then directs the family to the related institutions to 
complete the screening.

The head trainer team in the center which is consisting of ministry and scientific committee 
members is giving training to provincial trainers team. This team trains the staff -NHS practitioners- 
who will perform screening. Totally 2,529 health staff had received Newborn Hearing Screening 
Practitioners Training.

**TOWARDS COST-OPTIMISED HEARING AND VISION SCREENING: AN INVENTORY 
OF NEONATAL HEARING SCREENING IN EUROPE**

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**Introduction:** During the past 15 years neonatal hearing screening (NHS) programmes have been 
introduced in most European countries, due to the introduction of otoacoustic emissions (OAE) and 
Auditory Brainstem Response (ABR). This has resulted in intervention at a much younger age in 
cases of hearing loss.

National screening programmes however vary widely among and within EU countries, regarding 
tests used, age of testing, frequency of testing, coverage, professions involved in screening, referral 
procedure and funding. To assess these differences, we made an inventory of NHS programmes in 
EU countries.

**Methods:** A survey was sent in February 2014 to national or regional coordinators of the NHS 
programme or to an otorhinolaryngologist or audiologist involved in NHS in 39 EU countries. These 
national contacts were asked about presence of a government-initiated NHS programme, universal 
or selective testing, hearing tests used, testing risk groups such as prematures, staged or not staged 
testing, testing one or both ears, coverage, and follow up after failing the test.

**Results:** Information on NHS could be obtained from 35 EU countries. Most countries have a 
universal NHS programme, four Eastern European countries report having only local sporadic 
programmes financed by various sources with a low coverage. Programmes are financed by 
government (15), health insurance (10), hospital (4) and various sources (6). More than 95% 
coverage is reached in 19 countries, 50 to 95% coverage in 9 countries or regions. The test most 
widely used is OAE, but automated ABR is used in several regions. Automated ABR is the primary 
test in risk groups. Staged and non-staged testing are both used. In Finland and some regions of 
Switzerland only one ear is tested. Children with a positive screening test are referred to the 
otorhinolaryngologist (3), audiologist (10) or both (19).

**Conclusion:** The large variety among EU countries in NHS procedures emphasizes the need to 
compare the cost-effectiveness in an EU-wide study.
EHDI IN THE UNITED STATES

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EHDI in the United States is organized on a state-by-state basis with each state and territory submitting data to the Federal Government Center for Disease Control and Prevention (CDC) on an annual basis. Data from 2011 (latest year available) shows that of almost 3.8 million births in the United States, 98.4% of newborns received hearing screening, with almost 95% of all newborns receiving screening before one month of age. Approximately 2% (65,041) of infants screened did not pass final/most recent screen. Less than 60% (56.9%) of infants who did not pass screening received a documented diagnosis. Overall prevalence of documented hearing loss in infants born in 2011 was 1.5 per 1,000. Although 86% of infants with documented hearing loss were referred to early intervention, less than 63% of these infants were documented as enrolled in early intervention. Newborn hearing screening in the United States remains a robust procedure with excellent coverage. Documentation of follow-up and early intervention, however, continues to demonstrate gaps in service with infants either loss-to-follow-up or loss-to-documentation. Initiatives to overcome these losses will be discussed.

QUALITY PERFORMANCE INDICATORS FOR EARLY HEARING DETECTION AND INTERVENTION PROGRAM AT A TERTIARY HOSPITAL IN RIYADH, SAUDI ARABIA

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Early Hearing Detection and Intervention (EHDI) that include Universal Newborn Hearing Screening (UNHS) in Saudi Arabia is relatively new. Although in the recent years many hospitals have introduced UNHS, it is not mandatory for all babies born to be screened for hearing. A national initiative has not been developed yet and each hospital offering UNHS is responsible to manage and monitor their program.

A well-established tertiary hospital in Riyadh, the capital city of Saudi Arabia, has started the UNHS in 2010 as part of its EHDI initiative under Cochlear Implant Program, making it mandatory for all newborns’ hearing to be screened before discharge. After nearly four years, the hospital has developed Quality Performance Indicators (QPIs) to evaluate the EHDI with the intention to improving the standard of care and delivery. The QPIs have five goals with its own objectives, divided into four priority stages. The stages are determined based on the Program’s five years’ strategic planning. Key indicators are set for the objectives to measure the level of achievement. Measurement is done twice with six months gap to allow either sustainability check or corrective measures to be taken.

Evaluation of Stage One indicated that ten collective indicators from nine objectives were 100% met. These include provision of results to parents, referral for rescreening and comprehensive audiological protocol availability. Results also indicated that despite running for more than three years with more than 27,000 babies screened, less than 98% of babies were screened before discharge and before one month of age. Less than 10% of infants who failed the UNHS and subsequently diagnosed with significant hearing loss were fitted with hearing aids or cochlear implant and enrolled in an intervention program. Among others, the findings highlighted the needs to revise the internal processes in both administrative and clinical areas.
DEAFNESS: WHAT HAVE DONE IN OMAN

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There was no deafness program before 1990. Deafness as a health priority was introduced in the 5th five year plan. We highlight the achievements in Ear care and Deafness since till date; and show what can be accomplished.

SURVEY ON INFANT HEARING LOSS AT CARITAS BABY HOSPITAL IN BETHLEHEM-PALESTINE

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The research describes the epidemiology of the infant hearing loss of patients 3 months of age in the only pediatric hospital in Palestine. The purpose of this study was to highlight infant hearing loss as a major health problem in Palestine and to assess the first available data about newborn hearing screening between the period of September 25, 2006 & December 31, 2011. Data collected were uploaded and analyzed using Microsoft Excel & SPSS software. The sample population consisted of 8144 infants of which 4812 (59%) were males and 3332 (41%) were females. 72% (5886) of the infants were from Bethlehem district, 25% (2044) from Hebron district, while 3% (214) from the other Palestinian districts (Jericho, Ramallah, Nablus, Jenin and Jerusalem). The Transiently Evoked Otoacoustic Emissions (TEOAE) and AABR (Automated Auditory Brainstem Response) were used according to the manufacturer guidelines. The results were interpreted according to the American Academy of Pediatrics, the National Institutes of Health, the European Consensus Development Conference on Neonatal Hearing Screening. Of the 8144 infants tested, 1507 (14.6%) infants did not pass the 1st test 477 (32.8%) of the 1507 failed the retest, while 498 (33%) patients did not follow-up and. Only 152 (31.9%) of the patients that failed retesting went to an audiologist. The audiologist evaluation revealed that 101 (66.4%) patients presented with mild-moderate or profound hearing loss according to the BIAP (Bureau International of Audiophonologie), while 44 (28.9%) patients presented Otitis media and 7 cases (4.7%) had no problems. Chart review shows that jaundice, sepsis, prematurity, lung disease are more common among the affected patients.

The high prevalence of childhood deafness in Palestine is of utmost importance and needs the immediate attention of the Palestinian government to combat this problem. Meanwhile, Caritas Baby Hospital took the initiative to start a newborn hearing screening unit utilizing the TEOAE & AABR.

COMMUNITY-BASED INFANT HEARING SCREENING: OAE AND AABR OUTCOMES FOR 7500 INFANTS

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Developing countries require contextual models for infant hearing screening to optimise screening coverage and cost-effectiveness. Postnatal visits at community-based midwife obstetric units
(MOUs) have been proposed as an alternative screening platform to immunisation visits at primary healthcare clinics. As a result a community-based universal infant hearing screening project was initiated at three MOU facilities in partnership with the Western Cape Government Department of Health in Cape Town, South Africa. This study aims to compare the screening outcomes of Distortion Product Otoacoustic Emissions (OAEs) and Automated Auditory Brainstem Response (AABR) screening conducted at one of the community-based MOUs. The target population were newborns attending postnatal visits at the MOU. A dedicated screener was trained to follow a two-stage screening protocol targeting bilateral hearing loss. A two group comparative design was used to investigate the screening outcomes of OAE and AABR screening in terms of benchmarks provided by the Health Professions Council of South Africa’s 2007 Position Statement. The Maico MB11 BERApone™ was utilised for the AABR measurements because of negligible disposable costs and proposed advantages in test-time and ease of use. Distortion Product OAEs were elicited by means of the Bio-logic AuDX I as it was utilised in the preceding community-based screening project, is easy to use and robust in nature.

Postnatal visits at community-based MOUs are an ideal platform for hearing screening and high coverage rates could be attained. Over a period of 16 months 7500 infants were screened of which 48% with OAE and 52% with AABR technology. The overall first stage screen referral rate was 6.9% for OAE and 4.5% for AABR. The MB11 BERApone™ provides opportunity for AABR technology to be utilised in community-based screening programmes with reduced disposable costs and lower referral rates.

MULTICENTER ANALYSIS OF NHS DATA RECORDED BETWEEN 2009 AND 2012 IN FOUR GERMAN STATES

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Background: Five years after the implementation of a nationwide universal newborn hearing screening (NHS) and bearing in mind the impending evaluation in Germany, this study investigated whether a multicenter analysis of the screening results from four German states with different protocols is possible and to what extent the results meet national quality and outcome criteria.

Materials and methods: The data from 170 hospitals from 2009 to 2012 were evaluated according to definite rules and analyzed in terms of averages, as well as over time.

Results: During the investigated period and averaged over the hospitals, the quality criteria “percentage of screened newborns” and “percentage requiring further follow-up”, the “day of screening”, as well as the target parameter “age at diagnosis” were not met. Steady improvements were observed over time. The reduction in variance of most of the variables from the participating hospitals indicates continual improvement.
SWITCH-OVER TO NEW NEWBORN HEARING SCREENER FOR FLANDERS

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In 1998 Kind en Gezin successfully implemented universal newborn hearing screening in the Flanders region and the Brussels Capital region.

In 2012 the Maico MB 11 Classic was introduced to all regions of Flanders as a replacement for existing ALGO® 3i devices. In order to ensure smooth transition, a comprehensive programme integrating technical support, training and communication was developed. A call centre staffed with trained IT support specialists was set up and instructional videos and a web-based learning module were introduced.

This presentation shows the strengths and weaknesses of the implementation process, as well as preliminary results of the screening programme with the new device.

IMPLEMENTATION AND INITIAL RESULTS FROM THE NATIONAL NEONATAL HEARING SCREENING PROGRAMME (NHSP) IN IRELAND

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Objectives: The aim of neonatal hearing screening is to detect hearing loss in the neonate. NHSP was implemented in Ireland in April 2011 with completed roll-out nationwide in February 2014.

Methods: NHSP is maternity hospital based with a well-baby and NICU baby protocol. Well babies receive a TEOAE with an AABR only if no clear response on screening. NICU babies receive TEOAE and AABR routinely.

Results: Over 83,307 babies have been screened for Permanent Childhood Hearing Impairment (PCHI) since the programmes was commenced. The percentage of eligible babies offered hearing screening was 99.2%. 2,830 (3.4%) were referred for immediate diagnostic audiological assessment. 109 (1.3/1000) babies have been identified with a PCHI within this period. The prevalence of PCHI is 7.3 per 1000 in the NICU population compared to 0.6 per 1000 in the well-baby population. 1,079 (1.3% of total babies screened) had a clear response in the screening programmes but were deemed to be at risk of an acquired childhood hearing impairment. These babies were reassessed with a diagnostic audiology appointment at 8-9 months of age. To date, there are 25 cases of acquired hearing impairment through this targeted follow-up. Of the 109 cases of PCHI identified, 48% were admitted to the NICU for >48hours and 53% of these admissions had one or more risk factors for hearing loss. 8 babies were diagnosed with Auditory Neuropathy Spectrum Disorder (ANSD).
The Polish Universal Neonatal Hearing Screening Program is one of the most successful programs in Europe with respect to structure, maintenance and numbers of newborns identified with hearing loss. The Program was made possible by citizens' initiatives with the help of The Great Orchestra of Christmas Charity Foundation.

The Polish Program is based on three levels that represent principles of early detection, diagnosis and intervention. By May 2013, there were 3,920,743 children registered in the Program. The database represents 96% of the newborn population. On average, 8.8% (326,515) of the screened children who did not meet the pass criteria were referred to further hearing evaluations. The median age of diagnosis during the analyzed period was 83 days.

A hearing problem was defined as any hearing impairment greater than 20 dBHL. It was diagnosed in 9,872 children. Thorough evaluation was obtained in the group of 6,293 children diagnosed with hearing impairment in the consultation centers of the Program. Within this group, any permanent hearing impairment defined as 20 dB or worse for the better ear was observed in 1.57% of the cases. The incidence of hearing loss (bilateral sensorineural hearing impairment worse than 90dB) in children registered in our database was 0.4% (798 children). All children diagnosed with hearing loss were further referred to the audiological centers to receive proper treatment, including hearing aid fitting, rehabilitation or medical treatment, including CI, whenever it was deemed necessary.

According to our database, only half of children from the screening level were registered and diagnosed at the diagnostic centers. This may be related to the structure and philosophy of the Polish Program, which registers only public facilities. These barriers should be taken into consideration when discussing why ‘early treatment’ is still not standard.

The prevalence of hearing loss in children increases with age and may involve different types of hearing problems that cannot be identified by neonatal hearing screening. It is estimated that 9-10 per 1000 children will have identifiable permanent hearing loss in one or both ears by school-age.

The aim of this paper is to present the model, program, device and results of the hearing screening examinations conducted outside Poland.

For examination we used pure-tone audiometry, central tests (DDT and GDT) and questionnaires (special part for children and parents). There was also special survey on tinnitus. Questions were previously elaborated by the team of specialists from the Institute of Physiology and Pathology of Hearing. The tests were performed in the groups of first-grade students in the primary schools of Bishkek, Dushanbe, Chisinau, Bucharest (year 2012/2013), Krasnoyarsk, Yerevan. Examinations
were performed on Sensory Examination Platform®. We will present the results of hearing pure-tone threshold screening (.5, 1, 2, 4, 8 kHz). All the results were sent via the Internet and collected in a special telemedical database developed for the needs of our project.

Majority of children with positive screening result are individuals with minimal hearing loss. However, there is a concern that even minimal high frequency hearing loss – probably due to noise exposure – is more likely to progress in the course of growing to the levels that can be considered partial deafness.

Early detection of hearing impairments in the school-age children allows us to implement effectively medical and therapeutic programs and procedures. Such preventive treatment will lead in the future to lessening and eliminating various kinds of communication disorders and dysfunctions in this way creating equal opportunities for personal and social development.
COMMUNICATION OUTCOMES IN CHILDREN

COMMUNICATION OUTCOMES IN A LARGE POPULATION-BASED SAMPLE OF CHILDREN USING COCHLEAR IMPLANTS

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Objective: Randomised controlled trials (RCTs) constitute the highest levels of evidence to examine the efficacy of cochlear implants (CI) as a clinical treatment, but RCTs are often not ethical nor feasible in the paediatric field. Clinical research databases are a satisfactory alternative to RCTs when data integrity and accuracy are maintained. This retrospective database study reports demographic characteristics and communication outcomes for over 750 children who received CIs at the Cochlear Implant Clinic (CIC), Royal Victorian Eye and Ear Hospital, from 1985 to 2014. The sample constitutes all children who received a CI in the state of Victoria, Australia (population 5.5 million).

Method: The Melbourne paediatric database uniquely includes demographics (e.g. aetiology, other co-morbidities, IQ, communication mode), hearing (e.g. onset, course, severity of hearing loss, age at hearing aid/cochlear implant), test outcomes (e.g. speech perception, production and language), and family characteristics (e.g. maternal education, socioeconomic status) for children managed by the CIC.

Results: Current cohorts, post-newborn screening implementation, benefit from earlier access to hearing aid fitting and implants. CI candidacy has broadened over the years to include some children with significant residual hearing. The incidence of bilateral CI use has increased, while non-use/limited use has reduced. Speech production and language outcomes can be equivalent to milestones achieved by hearing children when CIs are provided early. Families with greater socioeconomic disadvantage tend to access cochlear implants later and maybe further affected by covariates such as child co-morbidities, maternal education, and English as a second language.

Conclusions: By examining the uptake and barriers to successful implant use, this study facilitates our clinical decision-making, improves patient education and counselling, and can delineate patient subgroups who are at risk for engagement with technology and early intervention. Further work is still required to make optimum use of this evidence to inform and change intervention practice.

LONG-TERM GROWTH OF SPEECH PRODUCTION ACCURACY IN PEDIATRIC COCHLEAR IMPLANT RECIPIENTS WITH PRELINGUAL DEAFNESS: VOWEL FEATURES

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The goal of this study was to examine the rate of vowel feature production following cochlear implantation (CI) and the effect of age of implant on this rate. Overall vowel accuracy of U.S. English vowels was examined. Longitudinal data collected from speech samples of 63 prelingually deafened children with CIs implanted between the ages of 10 and 170 months. Sixty-one of the children used Nucleus devices and two children used Advanced Bionics devices. Speech samples ranging from pre-implant to 11 years post-implant were analyzed using a multi-level growth model. This statistical
model was used to determine the rate of growth and deceleration of vowel accuracy as a function of age at CI activation. Age of implantation was a significant predictor of pre-implant vowel accuracy. Age of implantation also was a significant predictor of initial linear rate of growth following implantation meaning younger children had steeper growth curves than children implanted at older ages. Quadratic deceleration of growth was non-significant meaning age of implant did not significantly explain the rate of change in skill acquisition over time for overall vowel production. Analysis of three vowel features was also completed. Vowel place on a front-back continuum, and lip rounding associated with back vowels did show significant quadratic deceleration, meaning age of implant was a significant predictor in the rate of change of these two vowel features over time. Children implanted at younger ages approached mastery of these two features sooner than children implanted later. The vowel height feature was not significant meaning children’s age of implant did not impact the rate of accuracy over time on vowel height. Children implanted earlier had both more rapid rates of initial growth and more rapid rates of deceleration over time as they approached the ceiling or endpoint of vowel production accuracy on 2 of the 3 features used to classify vowels.

THE EFFECT OF HEARING AID USE ON OUTCOMES OF CHILDREN WITH MILD BILATERAL HEARING LOSS

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Introduction: Children with mild bilateral hearing loss (MBHL) are now being identified at much younger ages than in previous decades. Earlier identification allows for prospective research on the effects of MBHL on language outcomes. One existing research gap is evidence to support the provision of hearing aids (HA) and implementation of early intervention for children with MBHL. Research goals for the current study included 1) documenting consistency of HA use in children with MBHL, 2) documenting initiation of early intervention services and 3) examining outcomes as a function of HA use consistency.

Methods: Thirty children with MBHL participated. Consistency of HA use was determined by HA data logging when available and parent report of HA use when data logging was not available. Participants were 5 or 7 years of age at testing and were tested on language and phonological processing measures.

Results: Participants were divided into three groups based on amount of daily HA use: non-users (1 hour or less), part-time users (2-7 hours), and full-time users (8-12 hours). Multivariate analysis of variance indicated that children who did not wear HAs performed significantly worse on measures of receptive vocabulary, expressive grammar, phonological memory, and phonological awareness, compared to children who wore HAs full-time. There were no significant differences between groups in terms of socioeconomic status or age at confirmation of hearing loss. There was no significant correlation between age at HL confirmation or HA fitting and outcome measures. Thirty-three percent of participants had participated in early intervention services; the majority of these children were full-time HA users by age 5 or 7.

Discussion: Consistency of HA use had an impact on outcomes for children with MBHL. Early intervention services influenced consistency of HA use by school age. These data provide support for early provision of HAs in children with MBHL.
POTENTIAL BENEFITS OF MUSIC AND MULTI-MODAL TRAINING ON PERCEPTION OF EMOTIONAL PROSODY IN CHILDREN WITH COCHLEAR IMPLANTS

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Cochlear implants (CIs) are auditory prostheses that are able to restore some but not all auditory cues to an individual who is deaf. Children using CIs have characteristic pitch processing deficits leading to impairments in understanding emotional prosody. This presentation will review two exploratory studies we have recently completed to advance new methods for supporting the development of emotional prosody perception in children using CIs. The first study assessed whether deaf children who use CIs could benefit from formal music training. Children with CIs received six months of music training or six months of visual art training. Measures of perception (music and emotional speech) and production (emotional speech only) were obtained before and after training. Participants who received music training showed greater gains in music and emotional prosody perception than did participants who received art training. The second study assessed whether emotional prosody perception would benefit from congruent multimodal presentation of speech information. Examples of emotional prosody were presented in audio, audio-visual, and audio-tactile conditions. While benefits from audio-visual presentation were apparent immediately (i.e., performance for audio-visual was stronger than audio-alone), participants required an acclimatization period before receiving similar benefits from audio-tactile presentations of speech. Implications for auditory rehabilitation will be discussed.

WORKING WITH BABIES WITH HEARING IMPAIRMENT: STARTING AS WE MEAN TO GO ON!

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Babies are diagnosed and fitted with optimal technology younger than ever before. It is imperative that professionals are equipped to support families of young babies with up-to-date, practical advice about their baby’s audiological needs as well as giving them functional strategies to start building their baby’s auditory brain right from the start.

This session will give practical strategies for managing hearing technology in very young babies, and how to make the most of what the baby can hear. It will explore listening development in the first year; goals for intervention and how we support families through the emotionally turbulent period following diagnosis. The presenter will use video tape of very young babies and draw on the experience and learning from ten years of the Auditory Verbal UK programme and the new Listen and Talk as One initiative based in London – an innovative partnership between AVUK, Phonak and Chear.

The presentation will cover:

1. Audiological aims:
   a. Working with audiologists to ensuring optimal fitting as soon as possible following early diagnosis
   b. Optimal setting of the environment to show what babies are able to do in terms of functional listening from birth.

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2. Listening development in the first year
   a. Exploring what we would expect from a typically hearing baby in the first three months.
   b. Review of what babies typically use their listening for and how this learning underpins their verbal development.

3. Aims for intervention:
   a. Focus on what we want children to learn; how to set up sessions and best equip parents with the skills to support their child’s listening and speech.
   b. Our role in supporting parents through their emotional journey following diagnosis

The session will also explore applying information and learning to working with babies with complex needs, premature babies and babies with Auditory Neuropathy Spectrum Disorder.

CASE STUDIES OF CHILDREN WITH ANSD WHO WERE BORDERLINE CI CANDIDATES: OUTCOMES OF COCHLEAR IMPLANTATION

MacIver-Lux K
Sound Intuition/Clinical Services and Professional Education, King City, Canada

Advanced technology and EDHI programs have helped to identify an increasing number of children with sensori-neural hearing loss (SNHL) and/or Auditory Neuropathy Spectrum Disorders (ANSD) during the first year of life. There are a number of children diagnosed with SNHL who are later diagnosed with ANSD between 3 or 4 years of age. Depending on the degree of dys-synchrony, these children are at risk for significant delays in listening and spoken language development even if the hearing aids are meeting prescriptive targets. This presentation will provide an overview of two children who were identified with SNHL, and using hearing aids that were meeting prescriptive targets who made limited progress in the development of listening and spoken communication skills. Then, they received cochlear implant(s), even though they were considered borderline candidates for cochlear implantation based on their aided thresholds and speech discrimination scores, primarily because of the significant delays in their listening and spoken language skills. This presenter will provide a summary of their progress pre and post cochlear implantation, results of formal assessments, and a view of their listening and spoken communication skills through longitudinal video studies. A discussion of techniques, strategies and procedures that facilitate the monitoring and development of listening and spoken language skills during diagnostic therapy sessions will take place, so that the learner will be better equipped to determine whether or not children with SNHL and ANSD are benefitting from their hearing technology, and are receiving an intervention that most appropriately meets their needs.

FACTORS INFLUENCING AUDITORY BASED COMMUNICATION OUTCOMES IN SOUTH AFRICAN CHILDREN WITH HEARING LOSS

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As a result of no universal NHS in South Africa (SA), the average age of diagnosis of hearing loss is 23 months (± 17 SD) with intervention commencing at 31 months (±19SD). Despite this late start,
many children demonstrate good progress with regards to their communication development. Limited data is available about why some children can close this developmental gap, while others cannot.

**Purpose:** The primary objective of this study was to identify factors affecting performance in relation to rate of communicative development in children attending Carel du Toit Centre. The study aimed to:

a. Describe children with hearing loss accessing an auditory based intervention programme with regards to specific predictor variables

b. Identify children that present with accelerated progress in their speech production and receptive language development


**Method:** This study included 114 children (7 months - 9 years). Outcomes measures included speech intelligibility rating and receptive language scores. Predictor variables included in the regression analysis were degree of hearing loss, age of fitting, age of enrolment in intervention, multilingualism, family cooperation, socio-economic background, additional difficulties and audiological management.

**Results:** Variables that impacted communication outcomes the most, included degree of deafness, age of access to intervention, socio-economic status, followed by additional disabilities. 40% of children in the study are poor performers and are not closing the developmental gap. There is a significant difference between ages of diagnosis and accessing intervention.

**Conclusions:** In the SA context, children accessing appropriate intervention can demonstrate accelerated progress. The socio-economic climate and the lack of UNHS, continue to negatively influence the outcomes of children with hearing loss. These results can guide health and educational policy makers in South Africa about the implementation of timely intervention services and specialised schooling needs for children with hearing loss.

**ADVERSE OUTCOME OF EARLY COCHLEAR IMPLANTATION – IS THE EARLIER ALWAYS THE BETTER?**

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Many authors have been recommending early cochlear implantation in congenitally deaf children. Numerous studies have proven superior speech and language outcomes in children implanted before 24 months of age. However, this may not be true for the children with complex needs. According to NDCS report for 2012 almost 40% of deaf children have some other developmental problem besides deafness. Ching et al. (2014) in their study on outcomes in hearing impaired children have found 30% of children with additional disabilities. This fact could greatly affect outcome of cochlear implantation. Some of the developmental problems, such as autistic spectrum disorder, cognitive impairment, attention or memory deficit, hyperactivity, etc., could not be detected before the age of 2 years. Some of those children will not develop speech in spite of early implantation and intensive postoperative rehabilitation.

The authors have analysed outcomes in 27 children implanted before 24 months of age, with 1 to 10 years of cochlear implant experience. All of the children in this group had normal performance IQ. Age appropriate speech development was observed in 14/27 (51,85%). Some of the children in this study (7/27 – 25,92%) have developed speech below the expectations for the age, while 4/27
(14.81%) did not acquire verbal communication in spite of early implantation. They had elements of autistic spectrum disorder and/or cognitive deficit that were not diagnosed before the implantation.

**Conclusion:** Early implantation is not always a guarantee of favourable speech and language outcome. Considerable number of deaf children have additional disabilities that may not be obvious at an early age. It is important to explain these facts to the parents of deaf infants and toddlers in order to support realistic expectations from cochlear implantation.
HEARING SCREENING IN ADULTS

BENEFITS OF A HEARING LOSS SCREENING AND EDUCATION PROTOCOL IN PRIMARY CARE

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Problem: Although hearing loss is a significant problem for older adults, primary care practitioners rarely screen for it and those screened positive often do not take action.

Research Method: We tested a protocol consisting of screening (single item question plus finger-rub validated by hand-held audiometer) followed by a 5-minute educational session including a brochure and brochure review by the screener. Those agreeing to participate were followed for 3 months to see whether they were referred for further testing and what actions they took to address their hearing loss.

Results: 43\% of the 67 patients age 60 and older who took part were referred by their providers for further testing or went on their own. The brochure listed actions, other than obtaining hearing aids, to address hearing loss, such as where to sit in noisy restaurants and using assistive listening devices (e.g. in theaters or lecture halls, for the telephone, or amplifiers). 70\% noted adopting at least one action at follow-up. There were no differences by gender for being referred or for making changes; there were significant differences by age. 92\% of those in their 60’s, 62\% of those in their 70’s, but, surprisingly, only 50\% of those 80 or older made at least one change. For referrals, a different pattern emerged. Those in their 70’s were more likely to be referred than were those younger or older.

Conclusion: A simple screening and education protocol in primary care can be effective in promoting access to and use of hearing healthcare services; broaden the use of alternatives to hearing aids, especially for individuals unwilling to use or unable to afford them, and potentially minimize the negative impact of hearing loss. However, practitioners may need additional education about the benefits of referral for younger older adults.

DEVELOPMENT OF COMMUNITY-BASED HEARING LOSS SCREENING IN THE ELDERLY THROUGH A NOVEL MULTIDISCIPLINARY INTEGRATED CARE PATHWAY

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Background: The ageing population has led to increasing numbers (approximately 330,000) of older people residing in care homes across England; estimates suggest 75\% of them could have a hearing loss. Extrapolation to 2032, suggests an increase to 620,000, of whom almost 500,000 will have hearing loss. Many may not be aware or report hearing impairment. Reports suggest one third of older patients with hearing loss have never had a hearing test. The significant impact of hearing
loss upon the elderly and the relative ease of correction invites the development of an accessible and validated targeted hearing screening programme.

**Objective**: We plan to illustrate the current prevalence of undiagnosed hearing loss in a typical North London elderly care home with a view to catalysing local patient and commissioner support for evaluation of a novel multidisciplinary integrated care pathway.

**Methods & Materials**: As a pilot exercise, subjects over the age of 65 years were recruited from one Nursing home. A validated subjective bedside hearing screen (whisper test) was performed to identify individuals with hearing impairment. Subjects who failed or self-reported hearing difficulties were offered formal audiological assessment including pure tone audiometry.

**Results**: Of 14 patients, (age range 77 - 100), although only 4 (29%) self-reported hearing loss, 8 (67%) failed the screening whisper test. All 12 patients (86%) were referred for audiological assessment, of whom 2 declined. The remainder 10 patients (71% of pilot sample) were all found to have an audible hearing loss triggering referral on for hearing aid trial.

**Conclusions**: This pilot highlights a high incidence of undiagnosed hearing loss in elderly patients resident in a typical North London Care home. The results of further local Care home evaluation will be presented as well a novel multi-disciplinary integrated care pathway incorporating routine community-based hearing loss screening of the elderly.

**References**


**ASSESSMENT OF USEFULNESS OF AUDIOMETRIC MANUAL AND AUTOMATED TESTS TO HEARING SCREENING IN ELDERLY POPULATION**

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Age-related hearing impairments, often accompanied by deficits in communication abilities, are common problems in elderly population. They result in worsening of life quality and, in extreme cases, lead to social exclusion. Effective prevention of negative effects of hearing and communication deficits requires that the problem is detected early, and proper intervention is applied on time.

The aim of the work was to examine the possibility of applying simple audiometric hearing screening tests to elderly population. Both manual (operated by the tester) and automated tests were taken into account. One assessed effectiveness of the tests and evaluated user-friendliness of the applied devices.

The group that participated in the examinations consisted of 15 persons (8 women) in the age between 60 and 92 years, some of the subjects were hearing aid users. The testing device was the Audiometer S, a portable PDA-based audiometer, previously used in schoolchildren hearing screening programmes. Besides of manual and automated audiometric tests, each subject was asked to fill a questionnaire assessing his/her hearing abilities and the difficulty of performing the test.

In most of the subjects, hearing deficits were detected, ranging from mild-moderate to profound hearing loss. Results of manual and automated tests proved very consistent. According to the questionnaire, all examined persons assessed the tests as easy, and the device as user-friendly.
The results have shown that automated audiometric hearing screening tests can be successfully applied in elderly population, and can provide valid results. It is also desirable that the test battery is complemented with tests assessing central hearing disorders, which become a frequent problem in elderly population.
HEARING IN THE OLDEST OLDER ADULTS

IS BEDSIDE TESTING FOR AUDITIVE IMPAIRMENT IN THE ELDERLY FEASIBLE? -
THE EARPAD TRIAL

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Background: In geriatric care nearly every third patient > 70 yrs. and every second patient > 75 yrs. is hearing impaired to such a degree that a reliable conversation cannot be achieved without the use of handicap-oriented communication strategies or amplification (Lerch & Decker-Maruska 2007). In most hospital situations this handicap is not recognized, due to lacking awareness on behalf of the staff and the reluctance on behalf of the patient to acknowledge his own deficiency. This situation leads to a dysfunctional communication, misunderstandings, aggression and non-compliance.

Method: Over a six month period 128 of 321 geriatric patients (43 male, 85 female, mean age 81 yrs.) that meet the criteria (exclusion: Geriatric patients (age< 70), unable to use the iPad due to poor vision, MMSE <12, consent withheld) were screened with the three-digit screening test, using an iPad and Sennheiser earphones, in a bedside situation. Each patient was afterward included in the geriatric hearing care service, subjected to an ENT exam and PTA for reference. Further, the patient and the nurse/therapist filled in a questionnaire to judge the test concerning applicability, handling and helpfulness.

Results: Nearly 40% of the participants found the test straightforward, but only 1/3 was able to use it without external help. 73% found the test result congruent with their expected hearing ability. Unfortunately, > 45% of the participants were unlikely following up on a pathological result. 97% of all participants showed a pathological test result which complies with the PTA results.

Conclusion: The three-digit online test is a feasible bedside test for a geriatric setting. Nevertheless the test procedure is unlikely to be undertaken unassisted. Apart from that, the likelihood of an follow up with an ENT physician or an audiologist, regarding a hearing impairment and its treatment, was not enhanced by a pathological test result.

STRUGGLING TO UNDERSTAND THE SPOKEN WORD: A GERIATRIC CASE STUDY

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Older persons residing in long term care environments that have not purchased hearing aids, or no longer benefit from hearing aids, struggle to understand speech. Long term care environments are traditionally noisy places, where healthcare information and education is still important for residents to understand. This exploratory study examined the acceptance of frequency modulation devices to amplify speech in noisy environments. Eight subjects (over 80 years of age) were recruited out of 64 bed independent living facility. Average hearing thresholds of these subjects were 35 decibels of hearing lost (dB HL) at 250 KiloHertz (KH), 40 dB HL at 500 KH, 44 dB HL at 1000 KH, 50 dB at 2000 KH, 58 dB at 4000 KH, and 67 dB at 6000 KH, which is typical of a population of persons over the age of 80 years. Residents were very interested and accepting of these devices. The frequency modulation devices were used by residents in the dining room, the health center, groups, and
anytime health related teaching was conducted. One couple used the devices in their daily communication between each other. Overall, the devices were highly accepted and found to be useful. Frequency modulation devices are useful tools to improve speech understanding in a cost effective manner. It is essential when purchasing frequency modulation devices to consider the cost, the quality, and size of the buttons and knobs for ease of use with older persons. In addition, frequency modulation devices will be helpful to improve privacy concerns in all healthcare areas. Recommendations would be to use frequency modulation devices in long term care environments for all healthcare related communication.

VOCAL ACOUMETRY: A VALID, EASY AND RELIABLE TOOL FOR DETECTING, QUANTIFYING AND FOLLOWING UP HEARING IMPAIRMENT IN THE ELDERLY.

ACOUMAUDIO, A FRENCH INSTITUTIONALIZED POPULATION STUDY

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Background: In the absence of treatment, presbycusis can lead to serious complications. Combining early hearing aid wearing with auditory-verbal rehabilitation is an effective solution. However, it is insufficiently prescribed, mainly because hearing screening is not systematically made during non-specialized consultations. Most often, the diagnosis is delayed and elderly patients have to wait for an ENT consultation to carry out a pure tone audiometry (TAud).

Objective: To assess the vocal acoumetry (VAc) as an alternative to the gold standard test represented by the TAud, firstly to detect and quantify hearing impairment, secondly to evaluate the functional gain of aural rehabilitation.

Method: Cross-sectional comparative study in 207 institutionalized elderly, aged over 60 years. Participants’ hearing was evaluated using free-field VAc and air conduction TAud. We assessed the informational value of whispered VAc and tested for a correlation between VAc and TAud measurements. Finally, VAc with and without hearing aids were tested in 77 patients and the resulting functional gain was compared with a test-retest procedure in a matched group of 77 patients without hearing aids.

Results: Whatever the selected diagnostic threshold for TAud (15, 21 or 30dB HL), whispered VAc showed a 100% sensitivity, whereas optimal specificity (91%) was achieved for a 15-dB threshold. The linear regression analysis showed a positive correlation between audiometric and acoumetric data. Finally, the auditory functional gain was statistically significant only in the group wearing hearing aids.

Conclusions: VAc is an adequate clinical test for screening and quantification of hearing loss in the institutionalized elderly. Requiring no equipment, it is easily usable by all carers, especially geriatricians and GPs. Its systematic implementation could facilitate early management of presbycusis and avoid complications. Furthermore, VAc could be a simple and rapid method for assessing aural rehabilitation benefit in conditions closer to the daily life than TAud.
INFANT DIAGNOSTIC AUDIOLOGICAL EVALUATIONS BY TELE-PRACTICE

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From October 2011 through July 2013, Children’s Hospital Colorado and the University of Guam collaborated on a pilot project to provide infant diagnostic audiological evaluations (DAE) over the internet for Guam babies who referred on newborn hearing screening. The DAE evaluation consisted of otoscopy, tympanometry, otoacoustic emissions, click-evoked auditory brainstem response (ABR), and auditory steady state response (ASSR). Testing was conducted by air- and bone-conduction techniques as appropriate. During the project, we tested 25 infants and identified 7 babies with permanent hearing loss, including infants with conductive, sensorineural, and neural (auditory neuropathy) hearing disorders. In this presentation, we will discuss the issues associated with conducting infant DAEs by telepractice including personnel, equipment, software, privacy and confidentiality, liability and malpractice, clinical standards, candidacy criteria, parent satisfaction, clinician satisfaction, and reimbursement. We will also explain the importance of developing a memorandum of understanding between collaborating institutions and the value of site visits. The challenge of preparing families for infant DAEs by telepractice will be discussed as well as solutions to this challenge. Finally, we will describe how the early hearing detection and intervention (EHDI) program on Guam continued infant DAE services at the conclusion of this project.

TIME FOR PARADIGM CHANGE IN CLINICAL CARE

Lehnhardt-Goriany M

Prof. Ernst Lehnhardt-Stiftung, Badenweiler, Germany

The number of people with hearing loss is constantly increasing (ageing population, noise induced HL), the number of CI recipients is exponentially growing (broadening indication, no age limit, establishment of CI programs in countries with a high population and lack of infrastructure). Overload of clinics and lack of qualified audiologists globally is evident. The traditional Clinical Care system is neither efficient nor sufficiently effective any longer. We call for scalability of services – search for clinical care innovations.

The recent developments of Internet-based technologies and organizational models promise new dimensions of scalability. Faster, safer and cheaper Internet connections offer new opportunities to provide direct services and meet the needs of CI recipients and HA users.

The future of Tele-Practice has already begun

Technically feasible today and partly implemented are

- Registration online
- Share intra-operative data to create first maps
- Tele-fitting (experienced expert manoeuvres the software programme on the hardware of the less experienced in another location)
- Remote support (experienced therapist counsels less experienced via Skype and video camera)
• Exchange of experience amongst parents and experts in Live Online rooms across countries and language barriers
• Online consultation of surgeons, therapists and other experts for parents seeking advice

The Lehnhardt-Foundation offers Live Online Seminars for Russian speaking therapists since 2009. We are preparing a platform for special interest groups and teach them how to use Tele-Practice service delivery models.

THE ROLE OF TELEPRACTICE IN COCHLEAR IMPLANTATION CANDIDACY AND HABILITATION

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Telepractice is currently recognised in the fields of audiology and speech pathology as a viable alternative to traditional in-person models of service delivery. The Royal Institute for Deaf and Blind Children (RIDBC) has recently expanded the use of telepractice beyond early intervention and auditory training to incorporate cochlear implant candidacy, habilitation and mapping.

This paper will present a case study demonstrating a model of home based cochlear implant management using telepractice methods. In particular, this paper will highlight the use of telepractice for managing all stages of the cochlear implant process, except for surgery and radiology. All participants in the program, including recipients, caregivers and professionals, completed satisfaction surveys regarding the use of a home-based model. Questionnaire data revealed high levels of satisfaction among participants.

The use of telepractice to deliver cochlear implant services overcomes barriers to access often faced by recipients living in rural and remote areas. A multidisciplinary approach can be delivered through technology and ensure minimal disruption to the recipient’s routine as well as inclusion of local professionals to maximize outcomes in ongoing management.

ONLINE REHABILITATION OF ADULT HEARING-AID USERS

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Audiological rehabilitation can successfully be performed on the Internet. This presents a cost efficient supplement making it possible to include time consuming but necessary rehabilitation components otherwise disregarded. Conventional clinical processes typically suffer from time pressure, and components such as guidance about communication strategies, hearing tactics and how to deal with hearing aids are not always included.

The purpose of these studies was to examine and evaluate the effect of an online rehabilitation program for experienced hearing-aid users. The rehabilitation program consisted of self-study, guidance by professional audiologists and the possibility to discuss with other participants in a monitored, online discussion forum. The effects of the rehabilitation program were evaluated with
online questionnaires and the results were compared with a control group. The control group had access to literature about historical hearing aids waiting to undergo the online rehabilitation program. In the studies were 134 participants, recruited via advertisements in newspapers, participating. The participants were on average 66 years and had used their hearing aids at least a year.

Results from the studies are presented in quantitative and qualitative outcomes. The outcome from the interviews showed that the participants felt secure in communication after taking part in the course. Further on, the intervention group showed significant improvements in quantitative outcome measures, for example, they estimated their problems related to the hearing functions as significantly lower after the study than they did before they took part in the rehabilitation program, while participants in the control group did not change the perception of their hearing handicap.
PSYCHOSOCIAL EFFECTS OF HEARING LOSS IN ADULTS

HEARING AID USE AND PERCEIVED SOCIAL ISOLATION AMONG OLDER ADULTS

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Designed to determine if a relationship exists between hearing aid use, hearing aid benefit and perceived social isolation, this study is among the first to include perceived social isolation as a baseline and outcome measure. Participants with mild to moderately severe hearing loss who were self referred for hearing aids to a local audiologist in private practice participated. All were free of cognitive impairment based on scores on the MMSE. Baseline and outcome measures were assessed using the following: (1) word recognition ability in noise, (2) (Quick SIN), (3) test of working memory (The Reading Span Test), (4) perceived social isolation/loneliness (DeJong Gierveld Loneliness Scale), and (5) self perceived hearing handicap, readiness and self efficacy (Hearing Health Care Intervention Readiness - HHCIR). Hearing aid responses for all participants met prescribed targets (DSL). At baseline, the majority of participants demonstrated self-efficacy, readiness, and considerable self reported activity limitations and participation restrictions. However, the majority denied feelings of loneliness, and perceived social isolation. At the four week follow-up visit, participants demonstrated differential benefit across the various outcome domains assessed. While, all experienced significant improvement in activity levels and fewer participation restrictions, aided performance on the QuickSIN and the Reading Span Test was more variable. Regarding perceived social isolation and loneliness, it appears that people who voluntarily seek out audiologic services may do so because they want to remain engaged. Implications of the findings will be discussed including the importance of community outreach and screening efforts.

STAGES OF CHANGE IN ADULTS WHO HAVE FAILED AN ONLINE HEARING SCREENING

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Hearing screening has been proposed to promote help-seeking in adults with hearing impairment who are yet to seek help. However, studies point to low help-seeking after a failed hearing screening. Some barriers could be inherent to the people who fail a hearing screening. To understand those, theories of health behavior change could be helpful. The transtheoretical (stages-of-change) model of health behavior change has been proposed to describe profiles and needs of people facing behavior changes such as seeking help. According to this model, people go through two stages before taking action: pre-contemplation and contemplation. The University of Rhode Island Change Assessment (URICA) is a questionnaire to measure stages of change. As part of this study, 224 adults who failed a Swedish online hearing screening (results expressed as a signal-to-
noise ratio required for word-in-noise recognition) and who were yet to seek help completed further questionnaires online, including the URICA. URICA scores were analysed and relationships with other variables (online hearing screening results, self-reported hearing disability and self-reported duration of hearing impairment) were investigated. Factor analysis of the URICA scores identified three stages of change before action: pre-contemplation, contemplation and preparation. Most participants were in the contemplation or preparation stage of change. A significant association between stages of change and self-reported degree of hearing impairment, but not speech-in-noise recognition scores or self-reported duration of hearing disability, was found. People who failed an online hearing screening are in one of three stages before seeking help. The extra stage this study uncovered, preparation, highlights the need for adequate information provision to adults who are yet to seek help for their hearing. The fact that very few people were in the action stage signals that screening alone is unlikely to be enough to improve help-seeking rates.

EXPERIENCES OF FAMILY MEMBERS AND CAREGIVERS OF OLDER ADULTS WITH HEARING IMPAIRMENT

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The negative consequences of hearing impairment, such as social isolation and reduced overall well-being, are not limited to the impaired individual. Rather, hearing impairment, especially in older adults, can also have devastating effects on family members and caregivers. These effects, termed third-party disability, can lead to concurrent changes in the significant others’ mental and physical health, as well as declines in their everyday social interactions and overall function, and increases in feelings of burden. Although little research has been conducted in this area, it is likely that third-party disability is exacerbated if an individual with hearing loss is also experiencing suboptimal cognitive function. In particular, for older adults with cognitive impairment, the responsibility for hearing health care may fall to family members and caregivers, with concomitant hearing and cognitive impairments in care recipients leading to even higher levels of burden in the care providers. If the caregiver is unfamiliar with, or does not feel that they have the competence or self-efficacy to deal with the hearing aid, it is quite possible that the communication needs of the care-recipient will become neglected and they may even cease receiving hearing care services. Thus, it may be necessary to involve family members and caregivers of those with cognitive impairment to a greater degree than is typically done for clients with normal cognition. Additional intervention and support may help them in dealing with increased hearing health care responsibilities. In this presentation, we will summarize the current state of the literature on third-party burden in older adults, present preliminary data from interviews with family members of older individuals with both hearing and cognitive impairment, and discuss potential changes to audioligic rehabilitation best practice techniques that could increase inclusion of significant others to optimize benefits for patients.
THE ASSOCIATION OF SELF-REPORTED HEARING WITH TIME SPENT OUTSIDE THE HOME AMONG OLDER ADULTS

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Hearing problems are prevalent among older adults and lead to difficulties in social interaction, which, in turn, may hinder participation in social activities. Consequently, less time may be spent outside the home, which may accelerate the decline in wellbeing. We investigated whether self-reported hearing difficulty is associated with time spent outside the home among older persons with and without walking difficulty.

The participants (n=533) were 75 to 90 year-old community-dwelling men and women, a subsample of the participants of Life-Space Mobility in Old Age study. Self-reports of hearing, diseases and walking difficulty were obtained via home interviews. Subsequently, the participants completed a diary for seven days registering the time spent outside of the home.

The median time spent outside the home per day was 156 minutes. Of the participants, 222 reported no hearing difficulty, 262 reported some and 48 major hearing difficulty. Among people who reported no difficulty walking 2 km (n=341), the group with major hearing difficulty spent significantly less time outside the home (estimated marginal mean 154 minutes, 95%CI 118-202, p=0.003) than those with no hearing difficulty (236, 95%CI 209-266), but having some hearing difficulty (220, 95%CI 197-245) did not reduce the time spent outside home compared to no hearing difficulty (p=0.322). Among persons who reported difficulty walking 2 km (n=191), some (156, 95%CI 133-284, p=0.769) or major (156, 95%CI 119-204, p=0.862) hearing difficulty did not reduce the time spent outside the home compared to no hearing difficulty (151, 95%CI 124-185). The analyses were adjusted for age, sex, vision, and cardiac, circulatory, and locomotor diseases.

The results suggest that among older people without mobility difficulty, hearing problems may contribute to decreased time spent outside the home. Decreased activity outside the home may have negative effects on older persons' social and physical functioning and consequently on quality of life.

NEEDS IN HEARING HEALTH CARE: PERSPECTIVES FROM PATIENTS

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 Approximately 77% of individuals with hearing loss have not sought treatment (Kochkin, 2007). Many individuals perceive a negative stigma of hearing loss or the use of amplification, preventing action. Although research suggests that hearing aid use improves quality of life, only 14% of individuals who have sought treatment and have amplification report regular use (Popelka, 1998). Many patients continue to express dissatisfaction with hearing devices or with their hearing ability. Research aimed at eliciting the views and experiences of individuals with hearing loss is important to understanding the low numbers of individuals pursuing treatment or use of amplification. Focus groups are an effective research tool used to gather perceptions of target populations (Kroll, 2007). A focus group of individuals with hearing loss may shed light on perceived needs and desires related to hearing health care. Recently, the University of South Florida Sarasota-Manatee held focus groups in the community in an effort to assess the community’s perception of needs in hearing health care. This presentation will discuss the results of a focus group comprised of individuals with hearing loss. Fourteen adults with hearing loss participated in the session. Although some
discussion focused on diagnostics and amplification, most of the participants discussed patient education, services, and training as key needs.

HEARING LOSS: HIGHLY PREVALENT BUT UNDERRATED AMONG AGING ADULTS

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Although hearing impairment and visual decline are highly prevalent in older adults, acceptance of hearing aids has been poorer than spectacles. This study aimed to describe opinions on comparative impact between hearing and visual impairment, and to compare audiometric results and self-perceived hearing status among aging adults. Participants aged 40 years and older were recruited from a state, in Malaysia, by multi-staged random sampling. The mean age of the 405 participants was 65.5 (SD ± 8.4) years. Of the participants, 56% were female. Opinions about the relative importance of hearing and visual impairments and evaluation of self-perceived hearing status were assessed through interview. Hearing thresholds were measured using a diagnostic audiometric testing. The results revealed that visual impairment was considered more troublesome and important to treat than hearing impairment; 61.6% opined visual impairment to be more burdensome, on a hypothetical situation of having both impairments, 67.2% chose to attend to visual impairment first, and 62.3% indicated being more ready to wear spectacles than hearing aids. Audiometric results showed that 74% of the participants had at least mild hearing impairment in the better ear. Of those with hearing impairment only 33% perceived themselves as having hearing problem, 12% had sought treatment and only 3.4% used hearing aids. Although self-perceived hearing status was significantly associated with the severity of hearing loss (p<0.001), no association was found between readiness to seek treatment and the degree of hearing loss, p>0.05. In conclusion, lack of self-perceived hearing loss and disinclination to wear hearing aids pose as barriers to management of hearing loss in adults. Efforts to increase the awareness on the importance of hearing amplification and its benefits are crucial before we embark on hearing screening in adult populations.
HEARING LOSS AND MEDICAL CONDITIONS

THEORY-OF MIND IN ADOLESCENTS AND YOUNG ADULTS WITH ALSTRÖM SYNDROME

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The presentation focuses on Theory-of-Mind in adolescents and young adults with Alström Syndrome (ALMS). ALMS, an autosomal recessive syndrome causes juvenile blindness, sensorineural hearing loss, cardiomyopathy, endocrinological disorders and metabolic disorders. Theory-of-Mind (ToM) refers to the ability to impute mental states to one self and to others. Clinical observations have revealed an increased occurrence of deviances in mental state understanding. In this study ToM has been examined and related to working memory (WM), verbal ability and sensory loss. Twelve young individuals (age range 16-37) with ALMS and 24 non-disabled individuals matched on age, gender and educational level participated. ToM was assessed by means of a task that taxes the ability to understand thoughts and feelings of story characters’. WM was examined by means of a reading span task and verbal ability by means of a vocabulary test. The ALMS group performed at significantly lower levels in ToM tasks and displayed a higher variability in performance than the control group. Individuals with ALMS and a relatively poor level performance provided fewer correct mental state inferences than ALMS individuals with relatively higher performance levels. ALMS individuals with relatively high performance levels made as many correct inferences as the control-group, but their inferences were more often incomplete. Vocabulary skills and educational level, but not WM-capacity predicted ToM performance. Degree of deafblindness did not have an impact on ToM. Onset of visual loss in contrast to hearing loss related to ToM. The individuals with ALMS displayed a high degree of heterogeneity in terms of ToM, where some individuals reached performance levels comparable to nondisabled individuals. The results are discussed with respect to how cognitive and verbal abilities and factors related to the disability affect ToM.

PHONOLOGICAL DEVELOPMENT IN SWEDISH CHILDREN WITH OTITIS-PRONENESS

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Hearing care settings primarily focus on individuals with hearing impairment. However, there is also a significant population of normally developing children with generally normal hearing who have transient hearing difficulties. These are the children suffering from recurrent episodes of acute otitis media during the first years of life. One complication of acute otitis media is middle ear effusion, resulting in fluctuating conductive hearing loss. Fluctuating conductive hearing loss has been found to affect children's phonological development. To date, the numerous investigations on hearing effects of otitis media have concentrated on those children who have presented at hearing care
clinics. Little is known about the effects of fluctuating hearing loss among the majority of otitis media children who do not reach hearing care settings. Therefore, the present longitudinal study included children with a history of recurring otitis media who were selected via medical records in a number of Child Health Care Centers. Initially, none of the children was involved in any specialized hearing care. The study aimed to describe phonological development in terms of the emerging phonological system (word- and syllable-shapes, phoneme inventories), and developmental phonological processes, in Swedish children prone to otitis media.

A total number of 43 (23 prone to otitis media, and 20 controls) were included in the study. The children's phonological development was longitudinally investigated at ages 2.5, 3.5 and 4.5 years. Speech samples, containing a maximum of 104 words for each child, were elicited by standardized picture naming tasks, then narrowly transcribed, and analyzed.

The findings indicate that the phonological development for most of the children prone to otitis media was the same as that of the controls.

A COMPARISON OF AUDITORY BRAINSTEM RESPONSE THRESHOLDS IN INFANTS BORN WITH OTITIS MEDIA WITH EFFUSION AND WITH OR WITHOUT CLEFT PALATE

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Background: The prevalence of otitis media with effusion (OME) is much higher in infants born with cleft lip and/or palate (CP±L) than without CP±L. However there are only a few studies to date that have examined the difference in hearing in young children with CP±L and OME. These studies which have used ABR as an evaluation for assessing the auditory thresholds in babies with CP±L, had no control group. Therefore, it is not clear if there is a difference in the threshold levels for children with OME with and without CP±L. Is there a difference between infants with and without CP±L?

Aim: The aim of this study was to investigate the early hearing thresholds in infants with OME with and without CP±L and if there is a difference in the early hearing thresholds between the two groups of infants.

Methods: All infants diagnosed with OME, and presented with no additional disabilities or known syndromes were included in the study. Fifty-five infants were included in the CP±L group and 67 infants were included in the control group.

Results: Results will be discussed in terms of overall hearing thresholds and possible differences in thresholds between the groups.

LARGE VESTIBULAR AQUEDUCT SYNDROME AND COCHLEAR IMPLANTATION: SCIENTIFIC, CLINICAL, AND PERSONAL PERSPECTIVES

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¹University of Oklahoma Health Sciences Center, Department of Communication Sciences and Disorders, Oklahoma City, OK; ²Hearts for Hearing, Oklahoma City, OK; ³University of California, Santa Barbara, CA, USA

This paper involves a systematic review and case study which provides a unique perspective on large vestibular aqueduct syndrome (LVAS) by using evidence-based practice combining the best scientific evidence and clinical expertise with a patient’s experiences in making clinical decisions.
about the diagnosis/treatment of his LVAS. LVAS occurs in vestibular aqueducts > 1 mm in diameter and may be caused by mutations in the SLC26A4 gene. LVAS occurs in ~5 - 15% of children with sensorineural hearing loss. This case study involves the first author’s (JCS) journey as a patient with LVAS. JCS was diagnosed with LVAS at four years of age and initially fit with binaural analog hearing aids (HAs), and later with advanced digital HAs before receiving a unilateral cochlear implant (CI). Objective measurements and subjective perception of his speech recognition performance in young adulthood fluctuated and deteriorated over time which necessitated consideration of CIs. Before deciding on the unilateral CI, JCS and his family considered sequential versus simultaneous CIs and how the surgeries and adaptation times might disrupt his academic career and quality of life. We conducted a systematic review of the literature to answer: (1) What are the risks and benefits of CIs for young adults with LVAS who already wear binaural HAs?, and (2) What are the advantages and disadvantages of bimodal stimulation compared to bilateral CIs? We created and submitted a list of search strings to PubMed, CINHAL, Clinical trials.gov, and Google Scholar databases which yielded 23 articles that were of relatively low levels of evidence involving cohort and case studies. The results are discussed within the context of this case study and this paper shows how clinical expertise and patient perspectives impact clinical decisions. Information is presented about LVAS and implications for counselling young adults with LVAS who are considering CIs.

MICROTIA AND ATRESIA PROGRAM AT HEAR AND SAY

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Hear and Say, Brisbane, Australia

Microtia and Atresia are low incidence congenital disorders with, in 90% of cases, the condition being unilateral; therefore support services have been loosely structured and perhaps not seen as a priority. Universal Newborn Hearing Screening has resulted in an increased number of families who have children with either unilateral or bilateral Microtia and/or Atresia enrolling at Hear and Say for early intervention services, highlighting to Hear and Say the special and complex needs of these children and their families. In 2008, the Microtia and Atresia Parent Support Group was formed, with annual conferences, relevant to both parents and professionals, commencing in 2009. The launch of the Hear and Say Australian Microtia and Atresia Support Centre, in 2012, has provided a forum for sharing of knowledge and expertise from medical, surgical, audiological and educational disciplines, formalising a coordinated service for these children and their families.

The objectives of this presentation are to:

- provide an overview of the program at the Hear and Say Microtia and Atresia Support Centre.
- highlight the importance of early intervention for children with Microtia and Atresia, regardless of whether the condition is unilateral or bilateral.
- discuss treatment options for these children, including surgical opportunities and the use of a range of hearing devices.
- demonstrate the importance of a coordinated multidisciplinary team approach.

Feedback from both parents and professionals, along with individual case studies, will highlight the impact of Microtia and/or Atresia and the importance of targeted early intervention to assist these children to achieve their full potential.
HEARING LOSS AND CEREBRAL PALSY: PARENTAL PERCEPTIONS AND EXPERIENCE OF EARLY INTERVENTION SERVICES IN SOUTH AFRICA

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Background: The effective implementation of Early Intervention (EI) services has been a persistent problem in South Africa, particularly when children present with hearing loss (HL) and an additional disability. Little is known about cerebral palsy (CP) as a co-morbid disability in children with HL in the South African context.

Purpose: The main aim of the study was to describe the parental perceptions and experiences of early intervention services in Gauteng (South Africa) for children with hearing loss and a co-morbid diagnosis of cerebral palsy.

Method: A mixed method research design was employed. A retrospective review of the records of children that presented with CP in addition to HL (N₁ = 21) were conducted. Face-to-face interviews were then conducted with parents (N₂ = 5) of the children whose records were reviewed to determine their perceptions and experience of EI services.

Results: Four themes emerged in the face to face interviews with the caregivers, namely early intervention, access to transport, employment and desired improvement. The results will be further explored in the presentation.

Conclusion: It is clear that the socio-economic status of the children’s caregivers plays a role in their understanding and awareness of intervention options and procedures. The socioeconomic status also came into play with factors such as transport preventing caregivers and children from accessing healthcare services. It is evident that the awareness of early intervention is inadequate in the South African context.

THE ROLE OF AUDITORY BRAINSTEM RESPONSE IN DIAGNOSING AUDITORY IMPAIRMENTS OF DEJERINE-SOTTAS

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Dejerine-Sottas disease is classified as hereditary motor sensory neuropathy (HMSN) type III and shows evidence of Friedreich’s ataxia, significant reduction in nerve conduction velocity (NCV), hypomyelination and demyelination of the nerve fibers. In this study, a 10-years-old girl with Dejerine-Sottas disease is presented in which routine clinical signs (ataxia and reduced NCV) are seen with significant impairments of auditory brainstem pathway. It is indicated that pure tone audiometry, standard tympanometry (tympanometry and acoustic reflex), and otoacoustic emissions (OAEs) showed normal results in both ears (normal peripheral auditory system). In contrast, auditory brainstem responses (ABRs) indicated abnormal findings in absolute latencies of I, III, and V and inter-peak latencies of I-III and I-V. These findings suggested auditory brainstem involvement especially in low and mid regions.
CLEFT AUDIOLOGY STANDARDS
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The majority of infants born with CLAP do not have OME at birth, but OME is often present within the first six months of life. OME has been reported to occur at least once before the first birthday in up to ninety percent of the CLAP population, increasing to ninety-seven percent by the age of two years. Even though the likelihood of OME is reduced when this population reaches adulthood, about fifty percent will have permanent conductive hearing loss. This population require close audiological care.

In the UK standards for audiological care of CLEFT children are published as network guidelines.

In this study adherence to guideline standards are examined for a children’s audiology service in Bath UK.

Children with CLEFT born between 2004 and 2012 were identified from the Child Health Database and cross referenced to the newborn hearing screening database which also flags children with CLEFT. Case notes for identified children were examined against six of seven published standards.

A total of forty three children with CLEFT were identified. All children received newborn hearing screening (NHSP). Of the sixteen babies referring at NHSP, two were identified with a permanent childhood hearing impairment (PCHI) and six with conductive hearing loss. The standards specify audiological review annually for the first three years and then at age five and ten years. In many cases standards were not applied consistently and often ignored. Non attendance levels were high as were clinician discharge rates. Documentation was poor and in some cases early hearing assessments were not recorded at all, with little or no evidence of discussion with families about risk of hearing loss and how to manage this.

As a result of this study the audiology pathway for CLEFT children has been reviewed and closer engagement with the CLEFT team initiated.
FRIDAY, JUNE 6, 2014
ROOM AIDA

SPECIAL SESSION

INTERVENTION AND OUTCOMES OF CHILDREN DETECTED WITH HEARING LOSS

OUTCOMES OF CHILDREN WITH HEARING LOSS: IMPLICATIONS FOR MANAGEMENT

Ching TYC

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Congenital bilateral hearing loss greatly reduces children’s language skills, academic attainment and life chances. Over the past 10 years, universal newborn hearing screening (UNHS) has been implemented across Australia, now reaching a national coverage of >95%. UNHS allows early detection and amplification, and its ultimate goal is to improve long-term outcomes at a population level. Can we expect children who received early intervention to catch up with their normal-hearing peers by elementary grades? We addressed this question by conducting a population-based study that prospectively monitor children’s outcomes over their first 10 years of life – the Longitudinal Outcomes of Children with Hearing Impairment study (LOCHI; www.outcomes.nal.gov.au). Outcomes in speech, language, literacy and psychosocial skills of children in NSW, Victoria and Queensland are assessed at multiple intervals for determining development of speech production, language and literacy, and psychosocial skills. We identify factors that predict which children would achieve age-appropriate outcomes, and examine the extent to which early measures can predict later outcomes.

SPEECH-LANGUAGE DEVELOPMENT OF HEARING IMPAIRED CHILDREN IDENTIFIED THROUGH UNIVERSAL NEWBORN HEARING SCREENING PROGRAM

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Universal Newborn Hearing Screening (UNHS) program has been proven to successfully identify hearing loss among children at very early ages. However, evidences on whether early identification will lead to early intervention and better speech-language outcomes are scarce, especially, from countries with limited availability of audiology and speech-language habilitation services. This presentation will describe speech and language outcomes of hearing impaired children identified through the UNHS program in the University Kebangsaan Malaysia Medical Centre (UKMMC) from August 2007 until August 2011. Their speech and language were compared against the profile of normal children (0 to 4 years) using the Integrated Scales of Development-Malay version two (ISD-Mv2). In addition, challenges of early intervention of hearing impaired children identified through UNHS will also be discussed.
AUDITORY THRESHOLD AMELIORATION DURING THE FIRST YEAR OF LIFE IN A GROUP OF SEVERELY/PROFOUNDLY HEARING IMPAIRED CHILDREN

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All children affected by severe to profound hearing impairment should receive conventional hearing aids as soon as possible and then be monitored in auditory perceptual achievements during the first months of life, in order to be readily included in the cochlear implant (CI) program, when needed. Among 438 severely/profoundly impaired children diagnosed during the last 3 years at Paediatric Audiology Department of Padua University, 23 cases (42 ears) significantly ameliorated their hearing in the first 6-8 months of life and were not candidate for surgery. All these cases but five were diagnosed to be hearing impaired due to various etiological factors present at birth, such as CMV infection, severe prematurity, aminoglycoside antibiotics therapy or hyperbilirubinemia. The last five children were well babies, identified during universal hearing screening. All cases were examined by means of a full audiological battery test, comprehending DPOAE and ABR till two months of age and then associated to CAEP registration, behavioural audiometry, parental questionnaire (P.E.A.C.H.) and clinical evaluation. Signs of threshold amelioration occurred from 4 to 6 months of age in most cases, up to 85 weeks of gestational age in few preterm newborns. The lack of reliability of ABR and conventional behavioural audiometry in these cases could be overcome by means of cortical evoked potentials and parental questionnaire administration. The presence of aetiological factors affecting both peripheral and central auditory system should be accurately considered with regard to the availability

COMMUNICATION DEVELOPMENT IN EARLY-IDENTIFIED CHILDREN WITH MILD BILATERAL AND UNILATERAL HEARING LOSS

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Universal newborn hearing screening (UNHS) has led to an increase in the number of children with unilateral hearing loss and, in some regions, with mild bilateral hearing loss identified during the neonatal period. Until recently, these children were typically not identified until 4 to 5 years of age and little is known about the effects of early-identified hearing loss in this population. This paper will present a brief overview of the prevalence and characteristics of mild and unilateral loss from population-based data collected from a newborn screening cohort of approximately 140,000 children (2003-2011). More than 30% of the children identified with permanent hearing disorders during the study period have mild bilateral or unilateral loss. In addition, data from a longitudinal study of the auditory and language development of children with early-identified mild bilateral or unilateral hearing loss will be presented. To date, 110 children, 60 with hearing loss and 50 with normal hearing have been enrolled and are assessed at 12-month intervals from 12 to 48 months. Preliminary results of children’s functioning based on auditory questionnaires, language samples, and parent language reports will be presented. Based on an analysis of interviews with parents, their perceptions of the effects of milder hearing loss and of their children's functioning will be summarized.
SPEECH AND LANGUAGE DEVELOPMENT

USING RECEPTIVE VOCABULARY ACQUISITION TO DEVELOP A SPEECH PERCEPTION TEST FOR CHILDREN WITH HEARING LOSS

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Early hearing detection and intervention programs effectively identify infants with hearing loss. However, valid, reliable behavioral measures do not exist to evaluate speech perception in infants and toddlers. In contrast to the paucity of audiological assessment tools, detailed early-emerging language data on hearing children provides normative data for different chronologic ages. There is a strong relationship between language outcomes and speech perception skills in older children with hearing loss. The association between spoken language and speech perception should persist in younger children with hearing loss. At present, we need more information about the composition of early vocabulary not only in hearing children, but also in children with hearing loss. This would allow creation a developmentally-appropriate speech perception measure for this young population. Participants include parents of 150 young children (11-36 months) with hearing loss ranging from mild to profound wearing hearing aids, cochlear implants, or both for 0-24 months. Parents independently completed a MacArthur-Bates Communicative Developmental Inventory: Words and Gestures parent report vocabulary checklist. We analyzed size and inventory of receptive vocabulary acquired by age 30 months. Receptive vocabulary size increased with chronologic age, but depended on both degree of hearing loss and duration of listening experience. Children with mild hearing loss had larger mean vocabularies than children with severe-profound hearing loss. Children with longer listening experience exhibited larger mean vocabularies than those with shorter listening experience. Similar to hearing peers, young children with hearing loss acquire a vocabulary dominated by animal names, toys, and body parts, regardless of degree of hearing loss or type of device. Knowledge of the core vocabulary of young children with and without hearing loss provides a starting point for the development of a picture-based speech perception task to be used for very young children.

THE EFFECT OF HEARING STATUS ON PERCEPTUAL PREFERENCES FOR CANONICAL SYLLABLES IN INFANCY

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Infants with hearing impairment develop different syllable production patterns than infants with normal hearing during canonical babbling. Normal hearing infants produce a high proportion of canonical syllables with a consonant onset, and a higher proportion of these syllables have coronal consonant onsets (with labial onsets as the second most frequently occurring pattern). Within canonical syllables, the consonant and vowel combinations that co-occur with higher proportion are coronal-front (e.g., /di/) and labial-central (e.g., /ba/). These articulatory co-occurrences are described by the frame-content-hypothesis. Canonical syllables produced by infants with mild-to-
moderately-severe hearing loss generally conform to the frame-content-hypothesis, but show an opposite pattern than normal-hearing infants in consonant-onsets, (higher proportion of labial onsets rather than coronal). Currently, it is unknown whether infants exhibit perceptual preferences for these commonly produced syllable patterns. The present study examined listening preferences for (1) consonant onsets and (2) consonant-vowel co-occurrences in infants with normal hearing and hearing impairment.

A head-turn preference procedure was used to test infants’ preferences for the following syllables: Labial-Central, Coronal-Front, Labial-Front, and Coronal-Central. 24 infants with normal hearing were tested at three time periods: prior to entering the canonical-babbling stage, during the babbling stage, and during first-words. Their listening preferences were compared to infants with hearing impairment in the pre-babbling stage (n=4) and during first words (n=9). Data collection is ongoing. Preliminary data suggest a growing preference for Non-Frame-Content syllables from pre-babbling to first words for infants with normal hearing, whereas the majority of infants with hearing impairment showed a preference for Frame-Content syllables. Both groups of infants showed changing patterns of consonant onset preference across each production stage, however specific preferences appear to be tied to hearing status. Results suggest that auditory experience alters perceptual development. Implications for the relationship between speech production and speech perception in early development will be discussed.

THE EFFECT OF HEARING IMPAIRMENT ON WORD PROCESSING OF INFANT- AND ADULT- DIRECTED SPEECH

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Infant-directed speech (IDS) is an exaggerated form of speech caregivers use with infants and young children. In addition to capturing infant attention, IDS is thought to facilitate language learning in normal hearing (NH) infants. For example, 21-month-old NH infants learn novel words produced in IDS more readily than those produced in adult-directed speech (ADS). Relatively few studies have examined the influence of IDS on word learning in infants with hearing impairment (HI). The purpose of this study is to determine whether HI infants, like their NH peers, benefit from IDS during online word-learning and word recognition.

Twelve infants with sensorineural hearing loss (wearing either hearing aids or cochlear implants) and 12 infants with NH (matched for hearing-age and socioeconomic status) are being recruited for the study. Infants are trained to map two novel labels to two novel objects. Each infant will participate in both the IDS and ADS conditions, counterbalanced across participants and testing sessions. Following training, word recognition for both newly learned and familiar words is assessed using a looking-while-listening procedure. Word processing is assessed through reaction time and accuracy. The relationship between size of vocabulary and word learning will also be explored in each group.

Preliminary results (HI group, n = 9) for familiar words show that accuracy and reaction time are better in IDS than ADS. Preliminary results for novel word learning show a different pattern for the infants with HI.

The results of this study will be discussed in the context of current theories of early lexical acquisition. Additionally, the present study will provide crucial information regarding the influence of...
IDS on early word learning in infants with hearing loss. The findings provide evidence that may be useful for early intervention therapists whose priority is promoting early language development.

**BORN TO HEAR: BRAIN DEVELOPMENT FOR OPTIMAL LISTENING AND SPOKEN LANGUAGE DEVELOPMENT IN CHILDREN WITH HEARING LOSS**

Dornan D  
*Hear and Say; HEARing Co-operative Research Centre; School of Health and Rehabilitation Sciences, University of Queensland, Australia*

Hearing technology is a necessary first step for accessing the auditory brain of a young child born with hearing loss, and as such is of critical importance if the child is to develop optimal listening and spoken language. However, hearing technology alone is not enough, as the auditory brain needs the appropriate amount, frequency and quality of auditory input for optimal outcomes. This presentation will explore the neurodevelopmental basis of listening and speech, and its significance for a child born with hearing loss. Current research on neuroplasticity and the principles of brain development will be outlined with particular reference to children with hearing loss and hearing technology. This presentation will also discuss the role of professionals in educating parents to accelerate development of neural pathways for listening and speaking success in everyday life.
GLOBAL DEVELOPMENT (PART I)

EXAMINING GLOBAL DEVELOPMENT IN EARLY INTERVENTION FOR HEARING LOSS


Children’s Hospital of Eastern Ontario, Children’s Hospital of Eastern Ontario Research Institute, University of Ottawa, Ottawa, Ontario Canada

Up to 30 to 40% of children with severe to profound hearing loss may be at risk for other medical and developmental challenges. Universal newborn hearing screening programs allow for early identification of hearing loss, and subsequent intervention to address hearing needs. However, other needs may emerge as children develop. These may be first recognized by hearing professionals, require services of different professionals, and may impact on interventions for hearing and communication. The purposes of this presentation are to (1) describe a project where systematic screening of development is conducted as part of early identification of hearing loss and intervention, (2) present initial results in 5 areas of development for children identified with hearing loss, (3) describe therapist-satisfaction with implementation of the screening tool.

Participants in the study include children who were screened and then identified with hearing loss at a tertiary care academic health center, and were participating in communication intervention. To date, 60 children and their families have participated. The Developmental Profile III, examining children’s development in the areas of physical, adaptive, social-emotional, cognitive and communication skills, was administered as part of an assessment protocol. This protocol also included standardized measures of hearing, speech and language. In addition, a focus group was conducted with therapists who use the tool to obtain their perspective on its use, and its relative benefits and limitations.

To date, the results indicate that a wide range of functioning is apparent in all areas of development. A number of factors were examined to determine their relationship to these areas, as well as direct assessment of communication. Therapists indicated benefits in counseling families and facilitating referrals to other services. Issues in the interpretation of these results in context of hearing loss are discussed, as well as recommendations for future directions.

LANGUAGE, ACADEMIC OUTCOMES AND PREDICTIVE FACTORS FOR EARLY-IMPLANTED CHILDREN WITH BILATERAL VERSUS UNILATERAL COCHLEAR IMPLANTS

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¹Department of Audiology and Speech Pathology, The University of Melbourne; ²Department of Econometrics and Business Statistics, Monash University, Australia

Aims: To determine whether there was a significant difference in language and academic outcomes for children with unilateral and bilateral cochlear implants (CIs), and to identify predictive factors for these outcomes.

Method: The language outcomes of 91 primary school-aged children with CIs were measured using standardized tests. Academic outcomes for 44 8-year-old children in the same study were also assessed using a standardized academic assessment tool. Information about other factors known to
influence language and academic development was also collected. Outcomes were examined, and predictors identified, using linear regression analyses.

**Results**: Older (8-year-old) children with bilateral CIs achieved significantly better language scores than did children with unilateral CIs. Although mean scores for the younger (5-year-old) children were greater, these differences were not statistically significant. Age at second CI was found to predict the rate of language growth, along with higher levels of parental involvement, higher cognitive ability, female gender, less screen time and more time spent by parents reading to their children. Between 59-69% of the variance in language outcomes was predicted by the regression models. Children using bilateral CIs also achieved significantly higher scores for oral language, math, and written language on the academic assessment than did children using unilateral CIs. Greatest improvements were predicted for younger ages at second CI. High levels of parental involvement, greater time spent by children reading, and hearing aid use after first CI were the main predictive factors for academic success, although other factors were also identified.

**Conclusions**: Older children with sufficient bilateral CI experience had significantly better language and academic outcomes than did children with unilateral CIs, when other factors were controlled for. Outcomes were significantly predicted by a number of factors related to parenting and child characteristics.

**A MODEL OF SELF-ESTEEM IN ADOLESCENTS WITH SIGNIFICANT HEARING LOSS**

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Cochlear implants and hearing aids provide children with hearing loss access to speech, resulting in improved communication skills such as speech perception, speech and language use, but we have less information about their quality of life and self-esteem. Children with significant hearing loss are at risk for low self-esteem, even after receiving hearing aids and/or cochlear implants, due to differences in speech perception abilities, speech intelligibility, language skills, and feeling/looking different from the mainstream. Other factors such as gender and temperament also affect self-esteem, with girls and shy adolescents reporting lower esteem. We need to understand components that contribute to self-esteem in children with hearing loss to develop better tools to identify and counsel children at risk for developing low self-esteem.

Participants include 55 children and adolescents with hearing loss (M=12.8 years, SD=2.3) wearing either cochlear implants (n=44) or hearing aids (n=11). Participants completed a demographic survey, Rosenberg self-esteem scale, and the Early Adolescent Temperament Questionnaire-Revised questionnaire. We compared self-esteem levels with gender, speech perception abilities, speech intelligibility, social competence, and temperament scales. Results indicate the group as a whole report self-esteem within the typical range, although children with cochlear implants expressed higher levels of self-esteem. Level of self-esteem correlated positively with speech intelligibility, number of friends, and depressive mood temperament, suggesting that children with better communication and social skills and without depressive mood rate self-esteem more positively. Simultaneous examination of these factors will help clinicians identify children with hearing loss potentially at risk for low self-esteem. Such identification will help generate referrals to mental health professionals to enhance quality of life beyond communication skills in children with significant hearing loss.
BENCHMARKING THE SOCIAL INCLUSION OF CHILDREN WITH HEARING LOSS EDUCATED USING A LISTENING AND SPOKEN LANGUAGE APPROACH

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Social inclusion (SI) is of growing interest to early intervention providers. However, few studies have examined the SI of children with hearing loss and none have specifically looked at children educated using a listening and spoken language (LSL) approach. This study compared the social inclusion of young children with hearing loss educated using a LSL approach with the SI of their hearing peers. A purpose-designed, parent-report survey was used to measure two faces (perspectives) of SI in children with hearing loss, ‘education’ and ‘interacting with society and fulfilling social goals’. A framework of SI for children with disabilities guided the selection of these faces, and the aspects measured within them. The survey drew questions from the Longitudinal Study of Australian Children (LSAC), allowing the outcomes to be benchmarked against this national dataset. The survey was completed for 78 children aged 4-5 years with hearing loss, educated using a LSL approach for a minimum of six months in a First Voice Centre in Australia or New Zealand. The outcomes of children with hearing loss were benchmarked against their hearing peers using t-tests and Pearson chi-square analyses. The children with hearing loss were found to have comparable social inclusion levels to, if not better than, the typical hearing children from the LSAC. These outcomes provided support for the positive influence that a LSL approach has on the social inclusion of this cohort of children with hearing loss.
LITERACY ACHIEVEMENT OF DEAF LEARNERS WITH COCHLEAR IMPLANTS

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The goal of this study was to examine the reading and writing abilities of a cohort of school-aged, Canadian children with cochlear implants and compare performance to hearing age peers. Research was conducted in a large urban school board in central Canada. Data were collected from 64 students with cochlear implants (mean age 9 years, 2 months with a range from 5 years, 4 months to 19 years, 3 months) with the majority (58 of 64) using spoken language as their communication mode, and 6 using spoken language with sign support. There were no exclusion criteria and all school-aged students with cochlear implants were included in the study irrespective of age of implantation, placement, achievement level, home language, or additional disabilities. As a measure of reading performance, five subtests of the Woodcock-Johnson Diagnostic Reading Battery-III [WJ III-DRB] (Woodcock, Mather & Schrank, 2004) were administered. In addition, six subtests of the Comprehensive Test of Phonological Processing [CTOPP] (Wagner, Torgensen & Rashotte, 1999) were given to assess phonological awareness, phonological memory and rapid naming. Uncorrected written language samples were collected to provide data in an area that has received relatively less research attention (Mayer, 2010).

Findings indicate that 67% of these students are achieving in the typical range for hearing learners (within 1 standard deviation of the mean), 55% are achieving in the typical range for phonological awareness, and 60% for phonological memory. Data analysis of subtest performance, relationships between outcome measures, and qualitative analysis of writing samples will be discussed. These are encouraging results and speak to the need to systematically track literacy development in children receiving cochlear implants to determine the extent to which these learners achieve age-appropriate outcomes, to consider the reasons why some continue to face challenges, and to reflect on implications for research, early intervention and practice.

EMPOWERING CHILDREN & YOUTH THROUGH PEER SUPPORT

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Children and youth with hearing loss frequently experience difficulty with peer relationships and are at greater risk of social isolation and loneliness. Early social competence influences later peer and adult relationships, as well as academic success, school adjustment and social-emotional development. The Cora Barclay Centre has developed a successful model of peer mentoring and support for youth and young adults, aged from eleven to twenty five years. It is called Web of Hearing Impaired Students’ Peer Alliance or WHISPA. The presentation will explore aspects of the program which are fundamental to its success, including regular social events, personal development and life skills workshops, and an expectation of regular attendance at the activities. The young adults provide leadership and mentoring of the younger participants. Outcomes measurement has been in the form of participant and parent surveys. These surveys have also informed evolution of the program.
After a successful pilot, the program has recently been extended to include a Junior WHISPA group. Children (with hearing loss) in mainstream schools, aged from five to ten years are invited to attend this group which focuses on social activities to promote friendships and social-emotional well-being. After a suitable period, program evaluation will occur through parent and participant surveys, as well as externally developed measures of self-esteem.

**VOCAL SINGING ABILITY OF PRELINGUALLY-DEAFENED CHILDREN USING HEARING AIDS OR COCHLEAR IMPLANTS**

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**Objective:** Singing is a combination of music and language. It exerts important functions in social activities as well as in communication. The purpose of the present study was (1) to investigate vocal singing performance of hearing-impaired children with cochlear implants (CI) and hearing aids (HA) and (2) to evaluate the relationship between demographic factors of those hearing-impaired children and their singing ability.

**Methods:** Thirty-seven prelingually-deafened children with CIs and 31 prelingually-deafened children with HAs, and 37 normal-hearing (NH) children participated in the study. The fundamental frequencies (F0) of each note in the recorded songs were extracted using an autocorrelation method and the duration of each sung note was measured. Five metrics were used to evaluate the pitch-related and rhythm-based aspects of singing accuracy.

**Results:** Children with CIs and HAs showed significantly poorer performance in either the pitch-based assessments or the rhythm-based measure than the NH children. No significant differences were seen between the CI and HA groups in all of these measures except for the mean deviation of the pitch intervals. For both hearing-impaired groups, length of device use was significantly correlated with singing accuracy.

**Conclusions:** There is a marked deficit in vocal singing ability either in pitch or rhythm accuracy in a majority of prelingually-deafened children who have received CIs or fitted with HAs. Although an increased length of device use might facilitate singing performance to some extent, the chance for the hearing-impaired children fitted with either HAs or CIs to reach high proficiency in singing is quite slim.

**SCHOOL-AGE EDUCATIONAL OUTCOMES OF CHILDREN WITH SIGNIFICANT CONGENITAL BILATERAL SENSORINEURAL HEARING IMPAIRMENT**

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**Introduction:** The Universal Newborn Hearing Screening (UNHS) program in KK Women’s and Children’s Hospital (KKH) screens infants pre-discharge, providing the opportunity of early intervention for those diagnosed with hearing impairment (HI). Their long-term outcome is unknown.

**Aim:** To study the school-age educational outcomes of children with significant congenital bilateral sensorineural HI (SNHI).
Methods: Children with congenital bilateral SNHI of at least moderate severity in the better ear, born between April 2002 and March 2004, were identified from the UNHS database. Information on the child’s academic status and intervention received was obtained through a telephone interview.

Results: 30 infants were identified. The parents of 15 (50%) children were contactable and participated in the study. Their mean age was 10.6 years (±0.3). 13 (86.7%) were male. 12 (80%) were fitted with hearing aids (HAs), 8 (66.7%) before six months of age, in keeping with international guidelines. 8 (53.3%) received intervention (Auditory Verbal or speech therapy) before 12 months of age. Two (13.3%) had cochlear implants. Of 12 (80%) in mainstream schools, 11 had HAs. 3 (25%) started school at least one year later than their peers, one of whom transferred from a special school at age 10. 7 (58.3%) required varying school accommodations (foundation level [1], mother tongue exemption [2]) or had difficulties with their studies. 7 (58.3%) were currently receiving intervention (classroom FM systems, speech/occupational/physiotherapy). Of the 3 children who were not fitted with hearing aids, one was succeeding academically. The other two were disabled and in special schools. One was not fitted with hearing aids due to financial constraints.

Conclusion: The majority of children (80%) with significant bilateral SNHI had a hearing aid/cochlear implant, received intervention before 6 months and was in mainstream schools. Only 3/12 (25%) needed academic accommodations. The UNHS program in KKH has contributed significantly to their successful rehabilitation.
BEYOND NEBROWN HEARING SCREENING

NEWBORN HEARING SCREENING: WHAT HAVE WE LEARNED ABOUT PROGRESSIVE HEARING LOSS?
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Background: Widespread implementation of universal newborn hearing screening (UNHS) in the last decade provides unprecedented opportunities to learn about the clinical characteristics and trajectory of early-identified hearing loss. Deterioration in hearing thresholds is of concern, but prior to UNHS, precise information on the progression of hearing loss has been difficult to document in the absence of accurate knowledge regarding hearing loss onset.

Objective: The objective of this study was to document the prevalence of progressive hearing loss in a birth cohort of approximately 140,000 children followed through a provincial UNHS program in one region of Canada. To better understand the progression of hearing loss, audiologic and other clinical characteristics of children were examined.

Methods: Population-based data were collected prospectively on a cohort of children identified from 2003-2013. Clinical characteristics including etiology, age at diagnosis and intervention, type and severity of hearing loss, initial diagnostic and serial audiometric information were recorded. Comparisons were made between initial and most recent audiometric thresholds to determine the number of children who experienced progressive hearing loss. For these children, comparisons were made between audiometric thresholds collected at various time-points since diagnosis. The presence of progressive hearing loss was examined in relation to factors such as etiology, neonatal intensive care unit status and other risk indicators.

Results: Our analysis to date of 250 children with detailed audiologic records showed that more than 50% showed some deterioration (> 10 dB) in hearing thresholds in at least one ear. More than 25% of children showed progressive loss of 20 dB or more (PTA) in at least one ear. Of 16 children with unilateral loss, 5 progressed to bilateral hearing loss.

Conclusion: Given the large proportion of children who experience deterioration in hearing, close monitoring of hearing following early identification is essential to ensure optimal amplification and therapy.

THE ROLE OF REPORT-BASED MEASURES OF LISTENING DIFFICULTY FOR UNDERSTANDING AUDITORY PROCESSING DISORDER
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Children referred for auditory processing disorder (APD) present with a complex array of symptoms, in addition to listening difficulties. This has led to a debate about the nature of the disorder, and the
assessment and management of children affected by it. To progress understanding of APD, it is necessary to reliably capture the reason(s) why children present for assessment, and then relate those reasons both to the disorder itself, as well as to the broader range of listening-based learning difficulties. The Evaluation of Children’s Listening and Processing Skills (ECLiPS) was developed as a first step towards achieving these goals. The ECLiPS is a report-based measure comprising a five factor structure which is designed to assess everyday listening in the context of cognitive abilities commonly affected in APD.

Here, we performed a series of correlational analyses to compare parental responses on the ECLiPS for 50 children (35 referred for suspected APD) with their performance on 5 tests used to diagnose APD, 4 tests of cognitive ability (nonverbal IQ, sustained attention and auditory serial and working memory), and 2 measures of academic ability.

Few correlations were observed between the ECLiPS and the diagnostic tests of APD, confirming previous conclusions of a mismatch between abilities probed by clinical tests of APD and report-based measures of listening difficulty. Correlations with all ECLiPS factors were observed with academic abilities ($r_s = 0.52 – 0.40$). Finally, auditory working memory correlated with all ECLiPS factors ($r_s = 0.30– 0.45$), while attention was associated with language abilities ($r_s = 0.57$). These findings suggest cognitive difficulties associate with many of the symptoms of APD that parents are sensitive to, and they further underline the importance of understanding the role of these deficits in listening-based learning difficulties.

THE NEED FOR SCREENING NEWBORNS FOR CONGENITAL CMV REFERRED IN THE NEONATAL HEARING SCREENING PROGRAM

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**Introduction:** Congenital Cytomegalovirus (cCMV) infection is the most frequent cause of non-hereditary congenital hearing loss. Hearing loss may be the earliest indication of a cCMV infection in otherwise healthy infants. The earlier infants with cCMV are diagnosed, the better their chances for appropriate medical treatment and audiological care. Infants referred in the neonatal hearing screening program (NHS) for audiological diagnostics have a higher possibility of having hearing loss. Therefore, it could be effective to investigate whether these referred infants have a cCMV infection before waiting for the final diagnosis of hearing loss.

**Aims:** Determine the prevalence of cCMV and describe the hearing loss in the group of referred newborns in the NHS program. Determine whether referred newborns should be screened for cCMV.

**Methods:** Parents of infants who failed the NHS in The Netherlands are invited to participate in the CONCERT study. Dried blood spots are tested for CMV. The outcome of audiological investigations are recorded.

**Results:** Parents of 433 infants who failed NHS agreed to CMV testing in dried blood spots. Of these, 22 (5.14%) were positive for CMV (0.54% birth prevalence). All infants except one with cCMV had confirmed hearing loss: 9 with bilateral and 10 with unilateral hearing loss, 1 waiting for further testing and one infant with normal hearing (at risk for late-onset hearing loss).

**Conclusions:** Newborns referred for possible hearing loss by the NHS should be tested for CMV. Medical and audiological care and follow-up can then be expedited for the individual infant. Future
studies may decide if testing all infants with suspected hearing impairment for congenital CMV is necessary.

**USING RASCH ANALYSIS TO EXAMINE THE ITEM-LEVEL PSYCHOMETRICS OF THE INFANT-TODDLER MEANINGFUL AUDITORY INTEGRATION SCALES**

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**Objectives:** To analyze the item-level psychometrics of the Infant-Toddler Meaningful Auditory Integration Scales (IT-MAIS; Zimmerman-Phillips et al. 2001), an assessment designed to measure listening skills in children with hearing loss aged 0-3 years.

**Design:** We analyzed the psychometric properties of the IT-MAIS using a modern test theory methodology, Rasch analysis (Rasch, 1960/1980). Specifically, we evaluated longitudinal pre- and post-cochlear implant (CI) IT-MAIS data from the parents of 23 CI users aged 10 to 36 months.

**Results:** The IT-MAIS did not demonstrate ideal item-level psychometric properties because: 1) 2 of 10 items did not fit the construct and were removed from the final analysis; 2) the item difficulty hierarchy did not sufficiently measure the full range of the children’s reported abilities; and 3) the parents reporting on their children’s behaviors did not use the 5-unit rating scale reliably.

**Conclusions:** Rasch analysis demonstrated that the IT-MAIS might be improved for greater utility among researchers and clinicians who diagnose and treat infants and toddlers with severe to profound sensorineural hearing loss by formally defining the listening development construct; adding questions to tap higher-level skills; transforming the ordinal scale into an interval scale which allows for meaningful comparisons of change pre- to post-CI, or between children at a given time point; and modifying the response units from 5 to 4 points.
HEARING IN PRE-SCHOOL AND SCHOOL-AGE CHILDREN

PROGRESSION OF HEARING LOSS IN INFANTS AND CHILDREN

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Children who are hard of hearing require audibility provided by well-fit amplification to minimize the potential for developmental delays. Progression of hearing loss represents a significant barrier to providing consistent aided audibility of speech. The purpose of this investigation was to describe the prevalence and time course of progression of hearing loss in a large cohort of children who wear hearing aids that were followed as part of a longitudinal study of developmental outcomes. Approximately 14% of the cohort experienced a negative change in hearing >10 dB during the study period. The factors that were associated with progression of hearing loss included changes in middle ear status and etiology of hearing loss. Factors that were not associated with changes in hearing included: degree of hearing loss, age, aided audibility or average hours of hearing aid use. The implications for diagnosis and management of children who are hard of hearing will be presented, as well as strategies for counselling parents about the likelihood of progression of hearing loss.

COMMUNICATION OUTCOMES OF PRE-SCHOOL DEAF AND HARD OF HEARING CHILDREN IDENTIFIED BY THE ENGLAND NEWBORN SCREENING PROGRAMME (NHSP)

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Newborn hearing screening has been universally available throughout England since November 2006. The Programme has focused on all elements of the child and family care pathway: screening, diagnostic assessment, medical management, and early intervention. From 2006 to 2013, a programme of Quality Assurance (QA) was undertaken to assess professional service provision along the full care pathway against nationally agreed standards covering early screening, rapid referral to Audiology, and entry into one of 120 local Early Intervention (EI) services within 24 hours of identification.

In September 2012, NHSP launched a project to audit the communication outcomes of 388 early identified children (aged 7 – 46 months, 31% of whom have additional disabilities) who are receiving routine service provision in 34 EI services judged by national QA as meeting or exceeding required standards. Assessment data included MacArthur CDI and the Play Assessment Questionnaire. EI services also supplied data on the screening, audiological and support history of the children, and wider contextual information from families to provide an understanding of the child/family experience.

The project aims to explore the impact of early identification and access to quality early intervention on child outcomes in terms of their CDI expressive vocabulary scores and Play Assessment
Questionnaire quotients. Early analysis of the data indicates that younger children (0-16 months) are achieving slightly better than their older counterparts against aged norms. The majority of the cohort is achieving expressive vocabulary levels within the average range albeit below the 50th percentile. Analysis of the data is seeking to explore not only the relationships between child outcomes, child and family characteristics and formal support mechanisms (e.g. quantity and type of professional input) but also to consider aspects of the child's early years experience and family support, with the aim of increasing understanding of how these wider factors may impact on outcomes. The project will be completed April '14.

BEYOND NEWBORN SCREENING: COMMUNITY-BASED HEARING SCREENING PROGRAMS FOR INFANTS AND TODDLERS SUBSEQUENT TO THE NEWBORN SCREENING AND FOLLOW-UP PERIOD

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It is estimated that the incidence of permanent hearing loss in the United States doubles between birth and the time children enter school as a result of injury, illness or genetic factors, rising from approximately 3 per thousand at birth to 6 per thousand by school age. Additionally, approximately 35% of the children who do not pass newborn screening in the United States are not documented as having received needed diagnostic assessment. Therefore, screening children's hearing during early childhood is likely to result in additional identification of hearing loss. Many parents in the United States erroneously assume that their child's hearing is being checked periodically as part of routine well-child visits with health care providers. In reality, however, health care providers look for common middle ear disorders, but are typically unable to screen for hearing loss. Consequently, the majority of children do not receive any additional hearing screening beyond newborn screening until they are in school.

Since 2001, the Early Childhood Hearing Outreach (ECHO) Initiative at the National Center for Hearing Assessment and Management (NCHAM) has been developing community-based hearing screening programs for infants and toddlers subsequent to the newborn screening and follow-up period. This presentation will report on the post newborn otoacoustic emissions (OAE) hearing screening outcomes of more than 24,000 children under 36 months of age living in poverty and served by the federally funded Head Start program. This presentation will also provide a thorough overview of lessons learned in developing hundreds of community-based OAE hearing screening programs in urban, suburban and rural settings and introduce a comprehensive set of web-based program development and training resources available for translation and use by others interested in establishing hearing screening programs subsequent to newborn screening and follow-up.
COMPARISON BETWEEN HEARING SCREENING-DETECTED CASES AND SPORADIC CASES OF DELAYED-ONSET HEARING LOSS IN PRESCHOOL-AGE CHILDREN

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Objective: This study aimed to compare the diagnosis and ages of intervention for cases of delayed-onset hearing loss identified sporadically or via a preschool hearing screening program.

Design: Retrospective study with the comparative analysis of two groups of children.

Study sample: Cases identified from screening were selected from 34,321 preschool children who underwent screening for delayed-onset hearing loss between October 2009 and May 2011. Sporadic cases of delayed-onset hearing loss were selected from pediatric clinical records. Cases from the first group were excluded from the latter to avoid duplication. Two groups were given the same questionnaire to record risk indicators, diagnosis, and age at intervention.

Results: The average age of 26 children at the time of diagnosis in the screening group was significantly earlier than in the 33 cases identified in the sporadic group. The age at intervention of children with bilateral moderate to severe hearing loss in the screening group was also earlier than in the sporadic group.

Conclusions: Improved rates of early diagnosis could therefore be achieved with hearing screening for preschool children with no significant symptoms of delayed-onset hearing loss.
NOISE AND OTHER RISK FACTORS

ESTABLISHED AND NOVEL LIFESTYLE RISK FACTORS FOR SENSORINEURAL HEARING LOSS IN OLDER ADULTS

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Objectives: Identifying modifiable risk factors that could prevent/slow the development of sensorineural hearing loss would be valuable. We aimed to investigate a range of nutritional and lifestyle risk factors contributing to sensorineural hearing loss risk and progression in older adults.

Methods: The Blue Mountains Hearing Study is a population-based survey of age-related hearing loss (1997-9 to 2002-4), involving 2956 participants aged 50+ at baseline. Hearing level was measured using pure-tone audiometry and was defined as the pure-tone average of frequencies 0.5, 1.0, 2.0 and 4.0 kHz >25 dBHL. Dietary data were collected in a semi-quantitative food frequency questionnaire. Lifestyle risk factors such as smoking and noise exposure were determined using an interviewer-administered questionnaire.

Results: After multivariable adjustment, consumption of ≥2 versus 1 serve/week of fish reduced the risk of hearing loss by 42%. Long-chain omega-3 fatty acid intake was inversely associated with incident hearing loss. A high-glycemic load diet increased the risk of developing hearing loss by 76% over 5 years. Low intake of sugar was associated with 45% reduced risk of developing hearing loss. Participants with folate deficiency had 37% higher likelihood of having hearing loss. Antioxidant intake was not prospectively associated with hearing function. Current smokers compared to non-smokers who were not exposed to work-place noise had 1.6-fold increased odds of having age-related hearing loss. Moderate consumption of alcohol versus no alcohol consumption was associated with a 75% reduced odds of impaired hearing. Nearly one in five older adults reporting exposure to workplace noise developed hearing loss over 5 years. Participants reporting past noise exposure had a 66% higher risk of developing hearing loss 5 years later.

Conclusions: The validation of these modifiable risk factors for sensorineural hearing loss provided by our study could facilitate relatively simple dietary and lifestyle recommendations specific to older adults with hearing loss.

HEARING STATUS AND AUDITORY EVOKED POTENTIALS IN TEENAGERS AND YOUNG ADULTS WHO REPORTED EXPOSURE TO SECONDHAND SMOKE

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While harmful effects of Secondhand Smoke (SHS) on human health are well-known, Lalwani (2011) found sensorineural hearing loss in adolescents exposed to SHS. Minimal information is known about possible links between SHS exposure and auditory function. The current study...
investigated SHS effects on auditory function in nonsmokers; N=10 young adults (19-23 years) and N=4 teenagers (14-18 years) who reported exposure to SHS in their living/social environments. The control group (N=14) were age and gender matched nonsmokers reporting no regular SHS exposure. All participants (N=28) completed a questionnaire regarding biography, health history, communication skills, and SHS exposure; this information defined participant study eligibility. Audiologic tests including otoscopy, tympanometry, pure-tone audiometry, auditory brainstem response (ABR), and auditory middle latency response (AMLR) were administered per participant in each ear. Also, laboratory urine analysis evaluation was conducted in all participants, measuring the cotinine level, a biochemical marker of SHS exposure.

Data from young adult nonsmokers (N=20) revealed normal pure-tone hearing thresholds (≤ 25dBHL) with no significant group differences between SHS-exposed and control participants. ABR amplitude (V/I ratio) was decreased in SHS-exposed individuals, but latency was not significantly different between groups. AMLR latency was increased in the SHS-exposed group but there were no significant AMLR amplitude group differences. Data analysis from teenagers (N=8) is currently underway. Preliminary findings indicate no group differences on pure-tone thresholds but evoked potential waveforms suggest possible morphological differences. More detailed ABR and AMLR latency and amplitude analyses will be reported. This is the first known investigation to use evoked potentials to study the effect of SHS exposure on the central auditory system. Early findings suggest there is a toxic effect of SHS exposure as reflected in decreased amplitude but not increased latency in young adults. Implications for future research and clinical recommendations will be discussed.

**HEARING, TINNITUS AND LISTENING HABITS IN 9 YEAR OLD CHILDREN**

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**Introduction**: Listening to music is a common leisure activity, among children, and makes an important contribution to quality of life. Listening to music with portable music players is even more a common leisure activity in adolescents (Kim et al, 2009). Studies on listening to music with headphones have shown disparate results regarding impact on hearing function (Kim et al, 2009; Kumar et al, 2009; Peng et al, 2007).

**Objective**: To investigate hearing thresholds, prevalence of tinnitus and portable music player listening habits in 9-year-old Swedish children. Design: A cross-sectional study including otoscopy, tympanometry, pure-tone audiometry and SOAE to evaluate hearing functions. A questionnaire was used to evaluate listening habits, tinnitus and sound sensitivity.

**Study sample**: Children (415) who lived in larger, middle sized and rural areas.

**Results**: Hearing thresholds were surprisingly poorer than expected and hearing thresholds in 6 and 8 kHz were significantly poorer compared to low and mid frequencies. The prevalence of tinnitus was low (5.3%) and the pure-tone audiometry showed poorer hearing thresholds for children with tinnitus. Approximately 30% of the children listened regularly with headphones and showed poorer mean hearing thresholds in the right ear.
SCREENING FOR NIHL AMONG MILITARY PERSONNEL IN EASTERN PROVINCE OF SAUDI ARABIA

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Objective: To study the effect of noise exposure on the hearing sensitivity of the screened study subjects, analysis of the questionnaire for noise exposure and to compare between hearing impairment in different noise exposure categories.

Materials and methods: As a first part of the screening study, 1879 subjects were evaluated. Noise exposure survey was filled by the study group. Screening air conduction pure tone audiogram was done for each participant. Patient who did not pass the screening were referred to the ENT and audiology unit for further evaluation: complete history, otological examination, pure tone audiometry, tympanometry and DPOAEs.

Results: The average duration of duty for the study group was 10.26 ± 8.06 years. 33.9% of the study group was cigarette smoker. 188 subjects out of 1879 (10%) did not pass the screening air conduction pure tone audiogram and they were referred to an audiology clinic. The mean emission amplitudes across the DPOAEs measured frequencies in NIHL patients at high frequencies were significantly lower than that of the low frequencies. Also it was noticed that as the hearing loss increases at high frequencies with the NIHL, DPOAEs amplitudes decrease.

Discussion and conclusion: 10% of the high risk noise exposed subjects had high frequencies hearing loss. This hearing loss could be minimized with the proper use of the hearing protective devices on exposure to intense noise level. DPOAEs in NIHL evoked at low frequencies differ from those evoked at high frequencies. Reduction in the emission amplitude of DPOAEs at high frequencies region was significant in comparison with that of the low frequencies. These differences can be attributed to the hearing loss and the patho-physiologic mechanism at the level of OHCs encountered in those patients.
AUDITORY AND VISUAL INFORMATION IN SPEECH PERCEPTION: DEVELOPMENTAL AND REHABILITATIVE PERSPECTIVE
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When perceiving speech, the listener uses information from visual modality in addition to the auditory modality, especially in adverse listening conditions. In the current study, we evaluated the effect of age and hearing impairment on speech perception performance in different modalities (auditory, visual, and audio-visual). Normal hearing (NH) included 77 participants in five age groups (4-5 years (n=15), 8-9 years (n=17), 20-30 years (n=15), 40-55 years (n=15) and 65-80 years (n=15)). Hearing impaired (HI) were 17 students (19-26 years) with severe to profound hearing loss who were rehabilitated with hearing aids or cochlear implants and used oral communication. Speech stimuli included monosyllabic meaningful words in signal to noise ratio of 0 dB. Speech stimuli were introduced via auditory, visual and audiovisual modalities. The main results showed that: 1) for the NH groups speech perception accuracy was higher in the audiovisual modality, and then in the auditory modality, as compared with visual only. The audiovisual and auditory modalities results by age were in inverse U shape with lowest and comparable performance of 4-5 and 65-80 groups and highest results in the 20-30 participants. However, in the visual modality, performance of participants age 4-5 was comparable to 8-9, and 65-80 were similar to 45-55, with highest results in the 20-30 participants. 2) Speech perception performance of the HI in the visual modality was higher compared to the auditory modality. When compared with the NH, the HI had the lowest accuracy level in the auditory and audiovisual modalities, but the highest in the visual. These results suggest different developmental rate for auditory and visual modalities which carry clinical implications for rehabilitating older adults with hearing loss. Moreover, although all HI participants had early rehabilitation and used oral communication, when required to perceive speech with background noise they mainly used the visual modality.

AUDITORY AND VISUAL INFORMATION

VISUAL INFORMATION CAN AID IN SPEECH ENHANCEMENT
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In daily conversations, visual information significantly improves comprehension of speech, as well as providing the location and identity of the speaker. Persons with hearing loss can use techniques such as speechreading to significantly improve their speech perception. However, as the population in most developed countries is aging at a significant rate, the incidence of vision loss in addition to hearing loss is rising. In a survey, more than 70% of adults with dual sensory loss in the U.S. have reported that they occasionally avoid communicating due to the difficulties they face. To address this critical need, we are investigating the benefits of incorporating visual information obtained through a wearable camera in an intuitive and reliable way to enhance signal processing algorithms such as those used in digital hearing aids.

Prior research in using video to enhance speech recognition has shown promise. However, these algorithms typically need high-resolution frontal videos of the speaker, which is not feasible in
practical scenarios. Instead, we propose using robust, pixel-level information from low-resolution videos to aid existing well-developed speech enhancement algorithms. Hearing aid technologies such as voice activity detection (VAD) and adaptive microphone beamforming can enhance speech signals. However, in noisy environments, audio-based algorithms do not perform well. We show that using an audio-visual VAD, we can overcome this limitation and significantly improve performance in environments where there is high background noise.

Using machine learning techniques to determine the most informative video features, we have developed an audio-visual VAD. We compared this to a standard audio-based VAD by using the outputs in a Wiener filter to enhance speech in a noisy environment. The audio-visual VAD outperformed a conventional audio VAD in high-noise cases by up to 8dB in terms of the segmental signal-to-noise ratio (SNR).
EDUCATION AND TRAINING

SURVEY OF CURRENT PRACTICES IN PEDIATRIC AUDIOLOGY IN NORTH AMERICA

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The Joint Committee on Infant Hearing Supplement statement reinforces that “For the infant or young child who is deaf or hard of hearing to reach his/her full potential carefully designed intervention must be implemented promptly, utilizing service providers with optimal knowledge and skill levels and providing services on the basis of research, best practices and proven models.” (pg. e1324)¹ The development and use of clinical practice guidelines is a common method employed to ensure a high level of evidence-based practice (EBP) in clinical contexts. Despite widespread efforts to implement available pediatric assessment and amplification guidelines²⁻⁵ into audiology practice, gaps still exist between EBP and current clinical practice⁶,⁷. In August 2010, a group of North American audiologists formed The Knowledge and Implementation in Pediatric Audiology (KIPA) Group. One of the mandates of this group is to gain a better understanding of current clinical practice to determine changes that would positively impact D/HH children and their families, and to determine strategies to facilitate clinical change. In 2011, we conducted a survey of current best practices in pediatric assessment and amplification in North America to determine adherence to best practices guidelines. We also endeavored to gain an understanding of barriers and facilitators to implementing EBP in pediatric audiology clinics. Survey results will be presented and a discussed within a framework of two new areas of science that might facilitate the uptake of research knowledge into clinical practice. Knowledge Translation (KT) and Implementation Science have been shown to be effective strategies for promoting the systematic uptake of clinical research findings into clinical practice. The results of this presentation will further attendees understanding of EBP in pediatric audiology and encourage discussion among conference participants from other countries about barriers and facilitators to EBP in their clinical practice.

References:

IMPROVING THE AUDIOLOGY STUDENTS’ AUDIOLOGIST-PATIENT CONSULTATION SKILLS

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The quality of the initial contact between audiologist and patient is a key element for successful hearing care. The necessary skills for this are grounded during audiology training. One important task of audiologist training is thus to provide support for the student to acquire and develop the necessary skills for mastering the complexities of the (young) audiologist – (older) patient consultation. This is not only an important task for the students but also for their lecturers. Each patient is an individual with unique hearing problem experiences, and a unique way to communicate their problems. It is, therefore, not unproblematic to prepare students for these initial contact dialogues with patients. The student’s education includes theoretical issues about communication in general and health-care directed communication, in particular. Additionally, several student-student dialogues are recorded during training with the objective of providing practical experiences of the consultation. These recordings are analysed by the students, and the analyses are followed up individually with the academic teaching team. These individual follow-up sessions aim to coach the students in their emerging consultation skills. Nevertheless, many students report being unprepared for their first meetings with patients during clinical training. The present investigation examines students’ common insecurities. By identifying these, audiology educators will be better able to focus training to increase the quality of student audiologist-patient consultation. The most common student insecurities (often leading to errors) we found in the clinical training setting were a) reviewing the audiogram together with the patient, b) use of some backchannel expressions, c) listening carefully, d) perceiving and following up on patient’s feelings, and e) keeping control over the dialogue/structuring the consultation. These findings are discussed in terms of curriculum development and the introduction of interactive exercises supported by e-learning.

INTERPROFESSIONAL EDUCATION (IPE) FOR AUD STUDENTS: A HEALTH SCIENCES CENTER MODEL

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Interprofessional Education (IPE) can improve the safety, efficiency, and efficacy of how clinicians—including audiologists—provide patient care. The interprofessional collaborative model uses efficacy and efficiency as a basis for improving the quality of care for patients, families, and communities to include prevention and wellness. The University of Oklahoma Health Sciences Center’s (OUHSC) initiative for infusing IPE through a top-down model is presented showing how Doctor of Audiology (AuD) students receive didactic instruction and clinical experiences that develop knowledge and skills in IPE. Students’ IPE experiences include participation in the Empowering Patients through Interprofessional Collaboration (EPIC) programs involving separate OUHSC colleges: Allied Health, Dentistry, Medicine, Nursing, Pharmacy, Public Health, and Social Work. During the first half of the program, students are placed on interdisciplinary teams to foster development of knowledge and skills in core competency areas: teamwork, communication, values/ethics, and roles/responsibilities. The second half of the program involves clinical rotations on interprofessional teams that serve patients with complex health issues. Teams address patients’ immediate needs in addition to
providing plans of care that focus on prevention and wellness. Other IPE experiences for AuD students include participation in the Leadership Education in Neurodevelopmental Disabilities program that develops leadership potential and clinical expertise in students who intend to work with individuals having a variety of health conditions. In addition, AuD students can take part in an international interprofessional outreach program in the Yucatan. Finally, the IPE scholars program within the College of Allied Health fosters collaborative practice with interdisciplinary clinical rotations (e.g., cleft palate team and balance and falls risk forum). Adopting IPE training programs for practicing and future professionals is an important step in promoting a better patient care model, both intra- and inter-disciplinarily. Specific resources and methods for integrating IPE into academic and clinical training programs are provided.
DATA MANAGEMENT

EHDI-PALS (EARLY HEARING DETECTION & INTERVENTION- PEDIATRIC AUDIOLOGY LINKS TO SERVICES): A SCALABLE FACILITY DATABASE FOR PARENTS/PHYSICIANS TO FIND AN AUDIOLOGY FACILITY

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Families, especially the generation with parents who grow up with internet, increasingly rely on technology to locate health resources. To ensure families have access to the right information at the right time, newborn hearing screening programs increasingly utilize the internet as a means to reach out to families and other stakeholders. This is an update on a project introduced at the NHS 2010 Conference.

Over the course of 4 years, the U.S. Centers for Disease Control and Prevention (CDC) convened a work group of expert pediatric audiologists to:

1. create a survey to standardize and categorize the diagnostic and intervention service capabilities of an audiology facility for infants vs. young children (0 to 6 months old, 6 months to 3 years old and 3 to 5 years old)
2. develop a web-based tool for parents and providers to locate a pediatric audiology facility, based upon the search criteria provided, that reports having the recommended equipment and clinical expertise
3. develop a facility distribution map and management tool for U.S. newborn hearing screening programs to better monitor audiology resources in their respective and neighboring jurisdictions
4. to provide a better understanding of the geographic distribution and proximity of pediatric audiology facilities relative to the location of infants who are lost to follow-up

Families can now log onto EHDI-PALS (Early Hearing Detection & Intervention- Pediatric Audiology Links to Services) to locate information, resources, and facilities that provide services for children with hearing loss. The functionality of this facility locator tool will be demonstrated and the scalability of this project to other countries around the world will be discussed.

CHILDLINK: INTEGRATING NEWBORN HEARING SCREENING IN AN EARLY CHILDHOOD HEALTH SCREENING DATA SYSTEM

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ChildLINK is an integrated data system designed for early childhood health screening, including universal newborn hearing screening. It is a collaboration between the University of Maine and the Maine Center for Disease Control and Prevention, Children with Special Health Needs (CSHN) Program. ChildLINK is a population-based data system linking data from various programs within CSHN, including the Newborn Hearing Program, Birth Defects Program, Bloodspot Program, and
Cleft Lip & Palate Program. Using a second-order probabilistic linkage protocol developed by Shihfen Tu and colleagues (Tu & Mason, 2004; Tu, Mason, & Song, 2007), ChildLINK organizes the data at the family level. This enhances health officials' capacity to identify and track children at-risk for a specific birth defect or health condition, including hearing loss. In doing so, it helps the State serve children and families in a timely fashion. Recently, ChildLINK has been expanded to include early screening for autism spectrum disorders, and we are developing a module for newborn screening of critical congenital heart disease. In this presentation, we will describe the design of ChildLINK and the technology used with hospitals to enhance tracking and follow-up of at-risk newborns. For example, every month, birthing facilities receive an automated e-mail report of their hearing screening statistics. If the results do not match the hospital’s own record, hospital staff can access ChildLINK for a list of infants born in their hospital. Staff may update the information directly in the system to reflect the status of the child (e.g. death, parent refusal, etc.). Often, this process uncovers data entry errors or missed records. The result has been a reduction in the number of newborns with unknown screening status. Finally, we will discuss the benefits and challenges in creating an integrated data system for early childhood screening.

**GENERATION VICTORIA (GENV): BUILDING ON EXPERTISE AND SYSTEMS TO TRANSFORM THE HEALTH AND WELLBEING OF GENERATIONS OF CHILDREN**

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The Victorian Infant Hearing Screening Program (VIHSP) provides the only clinical service in the state of Victoria, Australia that sees 99.2% of births face-to-face within 30 days of birth, with the ability to track newborns in real time.

Generation Victoria (GenV) is an enabling platform for clinicians, researchers, policy makers, service providers and the public, to transform the health of children. GenV aims to connect research, clinical care and service delivery to each child Victoria.

GenV will comprise:

1. Recruitment of all babies born in Victoria in 2 calendar years (up to 77,000/year)
   - Surveillance of health, development and episodes of care
2. Biological specimens collection
3. Linkage to State and Federal datasets
4. Repository of clinical information on children attending health services
   - Capture data of admissions, surgeries, emergency presentations and outpatient visits.
5. GIS capability to allow geographic (both environmental and spatial epidemiology), place-based, health economic and health services research.

GenV will enhance existing services to transform how data and biospecimens are collected, stored and used within the Victorian Health and Educations systems. The excellent capture rate achieved by VIHSP is made possible by systems upon which GenV can model recruitment processes and data collection.

Learnings from GenV will help us ‘understand how healthy development happens, how it can be derailed and what societies can do to keep it on track’. Scientists, policy makers, service providers
and clinicians do not fully understand the interplay of biology, lifestyle, environment, and service provision in their contribution to the development and prognosis of health and disease. Furthermore, the disconnect between scientific discovery and changes to behaviour, policy and services continues to limit the individual, social and economic gains that could be realised in child health. Embedded population systems such as GenV are required to break down these barriers and respond to these challenges.

**PATIENT REGISTRIES PROVIDING VALUABLE EVIDENCE FOR POLICY MAKERS**

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**Background:** Currently, there exists a paucity of data concerning long-term patient related outcomes and Quality of Life following implantation of hearing devices in children. To address this need, we have developed a large, prospective, multicentre, multinational patient outcomes registry for children using implantable hearing systems. The data collected from this registry will provide valuable information for families, providers, purchasers and policy makers.

**Methods:** The Cochlear Paediatric Implant Recipient Observational Study (P-IROS) is a prospective international patient outcomes registry for children (<10 years) who are implanted with one or more hearing device/s. The study aims to collect de-identified data on patient comorbidities, device-use, auditory performance, quality of life, and health-related utilities, across all brands and types of implantable hearing devices. This includes a novel quality of life instrument, *Children Using Hearing Implants Quality of Life*, for children implanted below 4 years of age.

Most importantly the registry also captures data regarding the services supporting these children and their families, such as; newborn hearing screening, sources of referral, habilitation and educational placement.

**Discussion:** Data from the first 50-100 subjects recruited for the study provide information regarding the implementation and accessibility of newborn hearing screening, the habilitation services available to families of children with hearing impairment and the initial auditory performance and quality of life of these children and their families.

**Conclusions:** The Cochlear P-IROS registry generates valuable data relevant for a wide range of stakeholders such as, regulators, payers, providers, policy makers, and patients, each with a different perspective for the acceptance and adoption of surgical interventions for the treatment of hearing loss and the supporting services and investment required to optimise outcomes.
HIGH-RISK BABIES

HEARING LOSS BY WEEK OF GESTATION AND CATEGORIES OF BIRTH WEIGHT IN VERY PRETERM NEONATES: A POPULATION-BASED STUDY

van Dommelen P¹, Verkerk PH², van Straaten HLM³, and the Dutch NICU Neonatal Hearing Screening Working Group⁴

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Objectives: To present the risk of neonatal hearing loss (NHL) by each week of gestation and categories of birth weight in neonates born <32 weeks of gestation.

Methods: Results of the two-stage Automated Auditory Brainstem Response (AABR) Universal Newborn Hearing Screening Programme in Dutch neonatal intensive care units and diagnostic examination were centrally registered between October 1998 and December 2012 and included in this study. NHL was defined as impaired when the neonates' conventional Auditory Brainstem Response (ABR) level exceeded 35 dB in one (unilateral) or two (bilateral) ears at diagnostic examination. Birth weight was stratified into <750 g, 750-999 g, 1000-1249 g, 1250-1499 g, and ≥1500 g.

Results: In total 18,564 neonates with a gestational age between 24.0 and 31.9 weeks were eligible for this study. Logistic regression analyses revealed significant associations between gestational age, birth weight and both unilateral and bilateral NHL (all p<0.002). Gestational age (p<0.001) and birth weight (p<0.01) were both independent risk indicators of total NHL, and associated with NHL in a dose-response relationship. The prevalence of NHL consistently increased with lower gestational age (1.2% to 7.5% from 31 to 24 weeks) and lower birth weight (1.4% to 4.8% from ≥1500 g to <750 g).

Conclusions: Each week of gestation and category of birth weight has its own risk of NHL. This information can be used to gain insight into health and related costs associated with very preterm births.
THE RISK FACTOR PROFILE OF CHILDREN COVERED BY THE POLISH UNIVERSAL NEONATAL HEARING SCREENING PROGRAM AND ITS IMPACT ON HEARING LOSS INCIDENCE

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The high frequency of risk factors detected within the newborn population increases the total number of children that should receive regular follow-ups. Therefore, careful interpretation and selection of risk factors, and in particular of those factors not strictly defined, should be carried out during screening. For that reason analysis of the risk factor profile of children covered by the National Universal Neonatal Hearing Screening Program was conducted. The results were correlated with hearing loss incidence.

Analysis covered records collected from 472 neonatal and well-baby units over a period of 10 years (2002–2012). It was focused on children with at least one risk factor and subdivided into distribution of risk factors as well as to risk factors and hearing loss correlation.

In the studied cohort of n=137,432 children (4% of the total number of screened children) single risk factors were most frequently detected, accounting for 71% of records. The association of two or more risk factors appeared in 659 configurations (29%), with a mean of 3.1 coexisting risk factors and a maximum of 9. Hearing loss was dependent on the number of risk factors in a child, but reached its maximum with the association of 6 factors.

Hearing evaluation conducted in patients with a single risk factor revealed that hearing impairment was diagnosed most frequently in patients with "craniofacial anomalies" (31.9%) and “bacterial meningitis” (7.2%). Additionally, the odds ratio was calculated from univariate analyses to indicate the most important risk factors corresponding to hearing impairment. The highest odds ratio is present for “craniofacial anomalies” with an OR value of 10.1 in contrast to “ototoxic medications”, “TORCH infections” and “hyperbilirubinemia” which have a value lower than 1, the result to be further discussed.

ANALYSIS OF RISK FACTORS ASSOCIATED WITH HEARING LOSS IN CHILDREN WHO INITIALLY PASSED NEWBORN HEARING SCREENING


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Objective: To analyze Joint Committee on Infant Hearing (JCIH) risk factors in children with confirmed hearing loss (HL) who initially passed newborn hearing screening.

Methods: Retrospective record review of 20,949 children who passed newborn hearing screening but had one or more JCIH risk factors prompting subsequent follow-up through the universal newborn hearing screening (UNHS) program in Virginia from 2004-2012.

Summary of Results: Over the 8 year study period, 20,949 (2.0% of total births) children passed UNHS but had the presence of one or more JCIH risk factor. Ultimately, we identified 124 babies from this group with confirmed hearing loss (0.6%). The most common risk factors associated with the development of confirmed HL after passing the initial screen were neonatal indicators, family history of permanent childhood hearing loss and stigmata of syndromes associated with hearing loss.
**Conclusion**: Infants who passed UNHS but had one or more JCIH risk factor accounted for more than a quarter of all infants requiring follow-up after UNHS. Neonatal indicators was the category most often found in children with confirmed hearing loss who initially passed their newborn hearing screen. Further studies assessing the etiology underlying the hearing loss and risk factor associations are warranted.

**SCREENING INFANTS WHO ARE YOUNG AND TOO YOUNG: AN ANALYSIS OF GESTATIONAL AGE AT SCREENING IN VICTORIA**

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Screening programs such as the Victorian Infant Hearing Screening Program (VIHSP) must be regularly monitored and reviewed to ensure data are of a high quality, patients are not tested unnecessarily, staff are working to acceptable standards, and participants are receiving the best possible service.

Gestational age at screening data from the financial year 1 July 2011 – 30 June 2012 were examined, with a particular focus on infants screened young - prior to 36 weeks corrected gestational age (CGA), and those screened too young - prior to the eligibility of 34 weeks CGA.

Data indicated that 0.08% of infants screened were screened before they were 34 weeks CGA, and 2.85% of infants were screened with CGA below 36 weeks.

Records of infants screened before 34 GCA indicated that the majority of these infants were screened at 33 weeks and 5 days or 33 weeks and 6 days. The method used by the VIHSP database to ascertain CGA, and readiness to screen, rounds CGA at two points, which resulted in infants appearing to have reached 34 weeks of age a few days early. For infants screened between 34 and 36 weeks CGA, investigations revealed possible causes to be very short stays and Special Care Nursery infants being discharged within hours of completion of treatment. Not screening these infants when the opportunity arises, and waiting until these infants are greater than 34 weeks CGA may result in them missing their screen while inpatients.

An enhancement to the VIHSP database is due to be implemented to remove both points where the gestational age is rounded. VIHSP is confident that this database change will ensure staff do not inadvertently screen infants who are too young to screen. Further monitoring of CGA at screening will continue.
SUPRATHRESHOLD ACUITY IN NOISE

THE MULTINATIONAL-MULTILINGUAL PROJECT HD5090 - COLLECTING REFERENCE DATA FOR HEARING DEVICES

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Main target of the HD5090 project is to prepare and apply a test profile for the validation of the listening performance of hearing impaired persons using either hearing aids (HA) or cochlear implants (CI). The age range of the target group is between 50-90 years and the hearing loss range is from 50 to 90 dB HL.

Reference data for both acoustical hearing aids and cochlear implants will be collected in a multinational and multilingual context. If needed, also dialects will be involved.

Comparing and linking the data of hearing aids and cochlear implants should result in age-dependent values for Equivalent Hearing Loss (EHL). These EHL-values can be included as an evidence-based element in counselling patients in this age group re HA or CI.

Also, data will be collected for persons having a hearing loss but not fitted with one or two hearing aids. This might be included in a screening protocol to identify persons that might benefit from hearing aids.

The HD5090 test profile will be practical, easy to handle and take little time and effort for the patient as well as for the professional. The test profile will be „adaptive“ and allow the use of the test language as preferred or needed by the patient.

The test profile will contain PTA measurement (using duotone, Coninx) at 4 frequencies, speech recognition thresholds in quiet and in stationary as well as fluctuating noise (using AAST, Coninx), speech recognition threshold with focus on high-frequency consonants (using AAST-HF, Coninx), an identification test for non-sense words at MCL and an AAST-compatible version of the Text Recognition Test (TRT, Kramer and Zekveld) to assess cognitive-linguistic central processing skills.

DEVELOPMENT OF THE SUN (SPEECH UNDERSTANDING IN NOISE) IN PORTUGUESE

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Age-related hearing loss is a common health problem for older adults in many countries in the world. Unfortunately, hearing loss in adults is frequently underdetected or undertreated in the lack of guidelines, protocols and legislation. This delay on the hearing problems diagnosis results on later intervention bringing an impact on daily activities and causing substantial participation restriction in older people’s life. Adult screening tests should focus on how to identify the difficulties experienced in everyday life, particularly in challenging listening conditions. In order to target this aim, the Speech Understanding in Noise test (SUN Test) was developed. The test consists in a list of intervocalic consonants (VCVs, vowel-consonant-vowel) in background speech-shaped noise presented in a three-alternative forced choice paradigm. The aim of this study was to develop the SUN test in Brazilian Portuguese. VCVs were recorded from a mother tongue professional male speaker. 16 phonemes were recorded, excluding 3 nasal phonemes, because of the extra hint these
nasal phonemes give in the first “a” of the set. The psychometric curves of VCVs were measured for a wide range of SNRs, from chance performance to 100% recognition (in 2 dB steps) in a group of 30 normal hearing young adults to find out the best SNR for each stimulus. The SNR was set so that the intelligibility of test stimuli was approximately the same across the test list and stimuli in the test were equalized. As a result, the list of stimuli in the SUN test and the corresponding presentation SNRs were defined and the test list was developed to be used in the Brazilian version for the SUN test version. Research to tune the test in a population of adults and older adults with hearing impairment is ongoing.

**REPEATED TESTING OF SPEECH INTELLIGIBILITY WITH OPEN-SET AND CLOSED-SET SENTENCE TESTS**

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**Introduction**: The benefits of auditory rehabilitation can be evaluated by speech intelligibility tests. However, in the absence of an actual benefit in speech perception, results may improve with repeated testing because of learning. *Procedural learning or training* is the result of repeated testing with different test lists. *Content learning* occurs when the same test lists are presented repeatedly and the sentences can be memorised. The aim of this study was to investigate the size and pattern of both types of learning for two types of sentence tests.

**Methods**: Short-term, medium-term and long-term learning effects were studied for open-set (LIST) and closed-set (Matrix) sentence tests. Each subject participated in three test sessions, each containing blocks of unique and repeated test lists. Four groups of 15 subjects were tested with the open-set sentence test: normal-hearing subjects in stationary noise, in ICRA noise and in silence, and hearing-impaired subjects in stationary noise. A fifth group was tested with the closed-set sentence test in stationary noise.

**Results**: Procedural learning was most pronounced at the beginning of the first test session. One training list was required for open-set sentence tests, and two training lists for closed-set sentence tests. After excluding this initial training, the overall procedural learning for open-set sentence tests was limited to 0.7 dB, but a large amount of content learning was observed (up to 4 dB). The test condition or subject group did not have a significant effect on the learning size or pattern. For closed-set sentence tests the procedural learning continued over the different blocks. Results improved with about 0.2 dB per block of three lists. No additional content learning was observed.

**Conclusions**: Very different patterns of learning were observed for open-set versus closed-set sentence tests. For both types of sentence tests a short training is required.
EFFICIENT AND SENSITIVE HEARING SCREENING WITH THE DIGIT TRIPLET TEST (DTT) IN OCCUPATIONAL AND SCHOOL MEDICINE

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Introduction: The Digit Triplet Test (DTT) is a low-tech, robust, and quick self-screening test based on speech perception in background noise. Compared to threshold audiometry, the DTT has many advantages with regard to the screening of large populations.

Objectives: The aim of this study was to investigate the accuracy and sensitivity of the DTT for detecting different degrees of high-frequency sensorineural hearing loss in noise-exposed listeners, and, in a next step, to assess the feasibility of the test for school-aged hearing screening.

Methods: 118 noise-exposed workers, representing a wide range from no to severe high-frequency hearing loss, and 214 children, of which 100 from 5th grade (10-11yrs) and 114 from 7th grade (12-13yrs), participated. They conducted the French or Flemish PC-based version of the DTT, completely independently, in an office-like room at work or at school. Pure-tone thresholds were collected by a professional audiologist under optimal conditions.

Results: In the noise-exposed workers, a strong linear relationship (R=0.86) was found between the DTT and the high-frequency PTA. The sensitivity and specificity to detect the first signs of high-frequency hearing loss were 92\% and 89\%, respectively. The measurement error was very low (within-subject standard deviation = 0.8 dB). In children, no support from an adult was needed and a similar measurement error was found (0.7 dB). Testing both ears took on average 7m 22s (5th grade) and 6m 7s (7th grade). Results obtained with the two language versions of the DTT were highly similar.

Conclusion: Given its ease of use and its high accuracy in detecting different degrees of high-frequency hearing loss, the DTT is highly suitable when screening for acquired sensorineural hearing loss in large populations.
PATIENTS’ PERSPECTIVE

HEALTH-RELATED QUALITY OF LIFE BENEFITS FROM AMPLIFICATION IN THE ADVANCED DIGITAL ERA

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Untreated sensorineural hearing loss (SNHL) is associated with chronic health care conditions, isolation, loneliness, and reduced health-related quality of life (HRQoL). Only about one in five persons with SNHL seek help for communication problems and many wait 10 years or more from the time they first notice a problem before trying amplification. Over 10 years ago, an American Academy of Audiology task force conducted a systematic review (SR) with meta-analysis on HRQoL benefits of amplification in adults. That SR was conducted when mainly analogue devices were available. Mean effect sizes (ESs) and confidence intervals for within-subject designs and disease-specific instruments suggested that hearing aids had small-to-medium impacts on HRQoL. Between-subject studies supported at least a small effect for generic measures, and medium-to-large effects for disease-specific measures that hearing aids had positive impacts on adults’ HRQoL. The advent of advanced digital hearing aids warranted an update (from 2004 to 2014) of the original SR, which we conducted using the same methodology applying search strings (including new ones reflecting digital devices) to the same (i.e., PubMed and other relevant) databases. The updated SR included 33 articles that met criteria for meta-analysis involving between- and within-subjects design studies as well as generic and disease-specific HRQoL measures. After adjusting for publication bias, results were similar to the earlier SR, but indicated a larger mean ES for HRQoL benefits from hearing aids for within-subjects designs employing disease-specific outcome measures. In addition, meta-analysis determined that HRQoL benefits were sustained 1 year post-fitting of hearing aids. Unfortunately, the majority of the newly included studies in the updated SR had the same weaknesses as those in the original study. Moreover, failure to report types of hearing aids by investigators precluded determining if advanced digital hearing aids resulted in increased HRQoL over those with analogue technology at this time.

COCHLEAR IMPLANT SERVICE DELIVERY – NOW AND IN THE FUTURE

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The objective of this survey was to explore the perceptions of implant users and their carers and professionals across the UK about current cochlear implant service delivery and its challenges, and their views of how they should be delivered in the future to meet these challenges.

Data were collected via an online questionnaire consisting of 22 questions in total; there were 748 respondents. The questionnaire contained both open and close ended questions. The open responses were subject to content analysis to allow the pertinent themes to emerge.

In-spite of the wide range of respondents, there was a broad consensus of opinion across groups. The majority of participants were satisfied with the service they currently receive. They reported their current experience of implant services to be mainly driven by decisions made by the implant team.
For the future they preferred the service to be mainly driven by decisions made jointly by the team and the user and/or parent/carer. The majority of participants wanted the cochlear implant services to be integrated into local audiology and other services such as education. Restrictions on number of candidates who are funded and political decisions and issues were seen as the major challenges. Qualitative analysis of the open ended responses indicated that the majority of participants wanted some change in the current services and highlighted the quantitative responses.

This research highlighted the benefits and limitations of the current cochlear implant service delivery, as well as the potential implications for the long term. While respondents were generally happy with the current cochlear implant service provision, they expressed some concerns about the long term sustainability and management which can affect planning for the future.

**THE EXPERIENCES OF ADULTS ASSESSED FOR COCHLEAR IMPLANTATION WHO DID NOT PROCEED**

Athalye S, Mulla I, Archbold S

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**Objective:** The objective of this study was to explore, by interview, the experiences of adults who have undergone assessment for cochlear implantation and were considered unsuitable.

**Methods:** 10 adult participants were interviewed. Interviews were transcribed and thematic content analysis was carried out to analyse them. 6 main themes and 16 subthemes were identified.

**Results:** The findings from the study demonstrate that adults who underwent the assessment for cochlear implantation were significantly impacted socially and emotionally as well as at work as a result of their hearing loss. Most participants found the speech testing in the assessment process to be a poor representation of hearing challenges in everyday life. A range of expectations from implantation were noted; the most common one being improvement in speech and communication. The management of these expectations needed attention. After the refusal, participants reported a lack of ongoing support and advice. A number of other suggestions regarding the actual assessment process and aspects around it were highlighted.

**Conclusions:** A need to revise audiological criteria and modify speech testing methods to resemble hearing challenges in everyday life is highlighted. The impact of hearing loss on social, emotional and work aspects need to be addressed thoroughly. An awareness of available technology and other coping strategies should be part of the assessment protocol. Uniformity across different centres in terms of providing information pre-assessment needs to be achieved. Consideration of the individual and his hearing and communication needs in addition to formal hearing assessments before deciding/refusing implantation needs to be developed.

**IS THE IMPACT OF A HEARING LOSS TAKEN SERIOUSLY?**

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Hearing loss and sudden hearing loss is a life changing event for anyone who experienced it. There are interconnecting conditions which are affecting us such as tinnitus and vertigo.

We will discuss how the medical profession and social care reacts to hearing loss event and connected issues, and what can be done to support patients.
We would like to raise mental health issue which relates to sudden hearing loss and severe balance problems as well as social-economic impact of the person’s life.

We will examine latest technology successes and failures and show how social model of disability can be implemented by the medical professionals working with those who experience sudden hearing loss.

Are the patients the experts?

We will bring best practice examples in a positive and constructive way.

We will explain how working closely with patient representatives we can achieve the best outcomes.
SCREENING IN PRE-SCHOOL AND SCHOOL-AGE CHILDREN

THE BATH (UK) SCHOOL ENTRY HEARING SCREEN (SES): QUALITY IMPROVEMENT OUTCOMES

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Introduction: the timing of SES in the UK allows children with hearing impairment previously not identified to be offered intervention as necessary, at a time where good hearing is perceived to be important for education. Coverage with SES is variable and many questions arise concerning practice, value and effectiveness. Local programmes have no clear data management pathway. This study examines a local programme screening five thousand school entrants before and after introduction of clear data management pathways and service restructuring.

Methodology: in 2012 the quality of the Bath and North East Somerset School Hearing Screening Service offered to schools was reviewed. Coverage, date capture and yield, screener competence, identification of eligible population and the efficacy of the screen were identified as areas for quality improvement. Obstacles to successful programme performance were described. Responsibility for programme performance was unclear. Overall pathway integrity was poor.

Results: a series of recommendations were implemented, including reducing the number of ‘screen refers’ with satisfactory hearing, robust referral to clinic assessment, improved coverage and measurement of screener performance. A new consent process, audiometric specification, intervals for the two stage screen, and what constituted screen failure were clearly specified and a pathway for diagnostic assessment introduced. Improved data handling was introduced.

Summary: The outcomes of 2012-13 SES have exceeded expectation. Coverage increased by twenty-six percent. There was a fifty percent decrease in ‘screen refers’, all screens were assigned to a screener, each with correct outcome set. Data can be interrogated and monitored allowing measurement of agreed performance indicators. Children identified with potential PCHI and conductive loss requiring interventions are closely tracked. There has been significant increase in the confidence around data reliability, accuracy and improved screener performance. Above all service commissioners now receive detailed reporting on the SES performance indicators.
COMMUNITY PRE-SCHOOL SCREENING WITH SEQUENTIAL ULTRA-SHORT PARENT QUESTIONNAIRE & TYMPANOMETRY

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Background: Could pre-school case-finding efficiently identify non-consulting persistent OME, and also missed/progressive permanent impairments? Poor HL is the shared element, suggesting a single shared 2-stage system, where high parentally reported hearing difficulties (RHD, reputedly under-sensitive) would lead to tympanometry (objective, but under-specific). Confirmed OME, or very high RHD with normal tympanograms, would then attract further assessment. To minimise prospective respondent burden, we considered only three RHD items, re-optimising their response-level scaling in realistic context.

Methods: On 1616 ENT-referred cases in the Eurotitis-2 OM database having hearing level (HL), demographic data, tympanometry and 3 RHD items available, we floated parameter estimates for RHD item response levels in centre-adjusted linear regressions, both linear for HL and logistic for various dBHL cut-offs. We coded tympanogram combinations as equivalent binaural HL (ACET, previously published) and, for stability of re-optimised item scaling, sought consistency over 8 variants of the prediction model. Overall 2-stage screen-performance was simulated by re-combining predicted HLs for cases below (using RHD items only) and above cut-off (using ACET also).

Results: On an unaffected community sample (N=149), the RHD-based 3-item predictive pre-screen gave a distribution gap, hence natural cut-off zone, around the 85%-ile (approximately matching 25dBHL) suggesting tympanometry for the above-gap ‘worst’ 15% of a general population. For stability, only one RHD item justified re-optimisation. On the 79.8% of the Eurotitis-2 ENT cases falling above suggested cut-off, ACET plus the two best RHD items predicted HL acceptably (46.4% of variance). Overall 2-stage screen performance for 25dBHL criterion gave area under the ROC (0.849) with 77.2% specificity at 80% sensitivity.

Conclusions: Three RHD questions would efficiently precede tympanometry, in a promising 2-stage sequential system based on HL surrogacy. As cases were known, trial implementation now requires large asymptomatic samples; documenting performance for rare late/missed SNHL awaits monitored implementations.

PRESCHOOL HEARING DETECTION IN CYPRUS

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Hearing loss in early childhood is related to disorders in language and academic skills, as well as psychosocial adjustment. The incidence of hearing loss in the preschool population varies in related reports, from 1.2%, to 11.9%. Most countries implement hearing screening when school starts; however, the necessity to screen hearing in the preschool years is being recognized by experts and policy makers. Preschool Hearing Detection (PHD) is a project testing hearing in preschool children (4.5-5.5 years of age) in Cyprus. PHD combines otoscopy, tympanometry, and pure tone audiometry, with tablet-based tone audiometry and speech audiometry. The Adaptive Auditory
Speech Test (AAST, Coninx, 2006), consists of words presented in quiet and noise, in an adaptive procedure; the child has to choose the corresponding picture from a closed set. AAST has been adapted to Greek, and is presented via tablet PC, in order to assess feasibility, reliability, and validity of testing this population. Children are referred based on the ASHA criteria for otoscopy, tympanometry, or pure tone screening. Referred children are evaluated for speech and language disorders, and academic performance. Results of the recommended evaluation and follow up are tracked up to six months after initial referral in order to determine final outcomes.

VALIDATION OF HEARING SCREENING PROCEDURES IN ECUADORIAN SCHOOLS

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Childhood hearing loss negatively impacts speech-language, social-emotional, and cognitive development. Because of limited access to hearing healthcare, children often become isolated and have a reduced quality of life. Even though early identification of hearing loss through newborn screening is becoming more common in developed countries, it is not common in developing countries and worldwide, more than 90% of children born with hearing loss will not be identified early. Having a systematic mechanism to provide low-cost hearing screening during childhood is critical for optimizing future academic and vocational success for children with hearing loss.

A national study in Ecuador in 2010, Misión Solidaria Manuela Espejo Bio-Psycho-Social Study, conducted by Office of the Vice-President of the Republic, found that hearing disability had the third highest incidence of occurrence among disabilities in Ecuador. As a result of this study, a national initiative to screen the hearing of children was launched in 2011. The Ecuadorian government launched a program in 2012 to screen the hearing of all school-aged children (5 -9 years) using a teacher-administered questionnaire.

The purpose of the current study was to evaluate the validity of the teacher-administered hearing screening questionnaire by comparing the results of the questionnaire with the results of screening using pure tone audiometry administered by trained health care professionals. To obtain a sample of children for the comparison of the hearing screening questionnaire to pure tone audiometry, a sample of schools that participated in the national hearing screening effort in 2012 were randomly selected. The study was completed in two phases to include schools from each region of the country (i.e., Amazon, Highlands, Coastal). The sample for Phase 1 included 3,197 first grade students from 82 schools, and the sample for Phase 2 included 1750 first grade students from 37 schools. Results from the study will be discussed.
HEARING IMPAIRMENT IN THE UNITED STATES – MONITORING RECENT TRENDS IN HEARING HEALTHCARE USING HEALTHY PEOPLE 2010/2020 OBJECTIVES

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Background: U.S. Healthy People (HP) provides science-based, 10-year national objectives for improving the health of all Americans. HP encourages collaborations across communities, empowers individuals toward making informed health decisions, and measures the impact of prevention activities. HP hearing health objectives include newborn hearing screening, reducing otitis media burden, regular hearing exams, promoting hearing rehabilitation (hearing aids, cochlear implants, and augmentative devices), increasing hearing protection use, and reducing noise-induced hearing loss.

Methods: Most objectives are assessed using the National Health Interview Survey (NHIS) or the National Health and Nutrition Examination Survey (NHANES) that includes hearing threshold exams (n≈2,000 annually). The NHIS adult survey is a nationally-representative sample (2012: n=34,512) of the civilian, non-institutionalized population. The NHIS sample child survey (2012: n=13,263; age <18 years) is also nationally-representative but is answered by parents/caregivers. The 2014 NHIS includes expanded hearing healthcare modules for the adult and child samples.

Results: Prevalence of hearing impairment (HI) in 2012 was 37.6 million adults (16%) and 1.6 million children (2.2%). The trend in children’s reported HI declined 30%, 1997–2010, largely due to a steep decline in children with ‘a lot of trouble’ hearing; the number of ‘deaf’ children remained stable. HI of adolescents (12–19 years) showed two strong risk factors based on NHANES 2005–2010: ‘tinnitus’ (odds ratio [OR]=3.8, 95% confidence interval [CI]:1.3–11.7] and ‘ever had ear tubes’, OR=7.2, CI:2.4–21.8]. Hearing aid (HA) use for moderate-to-severe HI increased from 25.2% to 30.1%, 2001–2012, among older adults, 70+ years, but remained unchanged at 17% among those 20–69 years. Cochlear implant (CI) surgeries doubled from 2001–2010, with the highest prevalence among preschool-aged children, which increased from 9.0% to 13.0%, 2001–2009.

Discussion: The goal of HP is to demonstrate effectiveness through public awareness campaigns and prevention activities by tracking changes each decade.

DO THE AGEING BABY-BOOMERS HEAR BETTER THAN THEIR PARENTS?

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Ageing of the baby-boom generation together with the prolongation of lifespan is expected to increase considerably the number of hearing impaired people over the next few decades. In developed countries, roughly half of those who are now in their 50s face a 50 percent chance to live 10 years or more with hearing loss. From 2010 to 2012 we conducted a cross-sectional study on hearing abilities in the northwest of Germany (HÖRSTAT). Based on a stratified random sample, 1903 adults between 18 and 97 years participated in the study. Overall prevalence of hearing
impairment according to the WHO-classification (mean of air conduction thresholds in 0.5, 1, 2 4 kHz more than 25 dB HL) is approx. 16%. For comparison, we selected 13 international studies on hearing impairment, conducted in Europe, Australia and the US between 1985 and 2006. The overall prevalence in HÖRSTAT turned out to be in a similar degree, provided that the age-range and hearing impairment criteria used in the respective studies are applied on the HÖRSTAT data. Prevalence in subgroups by age, however, is mostly below the prevalence reported in other international studies. Considering the time the studies of comparison were carried out, HÖRSTAT prevalence correspond more closely to recent than to older studies. Thus, this contribution presents our results in comparison and discusses the possible impact of generational change along with socio-demographic sample differences on prevalence and degree of hearing impairment.
ISSUES ON GENETICS

ANALYSIS OF DEAF GENE MUTATIONS IN NONSYNDROMIC HEARING LOSS IN CHILDREN OF SHANDONG PROVINCE

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Objective: The GJB2, SLC26A4 and mtDNA A1555G mutations are the prevalent causes of nonsyndromic hearing loss of China. Numerous studies have revealed that the forms and frequencies of the mutations in the three genes are largely dependent on the ethnic or geographic origins. Hence, this study aimed to characterize the mutation profiles of the three genes in nonsyndromic hearing loss in Shandong province patients.

Methods: An investigation of 146 children with nonsyndromic hearing loss and 100 controls with normal hearing was conducted. Bidirectional sequencing (or enzyme digestion) was applied to identify sequence variations. All the children underwent audiological evaluation, medical evaluation and high-resolution CT scan on temporal bone.

Results: This study revealed 235delC of GJB2 was the most common type in the three common deaf genes. The mutant carrier rate for SLC26A4 was 15.75%, including 8.90% single mutant carriers. One patient had mtDNA A1555G, giving a frequency of 0.68%. 4 cases of normal hearing were single mutant carriers of GJB2 and SLC26A4.

Conclusions: We found that unilateral or mild hearing loss might be caused by gene mutations. Most of the patients had congenital hearing loss while several cases had late-onset hearing loss. The application of deaf genes testing made the early intervention more acceptable to the parents, whose children had no family history of deafness and not so bad hearing.

MASSIVELY PARALLEL SEQUENCING IDENTIFICATION OF NOVEL GENES AND MUTATIONS FOR HEREDITARY HEARING LOSS IN INBRED POPULATION

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Background: Identification of inherited mutations has been an ongoing challenge in human medical genetics. Using advanced targeted DNA capture and massively parallel sequencing technologies, in conjunction with homozygosity mapping relevant for consanguinous families, we are meeting this challenge for hereditary hearing loss. Our cohort consists of Palestinian Arab families of variable size and onset of hearing loss.

Methods: We constructed a custom design arrays of cRNA oligonucleotides containing 250 genes, responsible for both human and mouse deafness. We prepared paired-end libraries, followed by cluster amplification on v4 Illumina flow cells with our bar-coded multiplexed samples. A 2x72bp paired end recipe was used, resulting in a median base coverage of 300-572x and overall, 94.7% of our targeted bases covered by more than 10 reads, which was our cutoff for variant detection.
Results: We generated SNP and indel calls for our samples and filtered the variants against those of dbSNP131 and the 1000 Genomes project to identify private and rare variants. Novel genes and mutations were discovered. Most compelling, a number of mutations were found in genes previously known only to be involved in mouse deafness. Protein structure predictions were made to provide insight into how the mutations lead to the predicted phenotypes.

Conclusion: Discovery of additional deafness genes and mutations will allow for early clinical diagnosis, enabling prediction of phenotypes and enhanced management. Characterization of the proteins encoded by these genes will enable a comprehensive understanding of the biological mechanisms involved in the pathophysiology of these disorders.

PROGRESSIVE HEARING IMPAIRMENT WITH DELETION C.35DELG IN GJB2 GENE DESPITE NORMAL NEWBORN HEARING SCREENING

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Hearing impairment is the most common sensorineural disease in humans. About 1-3 per 1.000 neonates suffer at birth or in the first years from high-grade to severe hearing impairment. About half of the cases are due to genetic alterations. Most commonly, the GJB2 gene (connexin-26) is concerned with the mutation c.35delG. All patients showed a severe to profound hearing impairment to the course. DNA isolation, amplification and sequencing was performed using standard techniques. In the studied patient population we have 142 patients with a homozygous deletion mutation in GJB2 gene (c.35delG) and 29 patients who are heterozygous for this mutation on one allele and heterozygous for another loss-of-function mutation in GJB2 gene. Of these 171 patients 16 (9.3%) were on an inconspicuous newborn hearing screening using Otoacoustic Emissions (OAE). Total was observed a progression of hearing impairment in 31 of these patients (18.1%). This fact suggests that homozygous deletion mutation c.35delG does not always contribute to an congenital hearing impairment, but to a progressive hearing loss that might develop over the first months and years of life. Additionally, we have to re-evaluate the value of OAE for newborn hearing screening, keeping in mind that one positive result is no warranty for a normal development of hearing function, but a result that should be checked in the course. We recommend annual hearing tests to the paediatrician and, with a known familial hearing loss and other risk factors, pediaudiological controls.

A DOMINANT MUTATION IN THE STEREOCILIARY GENE TBC1D24 IS A PROBABLE CAUSE FOR NON-SYNDROMIC HEARING IMPAIRMENT

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Mutations in TBC1D24 have been linked to a variety of epileptic syndromes and recently to syndromic hearing impairment DOORS syndrome and non-syndromic hearing impairment DFNB86. All TBC1D24 mutations reported so far were inherited in the recessive mode. In a dominant family segregated with late-onset, progressive, non-syndromic hearing impairment, linkage analysis revealed a 2.07 Mb candidate region on chromosome 16p13.3 (logarithm of the odds score = 3.80) that contains TBC1D24. Whole-exome sequencing identified a heterozygous p.Ser178Leu variant of TBC1D24 as the only candidate mutation segregating with the hearing impairment within the family.
In perinatal mouse cochlea, we detected a restricted expression of *Tbc1d24* in the stereocilium of the hair cells, a critical cellular structure for mechanoelectrical transduction of the sound, as well as in the spiral ganglion neurons. Our study suggested that the p.Ser178Leu mutation of *TBC1D24* is a probable cause for dominant, non-syndromic hearing impairment. Identification of *TBC1D24* as a novel stereociliary gene may shed new light on its specific function in the inner ear.
OBJECTIVE MEASURES - NEW TECHNIQUES (PART I)

OBJECTIVE IDENTIFICATION OF CLICK-EVOKED AUDITORY BRAINSTEM RESPONSES USING TIME DOMAIN CROSS-CORRELATIONS BETWEEN INTERLEAVED RESPONSES

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The rapidly evolving field of early diagnostics following the introduction of newborn hearing-screening requires rapid, valid, and objective methods, which have to be thoroughly evaluated in adults before use in infants. The aim was to study cross-correlation analysis of interleaved auditory brainstem responses (ABRs) in a wide dynamic range in normal-hearing adults. ABRs were recorded in 14 normal-hearing subjects using 100 µsec clicks (71.5-18.5 dB nHL; 10 dB steps; ≤30000 sweeps; 39 Hz). Cross-correlation analysis between two sub-averages of interleaved responses was performed in the time domain. Psychoacoustical click thresholds (PCTs) were measured with the same stimulus as used for the ABR (20 Hz). Time elapsed (accepted sweeps/repetition rate) for the ensemble of sweeps needed to reach a cross-correlation coefficient (ρ) of 0.70 (=3.7 dB SNR) was analyzed. Mean cross-correlation coefficients exceeded 0.90 in both ears at ≥11.5 dB nHL. At 1.5 dB nHL, mean(SD) ρ was 0.53(0.32) and 0.44(0.40) for left and right ears, respectively (n=14) (=0 dB SNR). Mean(SD) PCT was -1.9(2.9) and -2.5(3.2) dB nHL. Average time elapsed needed to reach ρ=0.70 was ≤20 sec at ≥41.5 dB nHL and ≈30 sec at 31.5 dB nHL. The average stimulus level corresponding to ρ=0.70 for the nonfiltered ABR was 6.5 dB nHL, which coincided with the estimated psychoacoustical threshold for single clicks. In conclusion, ABR could be identified in a short period of time using cross-correlation analysis between interleaved responses. The average stimulus level corresponding to 0 dB SNR in the nonfiltered ABR occurred at 1.5 dB nHL, 4 dB above the average PCT. The mean input/output function for the ensemble of sweeps required to reach ρ=0.70 was parallel to the ABR based on all sweeps. Time domain cross-correlation analysis of ABR might form the basis for automatic response identification and future threshold seeking procedures.

REJECTION OF BACKGROUND ACOUSTIC ACTIVITY IN REGISTRATION OF TRANSIENT EVOKED OTOACOUSTIC EMISSIONS

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It was found that significant part of background acoustic activity recorded in the auditory canal can be depicted as a set of short tone peeps smoothly distributed among frequencies. This activity is not synchronized with stimuli used for recording of the transient evoked otoacoustic emissions (TEOAE) and consequently produces an additional noise in TEOAE recordings. A method for rejection of this activity was developed. In this method several overlapped segments of each response are split into frequency bands forming a grid of time and frequency cells. The signal is averaged independently in each cell. The averaging is performed with weight coefficients calculated by the instant intensity in this and adjacent cells. After averaging the whole signal is recovered.
It was shown that this method can reduce the power of residual noise in TEOAE records about five times in contrast with conventional averaging.

For optimization of this method the statistics of peeps were analysed. Tone peeps were detected using Pitch-Envelope Analysis. The data were obtained with and without stimulation. The simultaneous registration of electrocardiogram and breast was provided. It was found that the significant part of activity is not correlated either with breast or cardiac rhythm. We speculate that this is a cochlear activity which is not evoked and/or synchronized by stimuli.

**AN APPLICATION OF PITCH-ENVELOPE ANALYSIS FOR VISUALIZATION, CLASSIFICATION AND FILTERING OF TRANSIENT EVOKED OTOACOUSTIC EMISSIONS**

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An algorithm named Pitch-Envelope Analysis (PEA) was designed by our team primary as a first stage of the TEOAE signal analysis. The algorithm is suitable for the analysis of a signal where the signal supposed to consist of transient tonal components and a noise, the amplitude of components changes much faster than their frequencies and only few number of components (3 – 20) are significant simultaneously. In contrast with some other algorithms the PEA tries to describe each component by fast amplitude changing instead of a bunch of frequencies or a broadened spectrum.

In silent environment the algorithm has very high time as well as frequency resolution. The algorithm represents a signal as a set of dominant tones in a fixed number of channels.

This algorithm can be used for simultaneous processing of several data channels, particularly several averages. In this mode the frequencies are estimated by processing of sum of buffers, while the amplitudes are calculated from each buffer independently using the common sets of base vectors. The difference in amplitudes could be used for estimation of the component reproducibility. It is also possible to investigate the dependency of the amplitude on some factor, particularly on the stimulus amplitude.

It was found that the part of detected components can be classified as linear and sometimes even quadratic with respect to stimulus amplitude and therefore can be excluded from response. This method of the non-linear response detection seems more sensitive then the convenient one.

Poor reproducibility of components classified as spontaneous emissions was detected, which can be explained as an effect of a random phase shift. It seems that the presence of spontaneous activity not synchronized or partially synchronized with stimulus leads to a reduced reproducibility in TEOAE recordings.

**HEARING LOSS SCREENING WITH STIMULUS FREQUENCY OTOACOUSTIC EMISSIONS EVOKED BY SWEPT TONES**

Chen S, Li X, Li G

*Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China*

Otoacoustic emissions (OAEs) are soft sounds generated by the inner ear and can be easily recorded at the entry of the ear canal. Since the presence of OAEs can be closely related with the functional status of the inner ear, they have been widely used for hearing loss screening in the clinic.
However, there are limitations in current methods of clinical OAE measurements, such as the restricted frequency range and low efficiency. In this study, a new method which used swept tones with time-varying frequencies to evoke the stimulus frequency OAEs (SFOAEs) was developed to overcome these limitations. The swept-tone SFOAEs were generated with a three-interval experimental paradigm in which linear stimulus artifacts were cancelled and nonlinear OAE signals were preserved. A dynamic tracking filter that was able to trace the instantaneous frequency of the swept-tone SFOAEs was used to separate the OAE signals from various background noises. The results showed that the swept-tone SFOAEs could be successfully measured in human ears. The frequency range could be extended up to 20 kHz and numerous frequencies could be measured within just one or two minutes. The amplitude and phase of the swept-tone SFOAEs were reliable in repeated measures and also compatible with traditional methods. Moreover, results showed that the swept-tone SFOAEs were possibly capable of specifying the precise frequency range of the hearing loss. The method of swept-tone SFOAEs may be a great alternative of current clinical OAE measurements to provide more detailed and accurate information for hearing loss screening and hearing diagnoses.
DECONVOLUTION OF MAGNETIC ACOUSTIC CHANGE COMPLEX (MACC)

Bardy F\textsuperscript{1,2,3,4,5}, McMahon C\textsuperscript{1,2,5}, Yau SH\textsuperscript{4,5}, Johnson BW\textsuperscript{4,5}

\textsuperscript{1}HEARing Co-operative Research Centre; \textsuperscript{2}Department of Linguistics, Macquarie University, NSW; \textsuperscript{3}National Acoustic Laboratories, NSW; \textsuperscript{4}Department of Cognitive Science, Macquarie University, NSW; \textsuperscript{5}ARC Centre of Excellence in Cognition and its Disorders, Australia

The aim of this study was to design a new objective measure of spectro-temporal discrimination and to investigate the morphological characteristics of auditory cortical responses elicited by rapidly changing synthesized speech sounds.

We investigated the magnetic acoustic change complex (mACC), an obligatory auditory cortical response to vowel-vowel transitions. These transitions consist of a pitch change for a /i/ vowel (F0 transition) and a second formant transition perceived as a change from /u/ to /i/. The mACC responses to these transitions were recorded using two different stimulus onset asynchronies (SOAs). The long SOA of 1500 ms was compared to a short SOA, jittered between 100 and 172 ms. The Least Squares (LS) deconvolution technique was used to disentangle the overlapping MEG waveforms. The comparison between morphologies of the recovered cortical responses in the short and long SOA conditions showed high similarities, suggesting that the LS deconvolution technique was successful in disentangling the MEG waveforms. The mACC for the short SOA condition showed significantly lower amplitudes compared to the long SOA condition. The F0 transition showed a larger reduction in amplitude from long to short SOA compared to the F2 transition. Lateralization of the responses appeared to be associated with the spectro-temporal properties of the acoustic stimulus.

This is the first demonstration of the separation of overlapping cortical responses to rapidly changing speech sounds and offers a new clinical marker of discrimination of rapid transitions of sound.

BINAURAL EVOKED POTENTIALS IN YOUNG NORMAL HEARING ADULTS: OBJECTIVE MEASURES OF THE BINAURAL SYSTEM

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KU Leuven - University of Leuven, Department of Neurosciences, ExpORL, Leuven, Belgium

Normal hearing listeners integrate input from two ears. This allows them to understand speech (in noise) or attend to one speaker in the presence of others. The binaural system accounts for sound localization as well, by processing and integrating differences in phase (low frequencies) or intensity (high frequencies) between sounds arriving at the left and right ear.

The goal of the present study is to determine objective measures for binaural processing, thereby replicating and extending work by Ross et al. ((2008) A Novel Type of Auditory Responses: Temporal Dynamics of 40-Hz Steady-State Responses Induced by Changes in Sound Localization. \textit{Journal of Neurophysiology}, 100, 1265-1277]). Neural temporal coding is investigated by multiple-electrode Auditory Steady State Responses (ASSRs) and change responses detected in the EEG time domain and spectrum. Six young normal hearing participants listened passively to sinusoidal amplitude-modulated tones. Stimuli were 4 seconds in duration, with an overall phase shift of 180° in the sound carrier after 2 seconds (slow protocol) or recurring every 400 milliseconds (fast protocol).
ASSRs to different modulation frequencies (20, 40 and 80 Hz) were used to tap into different neural generators and phase responses to the IPD change were expected to elicit a short distortion in the synchronization of the ASSRs. Carrier frequencies ranging from 500 up to 1500 Hz were used, showing an upper level for phase response detection.

The electrophysiological results of the 40 Hz modulation frequency were similar to the ones reported by Ross et al. (2008). Preliminary data also show similar findings for a 20 Hz modulation frequency, which is believed to tap into more cortical sources than the 40 Hz modulation frequency. This is particularly interesting as it is believed to represent phonemic rate in speech. However, a 80 Hz modulation frequency (brainstem) fails to show a clear response so far.

**ABRS TO CHIRP AND CLICK STIMULI IN NEONATES AND ADULTS**

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Chirp stimuli maximize temporal synchronization of auditory nerve fiber responses by compensating for the traveling wave delay. Chirps have been shown to produce auditory brainstem responses (ABRs) with significantly higher amplitudes relative to those with click stimuli in adults. ABRs to chirps have been advocated for both newborn neurodiagnostic and hearing screening applications. Normative ABR data, however, is presently not widespread. We gathered normative ABR data to air and bone-conducted chirp and octave band stimuli and compare such to traditional click and tonal stimuli in newborns (N = 165) and adults (N = 20). ABRs to air- (AC) and bone-condcuted (BC) chirp and click stimuli were investigated. The effects of stimulus rate, polarity, and intensity were manipulated: Three rates were examined with 60 dB nHL alternating AC stimuli (i.e., 77.7, 57.7, 8.7/s). AC condensation, rarefaction, and alternating polarities were examined at 60 dB nHL at rates of 8.7 and 77.8/s. Intensity effects were examined at 60, 45, and 30 dB nHL and 45, 30, and 15 dB nHL with 57.7/s alternating AC and BC stimuli, respectively. We also examined ABRs to air-conducted toneburst versus octave-band chirp stimuli. With infants, longer wave latencies and larger amplitudes (with low and moderate intensities) with the chirp stimuli were found. Infant and adult differences were evident, as expected. Our findings suggest ABRs to chirp stimuli may be feasible for hearing assessments with newborns.

**40-HZ SINUSOIDAL ASSR AND TB-ABR THRESHOLDS IN DETECTING MILD CONDUCTIVE HEARING LOSS IN CHILDREN WITH OTITIS MEDIA WITH EFFUSION**

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Accurate diagnosis of mild, low frequency hearing loss is difficult in young children. Although 40-Hz automated auditory steady-state response (aASSR) is more accurate and has stronger correlation for mild hearing loss than tone burst auditory brainstem response (TB-ABR), aASSR threshold is based on automated detection of the response. The use of 40-Hz sinusoidal ASSR (sASSR) would allow subjective interpretation of the response similar to TB-ABR. This study aimed to determine the accuracy of 40-Hz sASSR compared to TB-ABR and behavioral thresholds to detect mild conductive hearing loss in children with otitis media with effusion (OME).
Methods: Hearing thresholds were measured behaviorally and electrophysiologically for 26 children (mean age 5.1 year) with mild conductive hearing loss using TB-ABR (rarefaction 500Hz and 4000Hz toneburst) and 40-Hz sASSR (narrow-band chirps) of the Integrity V500 system and its Kalman weighted filtering. TB-ABR and 40-Hz sASSR thresholds were recorded monaurally from right (Fz-M2, Fpz) or left (Fz-M1, Fpz) ear while children were actively awake. Two independent raters assessed waveforms to determine thresholds. Within-subject repeated ANOVA of sASSR vs. TB-ABR vs. behavioral thresholds were conducted for each frequency.

Results: The mean 40-Hz sASSR and TB-ABR thresholds were within 5 dB and 10 dB of the behavioral thresholds, respectively, at each frequency. There was no significant difference among thresholds of the three measures. The inter-rater agreement was better for sASSR (89%) than TB-ABR; (85%), partly because of the larger sASSR response and the less degraded waveforms due to conductive hearing loss.

Conclusions: Both 40-Hz sASSR and TB-ABR accurately detected mild hearing loss within 5 -10 dB of the actual thresholds. Response identification is easier for 40-Hz sASSR than TB-ABR because of its larger signal.
FOCUS ON TECHNOLOGY (PART I)

RESOUND SMART APP - PERSONALIZATION AND CONTROL WITH 2ND GEN. APP FROM RESOUND

Ceylan D
GN ReSound, Ballerup, Denmark

A Smartphone is priceless for most of us today. We use it for calls, playing music, paying bills, find our way and much more.

The new ReSound Smart app is the second app provided by ReSound. The ReSound Remote Control (RC) app was the first app ReSound developed. The RC app can adjust the hearing aids by turning the volume up/down and changing programs when needed. In other words, everything a well-known remote control can provide today.

The prior generation needed the Phone Clip+ to translate the wireless language between the hearing aids and the smart phone. Now with collaboration with the phone manufacturer, the hearing aids can communicate directly with the phone and thus, the ReSound Smart app no longer requires the intermediate device. This is unique to the hearing aid industry and allows the user to control the hearing aids without the Phone Clip+ and offers unique personalization options for any user in addition to the more traditional remote control options.

The geotagging feature is one of the features in the new ReSound Smart app. It makes it possible to personalize and save the user’s listening experience in specific listening situations. Going further than only being able to adjust the overall gain volume, it is also possible to adjust the treble and bass settings for even better sound experience. More features as Troubleshooting, Maintenance and Quick start make it easier for the user to get information about their used hearing aids without going through brochures and/or internet.

The ReSound Smart app enables the hearing aid user to behave as unconstrained and natural as possible in more situations than ever before.

WIRELESS SOUND TRANSMISSIONS FOR THE HEARING IMPAIRED IN THE PUBLIC SPACE

Bisgaard N
EHIMA/GN Resound, Denmark

In a few years most hearing aids will be equipped with compatible wireless system for receiving sound signals from transmitters placed in public places. Such systems will complement and possibly replace loop systems. In particular, the new systems will allow a number of improvements such as stereo transmission, non-interfering transmissions in adjacent rooms, public service information in places like train stations and airports as well as one-to-one conversations using point-to-point communication. Such installations will in many cases offer hearing aid users considerable benefits compared to non-hearing aid users. This development will most likely increase the acceptance of hearing aids as a normal and useful tool for everyday life.
WHEN THE BRAIN DOESN’T UNDERSTAND WHAT THE EARS ARE HEARING - PRESENTING A QUALITATIVE EVALUATION OF THE RESOUND UNITE MINI MICROPHONE IN CHILDREN AND ADOLESCENTS WITH APD

Haastrup A

*GN ReSound, Ballerup, Denmark*

Individuals with auditory processing disorder (APD) present one or more of the following behavioral characteristics: difficulty to understand auditory information (language) in competitive noisy or reverberant environment; inconsistent or inappropriate responses in speech, frequent requests for repetition of spoken message, difficult attention, easy distraction, difficulty to follow complex verbal orders, difficulty to localize the sound, difficulty to learn songs and rhythms, as well as reading and learning problems (Johnston, John et al. 2009; Lemos, Jacob et al. 2009). APD often causes higher impact in children, to whom such characteristics may interfere in their social, reading, speaking, language, comprehension, attention, and communication skills (Lemos, Jacob et al. 2009).

FM technology is recommended as a potential intervention strategy for the difficulties experienced in the classroom that characterize children with APD (Johnston, John et al. 2009). The Mini Microphones close proximity to the speaker’s mouth, and the direct delivery of the signal to the ears of the listener, both function to minimize the effects of noise, reverberation, and distance on the signal (Johnston, John et al. 2009). The Mini Microphone provides the same benefits as FM technology in that the signal is picked up at the location of the best signal to noise ratio, close the speaker’s mouth, and is delivered to the ears of the listener.

In this presentation results from a qualitative study will be presented; where children under 18 years of age diagnosed with APD were fitted with ReSound hearing aids and issued with the ReSound Unite Mini Microphone.

The presentation will also include results from studies done with GN Resound’s wireless microphone: ReSound Unite™ Mini Microphone, showing improved SNR compared to traditional FM.

USE IT, DON’T LOSE IT: RESOUND’S NEW APPROACH TO FREQUENCY COMPRESSION

Haastrup A

*GN ReSound, Ballerup, Denmark*

Speech is essential in human social interaction. As such an important facet to human life, it is imperative that speech is understood by the listener. For this reason, speech communication is typically linguistically and acoustically redundant. This redundancy helps us to understand in the often difficult listening environments we encounter on a daily basis.

One effect of hearing loss is that it strips away some of the acoustic redundancy in speech, as it reduces audibility for speech sounds. Amplification helps restore some acoustic redundancy to the speech signal that would be otherwise unavailable for the listener with hearing loss. A primary goal of fitting amplification is to provide access to as much speech information as possible. However, the common sloping configuration of hearing loss makes it particularly challenging to provide audibility for high-frequency fricatives such as /s/, /ʃ/, and /f/. Conventional amplification may limit adequate access to high frequency speech information or environmental high frequency sounds. Technical limitations with amplification (e.g., restricted high frequency bandwidth of the hearing instrument or acoustic feedback) can cause insufficient amplification for all speech frequencies.
A tool for improving audibility of high frequency sounds is frequency lowering. This term refers to sound processing strategies that move information from higher frequency areas to lower frequency areas, where the individual’s hearing is better. The idea behind frequency lowering is that audibility of these sounds even at “misplaced” frequencies is more beneficial than no audibility at all, even if it comes at the cost of poorer sound quality.

This presentation will discuss how linguistic redundancy helps us in the communication process, including the importance of audibility of high frequency content for speech understanding. The session will also discuss the technical limitations of amplification today. Finally this session will introduce Resound’s new approach to frequency compression.

INDEPENDENT STUDY IDENTIFIES METHOD FOR EVALUATING HEARING INSTRUMENT SOUND QUALITY

Jespersen CT
GN ReSound, Ballerup, Denmark

It is of great significance to the successful use of hearing instruments that a listener’s first experience be positive in terms of sound quality. Despite its importance, sound quality can be difficult to define and quantify for the hearing instrument wearer.

Unlike outcome measures that help quantify benefit and satisfaction with hearing instruments, methods for impartially assessing sound quality are lacking. Acknowledging the challenge in documenting good sound quality ReSound enlisted DELTA SenseLab, an independent test laboratory specialized in performing listening tests in a variety of domains, to evaluate sound quality in ReSound’s hearing instruments compared to other hearing aid manufacturers’ hearing instrument sound quality.

The method used by DELTA for evaluation of hearing instrument sound quality is inspired by the food and fragrance industry, which uses sensory panels consisting of trained assessors evaluating products based on methodologies that are well-established within food science. The idea is that methodologies used to assess taste and smell sensory domains can be transferred to other sensory domains like sound and hearing.

Eighteen assessors from DELTA’s hearing-impaired listening panel participated in the study. The results show significant differences between the evaluated hearing instruments. The hearing instruments with the highest rated sound quality also have similarities within the description of their sound as do the hearing instruments with the lowest rated sound quality.

CALL ME: INVESTIGATING END USER BENEFIT WITH DIFFERENT CONTEMPORARY PHONE LISTENING STRATEGIES

Jespersen CT
GN ReSound, Ballerup, Denmark

Inability to communicate on the phone is strongly linked to reduced quality of life for hearing-impaired individuals (Dalton et al., 2003). Contributing factors include the absence of visual cues and the presence of background noise (Mackersie, Qi, Boothroyd, & Conrad, 2009; Picou & Ricketts, 2011). Failure to use hearing instruments with the phone is reported as one of the main reasons why hearing instrument owners do not use their hearing instruments (Kochkin, 2000).
The aim of this study was to quantify the benefit that can be expected when using phone specific hearing aid strategies and to compare and contrast more classical approaches to recent advances in wireless technology.

Ten participants were tested in the presence of background noise using a modified Hagerman sentence test. Seven conditions were tested including acoustic coupling, telecoil phone, wireless streamed sound and direct streamed sound (Made for iPhone Hearing Aid strategy). Results of this study showed that the use of phone listening strategies, as opposed to the use of a non-phone specific hearing instrument program, improved the resulting speech reception threshold (SRT) score at a statistically significant level with benefit improving further when the phone signal was delivered simultaneously in both ears.
FOCUS ON TECHNOLOGY (PART II)

SIGNIFICANT TINNITUS IMPROVEMENT WITH EXTENDED WEAR DEVICE

Sanford M
CSG Better Hearing Center, Walnut Creek, CA USA

The Lyric Tinnitus study aimed to assess the effectiveness of continuous wear hearing devices for chronic tinnitus sufferers over a 3 month period. Lyric, the world’s only extended wear device worn 24 hours a day, 7 days a week was used. Patients were evaluated using four tests: Perceived Stress Scale (PSS), Patient Health Questionnaire 9 (PHQ-9), Tinnitus Functional Index (TFI), and Tinnitus Handicap Inventory (THI). The PSS measures nonspecific perceived stress and the PHQ-9 measures mental health issues specific to depression. TFI was used as a primary outcome measure and the THI was used as the secondary measure to assess subjects progress over time. All four scales tested were used to determine eligibility for the study and the TFI and THI were assessed again at two weeks, and one and three months. The TFI can be broken down into 5 levels in judging tinnitus: score of 0-18 No problem, 18-30 Small problem, 32-53 Moderate problem, 54-72 big problem, 73-100 Very Big problem. Each subject scored a minimum of 25. Initial TFI scores prior to using Lyric were 4 subjects -25-31, 7 subjects-32-53, 4 subjects 54-72, and 1 patient 73-100.(189) Final TFI scores had 6 subjects scoring under 18, 4 subjects scored 18-31, 5 subjects scored 32-53, 1 subject scored 54-73. The average initial TFI score was 45.4 and the final TFI score average was 26.1 a 42.5% reduction. Over 50% of subjects judged their tinnitus to be no problem or small problem at 90 days which is a significant reduction in tinnitus for the subjects. The initial THI score was 33 and the final score was 20.2 or a 38.8% reduction in tinnitus. This study showed significant improvement in tinnitus by subjects over a 90 day period.

EFFICIENT PAEDIATRIC HEARING ASSESSMENT

Sanchez C
GN Otometrics, Taastrup, Denmark

An accurate hearing assessment is the fundamental start for a successful fitting. This observation is even more significant when it is about children. However, getting the hearing threshold from a 2 years old child with a severe to profound hearing loss can be quite challenging for the professional. The main challenge is about creating a good test atmosphere, keeping both the conditioning and the attention of the child, and performing the test in the shortest possible time frame. The right equipment setup can play a crucial role in succeeding with this.

Recently a new tool designed specifically for paediatric audiology was added to the MADSEN Astera² audiometer from Otometrics. The main idea is enable the tester to bring the visual reinforcement into the audiometer offering the clinician an efficient way to stimulate the child both acoustically and visually via the same interface. The VRA devices are coupled to the audiometer via an infrared signal, and the solution is unique to the market. The single interface and the intuitive navigation offered by the new tool from Otometrics, bring a new level of efficiency and accuracy into the paediatric audiology practice.

The presentation will introduce the audience to this unique VRA solution and demonstrate through how it can make them more efficient and accurate when doing paediatric hearing assessment.
THE BENEFITS OF ROGER TECHNOLOGY FOR CHILDREN WITH HEARING AIDS AND COCHLEAR IMPLANTS

Rich S
Phonak AG, Stafa, Switzerland

In order for meaningful education to occur, children with a hearing loss require a +15-20dB signal to noise ratio in the classroom and other noisy listening environments. Phonak first introduced the MicroLink ear level FM receiver in 1996 and has continued to provide innovative FM solutions including universal, multi-channel receivers and adaptive FM advantage for the last two decades. In 2013 Phonak introduced Roger, the new standard in digital wireless operating on the 2.4GHZ ISM bandwidth, offering the industry’s best signal to noise ratio ever. Two studies have investigated the benefits of Roger over previous generations of FM technology. The first study conducted by Dr. Linda Thibodeau at the University of Texas in Dallas looked at 11 hearing aid users and evaluated the benefits of Roger versus both traditional fixed gain FM and Dynamic (Adaptive) FM. Dr. Thibodeau found that Roger provided 54% improvement in speech recognition using HINT sentences over traditional fixed gain FM in 70dBA of noise and a more impressive 35% improvement in speech recognition with Roger over Dynamic (Adaptive)FM in 80dBA of noise. The second study conducted by Dr. Jace Wolfe from Hearts for Hearing Foundation in Oklahoma City looked at 37 cochlear implant recipients using a mix of Advanced Bionics and Cochlear CI solutions. Results showed that Roger provides significant improvement in speech recognition at higher noise levels than previous FM technologies. Roger offers greater bandwidth for better speech understanding in noise and also interference free transmission as a result of the frequency hopping behaviour of Roger microphones and Roger receivers. There is no limit to the number of Roger receivers used in a Roger network and both receivers and additional microphones can be added to a network at any time with only a single press of the connect button.

EXPERIENCE WITH THE NAÍDA CI Q70 SOUND PROCESSOR IN COCHLEAR IMPLANT USERS: PRELIMINARY OUTCOMES

Mathias N¹, Brendel M²
¹Advanced Bionics AG, Stäfa, Switzerland; ²Advanced Bionics GmbH, European Research Center, Hannover, Germany

Introduction: Advanced Bionics launched its latest ear level sound processor: the Naída CI Q70 (Naída CI). The design and improved technology of the Naída CI will lead to high benefit in Advanced Bionics users’ everyday lives. New features such as UltraZoom enhance to superior hearing performance in noisy conditions.

Methods: A pilot study conducted in ten experienced cochlear implant users showed a remarkable improvement when using UltraZoom compared to the omnidirectional microphone when speech is coming from the front and noise from surrounding loudspeakers. Ongoing studies, implemented in the clinical routine at multiple sites, were designed to confirm the previously obtained speech performance data and to investigate the practical aspects of the processor in everyday life via questionnaires in a large number of users.

Results: The pilot study showed an average of 6 dB of improvement in the SRT when using the UltraZoom feature compared to the standard omnidirectional microphone, in a test set-up with five loudspeakers delivering stationary speech-shaped noise. Three questionnaires about the ease of use of the processor have been analysed so far. Most of the aspects were rated similar or above the
neutral score (5 out of 10) by the three adult users. Subjects inclusion is ongoing. An overview of the new sound processor and the projects as well as the results will be presented.

**Conclusion:** Preliminary subjective and objective outcomes showed a positive rating for the Naída CI. To confirm these results, data from a larger group of cochlear implant users of different countries and centres will be collected in these ongoing projects.

### MY EXPERIENCE BOOK – MOVING TOWARDS LITERACY

**Kendrick A**

*Cochlear Ltd, Rehabilitation, Sydney, Australia; Alexander Graham Bell Organisation; Carabez Alliance*

Experience books are personalized stories that can be highly rewarding and exciting because the child is the main character in the story. Creating experience books is an interactive communicative process between a child and significant adult which lays the foundation for natural development of listening, speech, language and literacy.

Create experience books to:

- Tell stories. Listening leads to talking which transfers into telling stories. This prepares your child for reading and writing stories;
- Practice receptive and expressive language about experiences that are uniquely meaningful, interesting and motivating for your child.
- Review teachable moments when adults capture opportunities to feed in language and reinforce incidental listening and learning.
- Develop conversational skills when you: Establish loving and natural social bonds; Interact about everyday routines; Retell experiences beyond the here and now; Use developmentally appropriate and targeted speech and language; Answer and ask questions; Take conversational turns; and Rehearse a story.

This program is based on four video tutorials that introduce to the 5'E’s of Experience Books; Expose, Expect, Experience, Expand, Express and creatively demonstrate children and parents, working with their clinicians, using the five key elements of writing stories: setting, characters, main idea, events and conclusion, to create a story based on a personal experience. A new App – My Experience Book supports parents and their children in creating personalises stories.

### DESIGN OF NOVEL SYSTEMS TO MONITOR COCHLEAR IMPLANT PERFORMANCE

**Tani A**, **Cambiaghi M**

1 *Studio di Audiologia e Acustica Psicofisiologica, Bergamo*; 2 *M.R.S. Electronics, Bergamo, Italy*

Cochlear implants in clinical use can partially restore hearing ability, showing good results for speech discrimination and rhythm detection but poor melody and pitch perception.

Hearing aids, on the other side, can restore – depending on the severity and pattern of hearing loss – a good melody & pitch discrimination, but reach less satisfactory results in temporal cues discrimination.

Many methods have been proposed to measure the performances of these auditory devices in terms of pitch and / or timing discrimination accuracy, but in both cases the correct evaluation of the
results is not easy and, due to the lack of standardized testing strategies (every researcher works out personal standards), the outcome is often measured through hardly comparable scales. In this paper we will present the first results of a new way of evaluation of pitch and timing threshold detection, based on a simple audiometric procedure administered via a clinical audiometer implemented with a gap-test and a $\Delta\phi$-test. The results are plotted on a normal audiometric chart, similar to the ones used for example in the S.I.S.I. test, in order to obtain a graph easily interpretable and comparable at a glance.
SATURDAY, JUNE 7, 2014
SPECIAL SESSION

CHALLENGES IN HEARING HEALTH CARE FOR THE OLDEST OLDER ADULTS

CHANGING THE AUDIOLOGY DELIVERY MODEL TO MEET THE NEEDS OF THE OLDEST OLDER ADULTS

Weinstein BE

Graduate Center, CUNY, New York, NY, USA

The complexity of the aging process and the presence of multiple morbidities create unique challenges when delivering rehabilitation and restorative care services most particularly to the oldest old. Associated with multiple morbidities, hearing loss is a risk factor for social isolation, cognitive decline, depression, impaired activities of daily living and mobility decline. In light of its association with functional decline and contribution to burden of disease, audiologists must deliver accessible, sustainable, valued, and patient-centered hearing health care interventions. A technology driven service model must be replaced by one focused on the human dynamic and the important role that comprehensive hearing health care plays in healthy living, maintaining independence, quality of life and care. A personalized needs assessment that goes beyond the traditional with a focus on readiness, motivation for change, and expectations, must drive the audiology encounter. Targeted treatment options, informed decision making and an outcomes driven orientation should be at the heart of the delivery model. Primary care physicians must come to understand the value added and improved outcomes achieved when persons with multiple morbidities at risk for hearing loss and its negative consequences are screened, referred and receive the hearing health care services necessary integral to positive health outcomes. The goal of this session will be to provide an overview of sound assessment practices and targeted strategies that will address the communicative needs of the oldest old with hearing loss. Appropriate care pathways based on clinical criteria and drivers for change will be described. Strategies designed to promote functional independence and optimal quality of life will be outlined. The session will conclude with a proposal for how audiologists should position themselves to demonstrate how targeted hearing rehabilitation is an investment in maintaining social interactions so critical to functional ability and independence.

HEARING CARE FOR OLDER ADULTS BEYOND THE AUDIOLOGY CLINIC

Öberg M

Technical Audiology, Department of Clinical and Experimental Medicine, Faculty of Health Sciences, Linköping University, Department of Otorhinolaryngology in Linköping, Anaesthesics, Operations and Specialty Surgery Center, County Council of Östergötland; The Swedish Institute for Disability Research, Linnaeus Centre HEAD, Department of Behavioral Sciences and Learning, Linköping University, Linköping, Sweden

Whether or not older adults are actively seeking hearing health care, they may be unaware of the extent of their audiometric hearing loss, they may not expect to benefit from using hearing aids, they
may hold ageist self-stereotypes, and/or have low self-efficacy for managing hearing-related problems. According to the Health Belief Model, such conditions are not conducive to action-taking or positive sustained rehabilitative outcomes. In addition to more traditional clinic-based audiology rehabilitation services, a community-based health-promoting approach to increasing information and providing a more positive outlook about hearing health care options could be useful in predisposing older adults to seek help and achieve better rehabilitative outcomes. Community-based strategies to promote successful hearing health may also be crucial in reinforcing the maintenance of hearing aid use and hearing-related behavior changes after rehabilitation has been provided. A community-based approach would involve new partnerships between audiologists and other health professionals and service providers working with older adults in the community, including primary care physicians and geriatricians. Such partners could help to promote earlier identification and awareness of hearing-related problems, and reduce the stigma of hearing loss and wearing hearing aids. For older people affected by multiple physical and/or mental health issues it is even more important to determine the most appropriate rehabilitation options for each person. Decision-making and rehabilitation planning, delivery and monitoring for these cases demands increased collaboration with other health professionals, family caregivers and significant others so that participation in everyday activities and quality of life can be optimized. This presentation will discuss different approaches based on the Health Belief Model that could be augment more traditional clinic-based hearing health care for the older in short and long-term.

Cognitive Decline and Hearing Health Care for Older Adults

Pichora-Fuller MK

University of Toronto, Department of Psychology, Mississauga, Ontario, Canada

The everyday functioning of older communicators with hearing loss may affect and be affected by one or more co-occurring health conditions. Arguably, cognitive decline is the co-morbidity that looms largest in the minds of patients, audiologists, and policy makers. Conversely, hearing loss is beginning to receive greater attention by neuropsychologists, primary care physicians, geriatricians, nurses, and other health professionals whose previous focus has been on cognitive loss. Nevertheless, much more awareness about hearing problems and their solutions, as well as increased inter-professional team work, is needed to ensure the optimal communication and participation of patients in a wide range of health services that are provided to older adults with dual hearing and cognitive losses. Importantly, tests of central auditory processing and even audiometric thresholds have been shown to predict future dementia, raising the question as to whether or not earlier or better hearing health care could stave off or slow down the onset of dementia. Another question of great practical importance concerns the extent to which hearing loss and/or noisy test environments may undermine the accuracy of cognitive assessments and how alternative approaches to testing could help neuropsychologists and other health professionals to better understand the differential and combined effects of hearing loss and cognitive loss on task performance. Other pressing questions that await answers pertain to how interventions for hearing loss and/or cognitive loss must be tailored to the ongoing needs of patients with dual hearing and cognitive losses and their family caregivers. This presentation will explore how hearing health care could play a new role by contributing to prevention, assessment and intervention strategies for older adults with hearing loss who are at risk for or who are already experiencing cognitive declines.
SCREENING IN REMOTE AND RURAL AREAS

WHAT OTHER COUNTRIES CAN LEARN FROM THE PACIFIC ISLANDS OF MICRONESIA IN ESTABLISHING A NEWBORN HEARING DETECTION PROGRAM

Sablan VA

University of Guam-School of Education, Division of Foundations, Educational Research, and Human Services, UOG Station - Mangilao, GUAM

After serving as the Project Evaluator for the Pacific islands of Guam and the Federated States of Micronesia, the author will present her insights on what the global community can learn from the Pacific experience in establishing a new health initiative in a context of limited health care professionals, limited fiscal resources, and technological challenges that seemed insurmountable. The author brings to the presentation her insights after 11 years of observing first-hand the commitment and dedication needed to establish a new health initiative to islands that are separated by thousands of miles of ocean. What can the global community learn? Is the Pacific island experience similar to or different from the experience of other countries? The author presents 10 things the global community can learn from the Pacific experience, she will encourage interactive discussion with participants and review the current statistics and ongoing challenges on the islands in newborn hearing screening. Participants will have an opportunity to share experiences from their countries in making a difference for infants and young children with hearing loss.

TELE-PRACTICE: DELIVERING EARLY INTERVENTION AND AUDIOLOGY SERVICES TO FAMILIES IN RURAL AND REMOTE AREAS

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Hear and Say, Brisbane, Australia

Advances in technology are changing the way health and educational practitioners are able to provide quality services to children with hearing loss. In order to benefit from the early diagnosis of hearing loss, professionals need to seek innovative ways of providing effective Audiology and Auditory-Verbal Therapy for all children, regardless of geographical location. Tele-Practice is providing professionals with exciting and rewarding opportunities to disseminate their services to all clients, wherever they may be throughout the world. It is changing the face of how professionals at Hear and Say interact with children with hearing loss and their families. This presentation will describe two aspects of the Hear and Say eMPOWER model of Tele-Practice: early intervention using Auditory-Verbal Therapy (eAVT) and remote MAPping (programming) of cochlear implants using videoconferencing (eAudiology). Video footage will be used to demonstrate these two programs.

Research outcomes will be tabled from

- A validation study of the eAudiology program, conducted with 40 children
- A survey of parent and professional satisfaction with the eAVT program
- A pilot study, showing the feasibility of the eAVT program, comparing a group of seven children in the eAVT program matched with seven children in the face-to-face program. This is the first comparison study of its kind world-wide.
THE MANY ROLES OF TELEPRACTICE IN EHDI: THE TIME IS NOW


Vanderbilt Bill Wilkerson Center. Vanderbilt University School of Medicine, Nashville, USA

In the United States, almost half of babies who do not pass their newborn hearing screenings are subsequently lost to follow up and do not receive (or are not documented as having received) further audiological testing. One possible barrier to the receipt of follow-up testing is the distance that some families must travel to receive such services. Furthermore, even when diagnosed with hearing loss, it is often a burden for families to travel long distances to receive audiological, educational, and speech and language intervention. Telepractice promises to play an important role in overcoming these distance barriers and provide families access to quality early hearing detection and intervention (EHDI) services. The Vanderbilt Bill Wilkerson Center is currently engaged in telepractice in the areas of remote newborn hearing screening, cochlear implant integrity testing, hearing aid support, early intervention, and support/coaching to educators around the globe.

The purpose of this session will be to present an overview of our center’s telepractice efforts and describe the steps involved in developing the infrastructure and partnerships required for success.

Logistical considerations and practical strategies employed to overcome obstacles will be discussed as well as the importance of ensuring the integration of family-centered practices. This presentation will feature data collected from each of the programs, methods that have been used to deploy the different programs, videos depicting telepractice sessions, and resources developed for patient education. A summary focused on real-world challenges, such as internet connectivity in remote areas, security and privacy regulations will conclude the session.

PILOT STUDY TO EVALUATE CHILDREN WITH HEARING AIDS THROUGH PEACH AND TEACH IN A RURAL COMMUNITY

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Rehabilitation of children with hearing loss in a rural community is a difficult problem with limited resources and late detection due to various traditional beliefs. In addition there are no standard questionnaires to assess the appropriateness of hearing aids and monitor the progress in communication. Sixty (60) children, age ranging from 6 months to 15 years with moderately severe to profound hearing loss, were evaluated .A detailed medical history was taken to rule out conditions causing acquired deafness and excluded from the study. An initial session of counselling was given to the parents/caregivers and teachers of the children in administering the PEACH and TEACH questionnaires. The booklet form of the questionnaire was translated in to Tamil and as many examples of the reported behavior were asked to be recorded.

Initial assessment of communication skills of the children were assessed by administration of questionnaires. Hearing aid fitting was done by the audiologist. A total communication model of education and rehabilitation was followed .The children were followed up at six months interval for 2 years by an aided audiogram and improvement in communication was assessed. Children were classified based on age and degree of hearing loss.

The relationship between PEACH and TEACH with age of amplification and type of hearing loss was calculated using SPSS and Chi-square tests.
It was found that PEACH and TEACH questionnaires can be easily administered in the rural community and give a quantitative measure of the effect of amplification. They also gave the caregivers motivation to take an active part in the rehabilitation. However because of the late age of rehabilitation, children with profound hearing loss showed minimal improvement in communication. This model of using functional evaluation tools to evaluate the suitability and effectiveness of amplification can be applied in children in developing countries.
EVOKEO POTENTIALS

ABR PEER REVIEW: BENEFITS AND MODELS FOR BEST PRACTICE

Lightfoot G\textsuperscript{1,2}, Sutton G\textsuperscript{2}, Ferm I\textsuperscript{3}

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The peer review (PR) of ABR tests on newborns is an important component of quality assurance and its positive effect has already been demonstrated. However, arrangements for PR can range from a cosy chat with colleagues every 6 months to the external review of systematically selected cases within a few days of testing, performed by trained and accredited reviewers, with an annual audit of the process. We have good evidence that the latter robust type of PR does markedly and significantly improve quality of testing, interpretation and helps the tester to choose a more efficient test strategy.

A number of models for PR have been implemented in England and guidelines for PR have now been produced.

In England PR is an essential component of the service specification being considered when diagnostic ABR services for newborns are commissioned.

This presentation will outline the benefits, hazards and practical arrangements for different models of PR of ABR tests on newborns and will conclude with recommendations for future adoption.

CLINICAL FEASIBILITY OF RECORDING SOUND FIELD OBLIGATORY CORTICAL AUDITORY EVOKED POTENTIALS IN INFANTS: FINDINGS FROM THE FIRST 55 INFANTS

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There is growing interest in using supra-threshold obligatory cortical auditory evoked potentials (CAEPs) to complement established paediatric clinical test procedures. As part of an on-going study investigating the clinical usefulness of aided CAEPs in infants, we have been obtaining data on feasibility and acceptability of the procedure within the clinical setting. Responses to short duration stimuli (/m/, /g/ and /t/), will be recorded in 100 normal-hearing and 10 hearing-impaired infants (between 4 and 39 weeks of age) from a loudspeaker at zero degree azimuth and a presentation level of 65 dB SPL. At the time of writing, we have the following data from the first 55 infants who passed new-born screening and have no reported hearing difficulties: completion rates, test duration and presence/absence of a response. The mean test duration was 27 minutes (range 17-89 min). A response was obtained to at least one stimuli in 100% of infants. Responses to /g/, /t/ and /m/ were detected in 96%, 88% and 80% of infants, respectively. The short test duration, and high completion and detection rates suggest that it may be feasible to record sound field CAEPs in infants within the clinical setting.
THRESHOLD CHANGES OF ABR RESULTS IN TODDLERS AND CHILDREN BY THE COURSE OF TIME

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Auditory brainstem responses ABR is a clinical established method to measure the hearing threshold in newborns and infants. For many years exists the nationwide obligation to perform this examination on every newborn with abnormal hearing screening.

The aim of this study is to analyze the changes of the auditory threshold after the first examination. For this retrospective study 1115 ABR measurements from the years 2012 to 2013 were analyzed. 156 newborns and infants, aged between 0 and 12 years (mean 14 months), obtained more than one examination. The auditory threshold was identified using click and/or NB-chirp-stimuli in in natural sleep or in general anesthesia. It was evaluated how frequently a difference of more than 10dB and more than 20dB, respectively, appeared at the second measurement.

In 29 children a unilateral improvement of the auditory threshold of more than 10dB was found; in ten of those children more than 20dB improvement was found. In 27 infants occurred a bilateral improvement of more than 10dB. That represents an improvement of the hearing in 36% of the examined children. Thus is confirmed that an improvement of the auditory threshold is possible and that it can occur in 36%. Therefore multiple measurements in newborns, in particular in at-risk children, continue to be very important.
In addition to communicative disorders, children with Auditory Processing Disorders (APD) often exhibit multifactorial issues including visual perceptual problems, motor disturbances, and attention deficits. New information may help explain some of these apparent comorbidities. Neuroscience research has shown that there are two auditory pathways that are active in children, the classical pathways and the phylogenetically older, non-classical pathways (Moller and Rollins, 2002). APD intervention, however, has only focused on addressing the classical auditory pathways, which respond specifically to sound stimuli. The non-classical auditory pathways receive multisensory inputs and are often overlooked in terms of diagnosis and treatment. This raises the question as to whether or not children with APD who show deficits in both classical and non-classical auditory pathways would fare better by addressing both pathways as opposed to only remediating the classical pathways. Seldom discussed and often overlooked, the non-classical auditory pathways are now gaining some recognition by researchers. While classical auditory pathways are frequency specific and finely tuned, the non-classical auditory pathways receive inputs from auditory and somatosensory receptors and are less finely tuned. The author discusses these often overlooked pathways and the potential contributions they play in auditory processing, particularly in our emotional reactions to sound. Identification of deficits in the non-classical pathways may be evidenced by retained primary (primitive) reflexes, which can be observed in infancy and may lead to earlier intervention for children at risk for higher order learning difficulties such as APD. Proposed methods of evaluating and remediating non-classical pathways using the Masgutova Method (MNRI) will also be discussed.

AUDITORY HYPERSENSITIVITY AMONG INDIVIDUALS WITH SENSORY PROCESSING DISORDER

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Aim: To study auditory hypersensitivity among individuals with Sensory Processing Disorder (SPD), using behavioral and objective neurophysiological assessments both from the receptor level and the cortex.

Background: Fifteen percent of the population manifests SPD which may result in extreme behavioral responses to non-noxious sensory stimuli. Most studies revealed the subjective traits of hypersensitivity, but only a few validated that SPD has distinct physiological manifestations. However, these studies did not follow responses from the auditory periphery up to the cortex.
Method: Thirty four right-handed adults with bilateral normal hearing, between 250 and 8000 Hz, were divided to either the control (17 subjects) or the study (SPD) group (17 subjects) according to their scores in the Adolescent/Adults Sensory Profile. Sensory hypersensitivity was assessed along the auditory pathway by measuring Transient-Evoked Ootoacoustic Emissions (TEOAEs), Auditory Steady-State Responses (ASSR) and cortical Event Related Potentials (ERP).

Results: A consistent trend of hyper-excitability to auditory stimuli was found among individuals with SPD, compared to the controls. Significantly higher levels of TEOAEs, consistently larger ASSR responses and larger ERP responses were found. This suggests an abnormal loudness and temporal processing of threshold and suprathreshold stimuli.

Conclusions: SPD is manifested in objective physiological responses along the auditory pathway. Physiological measures may be used to improve assessment and intervention programs to enhance performance and quality of life for people with SPD.

PROCESSING CONSEQUENCES OF UNILATERAL DEAFNESS-IMPLICATIONS FOR SCREENING
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To add to the understanding of the consequences of unilateral deafness, this investigation asked whether early-onset, unilateral deafness and the side of deafness influence natural hemispheric laterality of auditory system cortical activity.

Methods: subjects were 22 right handed, young adults with normal hearing in both ears (controls) and 12 unilaterally-deaf experimental subjects. Cortical Evoked Potentials were used to record Acoustic change complexes from 64 channels using NeuroScan SynAmps2 amplifiers and NeuroScan Electrode Caps. Stimulus change conditions included frequency (50% upward change) level (+ 10 dB change) and silent gap (20 ms). Tones of 500 and 4000 Hz were employed for all tasks and broad-band noise was used for gap and level tasks. Analysis of onset and change responses included latency and amplitude measures for N100.

Results-Controls: Tonal stimuli when presented to the left ear reveal larger responses from contra-lateral (right side) electrodes while tones to the right ear consistently shows a symmetrical response. The overall effect is for a predominant right hemisphere response for tonal stimuli. When noise is used both ears demonstrate a larger contra-lateral response. Unilateral- For tonal stimuli the contra-lateral response was greater for both left and right ears but for noise stimuli the response is greater from the right side electrodes regardless of ear. Thus, tonal processing of Left Ear Only subjects is similar to controls and shows enhanced Right Hemisphere activation but Right Ear Only subjects demonstrate a Left Hemisphere activation to tones (as opposed to a symmetric response seen in controls).

Discussion: Based on hemispheric specialization of processing, children with hearing only in the right ear may be disadvantaged for processing of tonal stimuli.
TEMPORAL PATTERNING SKILLS: COMPARISON BETWEEN TONAL AND NON-TONAL LANGUAGE SPEAKERS IN SOUTH AFRICA

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Background: Auditory temporal processing may be defined as the sensory encoding of aspects such as duration, interval, and order of different stimulus features, providing vital information to the nervous system in the perception of speech. Temporal patterning is an auditory temporal processing skill that relates to the capacity to process two or more auditory stimuli in order of their occurrence in time. These skills are crucial to the most basic processing of the timing elements of sound at the neuronal levels to complex higher level processing speech perception and spoken language processing.

The procedures known as frequency patterning and duration patterning are psychoacoustic methods of measuring temporal patterning. The Duration Pattern Test (DPT) and the Frequency Pattern Test (FPT) have proven to be sensitive, specific and efficient for the identification of dysfunction with regard to temporal patterning deficits.

Aims: The aim of this study was to determine and compare the auditory temporal patterning skills of tonal and non-tonal languages speakers in South Africa. Findings were also compared in terms of method of response and gender.

Methods: A quantitative, descriptive and comparative design was used. 60 participants (aged 18-30) received an audiological evaluation to rule out hearing loss and an auditory processing disorder. The DPT (humming and labeling test conditions) and FPT (humming and labeling test conditions) were conducted on all the participants. Results were analyzed using ANOVA to examine between-and within-group differences.

Results: Results indicated a significant statistical difference between the labeling and humming methods of response, as well as between tonal and non-tonal language speakers. No significant differences were obtained between the genders.

Conclusion: It can be concluded that language and method of response influence temporal patterning skills. The development of updated normative values for the South African context, where eleven official languages are spoken, is recommended.

EFFECTS OF 24 H SLEEP DEPRIVATION ON TEMPORAL RESOLUTION

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Background: Sleep deprivation is common in contemporary society and is considered to have an effect on performance by causing decreased arousal and slower cognitive processing. Research indicates that sleep deprivation impacts the functions associated with an intact prefrontal cortex, the same area which is apparently involved in temporal resolution.

Temporal resolution is an auditory temporal processing skill that relates to the capacity to observe rapid changes in an acoustic signal and as such facilitates the distinction between the voice-onset times (VOT) of speech sounds.

The procedure known as gap detection is a psychoacoustic method of measuring temporal resolution. The Gaps-in-Noise (GIN) test has provided a new diagnostic tool for the detection of temporal resolution deficits.
Aims: The aim of this study was to determine the gap detection thresholds of young South African adults after 24 hours of sleep deprivation and to compare the findings with regard to ear tested and gender.

Methods: A quantitative, descriptive and comparative design was used. 40 participants (aged 18-30) received an audiological evaluation to rule out hearing loss and an auditory processing disorder. The first GIN test was performed in a normal (no sleep deprivation) control condition. The second GIN test was conducted after 24 hours of sleep deprivation. The approximate GIN threshold (the shortest gap duration for which at least four of six gaps were correctly identified) served as the dependent variable. Results were analyzed using ANOVA to examine between- and within-group differences.

Results: Preliminary results indicate that the mean gap detection threshold is elevated after 24 hours of sleep deprivation. Within group analysis yields no statistically differences between ears and gender. These results still have to be verified with completion of all the data collection.

Conclusion: Preliminary results suggest that sleep deprivation affects temporal resolution and may thus influence language and speech perception.

AUDITORY PERCEPTION EVOLUTION IN A GROUP OF PEDIATRIC CI RECIPIENTS

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Objectives: the objective of this study is to analyse the development of auditory perception on a representative sample of 28 patients with a Cochlear Implant at the Bambino Gesù Hospital in Rome. The purpose is to evaluate the perception steps during the first year from the application and to identify a real improvement, i.d. when parameters in verbal perception change considerably. The examination concerns only auditory perception without considering other variables.

Methods: the sample consists of 28 patients, 16 females and 12 males. The age at the time of the cochlear implantation fluctuates between 1 year and 1 month to 8.9 years with a weighted average of 19 months. The intervention is unilateral in 72% of the cases, sequential bilateral in 14% and simultaneous bilateral in the remaining 14%. The speech therapist carried out the estimation by means of questionnaires IT-MAIS, LIP, CAP and Six Sounds Test, in a quiet room, in a conversational mode voice. For each patient we collected data every six months: before the activation of device, after six months and after one year. We consider a significant step when children reach the following results: IT-MAS minimum score 22-25/40, CAP: 4/7, Six Sound Test: 6/6, LIP: 12-16/40.

Results: the study leads to the following considerations: 32% of the patients had a significant improvement after 6 months from the activation of the CI, 46% after one year and the remaining 21% did not reach any considerable result. We analysed these three groups in order to find common features such as the diagnosis age, parental involvement, social problems and the beginning of rehabilitation.

Conclusions: the study let us conclude that patients with the best results are those who follow the best procedure of rehabilitation (early diagnosis, good parental involvement, limited social problems and early rehabilitation intervention). Therefore our representative sample reflects the results on cochlear implants as described in literature.
References


HEARING AID FITTING

ON THE USE OF AUDITORY SPECTRAL REPRESENTATIONS FOR THE COMPARISON OF HEARING COMPENSATION TECHNIQUES

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An objective method to give a reliable prediction of which compensation strategy should behave better for a given hearing loss is proposed. This method is based on the estimation of the Auditory Spectral Representations (ASRs) and the goal is to assess which compensation strategy produces ASR very similar to that generated in a normal hearing subject. ASRs are the representations of a speech waveform in the cochlea, after auditory periphery processing. The assumption underlying the current analysis is that the closer the ‘distance’ between ASRs obtained in a normal and an impaired listener after compensation, the more likely to achieve a better speech perception in the impaired listener. The ‘distance’ between the ASR of a normal and an impaired listener is evaluated for sloping sensorineural hearing loss of different degrees (mild, moderate, and severe) and two compensation strategies (NAL-R and FIG6).

As a general remark, it was clear that the distance between the ASR of the normal the impaired condition increased with hearing loss for both strategies. This would suggest that, as the degree of hearing loss increases, the compensated speech perception progressively deteriorates for both strategies. More interestingly, simulations showed that, for a given hearing loss degree, the two strategies produced different results: FIG6 generated ASR much more similar to the reference than NAL-R for all hearing loss profiles but the severe one. For this latter profile, NAL-R, generated ASR much more similar to the reference than FIG6. This seems to indicate that the use of a nonlinear strategy, such as FIG6, in severe hearing loss might generate more distortions than NAL-R.

AIDED SPEECH IN NOISE TESTING AS A PRE-FITTING MEASURE

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Difficulty understanding speech in noise is a common complaint of individuals with hearing loss, both when unaided and aided. Research has shown that an individual’s ability to understand speech in noise cannot be reliably predicted from routine audiometric data and that substantial variation exists in this population. Despite this variation and contrary to best practice guidelines, few audiologists routinely measure speech understanding in noise as part of the routine audiologic and/or hearing aid evaluation.

In this presentation, aided QuickSin scores obtained in a clinical environment from 40 adult patients with varying degree of sensorineural hearing loss will be presented. The measures were obtained as a pre-fitting measure in which the impact of audibility on the score was reduced in an effort to better measure true suprathreshold deficit. The mean score showed a 5.3 dB SNR deficit after the provision of amplification, however there was substantial variation in the data. Approximately 45% demonstrated a normal score, 29% a mild SNR deficit, 21% a moderate SNR deficit and only 5% demonstrate a severe SNR deficit. These results show significantly better performance in noise...
versus other studies using a similar population when testing was conducted unaided with a high presentation level.

There were significant correlations among the QuickSin scores and other patient variables (age, degree of loss, word recognition in quiet). The best predictors accounted for approximately 40% of the variation, however there still remains a large amount of unexplained variation consistent with the need to measure speech in noise ability on each patient.

Individual speech in noise measures can be used to help establish realistic expectations early in the fitting process. The results also have implications for the selection of appropriate hearing aid and/or assistive technology. Several case examples will be reviewed.

EFFICACY OF SELF-ADMINISTERED IN-SITU AUDIOMETRY – IMPLICATIONS FOR SELF-FITTING HEARING AIDS

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A self-fitting hearing aid is a device that can be managed entirely by the user without assistance from a hearing health professional or access to a computer. Such a device has the potential to help millions of people living in developing countries whose hearing loss currently goes untreated. A fundamental requirement of a successful outcome with a self-fitting hearing aid is the initiation and management of self-directed in situ audiometry by a layperson that results in reliable and valid threshold data. This talk presents data on 40 older adults who followed a set of written, illustrated instructions to complete self-directed in situ audiometry using a behind-the-ear hearing aid and a remote control to respond to stimuli, either on their own or with the assistance of an attendant partner or friend. The self-directed in situ threshold measurements were repeated on one ear, and thresholds were also obtained using conventional manual audiometry to study reliability and validity of the results. Individual measurements of locus of control, hearing aid self-efficacy, cognitive performance, health literacy, manual dexterity, age, gender, previous hearing aid experience, level of education, and occupation were obtained and used to predict a successful outcome. Of the 40 participants, 53% followed the instructions accurately. This population was characterised by an internal locus of control, higher level of cognition, and lower level of education. Inaccurate performances were related to insufficient device insertion (9), incorrect use of the remote control (5), and a lack of understanding of the overall task (5). Not all inaccuracies prevented a successful outcome; similarly, incomplete audiograms were obtained for some participants who completed the task accurately. Completed threshold data showed acceptable test-retest reliability and validity. The data and their implications for the effectiveness of self-fitting hearing aids will be discussed.

PILOT VALIDITY OF OTICON’S EASYRECD MEASUREMENT PROCEDURE

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This presentation will provide a demonstration of how to make an RECD measurement using a clinically available hearing aid. We will present results of a pilot validity study.

A clinical measurement of a child’s real-ear-to-coupler difference (RECD) values across frequencies is considered best practice. Challenges exist when making the RECD measurement because it is
somewhat dependent on several variables. Factors affecting the RECD measurement include: calibration procedure(s); differing earmold tubing lengths relative to the tubing length of the RECD measurement transducer; the earhook used during the RECD measurement procedure may differ in impedance from that used during everyday use; and robust connections of all components is a requirement if the hearing aid will be used for the RECD measurement. Recently, Oticon A/S has developed an RECD measurement method using a hearing aid as the signal delivery and measurement system called the EasyRECD. The EasyRECD measurement can be made using the hearing aid and the same software used to program the hearing aid in clinic. This pilot project was undertaken to investigate if the EasyRECD measurement could be used to accurately predict real-ear hearing aid performance for a group of school-aged children who wear hearing aids.

EasyRECD measurement values were obtained for one ear of each subject (n=9; 4 to 14 years of age) and used, along with 2cc coupler measurements of hearing aid performance, to predict real-ear hearing aid performance (REAR and RESR). These predictions were compared with frequency-specific measures of real-ear performance conducted for each subject.

Results of this study indicate that predictions of REAR and RESR derived using an acoustic transform measured with the EasyRECD were similar to the probe-microphone measurements across frequencies for these children. These findings support consideration of the use of the EasyRECD measurement in clinical practice.
IMPROVEMENTS IN IMPLANTABLE DEVICES

ELECTRIC-ACOUSTIC STIMULATION: FOR WHOM, IN WHICH EAR, AND HOW?

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This presentation draws on research conducted at the National Acoustic Laboratories and the HEARing Co-operative Research Centre to address three clinical questions: 1) should a hearing aid be used with a cochlear implant in opposite ears? 2) if a patient uses a cochlear implant and a hearing aid in opposite ears, should residual hearing in the implanted ear be aided? And 3) if electric-acoustic stimulation is provided in the same ear and a hearing aid is worn in the opposite ear, how should these devices be fitted to optimise benefits?

TECHNICAL DESIGN OF A NEW BONE CONDUCTION IMPLANT (BCI) SYSTEM

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Objective: Technical design aspects of a new Bone Conduction Implant (BCI) system that has been developed for long-term use in patients will be described.

Design: The BCI consists of an external audio processor (AP) and an implanted unit called the Bridging Bone Conductor (BBC). The BBC is a passive implant and uses an inductive link to communicate with the AP. In a BCI the skin is intact in contrary to a percutaneous Bone-Anchored Hearing Aid (BAHA).

Study Sample: In this study, evaluation of the full BCI system has been performed on a Skull simulator, cadaver heads, and on real patients. So far, six patients have been operated and received the BCI. In addition, a nasal sound pressure measurement was used as an intraoperative method to verify the implant.

Results: It was found that the output force of the BCI is robust for skin thickness range of 2-8 mm and total harmonic distortion is generally low in the speech frequency range. The current consumption is low and corresponds to 5-7 days use with a single battery.

Conclusions: The performance and verification tests show that the BCI has sufficient output for hearing rehabilitation of indicated patients. The next important step of the BCI project is to apply for CE mark based on the information from the clinical study.
THE NEW BONE CONDUCTION IMPLANT (BCI) – OVERVIEW AND CLINICAL RESULTS

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Background: A bone conduction device called Bone Conduction Implant (BCI) has been developed by researcher groups in Gothenburg, Sweden. It has been approved for a clinical study and has so far been implanted in six patients with conductive or mixed hearing loss. The BCI consists of an external audio processor and an implanted unit called Bridging Bone Conductor. The skin is intact and the audio processor is attached with magnets. The implanted unit contains a retention magnet, a signal demodulator unit and a transducer transmitting vibrations directly to the bone. The transducer is attached via a flat surface contact close to the bony ear canal opening in the temporal bone. The external audio processor uses advanced signal processing and the signals are transmitted to the implanted unit via an inductive link.

Objectives: The objectives are that the surgical procedure should be safe and simple, that the BCI should give a significant rehabilitation effect (similar or better than a bone conduction device on headband), and finally that the BCI performance should be stable over time.

Methods: Six patients have got the BCI so far and they have been followed 3 - 12 months with tone and speech audiometry, cone beam CT and nasal sound pressure. The BCI audiometric performance has been compared to a Ponto Pro Power (Oticon Medical) on a headband.

Results: The surgical procedure has been found easy and safe for the patient. The BCI offers a significant audiometric improvement over unaided condition and is also superior or similar to the reference device. The transmission properties of the implanted unit were also found to be stable over time.

Conclusion: The BCI offers a competitive rehabilitation for patients with conductive or mixed hearing losses. The next goal is to obtain a CE mark for commercial introduction.

VARIABILITY OF HUMAN COCHLEA: IMPLICATIONS FOR HEARING PRESERVATION

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Detailed knowledge of the extensive variability in human cochlear anatomy is important for cochlear implantation surgery. Eminently for the preservation of residual hearing an atraumatic implantation procedure includes a cautious insertion technique and the proper selection of an individually selected optimal electrode array.

107 corrosion casts of human labyrinths were digitalized by microscopic high dynamic range photography in reproducibly precisely defined views consistent with the consensus cochlea coordinate system. Relevant distances, angles and areas were measured and statistically evaluated.

The mean length of the outer cochlear wall was 40,9 mm (range 35,7 – 46,2 mm) coiling to a mean total of 969° (range 875 – 1080°). The first / second / third turn represented in mean 55 / 30 / 16% of the absolute cochlear length. Mean cochlear diameter (A) was 9,2 mm, perpendicular diameter (B) was 6,8 mm. A tangent to the modiolar wall originating from the round window touched the outer
cochlear wall after mean 8.2 mm (range 6.9 – 9.4 mm). The cochlear duct gradient showed a rapid slope (15° or 33%) at the transition from the basal to the second turn.

Typical trauma patterns are shown and related to anatomical characteristics. The extensive variability seen in human cochlear anatomy must be considered in the design of electrode arrays. An individual selection of an optimal electrode design based on preoperative assessment of cochlear dimensions could reduce insertion trauma and improve hearing preservation.
AUDITORY NEUROPATHY SPECTRUM DISORDER

AUDIOLOGICAL MANAGEMENT OF CHILDREN WITH AUDITORY NEUROPATHY SPECTRUM DISORDER

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Background: With the advent of newborn hearing screening, ANSD can be detected even in the youngest pediatric patients. ANSD has been reported in up to 10% of all children with hearing loss. It is widely accepted that clinical procedures for children with ANSD are not as effective as for children with sensorineural hearing loss. An important limitation in managing children with ANSD is that behavioral pure-tone audiograms are less predictive of a child’s intervention needs with respect to amplification and early rehabilitation.

The objective of this study was to characterize the clinical profiles and audiological management of children with ANSD followed through a provincial UNHS program in one region of Canada from 2003-2013. Communication outcomes were also examined.

Methods: Population-based data were collected at the Children’s Hospital of Eastern Ontario (CHEO), Ottawa, Canada between 2003 and 2013 for all children who were diagnosed with ANSD. Detailed characteristics were extracted including screening status, etiology, risk factors and severity of hearing loss. Diagnostic, amplification, and intervention outcomes were also documented.

Results: Analyses to date of 251 children indicate that 5% of children were identified with ANSD. Children were identified at a median age of 8.7 months and were fit with amplification at a median age of 14.9 months. Seven children had profound hearing loss at initial diagnosis. Audiologic management and communication outcomes of children with ANSD will be presented.

Conclusion: Children with ANSD represent a heterogeneous group and comprehensive evaluation and management are required to ensure early appropriate intervention.

IMAGING INFANTS WITH UNILATERAL ANSD (AUDITORY NEUROPATHY SPECTRUM DISORDER)

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Methods: From December 2005 until September 2013, 18 consecutive infants presenting to the Baby Hearing clinic at John Hunter Children’s Hospital, NSW, Australia, were investigated for unilateral auditory neuropathy spectrum disorder (ANSD).

Results: After three infants with a normal CT were shown to have unilateral cochlear nerve aplasia on an MRI, we changed our choice of radiological investigation. Initially we solely performed a CT
then we added an MRI and now we only do an MRI (allowing for logistics such as the distance travelled to see us which can be over 500km).

Six (33%) infants had an ipsilateral absent cochlear nerve. Three of these had had a preceding normal CT. A further infant had an ipsilateral hypoplastic cochlear nerve (the CT showed bilateral cochlear stenosis) and another had a congenital vascular loop abutting the cochlear nerve. Of the other eight infants, one had an ipsilateral Mondini type deformity, one had congenital CMV (both the CT and MRI were normal), two had a CT suggestive of probable absence of the cochlear nerve (one only had an MRI which was normal), five had a normal MRI (of whom three had had a normal CT) whilst the other had a normal CT.

**Conclusion:** On the basis of these results we argue that MRI is the radiological investigation of choice for unilateral ANSD. Of the six infants with cochlear nerve aplasia, half (three) had a normal CT. Eleven (62%) had an abnormal radiological finding.
PARENTS' PERSPECTIVE

QUALITY OF LIFE OF PARENTS AND SIBLINGS OF CHILDREN WITH COCHLEAR IMPLANTS

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The objective of this study was to assess the quality of life (QoL) of parents and siblings of children with cochlear implants. A total of 79 parents and 23 siblings from 44 families participated in this study. The questionnaire used was adapted from the Beach Center Family Quality of Life Scale and The Parent Questionnaire, Children with Cochlear Implants: Parental Perspectives focusing on three domains: Interaction, Emotional Well-Being and Support for Children with Cochlear Implants. Subjects were also asked to rate the overall family QoL and gave suggestions on the support needed to enhance their families’ QoL. In general, subjects gave high mean scores for the overall family QoL (Mean=4.44±0.57 for parents and 4.30±0.47 for siblings). There were significant associations between the overall QoL of parents with each of the three domains (p<0.01) while for siblings, the emotional wellbeing's domain was not significant (p>0.05). Multiple linear regression analysis showed significant effects of interaction and support for the child on the QoL of parents (p<0.05). These factors were however not significant for the QoL of siblings (p>0.05). Assessing the effects of duration of implant experience, family socioeconomic status and parents’ education on the tested domains, the results suggest that the duration of implant experience was the most significant factor (p<0.01). Parents with higher education and socio-economic status showed higher means on the emotional well-being as compared to other domains. In total, 50% of subjects recommended that teachers know about cochlear implant and the children’s needs in classrooms, 41.7% subjects requested for financial support for maintenance of the implant system, while 40% and 30% advocated for more regular follow-ups with the speech therapists and audiologists, respectively. The findings suggest that cochlear implant has improved the QoL of families and highlight the support needed by families for their implanted children or siblings.

THE NEEDS OF FAMILIES BENEFITING FROM AN AVT PROGRAM, USING THE “FAMILY NEEDS SURVEY” ADAPTED VERSION

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Introduction: The Auditory-Verbal Therapy (AVT) is a parental training program for Deaf and Hard of Hearing (D/HH) children, whose fundamental principles are the early diagnosis and intervention, auditory access using a state-of-the art hearing technology and training and guidance the parents to help their child to develop listen and spoken language. To provide a better service according to AVT Principles, professionals need to have deep knowledge of the needs of each family. To make this explicit knowledge of even, the adapted version of the "Family Needs Survey" (FNS), for families of D/HH children, has been widely used for this purpose.
Objective: This study aims to describe the view of parents of Deaf and Hard of Hearing (D/HH) children, their needs of support and expectations included in an intervention based on AVT Principles, in the Hearing Implants Unit (HIU) in the CUF Porto Hospital.

Materials and Methods: 8 families of children with Cochlear Implants followed in the HIU were interviewed. The adapted English version of the FNS for D/HH children version was translated into Portuguese and back-translated by two bilingual professionals and specialists in this field.

Results: All families highlighted the need for greater knowledge about the topics asked in the survey. Results indicate specific needs of each of the families interviewed, in each of the domains covered in the survey.

Conclusions: The adapted version of the FNS proved to be a valid tool for obtaining knowledge about the specific needs of families of D/HH children followed. This instrument could contribute to a greater capacity for reflection and readjustment of professionals, in order to enhance the guidance and training of parents in accordance with the AVT Principles.

WHY PARENTS REFUSE NEWBORN HEARING SCREENING AND DEFAULT ON FOLLOW-UP RESCREENING – A SOUTH AFRICAN PERSPECTIVE

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Objectives: This study describes screen refusal and follow-up default characteristics together with caregiver reasons for screen refusal and follow-up default in two South African universal newborn hearing screening programs.

Methods: A retrospective record review of universal newborn hearing screening conducted at two hospitals (Hospital A n = 954 infants; Hospital B n = 2135) over a 31 to 33 month period. Otoacoustic emission screening was conducted with rescreen recommended within six weeks for a uni- or bilateral refer. Program efficacy was described according to coverage, referral and follow-up rates. A prospective telephonic interview with caregivers who declined the initial screen (n = 25) and who defaulted on follow-up (n =25) constituted the next study component. Caregivers were randomly selected from the screening programs for a survey related to reasons for newborn hearing screening refusal and follow-up default.

Results: Screening coverage (89.3% Hospital A; 57.4% Hospital B), initial referral rates (11.6% Hospital A; 21.2% Hospital B) and follow-up return rates (56.1% Hospital A; 35.8% Hospital B) differed significantly between hospitals. The most frequent reasons for screen refusal were related to costs (72%), caregiver knowledge of newborn hearing screening (64%) and health care professional knowledge and team collaboration (16%). Reasons for follow-up default were most commonly related to caregiver knowledge of newborn hearing screening (32%) and costs (28%). Only half of caregivers (48%) who defaulted on follow-up reported being aware of initial screen results while 60% reported being aware of the recommended follow-up rescreen.

Conclusion: Caregivers most commonly refused screening due to associated costs and mostly defaulted on follow-up due to an apparent lack of knowledge regarding initial screen outcome and recommendations made for follow-up. Including NHS as a mandated birthing service is essential if coverage is to be increased, while reducing follow-up defaults requires proactive reminders and improved communication with caregivers.
PARENTS VIEWS ON THE ACCEPTABILITY OF RECORDING INFANT OBLIGATORY CORTICAL AUDITORY EVOKED POTENTIALS IN THE SOUND FIELD: THE ONLY PROBLEM WAS KEEPING HIM QUIET WITH ALL THE FUN HE WAS HAVING

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There is growing interest in using supra-threshold obligatory cortical auditory evoked potentials (CAEPs) to complement established paediatric clinical test procedures. As part of an on-going study investigating the clinical usefulness of aided CAEPs in infants, we explored the acceptability in a clinical setting.

Parents were asked to fill in a parental acceptability questionnaire (9 questions with 7-point scale, 1 being best). So far 29 parents have responded and the mean scores on the parent questionnaire range from 1.14-2.62. The highest score was for the difficulty of keeping the baby awake and quiet during the hearing test.

Additionally, constructivist epistemology was adopted in an exploratory qualitative study where parents were invited to narrate their own story. We were focusing on how they constructed and framed their experiences of having their young infant tested with cortical auditory evoked potentials; what evaluations they made of these experiences and what advice or suggestions they would give for the improvement of this process for others.
EMPOWERING PARENTS (PART I)

TRANSITION INTO PRIMARY SCHOOL (TIPS) PROJECT
Moores-Chadwick J, Galloway J

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This presentation will explore the implementation of a recently launched program by the Victorian Deaf Education institute. This program is called Transition Into Primary School for children who are deaf and hard of hearing. The presentation will identify and analyse initial findings of the observed benefits of a pilot program which implemented a transition program for deaf or hard of hearing children entering primary school in 2012 - 2013. Discussion will include some of the challenges families, schools, teachers and students face during this time of school transition and the perceived benefits from implementing the transition to primary school program.

This program has been specifically developed to support and empower families with a child who is deaf or hard of hearing. The recent implementation of the transition to primary school program has offered families an innovative and supportive service. The program can be modified to suit the family’s requirements whilst still following school transition guidelines. The transition to primary school program has enabled many families and their children who are deaf or hard of hearing to experience a positive transition to school.

The presentation will include research material supporting the original scope of the project, timelines, the pilot program and its subsequent evaluation, as well as specifically developed resources which are aimed at encouraging families to become strong advocates for their deaf or hard of hearing child. These resources include hand outs that can be used by families, schools, early intervention services and teachers of the deaf. A children's story book and an application for electronic devices, which have been developed around a central character who wears hearing aids called blue bear will also be presented.

SUPPORTING PARENT EMPOWERMENT THROUGH EARLY EDUCATION
McNally A, Muhs J

John Tracy Clinic, Los Angeles, CA, USA

The international services of John Tracy clinic build parent empowerment through a specially designed education program for families of children with hearing loss ages birth to five years. This oral presentation will review results of parents' post program evaluations identifying the significant changes they saw in themselves and their children. The foundation for this initiative is adult education that explores and explains childhood hearing loss, parent activism, listening skills, language learning and speech development. Parents are viewed as the primary students because they are the child's initial communication partners and ongoing educational advocates. In follow-up contacts after participating in distance courses or multi-week trainings families describe how these experiences empowered them. Parents report high levels of increased confidence in their own skills for helping their children. Many use the same words saying the training “changed our lives.”

From the typewriter seventy years ago to tele-practice now, John Tracy clinic uses accessible technology to reach out worldwide to families. Learning opportunities are designed to offer parents choices for the modality that they prefer to use to study childhood hearing loss. Options range from
written materials, web links, video clips, support groups, onsite instruction, online classes and individual tele-practice. Families across the globe relate how this early learning for parents was a key factor in securing services, garnering support and achieving success for their children. How these early childhood programs implement parent education as a guiding principle will be discussed with conference attendees. Effective strategies will be outlined that resulted in respecting caregivers as learners, promoting parents as partners in practice and recognizing families as leaders in hearing loss innovation.

**EDUCATING PARENTS ABOUT INTENSIVE BRAIN DEVELOPMENT FOR CHILDREN WITH HEARING LOSS**

Dornan D  
Hear and Say, HEARing Co-operative Research Centre; School of Health and Rehabilitation Sciences, University of Queensland, Australia

It is tempting to innovate too far ahead of conventional thinking, focussing only on new technology and improved habilitation. However, we must not overlook the power of parents guarding their young in the hearing healthcare chain. A recent population-based Australian study on children early and later identified with hearing loss has indicated the importance of maternal education as a significant predictive factor for outcomes. The question is asked whether educating parents specifically for the task of educating their children with hearing loss has positive outcomes for children’s listening and spoken language.

This presentation aims to review research evidence regarding listening and spoken language outcomes for education approaches which intensively educate parents simultaneously with children. Development of the neurobiological correlates of listening and spoken language will be discussed with reference to parents learning to provide the amount, frequency and quality of auditory input that is critical for maximising listening and spoken language outcomes. Recent research designed to investigate the measurement of parent participation and its relative influence on speech and language outcomes for young cochlear implant recipients will be reported.

The results of a longitudinal controlled study on the listening and spoken language for children in an Auditory-Verbal Therapy (AVT) program (which is by definition parent-based) compared to matched group of children with normal hearing and of the same initial language age will be presented.

**MEASURING PARENT PARTICIPATION AND ENGAGEMENT IN FAMILY SUPPORT SERVICES FOR CHILDREN DIAGNOSED WITH A PERMANENT HEARING LOSS THROUGH UNIVERSAL NEWBORN HEARING SCREENING IN QUEENSLAND**

Harris S  
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The Queensland Hearing Loss Family Support Service (QHLFSS) provides services to families identified with a permanent hearing loss through Universal Newborn Hearing Screening. The QHLFSS commenced service in 2008 with a vision to “support families to optimize the quality of life and potential of children with a permanent hearing loss.”

Developing a quality service in a sector rich with varied and sensitive cultural and communication norms has not been without its challenges. A specialised service, founded on Family Centred Care,
has emerged that is seen as unique in Australia in providing support services to families whose children have a permanent hearing loss.

With the following founding principles in the QHLFSS Mission statement to -

“Work in partnership with families and professionals …..Facilitate access and engagement to services which will promote health and well being for children .. and.. Utilise a family centred philosophy based on the delivery of comprehensive, unbiased access to objective information”

While also providing high quality services to families, the QHLFSS has engaged in a rigorous process of service development and quality management.

In 2011 the QHLFSS Service Model was created to articulate the model of care and lay a foundation for future goals of the service. The Service Model has created a template against which the service can be measured and evaluated, enabling an informed approach to service development.

A quality Clinical Audit has been developed to measure the service against set criteria as described by Australian Health Care standards, the QHLFSS Model of Service and proposed National Newborn Hearing Screening Standards. The audit also identifies and measures service components relating to consumer/family engagement.

This presentation describes this identifies emerging issues identified in the Clinical audit and strategies for the future development of the service and its clinical practice.
EMPOWERING PARENTS (PART II)

SOCIAL MEDIA AND FAMILY SUPPORT IN HEARING LOSS: A GLOBAL COLLABORATION

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The most important role of the family of a child born with a hearing loss is to love, educate and communicate with their child. Based on this fundamental approach, families develop an urgent desire to understand and meet their child’s needs. Families acquire knowledge, intuition and experience through access to resources and by participating in early intervention programs that offer audiological, medical, habilitative and educational sessions. This experience may be improved when the family decides to participate in support groups for parents.

The child greatly benefits through a model of association and collaboration among families of other children with hearing loss together with medical professionals. The passage of responsibility from the family to the child, develops gradually and increases with the maturity of the child, who becomes more and more independent and integrated in a hearing society.


Social Media offers the possibility of providing and sustaining a global network, as demonstrated in the Facebook Forum: Affrontiamo la Sordità Insieme Cochlear Implant Forum. This network provides parent to parent communication, validated practices, current research and fundamental support, enabling families immediate access to current resources and personal experiences. This support involves accompanying the families throughout the process of raising a child with hearing loss, including: newborn hearing screening, diagnosis, habilitation, cochlear implantation, etc., and permits interaction with families in all parts of the world.

SUPPORTING THE NEEDS OF FAMILIES OF CHILDREN WITH UNAIDED MILD HEARING LOSS

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Not all children diagnosed with permanent hearing loss are candidates for hearing aid fitting. In the case of infants and children with mild or borderline hearing losses, there may be reluctance on the part of parents, or audiologists, to progress to a hearing aid fitting, particularly while children are very young. This may stem from a lack of anticipated benefit, a lack of perceived need, or a reluctance to intervene where there is no apparent disability.
The parents of these children may have less access to professional support and information by virtue of not having a regular audiologist. In response to this need, RIDBC has developed a family centered program for families of children with mild unaided hearing loss. Families are supported in developing an understanding of their child’s needs, and are encouraged to take an active role in monitoring their child’s language development. Where delays become apparent, the services of speech therapists and teachers of the deaf are made available through RIDBC. Elements of the program will be outlined.

AUDITORY VERBAL THERAPY – BUILD PARENTAL SKILLS
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1CUF Porto Hospital; 2Oporto Polytechnic Institute; 3ESS-Aveiro University, Porto, Portugal

Introduction: The Auditory-Verbal Therapy (AVT) is a parental training program for deaf and hard of hearing children. Several of whose fundamental principles are centered on training and coaching parents in order to make them the main drivers of development of listen and spoken language in their children. It’s, however, necessary to carry out monitoring and evaluation of their progress throughout the program to ensure effectiveness of therapists with AVT education.

Objective: This clinical study aims to contribute to the design of a guide for assessing the performance of parents throughout the program accordingly with AVT targets, by the selection of target behaviors required to reach by any parent involved in the program, in the Hearing Implants Unit (HIU) at the CUF Porto Hospital.

Materials and Methods: 4 families of children with Cochlear Implants followed in the HIU were videotaped during all sessions, as required in AVT. The skills observed and analyzed in parents were grouped into three complementary aspects: use of hearing and communication strategies, planning of activity and control of behavior. Two independent therapists conducted the analysis of videos.

Results: All parents showed changes in their communicative attitudes globally. The biggest changes occurred in use of hearing and communication strategies and children behavior control. The skills of planning an activity showed more variance between subjects.

Conclusions: This study shows the need to create a script to evaluate progress with parents throughout the program, in order to determine the type and intensity of training for parents conducted by therapists with AVT education. From this study came the first specific lines of the script in preparation by our team.

PARENT EDUCATION FOR LOW INCOME FAMILIES OF CHILDREN WITH HEARING LOSS
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Adverse consequences of childhood hearing loss include delays in speech, language, cognition, academics, socialization and, subsequently, vocational attainment. During the past decade, advancements in hearing technology such as digital hearing devices and cochlear implants have significantly improved outcomes. Vulnerable youth can enjoy expanded possibilities.

For developing countries or areas of poverty, where resources are bleak, the future for deaf or hard of hearing youth is precarious. Great strides have been taken to improve the lives of youth with a
hearing loss through infant detection screening. Once diagnosed with a hearing loss, a deaf child will need hearing aids. For most developing countries, the cost of hearing aids becomes a barrier for a newly diagnosed child. Relief efforts by organizations such as the World Wide Hearing Organization (WWHO), Lions Club International, Starkey Foundation and Rotary International clubs have assisted by donating hearing aids to some remote and underserved communities. But having hearing aids is only one step to communication. Research supports parent involvement and advocacy are key factors to the success of deaf children’s communication competence.

This presentation will discuss the issues of poverty and how parent education can impact areas of stress, quality of parent-child talk, and the need for educators’ sensitivity to ethnically diverse families. Research strongly suggests that as more families learn advocacy skills, they increase the chances of success for their deaf or hard of hearing child’s future.
POSTER SESSION
HEARING SCREENING AND ASSESSMENT IN CHILDREN

1 - FURTHER COMPARISONS OF ABR RESPONSE AMPLITUDES, TEST TIME AND ESTIMATION OF HEARING THRESHOLD USING FREQUENCY SPECIFIC CHIRP AND TONE PIP STIMULI IN NEWBORNS

Ferm I1, Lightfoot G2,3

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A previous study has shown that auditory brainstem responses (ABR) to CE-Chirp stimuli of either 4 kHz or 1 kHz were on average 50% larger than their conventional tone tip counterparts when testing newborns with essentially normal hearing (Ferm et al, 2013). The mechanism for producing this larger response is thought primarily to be that the chirp stimuli maximises neural synchrony by anticipating the travelling wave delay of the cochlea. The study recommended that further studies are needed to be completed to check if this amplitude advantage extended to other frequencies.

Objective: To extend our previous study by evaluating the ABR amplitudes evoked by 0.5 and 2 kHz tone pip and narrowband chirp (NB CE-Chirp) stimuli when testing post-screening newborns and to determine the difference in estimated hearing level correction values.

Method: Babies referred from the national newborn hearing screen programme in England had their usual ABR hearing assessment starting with conventional 4 kHz 2:1:2 cycle pips. Babies passing the 4 kHz 30dBeHL discharge level were selected for the study. A total of 40 babies (42 ears) were tested using both 2:1:2 tone pips and NB CE-Chirps, either at 0.5 kHz or 2 kHz. The response size, response quality (Fmp) and residual noise were compared for the pips and chirps.

Results: For 0.5 kHz NB CE-Chirp responses were 33% larger than the tone pip responses and 52% larger for 2 kHz. Fmp was significantly higher for NB CE-Chirps.

Conclusion: Advantages seen when using NB CE-Chirps compared to tone pips at 4 and 1 kHz does extend to other frequencies. This result supports the use of NB CE-Chirps when testing newborns. We propose that the ABR nHL threshold to eHL correction for NB CE-Chirps should be approximately 5 dB less than the corrections for tone pips at 0.5 and 2 kHz.

2 - A COMPARISON OF AUDITORY EVOKED POTENTIALS ELICITED USING CLICKS AND FREQUENCY SPECIFIC TONES VERSUS BROADBAND AND NARROWBAND ICHIRPS

Delgado RE, Savio G

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A recently developed chirp stimulus set, iChirps, consisting of broadband and narrowband stimuli at 500, 1000, 2000 and 4000 Hz were compared to click and frequency specific blackman windowed tones. The iChirps were developed by segmenting and windowing corresponding portions of the classical chirp stimulus developed from de Boer's cochlear mechanics model. The click and
broadband iChirp stimuli were calibrated to generate the same peak SPL level. Narrowband iChirp stimuli were calibrated to generate the same RMS SPL level as their corresponding frequency specific tones. Stimuli were generated for acquisition of both transient and steady state responses. Twenty subjects were tested with both sets of stimuli using Auditory Brainstem Responses (ABRs) and Auditory Steady State Responses (ASSRs). ABR results showed that the broadband iChirp provided thresholds that were on average 6 dB lower than clicks with mean values of 18 ± 7 and 24 ± 6 respectively. The narrowband iChirp also provided lower thresholds across all frequencies as compared to frequency specific tones (36 ± 9 versus 22 ± 7 at 500 Hz, 32 ± 6 versus 23 ± 7 at 1000 Hz, 32 ± 8 versus 22 ± 7 at 2000 Hz and 32 ± 7 versus 23 ± 6 at 4000 Hz). On average, Peak V amplitude was approximately 0.1 μV larger for the iChirp data versus click and frequency specific recordings.

The iChirp ASSR results also showed improved threshold estimates as compared to modulated frequency specific tones. The average improvement across frequencies was 8.75 dB (19 dB at 500Hz, 1 dB at 1000 Hz, 4 dB at 2000 Hz and 11 dB at 4000 Hz).

This new stimulus set has potential applications in newborn hearing screening as well general hearing evaluation of adults. Further testing is still required to determine its efficacy with different hearing configurations.

3 - ESTIMATION OF HEARING LOSS IN CHILDREN: COMPARISON OF AUDITORY STEADY-STATE RESPONSE, AUDITORY BRAINSTEM RESPONSE AND BEHAVIORAL TEST

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The main issue regarding pediatric audiology diagnosis is determining procedures to receive reliable results which can be used to predict frequency-specific hearing thresholds. Infants with hearing loss routinely receive hearing aids several months before reliable behavioral responses can be observed. Auditory Steady-State Responses (ASSR) are being recognized as a promising technique in the assessment of hearing in children.

Material and Methods: Medical records from 14 children born in 2012-2013 who were submitted to ASSR were reviewed. The results of neonatal hearing screening tests using TEOAE, ABR, ASSR and behavioral thresholds with Visual Reinforcement test were reviewed.

Result: Nine children at the age of 6-22 months, identified with hearing loss had started the process of hearing-aid fitting. Four children had no ABR-response at 90dBnHL bilaterally and of these children one had no ASSR-response bilaterally and three had ASSR-response unilaterally at 75-85dBnHL.

Conclusion: The results obtained from ASSR recordings in some of these cases tend to add important hearing data, especially when it is not possible to obtain reliable behavioral responses—adding data to the battery of tests on children with hearing loss and providing data for a more accurate hearing aid fitting.
4 - HEARING SCREENING IN SWEDISH CHILDREN AT 4 AND 6 YEARS OF AGE

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Hearing screening of children and young adults have a long tradition in Sweden. Hearing test is performed in all children at school start (6 year) and in many schools at later stages in education. Preschool testing at 4 years is performed in most places in Sweden. Hearing screening is part of the swedish child health care programme, recently revised. Cost-benefit of screening has been discussed, and more so after implementation of neonatal hearing screening (NHS). However, about 25% of hearing impairment in preschool children is presenting post NHS. Failed hearing screening at 4 and 6 years and parental concern are the two major tools of identification. Delayed diagnosis and intervention will have negative impact on language and social development.

5 - MINIMUM RESPONSE LEVELS OBTAINED WITH INSERT EARPHONES; BEHAVIOURAL OBSERVATION AUDIOMETRY PROTOCOL FOR INFANTS AGED 2-6 MONTHS

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In early hearing detection and intervention programs, behavioural observation audiometry (BOA) can be used to gain information about the child’s hearing ability. This information can be complementary to that obtained by objective measures, such as OAE-measurement or BERA. In the present study we measure the minimum response levels (MRL’s) for a clinically applicable method of BOA in normal hearing infants aged 2 to 6 months using insert earphones and narrow band-noise stimuli.

**Subjects:** 38 infants with normal hearing and normal overall development.

**Results:** the insert earphone was not accepted in 2 infants and 3 infants were too fuzzy or uncomfortable to test. In the 6 months group, 4 infants had flat tympanograms and were not included. Of the 29 children that were included, 20 produced at least 2 MRL’s. Mean MRL-values of around 60, 50 and 40 dB nHL were found for the 2, 4 and 6 month children respectively. A false alarm rate of 25% or below was obtained in 11 infants who delivered 36 MRL’s. Less reliable experiments with a false alarm rate between 25% to 45% and of more than 45% were achieved in 10 and 8 children and resulted in 30 and 11 MRL’s respectively. A second session at the same visit, performed after a short break of at least 10 minutes, showed a clear decrease in the false alarm rate in most infants.

**Conclusion:** insert earphone testing is well accepted in the majority of very young infants. MRL’s, with a false alarm rate of 25% or below, could be obtained in around 38% of all children tested. The decreased false alarm rate, seen in the majority of children during the second session, suggests that performing a second session at the same visit can be efficient and effective in obtaining more reliable MRL’s.
6 - CLICK AND SPEECH AUDITORY BRAINSTEM RESPONSES (ABR) IN TYPICALLY-DEVELOPING CHILDREN

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Electrophysiological techniques are widely used in clinical research for assessing the central auditory nervous system (CANS) when processing auditory information. More recently, researchers have been using speech stimuli for investigating the processing of complex signals along the auditory pathway, since it provides more accurate analysis of the system, especially when studying children with language impairments.

The present study aimed to compare auditory brainstem responses to click and speech stimuli in typically developing children with normal hearing. Fifteen children, aging from 8 to 13 years old, participated in the study. All participants had air conduction threshold below 20 dBHL for octaves from 250 to 8000 Hz, A-type tympanogram with presence of ipsi and contralateral acoustic reflexes in both ears, no current or prior neurological disorders and no history of learning impairments. ABR were recorded at 80 dBHL for both clicks and speech stimuli using a Biologic NavigatorPro equipment. Normality criteria was defined as the presence of the waves I, III and V (clicks) and the waves V, A, C, D, E, F and O (speech) with latencies within the normal standards for this age range.

Results showed 15 children (100%) with normal click-ABR but only 12 children (80%) had normal speech-ABR.

These results may provide evidence in favour of the use of the speech-ABR as an effective tool for assessing CANS functioning in a more accurate way, once it can evaluate the biological processes underlying some auditory processing deficits not detected by responses to clicks. New studies with impaired and normal developing children are necessary to be conducted for a better understanding of the subcortical processing of speech sounds and for determining the use of speech-ABR in clinical practice.

7 - NON INVASIVE ELECTROCOCHLEOGRAPHY IN PEDIATRIC HEARING LOSS DIAGNOSIS: OUR EXPERIENCE IN 10 PATIENTS DIAGNOSED OF UNILATERAL DEAFNESS

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The implementation of the Universal Neonatal Hearing Screening in Catalonia (Spain) since February 2010 by the Public Health Department of Catalonia’s Generalitat, is based on a document prepared by an interdisciplinaty group of experts on infant hearing. The test is performed with an A-ABR in Maternity Hospitals of Catalonia. In case of failure, the test is repeated after one month and if the case is also positive, the infant is referred to the Reference Unit on Infant Deafness (RUID) to an early diagnosis, therapeutic orientation and interdisciplinary monitoring. The RUID in Catalonia is the ENT of Pediatrician Department of Sant Joan de Déu University Hospital. Due to the demand of auditory diagnosis in babies between one and six months, the objective auditory diagnosis starts doing an ABR with the equipment Integrity® Vivosonic®, which avoids the sedation/anaesthesia and reduces exploration time with physiological sleep. It is demonstrated very useful in the diagnosis of false positives and also in babies affected by hearing loss. After a long a positive experience handling this equipment and the need in some cases of a more thorough understanding of the
topography of the lesion, for example in the case of ANSD through an electrocochleography, made until nowadays by an invasive technique, we decide to try a new experience with the Integrity® device using a software form for practising a non-invasive electrocochleography. We describe our small experience comparing the results in a small group of infants previously diagnosed of unilateral deafness and contralateral normal audition.

8 - CHARACTERIZE OF SPONTANEOUS OTOACOUSTIC EMISSIONS IN FULL-TERM NEWBORNS

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Background: To analyze the characteristics of spontaneous otoacoustic emission in full-term newborns.

Methods: Using the Capella OAE equipment (Madsen, Denmark) to test Spontaneous Otoacoustic Emission (SOAE) in 147 cases (236 ears) who have passed the newborn hearing screening.

Results: (1) The SOAE prevalence per ear was 56.77%, including 41.51% in males and 69.23% in females or 64.17% of right ears and 49.14% of left ears. There was a significant difference in sexuality (\(\chi^2=18.285, p<0.05\)) and laterality (\(\chi^2=5.429, p<0.05\)) in this study. (2) The mean level of SOAE was 11.78±8.36dB SPL, including 11.73±8.25 dB SPL in male, 11.81±8.43dB SPL in female, and 11.97±8.56dB SPL in left ear, 11.65±8.22dB SPL in right ear. No difference in SOAE level was found in terms of gender or to ear side in this study (Z=-2.569, p>0.05). (3) The SOAE Frequency in these full-term neonates was focused on 3.2k~3.7kHz, and there was a significant difference in sexuality (2.9k~3.4kHz in males and 3.4k~3.9kHz in females; Z=-2.569, p<0.01), but no ear side effect was present in these subjects (3.2k~3.7kHz in left ears and 3.2k~3.6kHz in right ears). (4) The mean number of peaks of SOAE was 3.70±2.75: 3.86 (SE=2.87) in males and 3.62 (SE=2.70) in females, or 3.70 (SE=2.55) in right ears and 3.70 (SE=3.02) in left ears, but there was no significant difference in both gender and ear side in this study (p>0.05).

Conclusions: The prevalence rate of SOAE in full-term newborns is higher in females or in right ears; the acoustic frequency of SOAE is higher in full-term newborns than that in adults, especially in female neonates.
9 - SPEECH PRODUCTION AND INTELLIGIBILITY IN CHILDREN WITH COCHLEAR IMPLANTS
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In child cochlear implant (CI) users, early implantation generally induces highly intelligible speech. However, it may remain problematic for some children to become very intelligible. Studies of speech production in CI users have principally been based on perceptual judgment and acoustic measures. Articulatory measures, such as those collected using ultrasound and an optical tracking system provide the opportunity to more precisely evaluate what makes child CI users more intelligible. This study investigates speech production and intelligibility in children using acoustic and articulatory measures. We present preliminary data from six CI users (mean age of 7 years, congenitally deaf, and implanted before 2 years old) who were compared with six normal-hearing children of the same age and sex. CI users repeated the English vowels /i/, /a/ and /u/ with and without auditory feedback, where lack of auditory feedback forces the children to rely on internal commands. Synchronous ultrasound and Optotrak imaging were used to capture the tongue and lip positions of the children, and acoustic signals were recorded simultaneously. The acoustic quality of vowel production is provided by 1) contrast between vowels, where reduced contrast generally correlates with diminished intelligibility, and 2) dispersion within a vowel, where more accurate vowel production is associated with smaller dispersion within a vowel. Preliminary results revealed two main tendencies. Most CI users (5 of the 6) presented a similar contrast compared with the normal-hearing children. The contrast was generally smaller in the condition without auditory feedback, suggesting that most of the child CI users still needed to hear themselves to be able to adequately produce intelligible speech. For the dispersion measures, we observed no robust difference between conditions (with and without feedback). Articulatory and intelligibility data will be added and discussed later. Results will shed light on the articulatory abilities of deaf children.

10 - THE IMPORTANCE OF LIPREADING TO SPELLING ACCURACY FOR CHILDREN WHO ARE DEAF OR HARD OF HEARING
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Spelling is a complex linguistic skill that requires access to the phonology, orthography, and vocabulary of a language. Recent research (Bowers et al, 2013) indicates that the availability of visual (lipreading) information does not necessarily help students who are deaf or hard of hearing (d/hh) obtain important linguistic information during a spelling test. This study extended that research to answer the question: Do students who are d/hh demonstrate a difference in: (1) spelling accuracy and, (2) the type of errors they make, in spelling tasks that provide visual information vs. those that do not?

Sixteen high school students who are d/hh and communicate using ASL participated. Ten did not have amplification. Two used at least 1 hearing aid and two had at least 1 cochlear implant. Participants spelled 40 words in condition “A” (lipreading possible) and the same 40 words in
condition “B” (no lipreading possible) to total 80 words. In both, participants saw a line drawing of the target word, heard the word, saw it signed in ASL, heard and saw the word in a sentence, and then saw the word and sentence signed in ASL. In “A” the target words and sentences were spoken by the researcher and ASL interpreter. In “B” the target words and sentences were signed in ASL, but heard through speakers. The conditions were counterbalanced across participants.

Data were coded for accuracy and scored using a multi-linguistic rubric to identify phonological errors (PA), orthographic pattern errors (OPA), mental graphemic errors (MGR), semantic errors (SA), and morphological errors (MA). Participants made fewer errors with live voice ($F(1, 15) = 12.755, p = .003$) although spelling was poor across conditions. Errors were primarily PA, SA and MA. Results show that critical information is not being obtained through lipreading. These results have educational implications for spelling instruction.

11 - STUDY OF SPEECH AND LANGUAGE DEVELOPMENT IN BILINGUALLY RAISED CHILDREN WITH COCHLEAR IMPLANTS AND/OR HEARING AID

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Introduction: Bilingually raised children with a hearing disorder seem to have a higher risk to develop a speech and language impairment. Studies with this specific target group are difficult to plan. The speech and language abilities of bilingually raised children vary considerably due to the starting point of their learning process with regards to the age and the amount of information they receive in both languages. In addition some children are confronted by more than one other language. The diagnostic procedure for this patient group is difficult to undergo because of insufficient available diagnostic materials for bilingual or multilingual children.

Method: In a prospective cross-sectional study we included bilingually raised patients with hearing impairment (n=42) and monolingually raised children with hearing impairment (n=54) with an age range of 3;0-10;11 years in order to assess speech and language abilities. For comparison between patient and controls we also included bilingually raised children with normal hearing (n=23). With regard to the examination procedure we conducted a standardized anamnesis and used standardized as well as non-standardized German language tests available and suitable for the age of each individual participant.

Results: 44 children had been fitted with hearing aids, 34 with bilateral cochlear implants and 18 children with bimodal devices. In each group some of the children demonstrated an age-appropriate speech and language development in the German language. The comparison of monolingual and bilingual children with hearing loss yielded significant lower speech and language abilities in bilingual children.

Discussion: Examination of not selected but nearly complete cohorts often demonstrates less favourable outcomes. Due to language barriers bilingually raised children and their parents often do not participate in studies.

Conclusion: Our study confirmed our assumption that bilingually raised children with hearing loss should have speech and language examinations on a regular basis.
12 - EARLY HEARING DETECTION: LANGUAGE DEVELOPMENT OUTCOMES

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Universal Newborn Hearing Screening has been implemented in Cyprus since 2005. The reported Newborn and Infant Hearing project measured outcomes among children referred since the beginning of the screening Program. Participants were children whose families responded to the follow up call by the Center for Preventive Pediatrics, the organization responsible for prenatal and infant screenings in Cyprus. Language development was assessed using the Picture Vocabulary Test (morphosyntax, pragmatics), and Word Finding Vocabulary Test. Comparisons were made between the groups of children with normal hearing, unilateral, and bilateral hearing loss, based on degree of hearing loss and amplification option. There were no statistical differences in language development indices between children with hearing loss and with normal hearing, indicating that early detection of hearing loss and timely intervention leads to commensurate development of language skills.

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13 - CHILDREN WITH HEARING LOSS IN A MULTI-LINGUAL ENVIRONMENT - FACTORS INFLUENCING MAINSTREAM LANGUAGE ACQUISITION

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In today’s world an increasing number of children face challenges of a multi-lingual environment. Children with hearing loss are no exception. Early diagnosis and intervention enables many of them to develop their language ability in the same manner and pace as their typically hearing peers and success stories of bilingual children are no longer rare. Yet a bilingualism does present certain risks such as a semi-lingualism and a semi-culturalism. Questions, therefore, concerning family language management - which language, with whom as a role model, how many and when - require closer investigations.

Mimi was diagnosed with bilateral sensorineural hearing loss at the age of 16 months and started wearing her first hearing aids soon after. Having practically no gains from those HAs she then received a cochlear implant two days after her 2nd birthday and was given an intensive auditory-verbal therapy until the age of 5. Mainstreamed from the very beginning but relocating with her family several times globally, she grew up to become a trilingual teenager whose sole communication mode is listening and spoken language. There have been 5 different languages in her closest environment in 3 countries with different special education approaches.

This paper intends to derive a set of criteria of general relevance for the multilingualism from the development history of this young girl and analyses her linguistic horizon in relation to its geographical and chronological changes. The purpose of the inquiry is to demonstrate how different factors such as parental languages, auditory training, mainstream and special education settings can influence the language acquisition process in each of the developmental phases and to show to parents the possibilities of a multi-lingual path for children with hearing loss.
14 - AN ANALYSIS OF PERSIAN VOWEL FORMANTS IN SHIRAZI CHILDREN WITH HEARING LOSS AND NORMAL HEARING CHILDREN AGE 5-7 YEARS

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Due to inadequate access to auditory and sometimes lack of auditory experience with data, sound production is usually done with an error in children with hearing loss. What is important is that analyzing abnormal production of sounds based on perception and without resorting to laboratory instrumental equipments is not always possible. In many cases, being familiar with acoustic phonetics better reveals this issue. One of the errors in the speech production of children with hearing loss is vowel production errors. The aim of the present study is to analyze the acoustic features of Persian vowels by PRAAT and to present the vowel quadrilateral in children with normal hearing, children with moderate hearing loss and cochlear implanted children between 5-7 years old. In this paper, duration, fundamental frequency and the first 3 formants of the six simple vowels in Persian language which are /e/, /i/, /a/, /ɒ/, /o/ and /u/ in CV(C) context have been examined for each group. The results indicate that among the three groups of NH children, CI children and HA children, significant differences can be observed in the duration of /ɒ/, fundamental frequencies of /a/ and /ɒ/, the first formant of /a/, the second formants of /e/, /i/, /o/ and /u/, and the third formants /a/ and /o/. In addition, the vowel quadrilateral indicates that vowel production in CI children is within the range of NH children and that these children produce vowels closer to that of normal NH age mates.

15 - ANALYZING EARLY VOCAL PRODUCTION PATTERN AND PROVIDING CONTENTS FOR VOCAL DEVELOPMENT HOMEPAGE OF KOREAN INFANTS

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The objectives of this study were to analyze pre-linguistic vocal production pattern and provide contents for vocal development homepage for Korean infants. Early vocal development is characterized during the first 18 months of life in typically developing infants. The vocalization of this period is generally recognized as a foundation for meaningful speech and phonological development. These can be elements for aural rehabilitation process for the hearing impaired of this age. Normal hearing 1 to 18 months old 14 Korean infants participated with a mixed cross-sectional and longitudinal design after the parent’s agreements. Also, 2 CI infants, 13 months and 30 months old, participated after the parent’s agreements. Data were recorded and collected with 3 Sony camcorders for six age groups, 0~2 months, 3~5 months, 6~8 months, 9~12 months, 13~15 months, 16~18 months, then analyzed utilizing the Stark Assessment of Early Vocal Development-Revised (SAEVD-R). The results showed that early vocal development of 1~18 months infants with normal hearing produced a little higher level of SAEVD-R such as vowels, consonants, and monosyllables as the age increased. When the consonant production was classified according to place of articulation, the production started with bilabial and developed labiodental and velar later. When the consonant production was classified according to manner of articulation, plosives, and nasals were produced mostly. Also, central vowel /a/ was firstly produced and the process of vowel development was moved from the front vowels to the back vowels. For the cochlear implanted children, the vowel /a/ was produced most frequently and /i/, /i/ and /e/ were produced in the order. Based on the results of this study, contents for homepage design were presented with a structured intervention approach.
for stimulating vocal development in young children including 5 stages, reflexive, control of phonation, expansion, basic canonical syllables, and advanced forms of vocalizations characteristics.

16 - MINOR HEARING IMPAIRMENT AND LEARNING TO READ EUROPEAN PORTUGUESE

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Introduction: When children begin to learn to read around age six, the occurrence of hearing impairment is about 15%, and if only minor, it is rarely identified by teachers because it may be unilateral, fluctuating and usually there are no signs or inflammatory symptoms. This condition can lead to quantitative and qualitative hearing losses for the child, impacting the quality of phonological representations necessary for learning to read. The capacity of phonological processing involves abilities considered predictive for the ability to learn to read and crucially depends upon neuropsychological conditions of access of auditory input.

Objective: Test to discover if differences in phonological consciousness (performed through subtraction the initial phoneme), in the reading of words and pseudo words, exist between children with normal hearing and those with minor hearing loss.

Methodology: 24 children with normal hearing and 24 children with conductive hearing impairment in the first year of primary school were tested.

Results: The children with minor hearing impairment performed worse in all three tests. The differences were statistically significant in terms of subtraction of the initial phoneme (p=0.040) and in the reading of pseudo words (p=0.014), but not in the reading of words.

Conclusion: We can conclude that minor hearing impairment interferes with the development of two basic competencies related to the initial stage of learning to read – phonemic awareness and recodification. The effects of this condition upon the quality of phonological representations can make the establishment of two paths of identification of the written word more difficult: the visual-orthographic (lexical), and the phonological (sub-lexical). However, it is evident that global, lexical representations sustain the visual recognition of the word in both groups, without a significant distinction of performance between groups in this capacity, contrary to tasks that imply an awareness of sub-lexical units.

17 - LEXICAL AND SEMANTIC SPECIFICITY OF EXPRESSION IN DEAF AND HARD OF HEARING STUDENTS IN RELATION TO THE TYPE OF AMPLIFICATION THEY USE

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The sense of hearing is very important for the modern man. Hearing impairment has complex consequences. Improperly developed speech is the most prominent consequence of hearing impairment. When perception of acoustic information is disturbed the ability to imitate the speech of the social surrounding is reduced which causes delays in development of speech and language
skills. Hearing impairment has implications on all aspects of speech and language including lexical and semantic expression.

The aim of this research was to examine lexical and semantic specificity of expression in deaf and hard of hearing students of elementary school age with hearing aids or cochlear implant.

The research sample consisted of 34 deaf and hard of hearing students between 4th and 8th grade attending “Stefan Decanski” elementary school for deaf and hard of hearing students in Belgrade. In the sample there were 26 students with hearing aids and 8 students with cochlear implants. The following instruments have been used to conduct the research: Linguistic corps for the evaluation of particular lexical - style related characteristics (Dimic, Isakovic) and Semantic test (Vladisavljevic).

The obtained results showed that there is little difference in the average results of students with hearing aids and students with cochlear implants. Students with hearing aids achieved slightly better results than students with cochlear implants. However, statistically significant difference has not been found. It is necessary to mention that most of the students with cochlear implant do not regularly use their cochlear implant for various reasons such as: poor motivation for wearing it, malfunctions, irregular battery replacement. It should be noted that some students with cochlear implant for certain reasons did not develop hearing skills which are typically developed in persons who use this type of amplification.

18 - THE DEVELOPMENT OF WORD CATEGORIES IN HEARING IMPAIRED CHILDREN

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The process of voice and speech development in children is rules governed. Within those rules, there is semantics, i.e. understanding what words mean in a sentence.

The first historical data on the importance of semantics can be dated to the discourse of Ancient Greek philosophers. Naturalistic point of view claims that verbally overt words and physically perceivable objects are connected in a certain way. Conventionalism sees semantics as an accidental connection between the aforementioned verbally overt words and physically perceivable objects. Linguistically, semantics attempts to study meaning of words objectively.

It is known for a fact that certain words in context can have a concrete meaning (i.e. they can be easily conceptualized). On the contrary, not every spoken word can create a clear visual image linked to a certain phenomenon.

In the initial stage of speech development, a child uses words without understanding their genuine meaning. The full semantics of words consists of the specifically named notions (notions, components, semantic markers, etc.). It is also known for a fact that the process of acquisition of general semantic notions happens before the process of acquisition of special semantic notions. Inadequate use of words (extended word semantics) happens when children are between 13 and 30 months of age. This period lasts for about a year.

The decrease in usage of words with broader meaning manifests with the increase of children’s lexicon content. Only random words can keep their broader meaning; the remaining words are used by children in the same way as in adults. The categories of words with broader meaning are formed on the basis of overt relations between objects and experiences from a child’s surroundings (shape, size, taste, etc.).
Semantic Test (S. Vladisavljević, 1979) applied to children of different age indicates that there is a process of development of word categories. There are four categories of words that are formed at different age. The first are homonyms (when one word has more different, unrelated meanings, such as kosa – hair on one's head, a line in mathematical sense, or a tool). Synonyms develop when a child acquires the ability to name a notion, an action or a phenomenon and when their lexicon increases – they are different words with the same or similar meaning, such as student-pupil. The third category are antonyms – words with opposite meaning. In the end, when children’s thoughts are fully distinguished, metonymy in words emerges (words that do not mean what they literally mean).

The development and differentiation of word categories happens gradually, and there are certain differences within word categories content. That is why to some words children respond appropriately right away, yet later to some others. After the period of usage of words of broader meaning, compared to narrowing of word meanings, the assumption is that new notions are gradually assigned to words that used to have broader meanings before.

19 - CHILDREN WITH DAMAGED HEARING AND UNDERSTANDING OF THE READ TEXT ACCORDING TO VERBAL RESPONSES

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To read means to decode the symbols of written speech, say them or keep them in memory. It cannot be sad that one person reads if he does not understand what he reads. The child who hears, in the process of reading involves an existing knowledge base, which is the first experience in the developmental period of early childhood spoken language, which has emerged as the interaction between speech and language of parents and the environment. A child with hearing impairment usually enters very poor knowledge base in the process of reading. Given the lack of basic knowledge base, these children have problems with the ability of concluding figurative language and other linguistic abilities that children who hear develop automatically. In short, they do not experience cognitive and linguistic base, which is needed to learn to read fluently. Child with hearing impairment, which before starting of the learning to read, did not develop language skills to link information from the text with own experience, in which is important the ability of concluding, neither figurative language is not developed.

Speed, regularity and understanding are three dimensions that characterize a good reading ability. Even, there are the children who read well and understand well, and children who read poorly and poorly understand, but also children who, despite a slow and difficult reading manage to understand the written message.

In working with deaf and hearing impaired children, it is used a "three dimensional test of reading" where we were particularly interested in understanding read text.

The subject of this study was to examine the problem of understanding the read text, in children /pupils in primary schools for the deaf and hearing impaired children.

To test the research an article "Only one snow day" is used. The sample comprised 40 hearing impaired children of primary age, from III to VIII grade in special schools "Stefan Dečanski" and "Radivoj Popović", in Belgrade. According to the World Health Organization classification of the sample was divided according to degree of hearing loss in two groups: group A-moderate hearing loss and group B is very difficult hearing impairment. Quantitative and qualitative analysis of research results is performed and shown in tables.
Based on the obtained results, it can be concluded that reading and comprehending text depends on the development of speech, age and hearing remains. Hearing impaired children with moderate hearing impairment had the better reading and comprehension of the read text, compared to children with very severe hearing impairment.

**20 - UNIVERSITY OF IOWA'S TEAM APPROACH TO MEETING AURAL HABILITATION COMPETENCIES FOR GRADUATE STUDENTS IN SPEECH/LANGUAGE PATHOLOGY AND AUDIOLOGY**

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Listen and Speak Up is a 6 week preschool program at The University of Iowa for children with hearing loss. It will be entering its 11th year of operation during the summer 2014 session. This program was intended to provide summer services for children with hearing loss as well as provide graduate students in both Audiology and Speech/language pathology a means to develop competencies relative to aural rehabilitation with a pediatric population. This program focuses on an integrated model of instruction with verification of auditory functioning occurring in each session and an oral focus in thematic-based units. Graduate students in both disciplines are involved in hearing measurement, device checking (both cochlear implants and hearing aids), and designing and executing specific aural rehabilitation techniques encompassing the areas of auditory skills, speech production, receptive and expressive language, and emerging literacy skills. Group and individual sessions are alternated so that graduate student clinicians get experience managing and teaching groups of young children as well as developing focus on individual students’ specific unique communication needs. Within the group setting, students volunteer to be a group leader and design weekly therapy objectives along three separate classroom activities including “opening,” snack/language enrichment, and literacy. In addition, music therapy is provided during each session with language and speech goals being integrated in collaboration with the certified music therapists.

The content of the poster presentation will include the following.

1. A brief history of the Listen and Speak Up program at the University of Iowa will be presented
2. Program overview
3. Speech/language pathology graduate student objectives
4. Audiology graduate student objectives
5. Parent training objectives
REHABILITATION STRATEGIES AND OUTCOMES IN CHILDREN

21 - “ALL INCLUSIVE” – HABILITATION DAY FOR HEARING IMPAIRED CHILDREN, AGE 0-5 YEARS
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Sørlandet sykehus HF, Arendal, Norway

Sørlandet hospital HF Arendal and Kristiansand in Norway, is a hospital with a hearing centre. We treat adult and children with hearing problems. There are about 290 000 people in our area.

We started newborn hearing screening in 2002. In 2012 – 2014 we have had a project paid by the Norwegian Health Department to improve our routines; how to treat children after they have been diagnosed with hearing problems, with the age of 0-5 years.

Before the project, we fitted hearing aids in two hours. After that, the parents went home to make their own experience. When they come back after a month, the parents often told us that the grandparents couldn’t understand how to take care of the child with hearing aid, and the kindergarten have difficulty understands the child’s needs.

We, on the other side, experienced that we use a lot of consultations to make the parents understand what to do to make it the best for the child. Therefore we have to think different.

We have changed our routines: when we have diagnosed a child, we offer the family a follow-up day. On this day we fit hearing aid, take more tests. We take IG, give information about the hearing loss and consequences, and how to take care and treat the hearing aids.

We also invite the grandparents, uncles and aunts, employees from the kindergarten, other professional in state and municipality (working with the child later on), to this follow-up day. We give information about hearing loss, hearing aids and how to best support the little family.

Our experiences, so far, is very positive. We use more time in the beginning and this helps parents, grandparents, kindergarten to follow up the child in a better way. We don’t need so many consultations and the parents are more safe and able to use the hearing aids properly.

22 - PUBLIC HEARING SERVICES IN BRAZIL: IMPROVING EARLY COMMUNICATIVE SKILLS IN HEARING IMPAIRED CHILDREN OF LOW INCOME FAMILIES
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Objective: To investigate the use of a checklist protocol, integrated with other instruments to measure the development of sensory motor skills that will better enable the prediction of the development of auditory and speech skills enhancing orientation procedures for early intervention in low income children with hearing impairment.

Methodology: Analyze 23 deaf children whom were diagnosed before six months of age, aged 6 to 48 months. The study is being conducted at the Center for Hearing in Children (CeAC - DERDIC), Sao Paulo, Brazil. Ethics Protocol / PUC-SP Committee number 330/2009.
**Procedures:** Analyzing patient charts, audiological and demographic data, daily use of a hearing aid (individual); SII values; established situations to evaluate the development of auditory skills, speech perception, LittleEars questionnaire, language categories, MUSS, IT MAIS and a structured checklist protocol.

**Results:** The systematic use of hearing aids was the only variable with a strong relationship with the outcomes of auditory skills. The degree of hearing loss and age of onset of amplification did not explain the development of hearing amplification in the study. Other factors such as socio economic level and the adherence of parents and guardians to the treatment protocol should be noted. Lastly, the checklist protocol for Portuguese sounds has shown to be effective in assisting the healthcare professional measure the evaluation of auditory abilities for young children in low income families.

**Conclusion:** The checklist protocol has allowed for the systematization of processes and measuring points on the therapeutic intervention that monitors the overall development of hearing impaired children and strengthens the link between monitoring in highly complex rehabilitation performed in public services, including the involvement of primary care as part of the integral treatment adherence. This study sought to contribute to outcome evaluations Hearing Health Network in Brazil.

**23 - SII – SPEECH INTELLIGIBILITY INDEX IN CHILDREN WITH HEARING LOSS: THE RELATIONSHIP BETWEEN INTENSITY AND DISTANCE**

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**Objectives:** To comparatively analyze SII values for different signal inputs (75, 65 and 55dBNPS), obtained during hearing aid verification according to (DSLm[i/o]v5) target. This study also aims at relating loudness and distance to guide the intervention process during the first months of amplification use.

**Methods:** For the analysis of SII values, 78 ears were studied considering the thresholds used for fitting hearing aids (frequencies-0,25;0,5;1;2;4KHz), hearing loss configuration and fitting adequacy using DSLm[i/o]v5. All data were entered into a Microsoft Excel database for Cluster Analysis which established five groups (Gr1, Gr2 and Gr3 –SII ≤35; Gr4 –SII 36 to 55; Gr3 –SII>55). From these groups, SII value variation as change of input signal intensity and the relation between the differences of the SII values were analyzed. The averages of the differences between SII values were compared in the five groups.

**Results:** Changing the input signal intensity most affected Gr4 while for Gr 1, 2 and 3 the change of intensity caused little variation to SII values. As for the analyses of the relationships between SII values, the SII65 value equals 53.3% for which the difference between SII75 and SII65 is the maximum. For the difference between SII55 and SII65, the value obtained was 56.4%.

**Conclusion:** The use of SII obtained through adequate amplification allowed the study of audibility for speech sounds in relation to distance, given that, with the increase in distance between the sound source and the hearing aid microphone, the intensity of the acoustic signal decreases. Such findings guide rehabilitation strategies and counseling, as well as assisting cochlear implant and FM systems recommendation, early in the first months of the rehabilitation process.
Newborn hearing screening programs (NHS) in Israel's peripheral regions have been implemented since January 2010. Consequently, infants with congenital hearing loss (HL) are enrolled in early intervention programs (EI) at a younger age than previously. This study assesses the development of auditory and communication skills at 20 months, thereby contributing to the literature regarding early development following NHS in various countries.

Twenty-six toddlers with moderate to profound HL participated in the study: 54% wore hearing aids (HAs), 46% used unilateral/bilateral/bimodal cochlear implants (CI). Toddlers were enrolled in three EI centers at 6.08 months on average. The aural/oral method of communication was used with 38% of participants; 62% used the simultaneous method. At 20 months, mothers assessed early auditory skills with the IT-MAIS questionnaire (Robbins et al., 1991), and communication clinicians assessed pragmatic skills with the Pre-Verbal Communication Schedule (Kiernan & Reid, 1987).

Toddlers with less severe aided hearing levels outperformed participants with worse aided hearing levels in detecting sounds and inferring their meaning. The average scores attained in early auditory skills with any sensory devices resembled those of normally hearing infants about one year younger. No differences were observed in the outcomes of toddlers habilitated with either method of communication. Early enrollment was associated with higher scores of detecting sounds among infants using HAs, but not with other auditory skills. Among HA users, detection of sounds and inferring meaning were correlated with spontaneous vocal productions; imitation of vocal sounds; initial language comprehension; pointing and referential gestures. Such relations were absent among CI users. Findings confirm the linkage between early auditory skills and early communication developments in HA users at 20 months. The gap between CI and HA users will be discussed.

The sensory deficits imposed by profound hearing loss in children (even when remediated with cochlear implants-CIs) typically results in global delays in spoken language, verbal working memory (VWM), and other processes that rely on accurate encoding of verbal information. It is unclear, however, whether a similar deficit is observed for visual-spatial working memory (VSWM). The principal goal of this study was to examine the effects of auditory deprivation on working memory (WM) function in both the verbal and visual-spatial domains. The two main questions addressed by this study were: 1) Does auditory deprivation result in global or domain-specific deficits in WM in children with CIs; 2) Does WM function in children with CIs improve with age and, if so, how does the rate of developmental change compare with their NH peers? Measures of VWM and VSWM, receptive vocabulary, and verbal and non-verbal reasoning were administered to 25 children with CIs and 29 children with NH sensitivity in two age ranges (5-6 years and 8-9 years). The CI group
performed more poorly than age mates with NH sensitivity on measures of simple and complex VWM; however there were no significant differences in performance on measures of simple or complex VSWM. The CI group also performed significantly lower than their NH age mates on measures of receptive vocabulary and verbal reasoning; however performance on a measure of non-verbal reasoning was commensurate with age mates with NH. Children with CIs exhibit delays in working memory tasks which require the processing and encoding of verbal information, however, their ability to encode and process visual-spatial stimuli appears to remain intact. The unique influence of VWM and VSWM on measures of receptive vocabulary, verbal reasoning and non-verbal reasoning were explored using regression analyses and the implications for habilitation will be discussed.

26 - AUDITORY PREVERBAL SKILLS DEVELOPMENT IN MANDARIN PEDIATRIC COCHLEAR IMPLANT USERS. PRELIMINARY REPORT


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Objective: The purpose of the present study was to investigate the auditory preverbal skills development in Mandarin infant/toddlers with Cochlear Implant (CI).

Methods: Participants were recruited from the CI center of Beijing Children's Hospital, Capital Medical University. A total of 33 severe to profound sensorineural hearing loss children who received CIs participated in the study. The evaluation tools were LittlEARS® auditory questionnaire (LEAQ) and self-designed demographic information questionnaire. Evaluations were administrated immediately after the CI was switched on (0-month), 1-month, 3-month, 6-month, 9-month, 12-month, 18-month, and 24-month of the CI use.

Results: The mean total scores of the LEAQ in 0-month, 1-month, 3-month, 6-month, 9-month, and 12-month, 18-month, and 24-month were 1, 5, 10, 15, 21, 23, 30, and 33 points, respectively. This group of children’s early auditory preverbal skills development trajectory was consistent with the published norm data of the LEAQ, and the expected value even slightly higher than the norms. Analysis showed that the parents’ level of education and age of implantation influenced the final LEAQ score significantly (ANOVA, p<0.0001).

Conclusions: Auditory preverbal skills improved dramatically after cochlear implantation. Early implanted children exhibited a steeper and faster improvement in auditory preverbal development compared to the later implanted peers. This study confirmed the effectiveness of early implantation on auditory preverbal skills development.

27 - TEACHING PROCEDURES FOR IMPROVING AUDITORY SKILLS IN TWO ADOLESCENT SISTERS WITH SEVERE SENSORINEURAL HEARING LOSS

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Purpose: To investigate the effects of teaching auditory-visual tasks to two teenagers (CML, 15 yrs. and NTR, 12 yrs.) on their listening and speaking skills. CML had a history of failure in this kind of task in previous studies.
Method: The participants received the diagnosis before their first birthday and began to use hearing aids; later they received a CI (CML at five; NTR at two). Both received speech therapy to develop oral and written Portuguese, but they preferentially used sign language. A computer equipped with software that managed the experimental routines and data was used to conduct two studies. An assessment of receptive and expressive skills was conducted before the first study and after the second. Study 1 taught the girls to select pictures and printed words conditionally to spoken words (matching-to-sample task). The second study used sentences as the auditory stimulus, and video clips as the comparison stimuli (if the sentence was *Beto is peeling the lemon*, three video clips running simultaneously showed Beto peeling the lemon, Beto grating the lemon, and Juca peeling the lemon; correct responding required attention to sentence’s elements). The tasks were implemented with sets of words (Study 1) or sentences (Study 2). Periodical tests assessed relations directly taught and derived relations, in receptive (e.g., relating pictures and printed words) and expressive (e.g., naming a picture or saying the sentence that corresponded to a video scene) tasks.

Results: Both children showed higher scores on receptive than on expressive tasks on both tests. Their performances improved through the studies, but their speech showed partial correspondence to the standard use, especially concerning verbs.

Conclusion: Compared to the previous studies, the gains obtained by CML indicate that the procedures have potential for auditory rehabilitation of CI users, especially if used systematically. Supported by FAPESP (grant no. 05/57708-9).
RISK FACTORS

28 - MUSIC EXPOSURE THROUGH MP3-PLAYERS AND THE RISK OF MUSIC-INDUCED HEARING LOSS AMONG ADOLESCENTS IN THE NETHERLANDS

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The widespread popularity of listening to music through MP3-players among adolescents has become a major public health concern. Frequently listening to loud music for long periods may result into hearing damage among youngsters.

The aim of this research was to provide insight into the risk of music-induced hearing loss (MIHL) involving the use of MP3-players among adolescents in the Netherlands.

We tried to estimate the number of adolescents who listen to music through MP3-players in excess of safe music exposure levels. We also tried to explore socio-demographic factors such as age, gender, education level, and music style that potentially predispose adolescents to high music exposure levels.

A technical model to estimate sound output produced by MP3-players (based on type of MP3-player and earbuds, volume settings, and music style) was developed. This was followed by the development of a risk model for the prediction of music-induced hearing loss after 10 years of music exposure. These models were subsequently integrated in the MP3-Check, an online test developed to give insight into music listening habits, including listening duration and volume settings. Cross-sectional data derived from 32,522 test results of participants of the MP3-Check were collected, from which individual weekly equivalent music exposure levels were calculated.

An elevated hearing loss risk for 8 to 10% of the adolescents participating in the MP3-Check was predicted, of which about 5% are at high risk of developing MIHL. Older teenagers (18-24 years), boys, lower secondary and vocational education level students, and listeners preferring music styles such as dance and hip hop, are riskier in their music-listening behavior as compared to their counterparts.

This research provided a further step in understanding the problem of MIHL with a view to the development of targeted health education and MIHL-preventive measures.

29 - NEWBORN HEARING SCREENING AND EARLY DIAGNOSTIC CONFIRMATION IN THE NICU AND/OR INTERMEDIATE CARE

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Hearing screening as well as early identification and intervention of hearing loss enable better prognosis for child development.

The aim of this research was to analyze the results obtained in neonatal hearing screening (NHS) and audiological diagnosis in neonates who were hospitalized in the neonatal Intensive Care Unit (NICU) or Intermediate Care. The sample was divided in Group I (GI): neonates who underwent NHS in one step and Group II (GII): neonates who underwent a two-stage NHS (test and retest).
The procedure was the Automated Auditory Brainstem Response (AABR). Children who failed were referred to audiological, otorhinolaringological and genetic diagnosis. Audiological evaluation was composed by clinical interview, assessment of middle ear conditions, ABR evaluation (assessment of electrophysiological thresholds and integrity of auditory pathway), and evoked otoacoustic emissions. NHS was performed in 82.1% of surviving neonates. In GI, 18.6% failed the test and 63.8% were diagnosed as normal hearing. GI1, with the retest, showed a decrease in the failure rate to 4.1% and 12.5% diagnostic of normal hearing. Results pointed an incidence of hearing loss of 3.9%, of which 1.7% for sensorineural and 2.5% for conductive hearing loss.

Of all the screened neonates, sensorineural hearing loss was found in 12.4% and conductive in 26.4%. There was one case (1.9%) of auditory neuropathy spectrum disorder. Risk factors that had a significant relation with the outcome of the NHS and/or audiological diagnostic were craniofacial anomalies involving the ear and temporal bone, neonatal asphyxia, prematurity and genetic syndromes. In conclusion, retest reduced the failure rate and rate of false-positive, and not increased the dropout rate. Therefore, it is a recommendable step in NHS programs in the NICU. Hearing loss is common in neonates who stayed in ICU.

30 - NEONATAL HEARING SCREENING OF PRETERM NEONATES USING TEOAE IN COMBINATION WITH AABR

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**Aim:** To determine the frequency of hearing loss in premature infants.

**Materials and methods:** For the period from January 2012 to September 2013 243 preterm newborns were examined, aged 1-3 weeks (mean age - 1.5 weeks). Follow-up audiological diagnosis was performed at 3 month of age.

All preterm infants were screened on the device Sentiero (Path Medical Gmbh., Germany) using TEOAE and AABR. AABR installed on the level of 35 dB.

**Results:** Among all surveyed newborns for gestational age 27-32 weeks there were 111 newborns (46%) - 1 group, 33-36 weeks – 132 newborns (54%) - 2-group.

Distribution by birth weight: under 1500 g - 61 infants, 1501-2000 g - 68, 2001-2500 g – 46, 2501 g and above -68.

During the hearing screening by TEOAE in combination with AABR 35 infants had a negative result. All of 35 infants were from the 1st group with weight under 2000 g. On follow-up audiological diagnostic 7 infants were defined as having hearing loss: 2 – moderate, 5 – profound and severe hearing loss.

**Conclusion:** Our results show that a protocol using TEOAEs and AABR is accurate, feasible and effective. We found that 2% of the 243 preterm neonates failed neonatal hearing screening were diagnosed with SNHL. All of them under the category of extremely-preterm newborns (under 30 weeks of gestational age).
31 - AUDIOLOGICAL FOLLOW-UP IN VERY LOW BIRTH-WEIGHT INFANTS. OUTCOMES AND HEARING THRESHOLD CHANGES IN THE FIRST TWELVE MONTHS

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Objectives: To investigate hearing threshold changes during the first year of life in infants admitted in the neonatal intensive care unit (NICU).

Methods: From 2009 to 2013, 239 infants who were treated in the NICU with birth weight (BW) $\leq 1000$gr and/or gestational age (GA) $\leq 30$ weeks were enrolled. Their hearing was evaluated by means of otoacoustic emission (OAEs) before discharge and, auditory brainstem response (ABR) within 3 months of corrected age (CA). Infants affected by uni- or bilateral hearing loss were addressed to follow-up and further audiological evaluations until a definitive diagnosis (ABR, OAEs, impedance and clinical data within 6 months of CA). Changes in hearing threshold were also carefully analyzed.

Results: 207 (86.6\%) had normal hearing while 32 infants (13.4\%) showed hearing loss at the first ABR evaluation (9 mild, 16 moderate, 4 severe, 3 profound). At definitive evaluation, 15 infants (47\%) recovered a normal hearing and threshold improvement ranged from 10 to 30 dB (mean 18.5). Sensorineural hearing loss (SNHL) was confirmed in 17 patients. Among these, 3 infants were addressed to follow-up (one case of mild SNHL and two with moderate unilateral SNHL) while in 14 cases (44\%) (GA 26.2±2.2weeks, BW 820±330g) with bilateral SNHL (7 moderate, 4 severe, 3 profound) hearing aids were prescribed. Definitive diagnosis was obtained at 5.9±1.3months of CA.

Conclusion: Our study confirms the importance of audiological surveillance in preterm newborns. At 3 months of CA a 13.4\% of patients showed SNHL, needing hearing aids in 5.9\% of cases. The hearing thresholds of infants with congenital hearing loss can change during the first year of life and we observed normalization in 47\% of our patients. Therefore, the importance of administration of follow-up hearing tests is emphasized. Irreversible intervention (i.e. cochlear implantation) should be considered with great caution within the first year after birth.

32 - NEWBORN HEARING SCREENING AND AUDIOLOGICAL DIAGNOSIS IN NICU INFANTS

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Aim: To study whether the newborn hearing screening and the audiological diagnosis of infants who have been admitted to the Intensive Care and/or Intermediate Care Unit can detect auditive alterations in this population.

Methods: The hearing screening test was performed in infants admitted to the neonatal intensive care unit (NICU) at the University of Campinas (CAISM/UNICAMP) for at least 48 hours using the automated auditory brainstem response with click stimulus at 35 dB. The test was performed preferably before hospital discharge. The audiological diagnosis was performed only in infants who have failed hearing screening and retest, and comprised anamnesis, impedance, auditory brainstem response, and otoacoustic emissions. The infants that showed some hearing alteration were
forwarded to the Otorhinolaryngology Department. The infants who passed the hearing screening, but had risk indicator for hearing loss were referred to the auditory monitoring.

**Results:** Out of 703 infants born between August/2012 and December/2013, 74.39% (523) underwent hearing screening; of these, 91.20% (477) showed no changes in the tests, while only 8.80% (46) have failed the test in at least one of the ears. These were, then, re-evaluated. In this second assessment, only 2.30% (12) persisted in showing hearing alterations and were submitted to the audiological diagnostic. Conductive hearing loss was then diagnosed in 0.95% (5) of these infants.

**Conclusion:** The results showed that newborn hearing screening can identify and thus exclude a high percentage of hearing loss false-positive related cases. For infants that the tests had confirmed hearing alterations, it was of the conductive type. Although preliminary, the results of this study are promising as database for further investigations.

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**33 - TRANSIENT OTOACOUSTIC EMISSIONS IN NEONATES LEAVING THE INTENSIVE CARE UNIT OF THE IPS CENTRAL HOSPITAL, ASUNCIÓN-PARAGUAY, 2013. EXPERIENCE**

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**Introduction:** The Otoacoustic emissions (OAE) consist in sounds sensed in the external auditive canal, through a sensitive microphone, forth coming from a normal cochlea after a stimuli. Useful in the tracing, diagnose and monitoring of the hearing impairment. We carried out the study in neonates admitted into the neonatal Intensive Care Unit, due to the fact that it is a risk factor for audiological problems, to demonstrate the importance and need of the OEA, as in Paraguay there is no national program caring for the loss of hearing at birth.

**Objective:** To discuss the transient otoacoustic emissions in neonates admitted into the Intensive Care Unit.

**Material and method:** Descriptive study, observational and retrospective with a transverse cut-off bearing in mind as a criterium of inclusion the neonatal patients admitted into the Intensive Care Unit between the months of July and December, 2013. Cases without an admission into the neonatal Intensive Care Unit were excluded.

**Outcomes and Principal Findings:** The study included 152 patients, of which 79 (52%) were females, with the following results: 84 pass bilaterally (55.4%), 34 pass unilaterally (22.3%) and 34 do not pass bilaterally (22.3%). Prematurity was the most frequent cause for the admission into the Intensive Care Unit, 135 patients (88.8%), with associated maternal preeclampsia pathology in 32 patients (21.1%).

**Commentary:** There is a consensus in many parts of the World that the use of otoacoustic emissions to trace audiological problems in neonates and children incapable to be examined through conventional tests.

Our study demonstrated a high alteration ratio, to which a follow-up must be made considering that possible early audiological intervention will be needed. This information must be shared among health peers so as to create an obligatory neonate hearing screening program in Paraguay.
34 - PERINATAL FACTORS THAT AFFECT OTOACOUSTIC EMISSIONS IN HEALTHY NEWBORNS, VAGINALLY DELIVERED, DURING FIRST 48 HOURS OF LIFE

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Introduction: Most hospitals perform neonatal hearing screening because it is very useful. Otoacoustic emissions are an ideal technique for this screening. We analyze the possible influence of some perinatal factors in screening results.

Material and Methods: We collect retrospective data from 8,239 healthy newborns vaginally delivered in our hospital's maternity ward. We compare factors vs results of first performed otoacoustic emission around 48h of life, before discharge.

Results: 6.4% of newborns had abnormal response and failed the screening. Univariate and multivariate analysis show a significant (p<0.0001) positive relation between breastfeeding and normal otoacoustic emissions (OR: 0.65). Another less significant factor is female sex. The other variables were no significant (origin, studies or employment status of the mother, maternal smoking, distocic delivery, presentation, need of resuscitation, to be late preterm (34-36w), weight, length and maternal pathology as streptococcus detection, hypotiroidism, hypertension or diabetes).

Conclusion: breastfeeding resulted the most important factor related with a normal response in otoacoustic emissions. It may improve final results and lower the number of neonates that need to be rescheduled to repeat the test, the anxiety associated and the possibility of losing a patient during follow up. These are major problems in neonatal hearing screening.
PRE-SCHOOL AND SCHOOL-AGE CHILDREN

35 - THE STUDY OF THE SMART HEARING SCREENING SYSTEM FOR PRESCHOOL CHILDREN

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Objective: The Smart Hearing Screening system (SHS) is a new screening method combining pure tone test with multimedia network. This study aimed to explore the feasibility of the new system applied to preschool children and analysis the screening performance.

Methods: The system was applied to 6372 children. It auto-tested threshold at three frequencies: 1kHz, 2kHz, 4kHz, and 30dB HL was the critical intensity for passing. Children with positive results were referred for audiologic evaluation (pure tone audiometry, tympanometry and DPOAE assessment etc). In addition, 5% (246 children) of those who pass the initial SHS screening took the rescreening to assess the SHS stability, and from all the participants, another 312 children (5%) were randomly selected to receive audiology assessment for the test accuracy analysis.

Results: In this study, of the eligible 6288 preschool children, 582 children (9.3%) tested positive in the screening, and the referral rate of the four age groups from 3 through 6 years old was 18.8%, 11.9%, 6.5% and 4.0% respectively. Younger children showed higher positive rate and longer test time than older ones (p<0.01). A total of 463 children underwent audiological assessment, of which 12 cases (1.91‰; 95% CI: 0.83‰, 2.99‰) were diagnosed with permanent hearing loss, and 75 cases (1.19%; 95% CI: 0.92%, 1.46%) were diagnosed with temporary conductive hearing loss. The specificity of the system was 92.6% and the sensitivity was only 37.5%, with a kappa value of 0.504 for the test-retest reliability.

Conclusion: SHS has characteristics such as easy operation, reproducible results, automatic judgment and recording, etc. This screening system is suitable for the universal hearing screening of preschool children above 4 years old, and further improvements are needed to increase its sensitivity.

36 - EAR GAMES VIDEO GAME AS A HEARING SCREENING TOOL IN PRESCHOOL CHILDREN

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Hearing screening in preschool children is essential for detecting hearing pathology early and prevent potential deleterious effect of hearing loss on education achievements of a child. Hearing impairment, affecting 1% of pediatric population aged 5 to 7 years, could cause problems in speech-language development, attention, learning and social functioning of a child.

The authors will present preliminary data from a pilot project of hearing screening in preschool children using video game Ear Games, conducted in cooperation of Faculty for special education and rehabilitation with Rotary club Belgrade Singidunum. Similar screening procedure has been used in 30000 5-year olds in Italy (Lombardy region) from 2003 through 2011.
The objective of a study was to determine if Ear Games video game is an adequate screening tool for detecting preschool children with potential hearing impairment.

The sample for the pilot study consisted of 199 children (105 boys and 94 girls) aged 5 to 7 years from a kindergarten in Belgrade (Savski venac). They were screened by the use of Ear Games video game. The task for a child is to push the button on a computer every time he/she hears a tone through headphones in either ear. Frequency range is from 250 Hz to 4 kHz. Computer stores results for each ear separately. Duration of the game is 6 minutes. The children who failed the screening were referred for further audiological testing in order to confirm or exclude hearing loss.

Preliminary results of the study have shown no statistically significant difference between genders. Mean score was 8.27 for boys (SD=2.072) and 8.56 for girls (SD=2.045). There was no statistically significant difference between left and right ears within the groups (L-0.563; R-0.594). Spearman correlation coefficient did not show correlation between age and overall score on the test. A group of 32/199 children (16.2%) who failed screening by a video game were referred for further testing of hearing, speech and/or attention.

Acknowledgements: Complete IT equipment and software for the Ear Games has been provided by Rotary clubs Belgrade Singidunum and Milano Linate. Members of Rotaract club Belgrade Singidunum and postgraduate students of FASPER contributed to this study as well.

37 - UNIVERSAL NEWBORN HEARING SCREENING PROGRAM: WHAT COMES AFTER?

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Introduction: Bilateral permanent congenital hearing impairment (PCHI) is one of the most frequent congenital disease. A delayed identification can compromise child’s development of speech, language, cognitive and psychosocial skills. During the last years the number of infants evaluated for PCHI at birth has increased with universal hearing screening program (UNHS). One of the most urgent challenges of intervention programs involves follow-up among families whose infants were diagnosed a hearing loss.

The aim of this study was monitoring the cases of children and teenagers with hearing loss and the incidence in our county.

Methods: The update of the database regarding children and teen-agers with hearing disorders, who are seen by NPIA of Local Health Service, has been the starting point for the present work. The research focused on a sample drawn from patients with hearing disease who, over the last ten years, were given a diagnosis of hearing impairment, classified according to the classification ICD.10.

Results: A sample of 136 patients with hearing disorders has been selected, among them 81 are males (59.6%) and 55 are females (40.4%), which represents approximately 1% of the population receiving care by Local Youth and Childhood Neuropsychiatry Service. The distribution of statistics according to the diagnosis year shows that 117 new hearing cases have occurred in the period between 2006 and 2012.

Conclusion: Data storage systems is crucial for the monitoring of children hearing impairment, not only in order to develop the rehabilitation program, but also for a prediction of health needs, that are underlying every regional health planning. About 1% of population seen by Local Youth and Childhood Neuropsychiatry Service was diagnosed a hearing loss and the social and human impact
of this disease on children's life is considerable. It is, therefore, necessary to assure an early access to services with the aim of providing continuity of care and high quality cure, which is made possible through a multidisciplinary team able to provide a child with efficient integrated care pathways.

### 38 - ASSESSMENT OF HEARING OF UNDERGRADUATES IN SOUTH WESTERN NIGERIA

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Researches around this side of the globe have been concentrated on persons with hearing impairments, aviation workers, factories workers and nothing has been done in the area of the so called normal people or student whose social lifestyles and environmental factors predisposes than to hearing loss on daily basis. This research was therefore carried out to conduct hearing assessment of undergraduate in south western Nigeria in order to find their hearing level to detect possibility of hearing loss among the normal population, and find the possible causes of hearing loss.

Researchers made use of six universities with a total number of 1200 volunteer students as participants using description survey design of expo facto type. The students were given questionnaires to fill in order to gather information about their social lifestyle, Medical history and family background. Those that have history of hearing losses or have being on medication that could cause hearing loss were exempted from the study. Otoscopy and pure tone audiometry was carried out on the students after being informed about the purpose of the research. The findings of the study reveals that among the so called normal students, there are some who have different degrees of hearing losses ranging from mild to severe cases, it also confirms other researches that social lifestyles (such as use of musical enhancement devices, alcohol intake) engaged in by young adults of this millennium do expose them to hearing loss unknowingly.
PARENTS AND FAMILIES

39 - THE NEED FOR INFORMATION, SUPPORT AND EMPOWERMENT FOR PARENTS TO INFANTS AND CHILDREN WITH HEARING IMPAIRMENT – THE CONCEPTION OF A HANDBOOK

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Early intervention and on-going support are requisites in the management of families with children who have significant hearing loss.

The aim of the project was to produce a handbook for parents with a summary of evidence-based family-centered interventions. Other intentions were to present tools that can empower parents and support children in achieving self-esteem, appropriate communication, language and literacy.

Three sources were employed to define focus areas. The Swedish parent organization Barnplantorna opened a Facebook group. Topics perceived as important to parents with children using cochlear implants and/or hearing aids were asked for. A web-based survey to professionals working within pediatric audiology in western Sweden asked for areas in which they would like to council parents. Responses from parents and professionals were grouped. Informational material available to parents from the main care provider in western Sweden was analyzed. The authors made decisions on the contents of the handbook on the basis of these three information sources, and their long professional experience.

The printed handbook was divided into four sections: Diagnosis; Early family intervention; Pre-school years; School years. Each chapter presents information, evidence-based interventions, suggestions for interventions, and support that can be captured outside the family.

There are many stakeholders providing information to parents. Still, we could not find any Swedish publication that families could follow during their child’s upbringing. We believe that parents can be empowered, given the opportunity to participate and learn in a context in their “readiness for change”. We hope that the handbook will support parents in identifying the needs, challenges and utmost, the possibilities, for their child with hearing loss.

40 - QUALITY OF LIFE OF THE MOTHERS OF CHILDREN WITH COCHLEAR IMPLANTS: THE EFFECT OF A GROUP LOGO THERAPY

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The present study was conducted to investigate the effectiveness of group logo therapy on increasing the quality of life of mothers with cochlear implanted children. This study was an applied and experimental research with pre-test, post-test and follow-up test and control group. The population comprised all the mothers’ with cochlear implanted children who have attended in special schools. The study participants were selected through purposeful sampling. They were approachable volunteer subjects, who were then randomly assigned to the case group (n=15) and control group (n=15). Both group members tested based on the quality of life scale in the stages of
pre-test and post-test. The intervention was a group logo therapy consisted of 9 sessions each taking 90 minutes. Data was collected and processed through SPSS to calculate the mean score, standard deviation, t-test and analysis of covariance. The results showed that the intervention was significantly effective on increasing the mean score of the quality of life of mothers of cochlear implanted children in the case group compared to that of the control group. Thus, group logo therapy intervention can be effective in improving and increasing the quality of life of mothers with cochlear implanted children.

41 - THE EFFECTIVENESS OF RESILIENCY TRAINING PROGRAM ON QUALITY OF LIFE COMPONENTS MOTHERS OF HEARING IMPAIRED CHILD

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Caring for a child with hearing loss affects the quality of life of mothers and can increases their stress levels. The present study examined the effectiveness of the program on stress and resiliency of mothers of hearing impaired children. Our research method was a semi-experimental pre-test and post-test with control group. Sampling method to select a sample size of 30 case in the control and experimental groups were replaced. Abidin’s Parenting Stress Questionnaire pre-test and post-test were used. Results Using ANCOVA the significance level (p ≤ 0.01) were analyzed and the results showed that Resiliency Program were effective to lower mothers stress levels.

42 - QUALITY AND READABILITY OF INFORMATION PAMPHLETS ON HEARING AND PAEDIATRIC HEARING LOSS IN THE GAUTENG PROVINCE, SOUTH AFRICA

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Objective: The implementation of early hearing detection and intervention (EHDI) programmes are necessary in order to facilitate the early identification of hearing loss. An important component of EHDI is parental education. International and national guidelines stipulating that comprehensive, unbiased and appropriate information pamphlets should be provided to parents as part of EDHI programmes, however little is known about the availability and readability of such materials in South Africa. The objectives of this study were therefore to determine the availability of information pamphlets on hearing and hearing loss in children at public hospitals in the Gauteng Province of South Africa. In addition, the quality and readability levels of these pamphlets were determined.

Methods: A non-experimental, descriptive research design was employed for this study. Information on the availability of leaflets at public health hospitals was obtained through a telephonic survey. Twenty-one information pamphlets available at these hospitals were then evaluated to determine the quality and readability levels.

Results: It was found that 73% of audiology departments at public hospitals in Gauteng had information pamphlets available on hearing and hearing loss in children. Of the pamphlets evaluated, the majority were rated to ‘present with serious problems’ questioning the quality of the content included. In addition, it was found that on average the readability level of these pamphlets were at a sixth-grade level, much higher than the recommended fourth-grade reading level.
Conclusion: The need for development of quality educational material focused on providing parents with unbiased, comprehensive and appropriate information on hearing and hearing loss in children has been highlighted. Proposed guidelines were recommended to assist audiologists in this endeavor. The importance of providing appropriate parental educational materials for the success of EHDI in South Africa should not be underestimated.
EHDI PROGRAMS

43 - ARE WE SCREENING THE CORRECT BABY?

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The Australian National Safety and Quality Health Service Standards mandates that all patients be identified by at least three approved patient identifiers prior to undergoing any procedure. Babies are not able to verbally identify themselves and reliance on a cot card is not sufficient, as babies have been placed into the wrong cots. There are known instances of the incorrect newborn undergoing a procedure. Newborn hearing screening services are vulnerable to the same challenges – relying on checking a cot card alone has resulted in the incorrect baby being screened. Additionally, the hearing screen may have been undertaken without the parent or guardian providing informed consent.

Analysis of data from the Victorian Infant Hearing Screening Program (VIHSP) identified that there are occasions when a hearing screen has been performed on an incorrectly identified baby, or an incorrectly identified twin. There are significant implications when this occurs including unnecessary stress and anxiety for parents, the correct infant not undergoing screening (while their record erroneously indicates they have), requirements for call-back of infants for screening, and reduction in stakeholder and public confidence in the screening process.

Following a trial of mandatory checking of three approved identifiers prior to completing a hearing screen, VIHSP has now amended the screening procedure making it mandatory that all in-patients have their identification band checked for full name, date of birth and address before completing a hearing screen.

Compliance with the amended procedure has been validated through observational audits. Manually uploaded screening result data has also been reviewed to verify the results belong to the correct baby.

The VIHSP hearing screening procedure is now compliant with the ACSQHC (Australian Commission for Safety and Quality in Healthcare) National Standards for patient identification which is a requirement for hospital accreditation under the ACHS (Australian Council on Healthcare Standards).

44 - HEARING-SCREENING RECORD-KEEPING PRACTICES AT PRIMARY HEALTHCARE CLINICS IN GAUTENG

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Objectives: As little is known about hearing screening practices at primary health care (PHC) in South Africa, the study aimed to describe hearing screening- and record keeping practices of nurses during typical immunization sessions at PHC clinics in Gauteng, South Africa.

Methods: Data was obtained through observations ($N_2 = 80$) and questionnaires ($N_1 = 20$) which were then cross-checked to retrospective information collected from the Road-to-Health Charts (RtHC) and City of Johannesburg (CoJ) Child Health Services Blue Cards of children observed during typical immunization sessions.
Results: A key finding of this study was that PHC nurses who participated in this study do not adhere to the hearing screening record keeping practices as outlined by the National Department of Health (DoH).

Conclusions: Poor record keeping practices hinder service delivery which are necessary components to manage early hearing detection and intervention (EHDI) programmes effectively. Good and accurate record keeping practices are key elements in providing a means of outcomes measure to the efficacy of hearing screening programmes.

45 - REDUCING THE OUTPATIENT RECALL RATE IN THE UNIVERSAL NEWBORN HEARING PROGRAM: A PROCESS IMPROVEMENT PROJECT IN KK WOMEN’S AND CHILDREN’S HOSPITAL, SINGAPORE

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Aim: Newborns who do not pass the inpatient automated auditory brainstem response (AABR) are rescreened at 3-6 weeks of life in the outpatient clinic. Our aim was to reduce the outpatient recall rate by 30%.

Method: 3 parts of the current work flow were amended: 1. screening all newborns in the nursery at 7am in the morning, instead of trying to locate those scheduled for discharge, who might be with their mothers in their rooms and would need to be transported to the nursery for screening, 2. rescreening newborns immediately if they did not pass the first test, instead of waiting for the next day or giving an outpatient appointment and 3. amending the screening hours of one screener from 7am to 3pm to 9am to 5pm. The project was carried out in October 2013. Data was obtained from the hearing database and from manual records. Results were compared with screening data of October 2012.

Results: 863 newborns were screened in October 2013. The outpatient recall rate was 0.6% compared to 5.6% in 2012. The inpatient pass rate increased from 77% to 81.6%. None of the 157 infants who had a “refer” result at the first screen missed being rescreened before discharge, compared to 27.8% of 133 eligible infants in 2012. The ratio of newborns to number of inpatient screens was 1:1.22 in 2012 and 1: 1.24 in 2013 (P>0.05). 78 screens were performed after 3pm (7.3% of total screens). There was no significant difference in the pass rates of infants who were screened within the first 6-12 hours of life compared to those screened at 12-24 hours of life.(p>0.05)

Conclusion: 3 simple steps successfully reduced the recall rate to 0.6%, with resultant saving of resources, time and effort of parents and staff.

46 - NON-PARTICIPATION IN UNIVERSAL NEWBORN HEARING SCREENING

Degn C

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The universal newborn hearing screening (UNHS) program has been nationally implemented in Denmark since June 2005. However with a participation rate of 93%, the program does not meet international standards as set by the Joint Committee on Infant Hearing. This screening shortfall
exists despite the fact that health care in Denmark, including UNHS, is free of charge for all residents. The participation rate is also markedly lower when compared to the heel prick test, which achieves coverage of near 100%.

This lack of participation can partly be explained by the fact that UNHS in Denmark is not carried out until the child’s second day of life, a time where most families are already discharged from the hospital, subsequently making it difficult for the program to track families that do not return for the initial screening. In this ongoing study the selected national registers are linked on an individual level for all children born in Denmark in the years of 2008 to 2011 (251,000 children). The focus of the study is to compare families of children who attended the screening program with those who did not via their respective socio-demographic factors as well as the structural conditions involved in the maternity care process in order to identify the barriers to participation.

47 - NEWBORN HEARING SCREENING: THE AGE OF DIAGNOSIS ACROSS THE YEARS

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Background Information: The Joint Committee on Infant Hearing has endorsed early detection of and intervention for infants with hearing loss for long time. Our National systems of newborn hearing screening (NHS) has started and aimed to reduce the time of diagnosis since 2004.

Objectives: The current study was designed to determine the performance of diagnosis duration across the years.

Material and Methods: 117 infants who had obtained ‘failed’ in first screening in our national programme of our and other hospitals were enrolled for this retrospective study. We analyzed age of diagnosis according to each year from 2004 to 2012.

Results: Kruskal Wallis was used for the statistical analysis. Although there was no statistical significance, the numeric values reveal that in 2012 the age of diagnosis has declined compared to the value obtained in 2004.

Conclusion: our results showed that age of diagnosis hasn't timely improved since 2004. When we analyzed accurately, this outcomes were affected by late refer from other hospitals, transportation difficulties because of geographical condition, attitude of families. Another important factor which should be considered as a cause is that in the current hospital system, newborn hearing screening procedures are performed within the densely populated clinical interventions routine. Accordingly it is important to note that the newborn hearing screening practices should be implemented within separated NHS centers.

48 - BI-DIRECTIONAL DATA TRANSMISSION BETWEEN MOBILE TEST INSTRUMENTS AND TRACKING SOFTWARE BY THE EXAMPLE OF NEWBORN HEARING AND PRESCHOOL SCREENING

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Tracking procedures within public health care programs require the highest quality data available from all participating institutions. Redundant documentations as well as data transmission via
subsystems has proven to be inadequate for tracking purposes as they increase error rates. In contrast, direct and bi-directional communication between a mobile measuring device and the tracking-server using wireless radio modem technology enables prompt transmission of information and results and facilitates tracking of positively tested infants and children.

In today's newborn and preschool hearing screening, modern mobile measuring devices exist which integrate physiological and psychoacoustic measurements for screening and follow up. The advantage lies in the potential of data being recorded at one site and being automatically and promptly transferred to other sites which enables immediate usage of the data.

The stored measurements, patient data and diagnostic findings are sent directly to a central database. A request function on the measuring device can be used to receive and display all previous results of a patient from the tracking center. Data transmission takes place via an external GRPS/UMTS radio modem. Each test result contributes to the status of the child. All results, including graphs, comments, patient documentation, reminder letters, and phone protocols are stored and processed in the software. Tools for quality and completeness control and verification of status completion are integrated. An integrated statistics module provides scientific evaluation and benchmarking. Finally, the software is prepared for online peer-reviewing of anonymised results as is increasingly important in the field of telemedicine.

This "out of the box"-solution enables a secure and direct data submission without reference to local IT-systems. In addition, it is particularly suitable for the use of mobile measuring devices irrespective of their location, making it a unique "site-independent" solution.

49 - PREPARING AN ELECTRONIC VERSION OF THE LITTLEARS® AUDITORY QUESTIONNAIRE (MED-EL) FOR A SECOND HEARING SCREENING – RESULTS AND PLANS FOR THE FUTURE

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In this study an electronic version of the LittlEARS® (MED-EL) Auditory Questionnaire (LEAQ) is investigated. LEAQ was established in 2008-2010 in a German field study as a “second hearing screening” to detect children with a hearing disorder between 9 and 14 months of age.

In a group of n=5320 children that were screened with the paper-and-pencil version of LEAQ at a regular paediatrician check-up visit, 185 children (3.5%) had a conspicuous screening report. A follow-up examination three years later showed that 6 children out of these 185 were affected by a permanent hearing loss which is consistent to an incidence rate of hearing disorders in the study group of 1.1 per 1000. This confirms the expected prevalence rate of 1-2 per 1000 of infantile hearing loss.

The results of the German field study suggest that the LEAQ can serve as a screening tool to identify children with progressive or late-onset hearing disorders that could not be detected by the newborn hearing screening (NHS) shortly after birth.

The electronic version of LEAQ is expected to have significant advantages over the existing paper-and-pencil version. In the paper-and-pencil version paediatricians have to determine the exact chronological age based on which they have to look up the critical value that needs to be applied. Also the score needs to be calculated manually to determine whether a child has a conspicuous screening
report. In the electronic version, all these steps are automated. Furthermore, the electronic version makes it possible to present LEAQ in different languages and countries via Internet.

The electronic version of LEAQ is currently tested by paediatricians that had already been involved in the German field study. The final version of this paper will present results of the electronic study and compare them to the outcomes of the paper-and-pencil version of LEAQ.

50 - EXPERIENCE FROM A NEWBORN HEARING SCREENING PILOT PROGRAM IN NORTHERN FRANCE

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A pilot program of neonatal hearing screening was conducted from 2006 to 2012 on 160,000 newborns in Northern France. Screening was generalized by the French authorities in 2013.

Methods: The first test (AABR or OAE) was performed 36 hours after birth: if positive, a retest (AABR) was done 12 hours later. Newborns failing twice were referred to a specialized ENT unit. When hearing loss was confirmed, children were followed by an audio phonology team.

Results: 99.62% of the neonates were tested; 5.8% failed first test and 1.3% failed twice.

Of the 2127 cases referred to the specialized ENT unit, 156 had a bilateral hearing loss classified as “moderate” to “profound”. Confirmation of the diagnosis often needed repetitive ENT assessments. Among these 156 children, 52 had a family history of hearing impairment, 14 a neonatal risk factor and 57 a malformation syndrome. Genetic study was positive (connexin 26) in 19 cases (34 investigations).

Care was totally refused by parents for 4 children with hearing loss.

A high rate of nonattendance to the outpatient clinic was reported presumably reflecting difficulties for parents to deal with the deafness of their child and/or misunderstandings with health professionals. BTE hearing aid was proposed in 143 cases (50% before 15 months of age) and cochlear implant thereafter in 49(50% before 20 months of age).

Follow up >24 months was available for 105 children but complete for only 56. Communication ability was considered as good for 46, intermediate for 37 and limited for 26. Evaluation of individual performances was difficult without an efficient network.

Conclusion: Neonatal hearing screening is easily done and reliable. Confirmation of hearing loss may be long and difficult. A network of health professionals dedicated to the management of hearing impaired children is necessary.

51 - FIFTEEN YEARS OF A UNHS: AN OVERVIEW OF 1 MILLION SCREENING TESTS

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Kind en Gezin initiated universal newborn hearing screening in 1998. Since then one million babies have been screened by 750 district nurses.
In 2006 and 2012 the current screening devices were replaced, and new protocols were implemented. In collaboration with ‘centres of reference’ for diagnosis, early home based guidance and rehabilitation, a unique recall system was set up in order to limit ‘loss-to-follow-up’.

Information technology can make a significant contribution to the quality of the screening programme by ensuring consistently high coverage and limiting ‘loss-to-follow up’.

This poster gives an overview of the evolution of the screening programme over the last 15 years, focussing on new developments in the electronic referral system and data collection.

52 - UNIVERSAL NEONATAL HEARING SCREENING IN PORTUGAL: STATE OF PLAY

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Objectives: This study aimed to know the Portuguese reality of early hearing detection and intervention in order to: understand the functioning of the various programmes; analyze their level of effectiveness; propose strategies to improve its functionality.

Methods: To perform the investigation, 57 hospitals/(maternities) were contacted. From these, 40 responses were obtained, but as in 3 institutions the neonatal hearing screening is not currently held, only 37 questionnaire replies were received, 4 institutions did not answer the questionnaire and the other 13 did not answer at all. All data collected were then used for statistical analysis, ensuring its confidentiality.

Results: The working protocols of the programmes used in the sample under study are distinct, but all meet the recommendations published by the “Grupo de Rastreio e Intervenção da Surdez Infantil”. In 86.5% of the institutions studied, the programmes implemented are universal and the coverage rate is between 92% and 100%, with an average of 97.8%. From the sample collected, six institutions referred not possess current and available statistical data of screening.

Conclusion: The existence of a national database would make it possible to know the reality of all institutions, thus obtaining a better knowledge about the quality of each programme.

53 - IMPLEMENTATION OF NEWBORN UNIVERSAL HEARING SCREENING IN CATALONIA, SPAIN

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Introduction: Catalonia is an autonomous region located in the northeast of Spain. Newborn universal hearing screening was introduced in 2010 by the public health department. Hearing screening program was previously developed by an interdisciplinary team of experts in children hearing loss and registered in a document. The program consists on four steps:

Step 1: screening is performed in maternity hospitals by automated auditory brainstem response test (A-ABR).

Step 2: diagnosis is carried out in a reference unit of infant hearing loss (RUIH), allocated to otolaryngology department, Sant Joan de Déu University Hospital.
Steps 3 and 4: treatment and monitoring of all hearing loss infants diagnosed is done jointly between public health-education specialized team.

Screening program is monitored by health department through a computerized database.

**Cronology of implementation:** August-december 2010: training programs to screening teams maternity hospitals; performing database between health department, maternity hospitals and RUIH; start of screening programs

2011: total newborns: 81,133; newborn screening performed: 53,324 (66%); screening newborns registered in database: 37,303 (70%).

2012: total newborns: 77,098; newborn screening performed: 51,134 (66%); screening newborns registered in database: 45,639 (89%).

2013: under evaluation, awaiting results.

**Conclusion:** The implementation of newborn universal hearing screening in Catalonia is continuous and progressive and it is monitored by public health department. Program includes comprehensive care for children with hearing loss with a public interdisciplinary early intervention between public health and education departments. The obtained results are reported.

### 54 - ANALYSIS OF THE IMPLEMENTATION NEWBORN HEARING SCREENING PROGRAM IN SANT JOAN DE DÉU UNIVERSITY HOSPITAL, SPAIN

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Detection of infant hearing loss has been a discussion topic since longtime that has promoted development of different screening hearing loss programs. Integration of these programs to Public Health System has been performed differently from country to country.

In Catalonia (Spain) newborn hearing screening (NHS) was introduced in February 2010 by the Public Health System. 39 Catalonia Maternity Hospitals must perform NHS. AABR is the test choose. If it fails twice (birth and one month) the child is refered to RUIH (Infant hypoacusis reference unit) for diagnosis. Treatment and follow up is done between Health-Education Public department.

Result of screening test are collected in a database. Theoretical and practical training is offered before starting programs to Maternity Hospitals team.

Our goal has been to analyze results obtained in Sant Joan De Déu (HSJD), the first maternity that started the screening program.

2011: 3468 (98%) infants screened from 3532 HSJD Maternity newborn; 36 infants referred to RUIH; 29 (1%) FP; 7 (2.3x1000) infants hearing loss

2012: 3201 (97%) infants screened from 3294 HSJD Maternity newborn; 31 infants referred to RUIH; 28 (1%) FP; 3 (1x1000) infants hearing loss

2013: evaluation in process

The results observed show a level of coverage greater than 97% of newborns with a false positive rate of 1%.

Sant Joan De Déu NHS program is subject to a periodic revision between Public Health System in order to achieve on early implementation as a model to the Catalonia Region (Spain).
55 - DEVELOPMENT OF NETWORK OF NEWBORN HEARING SCREENING PROGRAM IN REPUBLIC OF MACEDONIA

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Introduction: Government and Ministry of Health of the Republic of Macedonia recognized the importance of introduction of NHSP. To bring Macedonia in level with international practice and successful programs in USA, Canada and EU countries they work on development of network of NHSP. Screening equipment (TEOAE-OtoRead, Interacoustics) was delivered to the hospitals in: Bitola, Tetovo, Strumica. At present we work on second phase-Government will supply equipment for next 3-5 cities in the country.

Aim: Our goal is to reduce the age at which infants with hearing loss were diagnosed and treated in the Republic of Macedonia (an annual birth rate is approximately 23000 newborns). Main problem is low comprehension with NHSP.

There is one practical solution to achieve good inclusion and to ensure equal access to NHSP for all children in the country. In January 2014 the national coordinator proposed to the Government and Ministry of Health MAP Project (Mobile Audiology Pediatric Project). Mobile Unit of Pediatric Audiology will give HS services to all children where network is not finished yet. Bitola, Tetovo and Strumica will get Cabinets for Pediatric Audiology (CAP).

Strategic Aim: for the first time in the country to develop integrated subsystem for high-risk infants and plus babies from NICU at University Clinic of Gynecology and Obstetrics (with an annual birth rate for 2013- 6000 newborns and 700 newborns from NICU-the only one for all babies in the country).

Methods: The protocol consisted of three stages. In the first two stages newborns were tested with transient click-evoked otoacoustic emissions. The first TEOAE test was performed by 24h of age (before discharge from hospital). The second one after 30 days in case of referral (in some cases babies were screened with the second TEOAE before the discharge from the hospital). The third stage was performed by diagnostic ABR, for those babies who failed the second TEOAE stage. MAP will use Interacoustics Titan with screening TEOAE and ABR.

Results: Our Report includes 4 main cities from 4 main country regions. The whole number of screened babies is 4300: 3980 without risk and 320 at risk of hearing impairment. Bilateral HI was identified in 12 newborns (7 from the no-risk and 5 from the at-risk population). Unilateral HL was found in 3 newborns from at-risk population.

Conclusions: The results show that the implementation of a hospital-based, UNHSP in the Republic of Macedonia is effective. MAP Project will introduce ongoing surveillance-audiological monitoring throughout infancy and early childhood of those children at risk for developing HL. These will strengthen our commitment to prevention and early identification to give young children the best possible start in life.

56 - HEARING SCREENING OF NEWBORNS AND INFANTS IN VARNA

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In 2008 the Association for prevention of hearing – Varna started hearing screening for newborns and infants. Our work proved that hearing screening can be held without financial support. But is this
enough? Of course not, however it gives chance to more than 40% of the newborn children in Varna and the region to be examined.

We work mostly with premature newborns, but every child has the chance to be examined. During the last 2 years we have screened also children between 1 and 7 years old in their GP-practice offices. With the help of Lions Club – Varna, together with the vision screening, we make OAE-exams in children up to 18 years old. We offer also audiometry tests to all older children.

In newborns with suspicious results we repeat the examination at 3rd and 6th month. In all cases suspicious of hearing loss ABR is done.

As a result of our screening 1345 children of all ages were examined.

We hope to be able to include in the screening program more than 90% of newborns and infants in the future.

57 - COMBINED NEWBORN HEARING AND GENETIC SCREENING: NEW APPROACH TO ETIOLOGY OF CONGENITAL HEARING LOSS

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Progress in molecular genetic testing has changed dramatically the approaches to etiology of congenital and neonatal deafness. Numerous studies pointed out the significant role of the GJB2 gene mutations in the development of sensorineural hearing loss. Heterozygous carriers of the c.35delG mutant allele in a healthy population in some regions of the Russian Federation vary from 2 to 6%. Taking into account the absence of hereditary pattern in half of families genetic testing is the only way to reveal the real etiology of congenital hearing loss.

The cohort of 264 infants with bilateral nonsyndromal sensorineural hearing loss born from 2009 to 2012 underwent both hearing and genetic investigation. Hearing loss was diagnosed during the first year of life. GJB2 testing identified 171 infants (65%) with two mutations and 11 children (4.2%) carried one mutation. The average age of detailed audiological studies and diagnosis in this group of children was 5 months.

According to the ABR protocol among infants with GJB2-related hearing loss the severe bilateral impairment was diagnosed in 77% of cases. During the first examination the moderate hearing loss was detected in 11% of cases and mild hearing loss - in 12% of cases. Compared to our previous research in older children (from 3 to 16 years) with hearing impairment due to GJB2-mutations the moderate hearing loss was detected in 19% of cases and mild hearing loss was diagnosed in 5% of cases.

Universal newborn hearing screening itself allows to determine more accurately the clinical description of deafness associated with GJB2 gene mutations: the age of onset, type, degree, symmetry and the inheritance pattern. Hearing concurrent gene screening in newborns improve the efficacy of newborn hearing screening may confirm the abnormal results from hearing screening tests, help to find the etiology and recognize infants need of the full hearing examination.
National program For Early Detection of Hearing Loss in state of Qatar depends on Otoacoustic Emissions and Automated Auditory Brain Response.

Permanent congenital hearing loss affected 1-2 babies in every 1000 born, which increased in NICU cases to reach up 5-10% with history 48 hours admission to NICU. Early identification and management will give opportunity to babies with congenital hearing impairment to develop and acquire speech and language with the normal range of their peers.

**Objectives:**

- Early detection of hearing loss; 
- Early intervention; 
- Cost effectiveness; 
- Non invasiveness.

**Methods:**

1. Hearing screening with the use of (OAE) with follow up regularly till the pre school age through the 3 stages of testing:
   - Prior to hospital discharge
   - After 2 month
   - Pre school screening.

2. Hearing screening with the use of (OAE +AABR) for NICU cases and Newborn with family history of hearing loss with follow up regularly till the pre school age through 4 stages of testing:
   - Prior to hospital discharge
   - After 2 month
   - At one year of age
   - Pre school screening.

**Results:** More than 11,000 babies are screened for hearing impairment annually, the results matches the international statistic of hearing impairment per 1000 births, detailed results will be discussed in the poster.

**Conclusion:** Neonatal hearing screening is an effective program for early detection of hearing impairment. The test protocol has been shown an accepted and reliable result.
AUDITORY PERCEPTION AND PROCESSING

59 - NEURAL SYNCHRONY TO AMPLITUDE MODULATED TONES: RELATIONSHIP WITH INTERAURAL PHASE DIFFERENCE SENSITIVITY

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Hearing difficulties occurring in middle-age and later may be due in part to reduced neural synchrony to the temporal characteristics of sounds. Neural phase locking across frequency channels provides an accurate representation of the stimulus, and can be recorded from the auditory brainstem as the electrophysiological frequency-following response (FFR). This study aimed to determine whether the degraded interaural phase difference (IPD) sensitivity associated with hearing loss and age is related to poor neural synchrony. IPDs appear to be important for locating sounds and separating them from background noises based on azimuth. Listeners (N=46) varied in age (18-83 yr) and absolute thresholds and their IPD discrimination thresholds have been reported previously [King et al. (2014), JASA 134(1), 342-351]. Four amplitude-modulated (AM) tones were played simultaneously (and dichotically, two tones to each ear) to listeners at 80 dB SPL whilst the FFR was recorded. Two AM tones had low modulation rates (fm) of 16 and 27 Hz and the other two had higher fm (115 and 145 Hz). The carrier tones (fc) had frequencies of 307, 537, 357 and 578 Hz respectively. The FFR phase coherence at fm and fc was compared to discrimination thresholds for IPDs in the fm and fc of AM tones respectively. Age and absolute threshold (at 250 and 500 Hz) were used to predict neural synchrony and IPD discrimination using a MANOVA design. Preliminary results (18 of 46 listeners) do not suggest clear or consistent correlations between IPD discrimination thresholds and FFR. The mean FFR to the stimulus components (not fm) decreased with absolute threshold, but age was not correlated with FFR, possibly because of the narrow age range of the listeners from whom FFR has been measured so far.

60 - ELECTROPHYSIOLOGICAL AND BEHAVIORAL CORRELATES OF SEMANTIC PROCESSING IN SUBJECTS WITH AND WITHOUT AUDITORY PROCESSING DISORDERS

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Purpose: We studied the interaction between semantic and syntactic information in language auditory processing in participants with and without Auditory Processing Disorders (APD) using behavioral and electrophysiological (Event Related Potentials, ERPs) experimental paradigms.

Methods (behavioral): The sample was 37 adults Portuguese native speakers (3 with confirmed diagnosis of APD). Semantic categorization task: in auditory pathway subjects listen to series of words denoting entities belonging to a lexical field (objects, fruits, animals), in series of three words of the same field and a fourth unrelated item from another semantic field (total 236). Subjects had to decide whether the word heard belonged to the current semantic field or not, via a button box. Reaction times and accuracy were recorded.
Methods (electrophysiological): The sample was 21 adults (3 with APD). Experimental conditions as above adapted for ERPs methodologies.

Results: In subjects with APD, the global reaction times (RT) were significantly higher than those of subjects without APD: 658ms and 587ms. However, in what concerns the congruency effect, the response profile of subjects with APD does not go in the same direction: incongruous words trigger lower RT than semantic related words. (617ms vs 671ms). ERP’s late positive waveform’s amplitude was significantly higher for unrelated words in left frontal anterior EEG channel. The same ERP’s effects were consistently observed in the subjects with APD.

Conclusions: The results suggest that subjects with APD process semantic information differently from normal subjects: the longer time to integration semantic related words in APD could increase the attention state to detect the semantic incongruence?

61 - CONCURRENT SPEECH SEGREGATION PROBLEMS IN HEARING IMPAIRED CHILDREN

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Objective: This study was a basic investigation of the ability of concurrent speech segregation in hearing impaired children. Concurrent segregation is one of the fundamental components of auditory scene analysis and plays an important role in speech perception. In the present study, we compared auditory late responses (ALRs) between hearing impaired and normal children.

Materials/Methods: Auditory late potentials in response to 12 double vowels were recorded in 10 children with moderate to severe sensorineural hearing loss and 10 normal children. Double vowels (pairs of synthetic vowels) were presented concurrently and binaurally. Fundamental frequency (F0) of these vowels and the size of the difference in F0 between vowels was 100 Hz and 0.5 semitones respectively.

Results: Comparing N1-P2 amplitude showed statistically significant difference in some stimuli between hearing impaired and normal children (P-value<0.05). This complex indexing the vowel change detection and reflecting central auditory speech representation without active client participation was decreased in hearing impaired children.

Conclusion: This study showed problems in concurrent speech segregation in hearing impaired children evidenced by ALRs. This information indicated deficiencies in bottom-up processing of speech characteristics based on F0 and its differences in these children.
PATIENTS’ PERSPECTIVE

62 - EFFECT OF SPEECH RECOGNITION TESTING ON SELF-REPORTED STATE ANXIETY

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Clinical measures of speech-in-noise and dichotic listening are designed to be difficult, thus tapping into the speech understanding difficulties faced by hearing-impaired patients. Task difficulty, however, has been associated with increases in an individual's state anxiety, potentially adversely affecting test performance. Therefore, the purpose of the present study was to assess increases in state anxiety as a function of four common clinical measures of speech recognition: the Quick Speech in Noise test (QSIN), the Speech Perception in Noise test (SPIN), the Words in Noise test (WIN), and a the VA Dichotic Digits test (DD). State anxiety, as measured by the state-trait anxiety inventory (STAI) was measured pre- and post-speech recognition testing across three groups of subjects: young, middle-age and older adults. Results revealed significant increases in state anxiety from baseline for the SPIN, WIN and DD tests for the middle-age adult group, and for the QSIN and DD tests for the older adult group. No significant increases in state anxiety as a function of speech recognition testing were observed for the young adult group. Recognition performance on all speech measures was as expected, with the young adult group performing the best and the older adult group performing the poorest. The relationship between speech recognition performance and state anxiety was also examined, and no significant correlations between performance and state anxiety were found. Although task performance was not adversely affected by increases in anxiety level, significant increases in state anxiety were noted across multiple measures, especially for the middle-age adult group. Results from the present study suggest that clinical measures of speech recognition impact the state of the patient, often raising their anxiety level. Awareness of the patient’s state anxiety by the audiologist may be beneficial for patient comfort and counseling purposes before and after diagnostic testing.

63 - BRAZILIAN HEARING HEALTH PROGRAM: COMPLAINTS ABOUT THE SUPPLIED HEARING DEVICES

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Introduction: Those who have a hearing loss are directed to the process of rehabilitation which begins, in many cases, with selection and adaptation of hearing aids. Since the fitting is a process and not an isolated event, it is expected that, during the adaptation, the users have complaints about the device, however these complaints must not be so important that they'll feel discouraged to use the device.

Objective: Verify the complaints of adults and elderly about the hearing aids supplied by the Health System of Brazilian Government.

Methods: Retrospective documental research. The health records of the adults and elderly who received hearing aids by the “Hearing Health Program” of the University of Campinas (UNICAMP)
between August and November of 2011 were analyzed. Adults and elderly were separated into different groups called “group A” (adults) and “group E” (elderly). The complaints about the hearing aids were analyzed.

**Results:** Group A was formed by 56 adults, 32% male and 68% female, with average age of 45 years old. Group E was formed by 103 elderly, 48.54% male and 51.46% female, with average age of 75 years old. In both groups the majority presented from zero to two complaints in one year. The most presented complaints were “not using the device”, followed by “low power device” and “uncomfortable ear mold”. There was not a significant difference about the complaints between the two groups.

**Conclusion:** Few complaints were presented in both groups.

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**64 - A DUAL-SENTENCE PARADIGM USING PRESTO TO ASSESS THE EFFECTS OF HEARING AID ALGORITHMS ON COGNITIVE PROCESSING**

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There has been a recent surge in the use of dual-task paradigms that attempt to measure listening effort and how it may be eased by different hearing aid processing strategies or how it may be adversely affected in younger or older listeners. These measures operate under the assumption that listeners have limited cognitive capacity and that performance differences on secondary tasks reflect the amount of cognitive resources or effort allocated to perform the primary task. Previous paradigms have used secondary tasks, such as reaction time or word recall, that do not necessarily reflect the listening demands of real-world situations in which listeners need to pay attention to a speaker while mentally rehearsing or taking notes on the speaker’s previous point. We designed a new test paradigm to be more representative of these learning situations. In the dual-sentence task, listeners hear sequential pairs of PRESTO (Perceptually Robust English Sentence Test Open-set; Gilbert et al. 2013, J Am Acad Audiol 24:26-36) sentences in noise spoken by opposite gender talkers with a variety of American dialects. The primary task is a traditional speech recognition test, in which listeners immediately repeat aloud the second sentence in the pair. The secondary task is designed to engage explicit cognitive processes such as verbal working memory, retrieval, lexical organization, etc. by requiring listeners to write down the first sentence only after holding it in memory while processing and repeating back the second sentence.

Development and validation of the dual-sentence paradigm will be discussed as well as results from normal-hearing and hearing-impaired adults who identified sentences processed with digital noise reduction or with frequency lowering. Attempts to relate performance differences on the secondary task to individual factors such as verbal working memory scores and age will also be discussed.
65 - CORRELATIONS OF SELF-EFFICACY AND COPING IN THE QUALITY OF LIFE (QOL) IN TINNITUS

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Tinnitus is the sensation of sound without external stimulation. Its approach is difficult, we still do not know precisely its physiological mechanisms, medical therapy is not effective, and subjective complaints do not match with psychoacoustic measurements.

It’s a chronic condition, with consequences on the Quality of Life (QOL). Many authors concluded that coping strategies used were not always effective and coping was identified as a predictor of QOL in individuals with tinnitus, which reinforces the idea that the use of effective coping strategies should be promoted in healthcare settings. The relevance of self-efficacy, for instance, as an effectiveness indicator of an intervention for tinnitus patients, is also clear in the literature. In fact, self-efficacy is very important for individual behaviour. Nevertheless, no study on the relationship between self-efficacy and QOL in patients with tinnitus was identified, contrary to what happens in other populations.

This study intends to (a) analyse the relations between coping strategies of individuals with tinnitus and QOL; and (b) explore the relation between self-efficacy and QOL of this individuals.

A total of 49 individuals with tinnitus answered to a socio-demographic and clinical questionnaire, the THI (QOL), the Brief-Cope (coping strategies), and the Self-Efficacy Scale.

The results indicate there are no statistically significant relations between the Brief-Cope scores and QOL measured with THI, neither for the total scale neither for the three subscales. Additionally, a statistically significant (p <0.10), but relatively weak (r=-.243), Pearson correlation was found between self-efficacy and QOL.
NEW TECHNIQUES

66 - ROLE AND ECONOMIC EFFECTIVENESS OF THE NEW INTRA-OPERATIVE ECAP DIAGNOSTICS

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The aim of this study was to confirm that the second generation of remote assistant CR220 which was recently released by Cochlear Ltd. for measuring Evoked Compound Action Potentials (ECAPs) intraoperatively can replace existing bulky equipment; that less overall operating time is required to complete the standard measurement battery; and that there is a reduced need for experienced audiological staff to be present.

Attention was also paid to whether equivalent threshold results were achieved with the new remote assistant, including success of making measurements, compared to the standard clinical set-up.

Material and methods: 113 patients to date have been included in the study. A specially developed survey was developed which recorded the time taken for every stage of the measurement activity. General subject demographic information was also collected to determine if age or aetiology factors impacted the measurement process.

Results: “Unproductively” spent time—travelling, waiting or setting up/tearing down equipment is considerable, measured in hours rather than minutes. The ECAP threshold measurement time with the CR220 remote assistant is on average less than with the standard clinical equipment. However, the “unproductive” time is significantly greater than the measurement time with either system. No relationship has been identified between measurement time and aetiology or patient demographic. A full overview of the study results will be presented, with an estimate of cost effectiveness for a non-expert audiologist to conduct the measurement activity.

Conclusions: The availability of the easy-to-use, handheld CR220 remote assistant therefore provides considerable opportunities for increases in cost effectiveness of the CI implantation and clinical process.

67 - AUTOMATED HEARING TEST TECHNOLOGIES

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Automating basic hearing tests can increase the efficiency, accuracy, and accessibility of audiologic services. Automated testing can be performed by computer control of commercial audiometers or by new hardware platforms that can control test signals and manage patient information and test results. In this poster presentation we will describe a variety of technologies for automated testing including:

- A self-calibrating diagnostic audiometer
- A quality-control system for assessing the accuracy of an automated audiogram
- A portable tablet-based audiometer for air-conduction testing
68 - APPLICATIONS OF THE DUOTONE PROCEDURE

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DuoTone is a new procedure with the aim to measure auditory detection thresholds. While using pure tones or narrow bands of noise, two ("duo") stimuli are included: Stimulus-A is one long low frequency tone and Stimulus-B contains three short high frequency tones. Finally, stimulus-C is a third option containing just "silence".

During testing one of the three stimuli is presented and the subject selects the answer on a touch screen. The procedure runs automatically and for the stimuli A and B, independent adaptive procedure are used to find the detection threshold. The procedure takes about 40-50 seconds, i.e. about 25 seconds for each threshold.

Details of the procedure will be presented as well as first results in pilot tests with children and adults. An interesting additional application of duoTone will be presented as well. The duoTone thresholds can also be measured in noise. The noise is a CCITT-shaped stationary noise, with two spectral gaps around the lower and higher frequency. The measured thresholds provide information on the steepness of the auditory filter.

69 - SINGLE-TRIAL PHASE-DENOISING OF AUDITORY BRAINSTEM RESPONSES

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In recent years, we have thoroughly analysed the circular dynamics of instantaneous phase of auditory brainstem responses (ABRs) single-trials using time-frequency / Hardy space methods. Here we propose for the first time a single-trial phase denoising of ABRs.

A total of 2000 artefact free (artefact threshold 20V) individual ABR responses were collected from 20 healthy subjects (13f/7m mean age 24±4y), with no history of hearing problems and normal hearing thresholds (below 15 dB HL). The ABRs were evoked using clicks and broadband chirps at 40 and 30dB SPL, respectively. The band limited versions of ABR single-trials were Hardy space projected, the instantaneous phase extracted, and the resulting 'phase single-trials' arranged in matrix. We applied then a directional regularization procedure to this matrix phase. The regularized phase was then combined with the original amplitude value and back projected to the time domain.

We applied established schemes to assess the SNR of our ABR data. Partial averages of single-trial phase denoised versions exhibited a significantly improved signal-to-ratio as compared to the traditionally filtered signal for 40 and 30 dB data. In fact, as clear ABR and reproducible waveform was noticeable using a few hundred trials only. As the 'phase single trial' matrix can be decomposed, this scheme can also be applied for an online improvement of the conventional
averaging technique, i.e., the phase denoised single-trials are online averaged and displayed instead of the original trials.

It is concluded that phase-denoising can significantly improve the conventional averaging technique. The work of the authors has been partially supported by Deutsche Forschungsgemeinschaft (DFG), Grant STR 994/1-1 and STE 571/11-1, respectively.

70 - OBJECTIVE ELECTROPHYSIOLOGICAL ESTIMATION OF LISTENING EFFORT: ASSESSMENT OF DIFFERENT MICROPHONE SETTINGS

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An objective estimate of listening effort could support the hearing aid fitting procedure. Most of the digital hearing aids have already hearing aid settings which may reduce the listening effort, but the effects of these settings on the individual’s listening effort remain unclear.

In this study, we propose an objective estimate of listening effort using electroencephalographic data. The new method is based on the phase distribution of the ongoing oscillatory EEG activity. Based on our previous work on the objective estimation of listening effort, we hypothesize that effortful listening results in a low entropy phase organization of the Hardy space projected oscillatory activity.

This method was tested in 14 hearing impaired subjects (moderate hearing loss, 65.64 ± 7.93y 7f/7m). The tested hearing aid settings were a directional microphone combined with a noise reduction algorithm in a medium and a maximum level, the setting turned off as well as a setting using omnidirectional microphones. As test material, noise embedded sentences (Oldenburg Sentence Test) were used. The task of the subject was to repeat each sentence and to rate the perceived listening effort on a subjective scale.

The results indicate that the objective estimate of listening effort maps the subjectively rated effort and for a listening situation like the presented one, the maximum setting of the directional microphone requires the smallest effort. Further work includes to test the measure using longer listening periods and distractors.

The work of the authors has been partially supported by Deutsche Forschungsgemeinschaft (DFG), Grant STR 994/1-1.

71 - AUDITORY STEADY STATE RESPONSES: AN OBJECTIVE TECHNIQUE TO ASSESS THE AIR/BONE CONDUCTION SIMULTANEOUSLY

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Objective: To evaluate the possible interaction between Auditory Steady State Responses (ASSR) evoked by simultaneous presentation of air and bone AM tones by means of analysing the ASSR amplitude values and exploring the presence or not of the occlusion effect in well babies and normal hearing adults.
Design: The bone and air conducted stimulus were a sinusoidal carrier tone of 500 and 2000 Hz modulated in amplitude (95% depth) respectively. Both the air and bone stimuli were simultaneously applied in the same ear thorough insert earphones and bone vibrator respectively.

Study Sample: 69 well babies (135 ears) with ages ranging from 1 to 16 days (mean of 9.2 ± 7.9) and 12 normal hearing young adults (18 ears) with mean age of 22 ± 3 took part in this study.

Results: Our results have pointed out that there is no interference between both AM tones presented by air and bone simultaneous stimulation because we couldn’t find significant differences between the ASSR amplitude values. According to the literature we are unable to find occlusion effect in well babies, however we have validate our recording procedure trough the presence of occlusion effect in normal hearing adults.

Conclusions: We are confident that our findings support the use of air/bone simultaneous stimulation technique as hearing screening tools to discriminate between conductive and sensorineural hearing losses.

72 - MULTIPLE-CHOICE-AUDITORY-GRAFICAL-INTERACTIVE-CHECK (MAGIC), SELF-CONTROLLED PURE TONE AUDIOMETRY, FOR ADULTS WITH INTELLECTUAL DISABILITY

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Hearing disorders are rather frequent in intellectually disabled persons with earlier onset of hearing loss for the elderly. However, regular hearing checks are seldom performed even in institutionalized persons. An easy-to-use, small hand-held device for self-controlled hearing threshold determination for children was tested on intellectual disabled athletes during the Healthy Hearing program of the regional Special Olympics.

The Multiple-Choice-Auditory-Graphical-Interactive-Check (MAGIC) (Sentiero, Path Medical Solutions, Germany) was performed in 103 intellectual disabled participating in the Special Olympics (age 25 ± 7 years, 68 men, 35 women). It is an image-based self-controlled pure tone audiometry with a touch screen. Both ears were consecutively tested on an automated 4-frequency program. The testing was supported by non-specialized volunteers who had a one-hour training on the method. Next to MAGIC, otoscopy, tympanometry and TEOAE-Screening was performed.

In 89 athletes (86%), MAGIC could be performed with support of the volunteers. 14 athletes refused the test or were not able to follow the instructions. TEOAE-Screening could be performed in 92 athletes. Taking TEOAE-Screening for comparison, results of OAE and MAGIC were consistent in 80 right ears and 81 left ears (87,5%). Consistency was given when OAE screening was “pass” and PTA threshold was better than 30dB or OAE screening was “refer” and threshold was worse than 25 dB in the higher frequencies.

For most athletes of the Special Olympics, MAGIC could be applied for hearing testing showing high consistency to an objective hearing screening using TEOAE. The measurements can also be supported by non-specialized persons. In contrast to TEAOE screening manipulations on the ear are not necessary and frequency dependent hearing threshold information is available. For a wider use, e.g. in institutions for the intellectual disabled, the impact of age and experiences with technology such as mobile phone or PC on the performance with MAGIC should be investigated.
73 - USING FLOATING LINEAR GAIN COMPRESSION TO IMPROVE SPEECH RECOGNITION OF CHILDREN WITH MODERATELY-SEVERE HEARING LOSS

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Providing optimal audibility for speech cues is the primary goal of most prescriptive hearing aid fitting methods. Children spend a large proportion of their day exposed to abruptly and greatly changing levels of sound (Crukley et al., 2011). Consequently, they can benefit greatly from technologies that automatically adjust gain to maintain audibility without discomfort such as wide dynamic range compression (WDRC) with fast syllabic time constants (Attack/release: <40/<100 ms). Inherent to this processing is the effective reduction of the natural amplitude dynamics of acoustic signals. Only very little evidence exists comparing the effectiveness of different compression characteristics on pediatric listeners (Souza, 2002a, Marriage et al., 2005, McCreery et al., 2012). In this study, the relative speech recognition and listening effort performance of children was compared for a Floating Linear Gain (FLG) and syllabic WDRC gain processing. Fifteen children with bilateral moderately-severe hearing loss aged 8 – 12 years participated in the study. Word recognition was assessed using the Hearing In Noise Test for children (HINT-C). Listening effort was evaluated using a dual task paradigm that included the word recognition task as well as a physical reaction time task. The study implemented a blinded repeated measures design with four test conditions (steady state or modulated noise) and the two types of gain processing provided in bilaterally fitted hearing aids. Similar listening effort was measured across all tests conditions. However, speech recognition was significantly higher (6-8 percentage points) for the FLG processing than the syllabic WDRC processing. This significant speech recognition in noise advantage was present across both noise types and both in the presence and absence of the secondary task. We hypothesize that the measured advantage was due to better preservation of the intensity contrasts in natural speech by the FLG processing.

74 - COMMUNICATION ADVANTAGES WITH BLUETOOTH CONNECTIVITY FOR AB NAIDA COCHLEAR IMPLANT USERS

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Aural communication for Cochlear Implant patients may be compromised by the attenuation of target speech, distortion of frequency response, the effects of reverberation and masking by additive noise. These may be overcome by various technical system improvements such as single microphone noise reduction, microphone ‘beam formers’, FM systems and remote input systems such as infrared and Bluetooth. We describe a remote microphone system consisting of a speaker communicating by Bluetooth to a ComPilot receiver that itself communicates with the AB Naida CI Speech Processor by a digital induction loop. A study in three patients compared their speech perception in noise with the wireless remote microphone and using the CI sound processor microphone. The study concluded that the RemoteMic was significantly better in adverse listening conditions, did not degrade in high levels of noise and was judged better for quality of sound in both quiet and noise.
75 - EVALUATION OF BATTERY LIFETIME IN PEDIATRIC USERS OF THE HARMONY SOUND PROCESSOR WITH THE HIRES OPTIMA STRATEGY

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**Objectives:** Recently Advanced Bionics launched a new version of its fitting software, SoundWave 2.2. The latter offers the possibility to fit a new sound processing strategy, HiRes Optima™. Based on HiRes Fidelity 120™ (HiRes 120) with the current steering technology, it is designed to optimize battery life while delivering the same speech performance. This new sound processing strategy can be used with the Naida CI Q70, the Neptune™ or the Harmony™ processors. The objective of this project is to evaluate the battery lifetime improvement using HiRes Optima compared to HiRes 120.

**Methods:** This project is conducted in multiple centres in India. New cochlear implant users (children only) fitted with a Harmony™ sound processor will use in a random order the HiRes 120 strategy and the new HiRes Optima strategy. Parents will report the battery lifetime of the various battery options via a battery log.

**Results:** A previous study conducted in adults showed an average battery life improvement of 53%, ranging from 25% to 109% for individual Harmony processors. Centres and subjects inclusions (30 subjects expected) are still ongoing.

**Conclusions:** This evaluation will reinforce the previous study outcomes showing an improvement of the battery lifetime when using the new HiRes Optima strategy.

76 - THE ACCEPTABLE NOISE LEVEL: EFFECT OF THE GENDER OF TARGET TALKER AND THE NUMBER OF BACKGROUND COMPETING TALKERS

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Acceptable noise level (ANL) is one of the useful measurements for determining acceptance of background noise level for each person. The objective of this study was to evaluate whether ANL values are affected by the gender of target talker and the number of background competing talkers.

Twenty adults who are normal hearing participated in this study. Two adult speakers participated as target talkers. Following recording method of the target story from Nabelek et al. (1991), eight talkers participated to record competing 4 speech maskers (1-, 2-, 4-, 8-talker maskers). To measure ANL, two values were pre-examined. Firstly, the most comfortable level (MCL) to listen to the target story in quiet was examined. Secondly, the maximum background noise level (BNL) that listeners could accept while following the target story at MCL was examined. The ANL was calculated by subtracting the BNL values from the MCL values.

Results of statistical analyses revealed that ANL did not differ by the gender of target talker no matter what speech masker was used. The effect of the number of competing talkers was statistically significant, indicating that the greater number of speech masker allowed listeners to accept more energy.

The current study determined the significant effect of background noise variability on ANL. The ANLs increased when the number of competing talkers decreased. One-talker speech masker seemed highly confusable since the meaning of masker can be audible while listening to the target story, being the most annoying and showing the highest ANL. This was agreement with the preceding research by Simpson & Martin (2005) showing little effect from 8- to 128-talker maskers.
Further, the babble speech masker from more than 4-talkers appeared not to be meaningful or intelligible to listeners, as this study found no difference in ANL between 4- and 8-competing talkers.

**76A - REINFORCEMENT OF AUDITORY PROCESSING THROUGH A “SERIOUS GAME”**

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**Background:** Auditory Processing (AP) is the brain’s ability to receive and process auditory inputs. Specific skills are hierarchically defined, interconnected and necessary for an intact AP ability. Developing auditory skills requires lots of practice and repetition, but computer games offer a solution since children are easily engaged in games on the computer.

**Aim:** To provide Speech Pathologists and other professionals with an interventional tool, that is able to strengthen AP through a step-by-step approach of four main parts. Thus, we target the auditory and visual systems simultaneously, so the brain becomes more efficient and effective.

**Method:** The “Serious Game” was developed by using Microsoft's XNA Game Studio 4.0 framework in combination with XACT (Cross-platform Audio Creation Tool). The game consists of four scenes. The first scene trains the end user to awareness, the second to discrimination, the third to identification, and the fourth to perception skills. When the game starts the user hears a sound and in order to play the game he/she must choose the object that produces the sound. The user chooses the object by moving on it an avatar. He controls the avatar with the keyboard.

**Practical Implications:** The innovativeness of this software is the four stages training. SLTs and Teachers of SEN children need intervention approaches which motivate the children and have great portability. This software is easy to use and ready for frequent updates, providing more possibilities to specialists.

**Conclusions:** Despite the existence or not of a hearing disorder there are actions that we can undertake to reinforce AP ability. What is necessary for a successful intervention is to provide a complete platform than manages all the necessary skills for an intact AP. The “Serious Game” is an interventional tool suitable for every-day clinical practice.
77 - AUDITORY SENTENCE PROCESSING IN ADULT COCHLEAR IMPLANT USERS

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Objective: The present study examines, whether postlingually deaf or hearing-impaired patients focus more on semantic information when interpreting linguistic utterances by incorporating contextual information, or whether they apply alternative strategies. For this purpose listening training has been developed, which requires both the identification of semantic and syntactic features in the set, and to match sonically fragmentary gap sentences.

Method: In a cross-over design, n=42 postlingually deafened CI users participated in all three training programs for two weeks each with patients from 14 homogeneous triplets being assigned at random to their first treatment, with a subsequent split into two groups of 7 participants each receiving one sequence of the other two training procedures. The patients were between 20 and 76 years old and had been fitted with cochlear implants unilaterally or bilaterally for at least 2 to a maximum of 9 months before inclusion in the training study Changes in linguistic performance in audiometric tests were assessed within each group before and after each training regimen and to a control group, which received no specific training in addition to their standard treatment.

Results: Analyses showed that problems with sentence comprehension mainly concerned extracting of morpho-syntactic information. Patients mostly profited from auditory sentence training, which also supports application of top-down driven comprehension and inference processes. In summary, all patients benefited from the sequence of auditory training procedures, but particularly positive changes in performance were found for the semantically oriented training for auditory speech understanding in quiet and in noise.

78 - THRESHOLDING POSTOPERATIVE EABR BY EXTRAPOLATION OF THE V PEAK AMPLITUDE GROWTH FUNCTION BASED ON LINEAR REGRESSION

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Introduction: Cochlear implants (CIs) sound processor fitting is one of the important parts of postoperative rehabilitation. Postoperative eABR on a par with eCAP and eSRT can be used as an objective fitting method for CI users who are non-responsive and has concomitant neurological diseases, or auditory neuropathy, or inner ear malformations. But eABR method for sound processor fitting is still not developed.

Methods: Postoperation eABR was performed on 12 CI users aged 2 to 8 years (mean 4,5) with MED-EL cochlear implants. Stimulation runs was represented as 2000 two-phase stimulus with alternating polarity at a 17 Hz stimulation frequency. 2, 5 and 10 channels used for stimulation in all subjects. Stimulation amplitude varied in steps by +/- 10, 20, 30% of the subjective MCL for the amplitude growth function of the V peak.

Results: Amplitude growth function (AGF) of the V peak shows a linear amplitude increasing with stimulation increasing (p<0,05) on all stimulated channels. 8 channels revealed amplitude saturation
of the V peak at stimulation level exceeds 20-30% subjective MCL. Using linear regression calculation of amplitude growth function to the zero stimulation level we got the extrapolated eABR threshold.

**Conclusion:** Since visual eABR threshold recognition can be difficult due to the small amplitude response, and using the suprathreshold stimulation levels facilitates visual estimation of the V peak amplitude. We propose to use the eABR threshold calculation using the linear regression of AGF. We suppose that the «calculated» eABR thresholds may predict sound processor fitting map MCL by analogy with eSRT and eCAP thresholds.

Further studies are required to extend the possibilities of this method.

**79 - THE INFLUENCE OF THE HEARING AIDS AFTER SENSORY DEPRIVATION**

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Studies suggest that the reintroduction of the auditory stimulus through the hearing aid can contribute to the stability of the degree of hearing loss and the functional reorganization of the auditory pathways following sensory deprivation. The aim of this study was to investigate the long-term benefit of the use of the hearing aid in the elderly. The study was composed of eight individuals, of both genders aged between 65 to 80 years. They had sensorineural hearing loss and bilateral hearing aids. Basic Audiological Evaluation and IOI-HA (International Outcome Inventory for Hearing Aids) were applied. We compared the recent audiological assessment with the previous one realized two years before when hearing aids were fitted in individual. The audiologic data were correlated with the responses of the questionnaire. We did descriptive analysis and exploratory data analysis by ANOVA, with significance value of 5%. In the IOI-HA, the patients showed high scores indicating high satisfaction with the use of amplification. The results showed that two years with amplification improved the performance in speech tests in most subjects, but the change was not significant. Tone thresholds did not change significantly, suggesting the contribution of amplification for the stabilization of hearing loss. We concluded that there was no significant change in tone thresholds and speech recognition tests after introduction of amplification.

**80 - EFFECT TO TONE RECOGNITION WITH DIFFERENT AUDITORY INTERVENTION**

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**Objective:** To study the influence of different auditory intervention for tone recognition.

**Methods:** 64 cases were divided into cochlear implant group and hearing aid group according to auditory intervention methods, 28 normal children for control. The tone recognition for monosyllabic word and spondaic word was measured.

**Results:** The tone recognition of cochlear implant group with monosyllabic and spondaic words was significantly higher than that of the hearing aid group (P<0.01), but was significantly lower than that of the normal children (P<0.01).

**Conclusion:** Cochlear implant provide a significant benefit in speech rehabilitation for prelingually deafened children.
81 - COCHLEAR IMPLANT OUTCOMES WITHIN 2.5 MONTHS POST-ACTIVATION IN OLDER ADULTS: A CASE REPORT
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Objective: To report differential outcomes of cochlear implant (CI) within 2.5 months post-activation in older adults with different conditions of hearing loss (HL).

Methods: Demographic, preoperative, intraoperative and postoperative medical and audiological information up to 2.5 months post-activation of 3 older adult recipients were analysed.

Recipients: All recipients had progressive sensorineural HL (SNHL) and were implanted between 9 to 24 months after hearing loss in the implanted ear became profound. Duration of HL for Recipient 1 (R1), a 78 years old male, was 35 years; for Recipient 2 (R2), a blind 62 years old female, was 20 years; and for Recipient 3 (R3), a 67 years old male, was 5 years.

R2 became totally deaf and stopped using hearing aid (HA) 9 months pre-surgery. She developed severe depression, treated with antidepressant. The non-implanted ears of R1 and R3 were moderate to profound SNHL. Both were inconsistent HA users and either had or suspected to have mild depression. All were implanted with Medel Concerto Standard Electrodes and fitted with Rondo Speech Processor Package. CI surgeries were unremarkable for R1 and R3. R2’s surgery was complex because of thick fibrous tissues in the middle ear causing incomplete electrode insertion.

Results: Intraoperative tests findings were good. R2 showed significant improvement within 2 weeks post activation (average aided responses/sentence test score: 40dBHL/75%) while R3 showed improvement 2 months after (average aided responses/sentence test score: 35dBHL/75%). R1 showed minimal improvement and depended a lot on his unaided non-implanted ear. Since activation, R2’s map had significantly higher Upper Stimulation Levels (USL) compared with R3’s that increased over time while R1’s USL showed no significant change. Vestibular complications and depression postoperatively were not reported.

Conclusion: Although differences were observed, good outcomes from older adults within a short period after activation are possible.

82 - COCHLEAR IMPLANTATION IN THE ABSENCE OF VISIBLE COCHLEAR NERVE: A CASE STUDY
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The study was done to describe the pre-and post-cochlear implantation findings of a client with invisible Cochlear nerve. A hearing aid user client, aged 4 years, reported for the purpose of cochlear implant (CI) candidacy assessment. Pure tone averages were 105 and 88.3 dBHL in right and left ear respectively. Speech Awareness Threshold was at 70 dBHL in both ears. Auditory Brainstem Response (ABR) evaluation revealed no response in the right ear, and peak V was obtained only for 500 Hz alternating tone bursts at 90 dBnHL in the left ear. Auditory Steady State Response was bilaterally absent. Findings were suggestive of bilateral severe-to-profound hearing loss. Left ear and binaural aided free field responses were within the speech spectrum. Aided responses were not within speech spectrum for right ear. Radiological evaluation revealed bilateral
stenosis and duplication of Internal Acoustic Meatus, and bilateral absence of cochlear nerves. Additional audiological testing was done. ESPT results showed some pattern perception, vowel recognition and word identification for the left ear, and minimal pattern perception for the right ear. Client’s aided performance on informal temporal perception tasks was found to be fair for short duration stimuli. She was unable to perform on localization tasks. Client could also repeat 3 syllable sequences with the use of hearing aids. Transtympanic Electrical ABR was present bilaterally, with better morphology on the right side. Thus, the client was implanted in the right ear. Intra-operative testing revealed the presence of ECAP in the right ear. Switch on was done a month after implantation. Child is now attending therapy to improve her speech and language skills. Post-implantation audiological battery revealed improvement in auditory skills. Thus, we conclude that cochlear implantation can be done in cases of absent visible cochlear nerve, using audiological tests as predictors of success of CI.

83 - CONSTRUCT VALIDITY ANALYSIS OF THE PORTUGUESE VERSION OF THE LISTENING SELF-EFFICACY QUESTIONNAIRE, P-LSEQ

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Introduction: Self-efficacy is considered a cognitive variable with motivational function that can influence the success of an Audiologic Rehabilitation program. The Listening Self-Efficacy Questionnaire (LSEQ) was developed in the U.S.A to quantify listening self-efficacy based on speech comprehension in daily situations. We chose to translate and adaptat the LSEQ due to the lack of instruments for assessing listening self-efficacy in Portugal. The results showed that the Portuguese version of LSEQ (P-LSEQ) was semantically equivalent to the original, possessing content validity.

Objective: To assess whether the responses to the 18 items of the P-LSEQ reflect listening self-efficacy, based on the analysis of the construct validity of the P-LSEQ.

Methods: The P-LSEQ dimensionality assessment was made using Varimax rotation analysis of the main components and by a selection of factors with eigenvalues greater than one criterion. Only factors of a minimum of 3 items were taken to consideration as well as those that would account for at least 5% of the variation. From the latter, only those with factor values of 0.50 or greater were considered.

Results: The factor analysis in P-LSEQ was similar to LSEQ resulting in a 3-factor solution (Directed Listening, Complex Listening and Dialogue in Quiet) explaining 81.628% of the variance. The results indicate that P-LSEQ measures predominantly the first factor (Directed Listening), showing a tendency to value situations in which individuals have to focus attention to understand speech.

Conclusion: There was agreement between the number of factors and items of P-LSEQ and LSEQ but there is a need for redistribution of items in relation to 3 factors/ subscales.
Sensorineural hearing loss among adults is a major handicap. In India, hearing loss is the third most common disability and most of the hearing disorders go undetected.

A total of 111(n) patients having sensori-neural hearing loss who were provided with hearing aids were followed up by three self benefit questionnaires APHAB, NAL-COSI, IOI-HA translated in to local language. APHAB follow up was done for before fitting, at 2 weeks, one month, three months and six months. IOI-HA and NAL-COSI questionnaires were filled by the patient at 2 weeks. Residual problems experienced by the HA users were evaluated with respect to their choices made in COSI only after six months, as all the situations in the questionnaires could not be answered by the HA users within two weeks. In this study we found that COSI is easy, quick to administer, and patient-centered. It eliminates unrealistic expectation and allows patient to monitor his/her own goals. IOI-HA can be used to assess the relative success of a hearing aid fitting, it gives the hours of usage of hearing aid. APHAB picked up significant improvements in communication especially in reverberant rooms and in settings with high background noise levels. Though the questionnaire is long, the questions take into consideration most of the situations the patients face in their daily life. It is the most comprehensive questionnaire and gives the patient a realistic expectation from a hearing aid. It can also be used at a later time when the patient upgrades his hearing aid and thus the benefits can be compared. This model of evaluating hearing aid benefit can be replicated in developing countries where there is paucity of audiological service.

Abbreviations: APHAB: Abbreviated Profile of Hearing Aid Benefit; COSI-: Client Oriented Scale of Improvement; IOI-HA: International outcome of hearing aids.
The Ndlovu Wits Audiology project addresses this challenge by providing comprehensive ear- and hearing health services at a primary health care clinic in Elandsdoorn (Limpopo Province). We strive to reduce the negative impact of hearing impairment on the health, lifestyle and communicative abilities of individuals with hearing loss and their families through (i) community education programmes; (ii) preventing the onset of ear and hearing problems, (iii) early identification and management of ear and hearing problems, and (iv) maintaining an active research programme.

This paper presents an overview of the Ndlovu Wits Audiology project and will focus on the ear and hearing health services provided in this rural community highlighting our successes and challenges.
ISSUES IN GENETICS AND BIOLOGY

86 - NONSYNDROMIC HEARING LOSS IN MORAVIAN PATIENTS: ONE FIFTH CARRYING BIALLELIC GJB2 GENE MUTATIONS, NO MUTATIONS IN SERPINB6, TMIE, COCH, ACTG1, KCNQ4 AND GJB3, VARIANTS WITH UNKNOWN PATHOGENICITY IN THE ESPN GENE


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GJB2 gene mutations are the most frequent cause of nonsyndromic hearing loss. There are many other genes less frequently causing this disorder. The aim of our study was to look for other genes mutated in Moravian population of patients with deafness. We have performed sequencing of GJB2 coding region on ABI3130 and Δ(GJB6-D13S1830) detection using PCR and gel electrophoresis in 142 patients with nonsyndromic hearing loss. Biallelic pathogenic GJB2 mutations were found in 31 patients (22%) thus explaining their hearing defect. In 9 patients (6%) only one pathogenic GJB2 mutation was found. No patient carried Δ(GJB6-D13S1830). Sequencing of SERPINB6, TMIE, COCH, ESPN, ACTG1, KCNQ4 and GJB3 genes was performed on ABI3130 in 13, 13, 13, 30, 20, 14 and 30 patients without GJB2 mutation, respectively. No pathogenic mutation was found in SERPINB6, TMIE, COCH, ACTG1, KCNQ4 and GJB3 genes. In ESPN gene, two variants with unknown pathogenicity were found in two unrelated patients: c.337C>T, p.Arg113Cys (Polyphen score 1.00) and c.1797_1808delCCCACCGCCGCC, p.Pro600_Pro603del. Both variants were inherited from parents without hearing loss. We cannot exclude big genomic deletion/duplication of ESPN gene on the other allele in the patients. There may also be bigenic mechanism of hearing loss pathogenesis. So far, however, we cannot conclude that these variants are causal in our patients. We are going to analyze WHRN gene encoding the whirlin protein, functionally associated with ESPN gene product espin.

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87 - ETIOLOGY OF CHILDHOOD SENSORINEURAL HEARING LOSS: THE IMPACT OF CONGENITAL CYTOMEGALOVIRUS INFECTION AND GJB2 GENE MUTATIONS

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Background: Childhood Sensorineural Hearing Loss (SNHL) is the most prevalent sensory disorder in developed countries. The main causes of deafness are viral infections, especially congenital Cytomegalovirus (cCMV), and genetic mutations, particularly GJB2 gene alterations. The early identification of these two factors in newborns allows for a prompt correction of hearing damage.

Aims: To estimate the impact of cCMV infection and GJB2 gene mutations in children with SNHL. Moreover, to describe deafness clinical aspects of children.
**Methods:** Ninety-six children with SNHL were analyzed for cCMV infection and for GJB2 gene mutations. Dried Blood Spot (DBS) specimens were used for CMV-DNA detection: CMV-DNA was extracted by thermal shock and amplified by nested PCR (CMV DBS-test). Blood samples were tested to investigate GJB2 gene alterations. Information regarding clinical characteristics of hearing loss (bilateral or unilateral deafness and severity of hearing damage) were retrieved for 94/96 children.

**Results:** cCMV infection and GJB2 gene mutations were identified in 17% and 44% of the patients respectively. In three cases both factors were present. 81% of CMV-positive children and 98% of children with GJB2 mutations had a bilateral hearing impairment (p >0.05). Severe-profound hearing loss was in 88% and 85% of babies with cCMV infection and GJB2 mutations, respectively (p >0.05).

**Conclusions:** cCMV infection and GJB2 mutations contribute here in more than half of SNHL. Hearing damage seems to be mainly bilateral and severe-profound in children with cCMV and with GJB2 mutations, but no statistically significant differences were found through these two factors. Because hearing loss at birth can adversely affect speech and language development, as well as social development, universal neonatal hearing screening associated with universal neonatal genetic and cCMV screening could be a feasible solution to early detect and correct hearing impairments.

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88 - ATRIAL NATRIURETIC PEPTIDE REDUCES EXPRESSION OF THE ALPHA SUBUNIT OF THE EPITHELIAL SODIUM CHANNEL (ENAC) MRNA IN THE MOUSE STRIA VASCULARIS

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Atrial natriuretic peptide (ANP) has been demonstrated to be expressed extensively in the cochlea including the stria vascularis (StV). It was proposed that ANP may participate in the regulation of the water electrolyte balance. However, the functional significance of ANP in the cochlea is less understood and little is known about the exact mechanisms. Studies suggest that the epithelial sodium channel (ENaC) is important for regulating sodium transport across epithelia. ENaC may be involved in the clearance of endolymphatic Na⁺ and maintenance of a K-rich and Na-poor composition in endolymph. Whether ANP has a regulatory effect on the Na⁺ channel in the StV is still unknown. The objective of this study was to evaluate whether ANP affects the expression of the α subunit of the ENaC mRNA in the mouse StV using the real-time quantitative reverse transcription-polymerase chain reaction (RT-PCR) technique. The mouse StV tissues were incubated with 10⁻⁶mol/L ANP for different times (2h, 6h, 12h, 24h and 48h), and thenharvested and α-ENaC mRNA was extracted for real time RT-PCR analysis of the mRNA expression of the α-ENaC. This study demonstrated the existence of α-ENaC in the mouse StV. Tissues treated with ANP (10⁻⁶mol/L) showed a significant reduction in α-ENaC mRNA expression (n=3, p<0.05). A maximum effect was reached at 2h after treatment. Our results suggest that ANP may regulate cochlear ion transport and endolymph fluid balance in the inner ear via reducing expression of the α-ENaC mRNA in the mouse StV.

This work was supported by the National Natural Science Foundation of China (NSFC 81271079 to Dr. Yuedi Tang) and the Scientific and Technical Supporting Program of Sichuan province (2010SZ0172 to Dr. Yuedi Tang).
89 - TISSUE ENGINEERING OF THE INNER EAR

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Electronic interfaces between living cells or tissues and conducting surfaces that serve to pass signals between the electronic devices and a living organism present an enormous scientific and technological challenge. Such bioelectronic interfaces are now widely used in medical devices including pacemakers, cochlear implants and neurostimulatory implants. These devices have become indispensable in many situations and extended or dramatically improved the lives of millions of people.

For example, worldwide cochlear implants have been performed in more than 100,000 persons and the current installed base of pacemakers is presently about 600,000 in the United States alone. Thus even modest improvements in these devices would quickly translate into improvements in human health and substantial advances would have tremendous impact. There is also a great deal of activity in other types of devices based on bioelectronics interfaces.

Strategy to rescue hearing and auditory nerve was developed using micro-contact technique. Surface for nerve guidance was designed with favorable extracellular proteins to promote the outgrowth of the neurons. Micro-contact imprinting provided a versatile and useful technique for patterning the guidance surface. Imprinting generated a patterned surface in a controllable, predictable, and quantifiable manner. A range of events followed the patterning including alignment, polarity and directionality was reported and observed by morphological and microscopic description.

The dynamic microenvironment that results from the synergistic combination of extracellular guidance cues and Schwann cells selectively instruct and direct the terminal extension of neurons into uni- or bi-polar fate. Applying new factors such as molecules, cells and surfaces provides unique possibilities to recruit spiral ganglion neurons into their regenerative ability. In summary, creating an environment that incorporates multiple molecular and cellular cues will offer exciting opportunities for elucidating the mechanisms behind nerve regeneration and highlight specific considerations for the future tissue engineering.

90 - NEWBORN HEARING CONCURRENT GENETIC SCREENING AND EARLY INTERVENTION

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Objective: In order to improve the abilities for early diagnosis and intervention for the hearing defects, an innovative mode of hearing concurrent gene screening in newborns were carried out in Tianjin.

Methods: Newborn hearing screening was carried out universally since March 3, 2004. In December 2011, newborn hearing concurrent genetic screening was put into practice. Newborn hearing screening methods include DPOAE and AABR for initial screening and two-stage screening. Newborns failing to pass were referred to comprehensive audiological assessment at 3 months. The genetic screening involved 20 hot spot mutations from 4 primary NSHL genes: GJB2, GJB3, SLC26A4 and 12S rRNA. The infants carried causative mutations were referred to audiological assessment regularly, and genetic counseling and valuable prognostic information were provided. All newborn information was collected into a newborn screening database.
**Results:** To date, the hearing screening rate in Tianjin was 99%. The incidence of hearing-impaired children was 2.14‰. Of infants diagnosed with permanent hearing loss, 95% were considered for hearing aids and early intervention, 80% were enrolled in ordinary kindergarten and primary schools. A total of 150,000 newborns were subjected to newborn hearing concurrent genetic screening. 284 infants got pathological mitochondrial DNA mutations, 80 infants were identified with causative mutation(s) in the forms of either homozygote or compound heterozygote in GJB2, and 47 infants were identified with causative mutation(s) in SLC26A4. 7418 infants were heterozygous mutation(s) carriers.

**Conclusion:** The newborn hearing concurrent genetic screening can provide direct clues about the pathogenesis of hereditary hearing loss, and improve the abilities for early detection of late-onset or progressive hearing impairment. Infants with risk factors of drug-induced hearing loss could be detected and avoided from deafness by keeping away from aminoglycosides. Causative mutation heterozygote carriers could be detected early and receive genetic counseling for pre-marriage, pregnancy and prenatal.
HEARING LOSS AND MEDICAL CONDITIONS

91 - CHILDHOOD OTITIS MEDIA: A COHORT STUDY WITH 30-YEAR FOLLOW-UP OF HEARING

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Objectives: To examine the extent to which various types of childhood otitis media causes permanent hearing loss and the interaction with noise.

Design: Population-based prospective cohort of 23,482 participants aged 20-56 years at the follow-up study with an on average 31 years follow-up period. The participants had their hearing examined in primary school: 1,975 children were diagnosed by an Ear-Nose and Throat specialist with hearing loss caused by various types of otitis media, the remaining sample were not diagnosed with hearing loss.

Results: Adjusted for age, gender and noise exposure, participants diagnosed with childhood hearing loss caused by chronic suppurative otitis media (n=108) had 17-20 dB worse adult hearing than participants not diagnosed with childhood hearing loss and a negative history of recurrent otitis media. Also the effect of this group increased by 0.5 dB per year through adulthood. Secretory otitis media (n=1254) resulted in 2 dB worse adult hearing. Childhood hearing loss as a sequela after recurrent acute otitis media (n=613) improved, still it was associated with 7-10 dB worse adult hearing than the reference group. Eardrum pathology added a marginally increased risk of adult hearing loss (1-3 dB). No significant interaction between childhood otitis media and noise was found.

Conclusions: Chronic suppurative otitis media and recurrent acute otitis media in childhood can cause a hearing loss that persist through adulthood. Hearing loss after chronic suppurative otitis media can be progressive. This underlines the importance of follow-up at an ENT specialist for children with chronic suppurative otitis media or complicated (persistent or recurrent) acute otitis media to assure optimal treatment and follow-up of hearing. Childhood otitis media is not associated with increased risk of noise-induced hearing loss.

92 - AUDIOLOGICAL FINDINGS IN KABUKI SYNDROME IN PAEDIATRIC POPULATION (CASE STUDIES)

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Kabuki syndrome (KS), also known as Kabuki Makeup Syndrome (KMS), or Niikawa-Kuroki Syndrome, is a very rare paediatric congenital disorder affecting 1 in 32,000 births. KS is of suspected genetic origin presenting with multiple congenital abnormalities and cognitive disabilities. In KS there is a high prevalence of otolaryngologic problems including ear diseases, hearing loss and airway problems. Although the otolaryngological features are common in KS only limited audiological data is provided in the published literature. The aim of this study is to look at the common clinical characteristics of KS, focusing on the audiological data collected from three patients who are currently under the care of the Nuffield Paediatric Audiology Department at the Royal National Throat Nose Ear (RNTNE) Hospital in London. Among the KS patients focused in this study there is no generalized pattern of the configuration or nature of the hearing loss. By looking at each individual case, the KS patients’ medical history, degree of developmental delay, audiological profile and audiological
management are studied. The audiological assessment and management of KS patients will be discussed and recommendations for future investigations will be made.

**93 - REDUCED ABR THRESHOLDS FOR NEW CHIRP STIMULI VIA THE EQUALIZATION OF INSERT EARPHONE FREQUENCY RESPONSE**
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Vestibular Schwannoma (VS) is a typically unilateral benign tumor of the vestibular nerve with a prevalence of 1-2 per 100,000. Patient's often present with hearing loss, with typical audiograms showing bilateral asymmetric or unilateral sensorineural hearing loss at high frequencies, with poorer thresholds on the tumor side. However, patient’s often have additional symmetric bilateral hearing loss due to presbycusis, because of the age at which VS commonly presents. Historically VS was detected by differences in click-evoked auditory brainstem response (ABR) wave V or wave I-V inter-peak latencies, between the tumor and non-tumor sides. Unfortunately the sensitivity for small tumours is relatively poor, and it is difficult to record ABRs in patients with significant hearing loss. A significantly more sensitive method for small tumor detection is the stacked ABR (Don et al, 2009), where the activity from different audible frequency regions are aligned in time. This compensates for the delay between high and low frequencies in the base and apex of the cochlea, and ensures a large ABR and detection is made by comparing wave-V amplitude with normative data or stacked ABR from the non-tumor side . Unfortunately, this method is time-consuming and has never gained the clinical interest its increased sensitivity probably deserves. This is likely due to the increased availability, high sensitivity and reducing costs of magnetic resonance imaging. However, there is still a need in early screening for a sensitive, low cost and quick VS detection method. This study presents preliminary findings on the use of chirp stimuli in a confirmed VS patient group. It is hoped to gain some of the sensitivity benefits of the stacked ABR, as chirps are similarly designed to pre-compensate for cochlear delay and upward spread of excitation (Elberling & Don, 2008), but reduce testing times to something that is clinically acceptable.

**94 - SUDDEN AND PROGRESSIVE HYPOACUSIS IN CLINICAL PRACTICE (TYPE, INTENSITY, EXTEND, RISK FACTORS, ACCOMPANYING DISEASES)**
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Goal: The goal of the study was to consider hypoacusis in all its bearings: type, intensity, extend, risk factors, accompanying diseases.

Material and methods: 300 patients with hypoacusis who were hospitalized at Otolaryngological Department were estimated. The investigated group was divided into the age-related groups: below 40 (group I), between 40 and 60 (group II) and above 60 (group III) years old. The full diagnostic procedure was performed to estimate the acoustic pathway: tonal audiometry, speech audiometry, tympanometry, supravelvel tests, otocoustic emissions (DPOAE), brain stem evoked potentials (BERA) together with detailed anamnesis and accompanying investigations (radiological, blood tests, etc).
Results: The sudden hypoacusis was the most frequently met in the patients older than 60 years old. The pure cochlear type of hearing loss dominated in groups II and II and mostly included 1-3 frequencies. In I and III groups these frequencies were predominantly higher than 6000Hz. But in the youngest group the tympanograms were useful to reveal the accompanying diseases of the middle ear that were not so rare. The statistical correlations were observed between hypoacusis and stroke in all groups, sudden acoustic trauma in groups I and III, prolonged acoustic overload in groups II and III, diuretic drugs in groups I and III and inflammatory therapy- independently on the age. The accompanying diseases strongly affected hearing were as following: hypertension, cervical diseases, atherosclerosis and sex hormonal disturbances in all groups; diabetes and lipids abnormality influenced the hearing mainly in the youngest ages.

Conclusions: The study particularly classified the hypoacusis met across the lifetime, being the helpful tool for the general practise doctors, laryngologists and audiologists as spread epidemiologic study on hearing loss.

95 - A STUDY ON THE HEARING OF INFANTS WITH CONGENITAL HYPOTHYROIDISM

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Thyroid Hormones (TH) are essential for the growth and development of various organs and tissues. Reports indicate that hearing impairment may occur in 20% of children with Congenital Hypothyroidism (CH) and hearing abnormalities remain even when treated.

Aim: to analyse hearing in infants with CH. The specific objectives were to analyse the results obtained in the electrophysiological and behavioural assessment considering the age range, gender, right and left ear, age at diagnosis and when treatment first began.

Methods: the sample consisted of infants aged up to 24 months, with CH. The audiologic evaluation consisted of the following procedures: assessment of Auditory Brainstem Response (ABR), Transient Evoked Otoacoustic Emissions (TEOAE), suppression of Otoacoustic Emissions, tympanometry, evaluation of minimal responses and behavioural hearing assessment.

Results: on the ABR no changes were observed in the integrity research, absolute and interpeak latencies of the waves. In search of the threshold in all cases thresholds of 30 dB in both ears were found. Of the 14 ears studied, only 2 right ears presented an absence of TEOAEs related to the changes in acoustic immittance, not being able to measure the suppression of the emissions. In the behavioural assessment all children presented satisfactory results. In relation to age, gender, age of diagnosis and beginning of treatment, up until now these variables were not associated with observed hearing impairments.

Conclusion: no alterations in the ABR responses were observed and the absence of TEOAEs corresponds to middle ear alterations. The mothers’ need for guidance with regards to the child and auditory development of children with CH was also noted, so that if changes in the child’s hearing occur, early detection and prompt intervention can be made within in the critical period of the child’s development. The results of this study are preliminary data from an on-going study.
Crouzon syndrome is an autosomal dominant disorder with complete penetrance and variable expressivity. Described in 1912, by the French neurosurgeon Louis Crouzon, it is a rare genetic disorder present since birth with tendency to aggravation in time, characterized by premature closure of cranial sutures, midfacial hypoplasia, and orbital defects. Common features include hypertelorism, exophthalmos and external strabismus, parrot-beaked nose, short upper lip, hypoplastic maxilla, and a relative mandibular prognathism. Conductive hearing loss is common due to deformities of the middle ear. Atresia of auditory canal, deafness and malformations of the middle ear are therefore the main manifestations of the disease in the auditory system. We can also observe not progressive conductive hearing loss in one third of cases, and even mixed hearing loss. Recurrent infections are common in the hearing system.

The majority of known genetic causes of craniosynostosis are mutations in the genes encoding fibroblast growth factor receptor types 1-3 (FGFR 1, 2 and 3), other significant genes are TWIST1 and EFNB1. Several variants were reported in these genes in the literature as genetic risk factors for craniosynostosis. The presence of mutations in the group of genes coding for the FGFR is now clearly established. These genes code for receptors on the cell surface, which mediate the effects of fibroblast growth factors (FGF). The FGFs are implicated in important cellular processes such as cell growth, differentiation, migration and survival.

Genetic counseling and individual study of each case are essential in order to promote advances in diagnosis. An early multidisciplinary approach is needed to program specific therapeutic targeting the prevention of the effects of a late diagnosis.

The aim of the present work is to describe a rare disease that affects the craniofacial skeleton development with conductive hearing loss.

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97 - GENETIC SYNDROMES AND EARLY INTERVENTION: NEW DIRECTIONS

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The incidence of individuals with genetic syndromes is quite impressive. There is an increase in the relative incidence of genetic anomalies of genetic origin that have been early diagnosed thanks to technological advancements. Two early diagnosed cases of bilateral profound hearing loss are going to be discussed, one with Waardenburg Syndrome and another with Mondini Syndrome. Both children came to the audiologist at four months of age, both used hearing aids until 18 months and underwent cochlear implant surgery at this age. Currently both children are aged 4 and paths were different. The first male child (D.F) is in regular school, has a vocabulary suitable for his age, makes effective use of the cochlear implant, has audiologic thresholds around 25 dB. The second male child, (G.S.L) is currently in school for the deaf, is learning Brazilian sign language, poor oral language, vocabulary features are simple, he doesn't show a good hearing recovery, and audiometry lies around 45dB. We will be discussing the paths chosen by the family at an early age. Difficult decisions since the decision by oral cochlear implant is the pursuit of orality, and when it is
not possible to achieve it finding another form of communication can be a daunting task for the family and for society. However, bimodalism is being an increasingly alternative.

98 - CHILDREN WITH CHRONIC NON-PROGRESSIVE ENCEPHALOPATHY: HEARING AIDS AND COCHLEAR IMPLANTS

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The universal neonatal hearing screening is a prerequisite for early diagnosis and treatment of congenital deafness, however children with chronic non-progressive encephalopathy (NPCE) with hearing loss have been a challenge for audiologists and otolaryngologists in decision making when it comes to suggesting cochlear implant and/or a hearing aid.

We will discuss 10 cases of children with NPCE where five children presented profound hearing loss and were candidates for cochlear implants. The performance of these children are not similar. Neurological complications, age and global stimulation are important factors in the development of listening and language skills. All children had benefited from the amplification with results of significative improvement in global development, although orality awaited by parents, did not occur as expected. The other five children presented hearing loss with decent configuration with up to severe and were candidates for the use of hearing aids. Sometimes, determining the degree of hearing loss may be delayed due to the delicate health of children, but when it is possible the benefit from the use of amplification is very good. Five children make effective use of the hearing aids with average of 10 hours of use per day. Two children are in regular school and present promising auditory development. We need to know more information about how the child will react to the amplification and how this amplification can promote the overall performance of children with NPCE. The quality of life of these children and their families is an important factor so we can make assertive decisions.

99 - EXTERNAL AUDITORY CANAL NEURO-REFLEXES AND THEIR OCCURRENCE DURING CLINICAL PROCEDURES

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There are three neuro-reflex mechanisms of the ear canal identified during various otological and audiological clinical procedures, namely, Vagus reflex, Trigeminal reflex, and Lymphatic reflex. The health of the Keratin layer also affects the occurrence of these reflexes (Chartrand, 2004). This study aims to identify the 3 neuro-reflexes of the ear canal and to find the correlation between the Keratin status of the ear canal and the severity of these reflexes during various clinical tasks. 120 ears of adults of ages 25 years and above (30 ears for each clinical task) were taken as subjects. An External Ear Neuro-reflex Checklist (adapted from a standardized checklist by Chartrand, 2005) was administered on the subjects during the clinical tasks of Cerumen Management, Otoblock Insertion, Impression Material Insertion and Earmold Insertion. The maximum percentage of subjects exhibited Trigeminal reflex (55.83\%) which was predominantly seen to occur during Cerumen management and Otoblock insertion; followed by Vagus reflex (24.1\%) during Otoblock insertion; and Lymphatic reflex (8.3\%) during Otoblock insertion and Earmould insertion. This indicated a considerable stimulation of the mechanoreceptors of the ear canal during these clinical tasks. A significant
positive correlation was found between the Keratin status of the ear canal and the sensitivity of Vagus and Trigeminal reflexes, which shows the direct role of the Keratin layer in shielding neural reflexes. The findings of this study can prove crucial in assisting audiologists and otorhinolaryngologists in addressing the complaints of discomfort of subjects undergoing these procedures from a physiological point of view.

100 - UNDERSTANDING OTITIS MEDIA AND ITS NEGATIVE EFFECTS ON CHILD DEVELOPMENT BY PRE-SCHOOL TEACHERS

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Verbal speech is the main tool for communication between humans. Normally children learn mother tongue through listening the adults’ speech. The first five years of life is a very important period for language growth. A mild or partial hearing loss then could have a negative effect on language development. The early identification of the problem that affects the listening skills and the timely therapy can reduce the complications it causes.

According to the scientific literature studies, one of the most prevalent illnesses of early childhood is otitis media (OM). Many authors provide data that early-life persistent OM causes hearing impairment, poor verbal comprehension, abnormal speech articulation, language delay, behavioural problems. The logopedic perspective of this scientific problem is not well studied in Bulgaria.

The aim of the research is to find out how the pre-school teachers understand OM and its negative effect on child speech and language development.

A questionnaire was developed for the purpose of the study. The subjects of the research are 62 pre-school teachers. They teach children from 3-7 years. The teachers reported 68 cases of OM in their groups of children during the last year, but 27 of the professionals reported lack of this middle ear disease in the groups they teach. 35% of the studied subjects mentioned that children with OM demonstrate poor speech articulation, 15% reported poor verbal comprehension ability, 15%-language delay, 5%-lower IQ and the rest of the pre-school teachers have the opinion that OM has no negative effects on child development.

The conclusion of the research is that the main part of the interviewed professionals is familiar with the common childhood illness OM and how hearing impairment affected the child development. This can be helpful for the early identification of the problem and recommendation for the parents to take care of it.

101 - APLASIA/HYPOPLASIA OF THE 8TH NERVE IN CHARGE

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We present a case of a child diagnosed with CHARGE syndrome where MRI has shown aplasia of the 8th nerve at the right side.

We performed repeat electrocochleography using transtympanic needle. The investigation initially showed normal AP-potential from both nerves.

The child has been suffering from recurrent otitis media and now shows progression of the hearing loss resulting in disappearing of AP potentials.
Early testing with electrocochleography has been valuable in evaluating hearing aid treatment with a presumed mixed hearing loss, and is crucial in future evaluation for Cochlear Implant.

**102 - AN INSTITUTIONAL PROTOCOL FOR EARLY IDENTIFICATION OF CONGENITAL AURICULAR DEFORMITIES ALLOWS FOR NONSURGICAL CORRECTION**

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**Objective:** To introduce a protocol in which newborn nursery department staff has been trained to identify congenital auricular deformities, allowing referral and early non-surgical correction.

**Methods:** Pediatricians, residents, and nurse practitioners in the newborn nursery received education on evaluation of congenital auricular deformities. Twenty-five infants with cup, Stahl’s, and prominent ears amenable to treatment were reviewed from January to October, 2013. A simple splint made from 6-French silicone feeding tubing with 24-gauge wire, and held in place with Steri-strips and Dermabond, was used to mold the auricles.

**Results:** Of the total number of infants born during the 10-month period, 1.4% was identified with congenital auricular deformities amenable to correction. Splinting was performed on 45 auricles of 25 newborn infants aged 1 to 5 days. Of the patients identified, 56% had cup, 42% had Stahl’s, and 2% had prominent ear deformities. All ears were assessed by physical examination and photographic documentation prior to splinting and at follow-up visits. All exhibited improvement from the original deformity, with 84% requiring no further intervention after 2 weeks of splinting. There were no complications related to splinting treatment.

**Conclusion:** Splinting of congenital auricular deformities in the first week of life while cartilage remains malleable is a safe and effective treatment option. Instituting a protocol for early identification is feasible with proper education of those making assessments. This is a modification of a previous protocol at a different institution reported on by the senior author, in which newborn hearing screeners were trained to identify these deformities. At our institution, the patient care assistants who perform the newborn hearing screens are not allowed to make assessments, thus the modification. However, at institutions where newborn hearing screeners can make assessments, the screeners can be educated on identification of congenital auricular deformities while they are performing newborn hearing testing.

**103 - PREVALENCE OF HEARING LOSS IN PATIENTS WITH CHRONIC RENAL DISEASE. OUR EXPERIENCE**

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Hearing loss is a common finding in patients with chronic renal failure (CRF) in the course of their disease. Possible etiologic factors may be uremia, anemia, pathologic levels of the electrolytes, uremic neuropathy, toxic degradation products from cellulose acetate dialiser membranes in dialised subjects, ototoxic medication.
**Objectives:** The purpose of this study was to determine an audiometric profile on these subjects according to our experience by measuring pure-tone audiometry (PTA) and distortion-product otoacoustic emissions (DPOAE) on chronic renal disease patients.

**Methods:** There were analysed 37 patients (72 ears). 12 subjects were patients starting hemodialise, 15 subjects were patients undergoing conservative treatment and 10 controls. We did hearing evaluation every 3 months for a period of 1 year by testing them using tympanometry, PTA and DPOAEs. Other parameters (blood pressure, body weight, blood chemistries) were also evaluated.

**Results:** The percentage of SNHL in our CRF patients was 45% as detected by PTA test. The difference between hemodialised patients and patients undergoing conservative treatment is not statistically significant. DPOAE raised the percentages of detection of SNHL indicating that it is a better technique than the conventional PTA for evaluation of hearing acuity.

**104 - A RARE CAUSE OF CONDUCTIVE DEAFNESS**


*Military hospital of Tunisia, Mont-Fleury, Tunisia*

**Introduction:** The aberrant course of the internal carotid artery in the middle ear is a rare congenital abnormality.

**Aim:** to report a case of rare conductive deafness and to clarify its epidemiological, clinical and radiological features.

**Case report:** A 23-year-old female patient consulted for a long dated left hypoacusis, with ipsilateral otorrhea (the last episode goes back to 2 years). She reported also a recent tinnitus without rhinological symptoms. The otoscopy showed in the left ear an atelectatic tympanic membrane with a posterior superior retraction pocket fixed and non-controllable. The rest of the ENT and neurological examinations was normal. The pure-tone audiometry found a left conductive deafness of 45dB. The temporal bone CT showed a filling of the middle ear and the mastoid air cells, a lysis of the long process of the uncus and the tegmen antri, and a cochlear fistula. Cartilage tympanoplasty was performed, there was no cholesteatoma but a vascular-looking mass filling the middle ear. Its manipulation was at the origin of an important bleeding requiring wax and surgicel compression packing. The review of the CT confirmed the aberrant course of the internal carotid artery in the tympanic cavity. A cerebral CT angiogram and a Doppler of the supra-aortic trunks have shown a complete thrombosis all along this artery, explaining why we were able to control the bleeding. The post operative controls were normal, especially no neurological sequellae after 2 months.

**Conclusion:** The diagnosis of aberrant course of internal carotid artery in the middle ear is rare but it must be evoked in front of a conductive deafness. A temporal bone CT should be requested when at doubt in order to avoid the dangerous hemorrhagic complications of a surgical act.
105 - FUNCTIONAL RESULTS OF TEMPORALIS FASCIA VERSUS CARTILAGE TYPANOPLASTY IN PATIENTS WITH CHRONIC OTITIS MEDIA


Military hospital of Tunisia, Mont-Fleury, Tunisia

Aims: We sought to compare the functional results of tympanic membrane reconstruction with temporalis fascia, cartilage shield grafting.

Patients and methods: A retrospective comparative study was conducted of 244 patients who had undergone type I tympanoplasty (254 ears) at the ENT department of the military hospital in Tunis over a period of 12 years from 1998 to 2009. Selection criteria included tympanic membrane perforation following chronic otitis in patients older than 16 years old during the first surgery and at least 12 months of postoperative follow-up. The marginal perforations relative to the frame, an intact ossicular chain, tympanosclerosis, hearing loss greater than 40 dB, perforations on retracted tympanic membrane, cholesteatoma, or younger than 16 years old during the first surgery were excluded. An underlay type one tympanoplasty, using either a cartilage graft or temporalis fascia, was performed: Temporalis fascia tympanoplasty was undertaken in 58,26% of cases, and cartilage tympanoplasty in the other case.

Results: The graft success rate was 90,1 per cent for the fascia group and 100 per cent for the cartilage group. Post-operatively, the best hearing gain was obtained in patients operated by a chondro-perichondral graft (27.07 dB), so the best closing percentage of audiometric Rinne was noted in this group (97.56% of cases). No worsening of hearing loss was observed in this group. Failure to obtain a significant value \( \rho \) (\( \rho = 1.00 \)) may be due to the heterogeneity of the groups in number of cases.

Conclusion: In patients with chronic otitis media, cartilage tympanoplasty seems to provide better hearing results than temporalis fascia tympanoplasty. There was, however, no statistically significant difference between these two techniques regarding hearing outcome in our study.

106 - TREATMENT SURGICAL RESULTS OF 78 CASES OF OTITIS CHOLESTEATOMA


Military hospital of Tunisia, Mont-Fleury, Tunisia

Introduction: Surgery is the base of treatment of the cholesteatoma. It still a challenge, especially in extensive cholesteatomas with invasion around the facial nerve and the labyrinth.

Objectives: Our aim was to report our anatomic and functional results after using the canal wall down technique.

Materials and methods: Retrospective study of 78 patients during 12 years (2001-2013). The subject of our study is to precise anatomic and functional results after using canal wall down technique. All the patients have an ENT exam, a rock CT-scan and a pre and a post operative audiometry. They were operated in canal wall down technique in the ENT department of the military hospital in Tunisia.

Results: Our study includes 45 males and 33 females. The mean age was 35 years. On the functional plan, the audiometric profiles meadow and post operating were compared for the calculation of the average hearing thresholds of the affected ear. An improvement of the average hearing threshold was noticed in 40%. On the anatomical plan, 3 patients had a cholesteatoma...
recurrence after one year of drop, and 5 cases had a recurrence after 5 years of recession drop. Three of these patients were taken back with a good anatomical result after a drop of 9 months.

**Conclusion:** The selection of the technique for cholesteatoma surgery depend on many anatomic and functional factors.

107 - ISOLATED OTITIS MEDIA WITH EFFUSION IN ADULTS

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Otitis media with effusion in adult is a common situation encountered in ENT. The aim of our work is dictate though our series and the review of the literature a diagnostic and therapeutic approach in the presence of otitis media with effusion in adults

**Patients and methods:** We conducted a retrospective study over a period of 10 years from 2002 to 2011. Were included patients over 18 years of age who was raised diagnosis of otitis media with effusion with minimum follow-up of one year.

**Results:** Our population consisted of 53 patients. 60% of patients had a history of cervicofacial radiation treatment. Twenty patients were followed for chronic rhinitis.

All patients had a complete ENT examination and a scan rock in all cases. 62% of patients had medical treatment. 92% of our patients underwent surgery, 17 patients had complete regression and persistent over time.

**Discussion:** The etiological diagnosis of chronic otitis media with effusion in adults requires a complete ENT examination completed by a injected ear scan. Treatment is not clearly codified.
HEARING SCREENING AND ASSESSMENT IN ADULTS AND OLDER ADULTS

108 - HEARING LOSS IN ADULTS IN ONE REGION IN THE CZECH REPUBLIC


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Background: Hearing impairment in adults is one of the most common chronic health conditions, and have important implications for quality of life, such as functional decline, depression and social isolation. In the Czech Republic there are not accurate data about frequency of hearing loss.

Aims: Based on epidemiological study comprising significant large number of respondents to assess the number of people with the hearing loss in Karvina region related to age and sex and to find out an impact of the hearing loss on their social and emotional sphere.

Methods: The ENT consulting rooms in the region of Karvina for hearing examination with sufficient equipment took part in the cooperation from July 2011 to the end of the year 2015. The entry criterion for including into the study is the age of individual (the person older than 18 years), the individual looking for ENT doctor, the Czech nationality and willingness to participate in the study. Exclusion criterion was the low age and the place of residence outside the region. The required data are collected by dialogue with respondents using questionnaire. Hearing is examined by means of audiometric and tympanometric examination for the right and the left ear respectively. The dialogue and filling out a questionnaire including hearing threshold examination is provided by professionally skilled audiologic nurses. The short questionnaire is focused on the specification of person, age, sex, work and social sphere, risk factors, the type of hearing loss and possible correction of hearing by compensation of hearing aids. The respondents filled out the hearing handicap inventory – screening form.

Results: 6 026 persons were examined aged 18 to 93 years, including 3 263 women and 2 763 men. Most of them 82,24% live in the town, 9,1% live in the village and 8,55% live in the suburban area. 71,27% of people evaluate their residence as a silent area, and 28,73% of people evaluate their area as a noisy one. Otitis media had 34,33% of them in history. There are 22,5% of non-smokers, 63,41% of smokers and 14,09% of respondents stopped to smoke. In a noisy environment more men are working than women. The skilled workers were exposed to noise the most, the graduates were exposed to noise the least. Hearing loss is getting worse with age. In the age category of 60 – 69 years the dependence of hearing loss on work in a noisy environment was evaluated in 529 respondents. Their exposure to noise was 26,2 years with SD 11,7. The average audiogram of respondents who did not work in noise is better than their equals in age who worked in noise, but they did not have to wear protective equipment. The worst average audiograms were in respondents working in the environment where there was necessary to use acoustic protection devices due to noise. 3 546 respondents filled out „the hearing handicap inventory – screening form“ with 10 questions The statistic significant dependence was found (p<0,001) between handicap and age. The persons without hearing handicap were 47,6 years old on average (SD=17,6) years, with light to medium hearing handicap 65,4 (SD=12,5) years and with heavy hearing handicap were persons older than 68,2(SD=16,2) years. The significant positive dependence was found between hearing loss and hearing handicap (r_s = 0,7421).
Conclusion: The study should help to identify groups at risk for hearing loss in industrial Karvina region (comprising 280 thousand residents), to improve the monitoring of risk factors for the assessment of the epidemiological situation and the effectiveness of prevention and compensation of hearing loss persons.

Work is supported by a grant from the Internal Grant Agency of the Ministry of Health of the Czech Republic No NT/12246 – 5.

109 - THE DEVELOPMENT OF SIMPLE-VERSION HEARING SCREENING QUESTIONNAIRE (VHCQ) FOR ELDERLY AND ANALYSIS OF THE SENSITIVITY AND SPECIFICITY


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**Objective:** The purpose of this study was to develop the Simple-Version hearing screening questionnaire (SVHCQ) for elderly and analyse the sensitivity and specificity.

**Method:** Summary of the hearing screening literatures on elderly, and captured the life behavior problem that elderly persons often encounter from the hearing clinic and community in the elderly population, and then combined these issues into the Simple-Version hearing screening questionnaire which was used for this study. Subjects were recruited from the physical examination center of Xinhua hospital. The questionnaire and pure tone test were administered to them. The results were analyzed statistically with SPSS17.0 to determine the sensitivity and specificity of SVHCQ.

**Results:** (1). Ninety-eight subjects were included in the study. Sixty had hearing impairment (61.2%), of which 22 (22.4%) were mild, 27 (27.6%) were moderate, 8 (8.2%) were moderate-severe, and 3 (3.1%) were more than severe. (2) The positive cases were 48 with the sensitivity and positive predictive value were 68% and 85.4%, and the negative results were 50 cases with the specificity and negative predictive value were 81.6% and 62%. Pearson correlation analysis showed that there was a significant correlation between SVHCQ and hearing loss (r=0.699, P=0.000).

**Conclusion:** SVHCQ has a good sensitivity and specificity, which can be applied to the elderly hearing screening. In the future study, the number of screening population will be increased in order to improve the sensitivity and reliability of SVHCQ.

110 - THE PERFORMANCE OF THE HEARING SELF-ASSESSMENT QUESTIONNAIRE (HSAQ) IN HEARING IMPAIRMENT SCREENING IN ADULTS

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Early detection of hearing loss is one of the most important prerequisites of successful aural rehabilitation, since it allows the intervention to be focused predominantly on hearing and communication difficulties, rather than socio-emotional difficulties that arise from long periods dominated by communication breakdowns accompanied by quality-of-life threatening intrapersonal experiences. It seems that screening questionnaires do possess the ability to fulfill this task, but the question remains whether the adaptations of commonly used questionnaires to other languages is compromised by cultural relevance of specific items. Therefore, the option to create domestic
screening test might be more clinically justifiable. In this study, diagnostic properties of Croatian hearing loss test for adults were examined, which was proposed as a screening tool for domestic clinical conditions.

The Hearing Self-Assessment Questionnaire (HSAQ) – a 10–item Likert type hearing loss screening questionnaire – was administered alongside audiological examination in 54 adult females and 70 males (mean age 56.5 years) who were healthy otherwise. Among them, 64 (mean age 52.4 years) had normal hearing (four-frequencies PTAs below 25 dB HL), and 60 (mean age 60.9 years) had hearing impairment (PTAs bilaterally over 25 dB HL). Internal consistency and intraclass correlation coefficient of the HSAQ were inspected, and validity was examined by Mann–Whitney U test. Correlation between HSAQ scores and PTAs was calculated, and ROC curve analysis was performed to calculate sensitivity, specificity, predictive values, likelihood ratios and probabilities. Finally, cluster analysis and Kruskall-Wallis test were employed to categorize hearing impaired subjects according to PTAs and HSAQ scores.

As indicated by the results of the statistical analysis, the HSQA gives reliable and valid estimation of presence of socio-emotional consequences of hearing loss, has the potential to roughly grade them, and is sensitive, specific and predictive enough for clinical application in screening for hearing loss over 25 dB HL in adults.

**112 - DETECTION OF UNCONSCIOUS EYE MOVEMENTS TO CHECK AUDIOMETRIC THRESHOLDS (PILOT STUDY)**

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In the geriatric patient, the development of audiometry becomes more complex due to the presence of multiples pathologies or a less interaction between the patient and the tester, particularly when cognitive impairment exists. However, involuntary facial reactions are observed in patients with “special needs”, mainly in the eye region.

**Objective:** we present a screening method that analyzes changes within the eye region as a response to sound, in order to corroborate hearing thresholds in elders with “special needs”.

**Methodology:** A fully-automatic computer-driven system has been developed to analyze video sequences of recorded hearing test sessions. The system processes the recordings to detect when the auditory stimuli are sent. Simultaneously, test subject eye region movements are also automatically detected and characterized by applying dynamic computer vision techniques. These gestures are then correlated to the test stimuli so that the system is able to establish the presence of a spontaneous and significant reaction to each one of them, allowing to evaluate the patient's hearing status when no collaboration exists.

**Results:** Initial results point out that significant movements are detected and a 100% of agreement is achieved between the expert and the automatic system for the detection of eye-based spontaneous reactions to the stimuli for the 5 analyzed sequences.

**Conclusions:** the development of an automatic system that detects facial reactions to sound would be very helpful for early detection of hearing loss when patient low collaboration exists. Clearly, further studies are necessary to corroborate these early results.
113 - IMPLEMENTATION AND VALIDATION OF DIGIT TRIPLETS TEST VIA TELEPHONE IN SINGAPORE

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Objective: To implement and validate the digit triplets test via telephone in Singapore.

Method: Sound files with pre-mixed digit triplets and noise were obtained from HörTech GmbH. The test introduction, instruction, result, and recommendation were developed and recorded in the four official languages in Singapore. A similar adaptive testing procedure as described by Smits was used. To validate the test, 577 participants were recruited from the otolaryngology outpatient clinic of the National University Hospital, Singapore. The modified single question, digit triplets test via telephone and pure tone audiometry test were performed on all participants. Univariate tests were conducted to ascertain if there were any significant demographic differences between the participants with and without hearing loss. Logistic regression was conducted to predict the probability that a participant has hearing loss. Area under the receiver operating characteristic curve of screening algorithms with different variables was calculated.

Results: The screening algorithm of the best Signal-to-Noise Ratio obtained in the worse performance ear during the telephone test, age, gender, and modified single question yielded the largest area under the curve (0.834). It was thus selected to predict the probability that a participant has hearing loss.

Conclusion: The telephone test was implemented and validated against the pure tone audiometry. The screening algorithm derived is sensitive to identify people with hearing loss and can be used for mass screening of hearing loss in Singapore.
HEARING LOSS IN THE OLDEST OLDER ADULTS

114 - COGNITIVE STATUS AND HEARING IMPAIRMENTS AT THE OLDEST AGES: DATA FROM ITALIAN CENTENARIANS (100+) AND SEMI-SUPER CENTENARIANS (105+)

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During the last century, human life expectancy is more than doubled and the numbers of oldest old individuals is increasing throughout the world. Centenarians are rare and exceptional individuals characterized by a peculiar phenotype representing the best example of healthy ageing in humans as most of them have survived, escaped, delayed the onset of major age-related diseases. On the other hand, extreme aging is accompanied by an increase in impairments, frailty and disabilities. This study aims to evaluate hearing capacity and cognitive status (Standardized Mini Mental State Examination, SMMSE) in two Italian populations of extreme aged subjects: i) n. 147 centenarians (100+, 28 men, 119 women, mean age: 101) ii) n. 83 semi-super centenarians (105+, 19 men, 64 women, mean age: 106).

52.4% of 100+ and 56.6% of 105+ were not able to hear a conversation with another person. Among them, 11.6% of 100+ and 22.9% of 105+ wore a hearing aid. Regarding cognitive status, 21.8% of 100+ resulted cognitively unimpaired (SMMSE: 24-30), 22.4% were mild impaired (SMMSE: 18-23) and 32.7% presented a severe impairment (SMMSE: 0-17). 23.1% of 100+ is unable to perform SMMSE test. In 105+ the cognitive status further decreased. In fact, only 10.8% of them resulted cognitively unimpaired, 13.3% were mildly impaired and 28.9% presented a severe impairment. A large part of 105+ (47.0%) were not able to answer the SMMSE. Remarkably, among the subjects unable to perform SMMSE, 67.6% of 100+ and 66.7% of 105+ showed hearing deficits. Certainly, existing methods are inadequate to evaluate cognitive status and to understand the real hearing capacity in extreme long lived individuals often characterized by multiple sensory impairments as well as fatigueability, reduced attention to ordinary life events, disability, sleepiness and unconsciousness.

115 - USING WHISPER VOICE TEST FOR EARLY DETECTION OF HEARING LOSS IN GALICIAN NURSING HOMES

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There is a high prevalence of hearing loss among older people living in Galician nursing homes. However, although auditory impairment impacts negatively on resident’s daily living, hearing screening is not routinely performed. To screen for auditory impairment, national health guidelines recommend the whisper voice test as screening tool.
Objective: a non-standardized technique exists for conducting the whisper voice test, so we have adapted the screening test to the characteristics of “our” older residents (illiteracy, language, cognition...). The objective is to examine the accuracy of our methodology on detection of hearing loss, to incorporate the whisper voice test as an integral part of overall health assessment of our residents.

Method: we evaluated 366 nursing homes residents (≥65 years). Otoscopy, Liminal Tonal Audiometry (air-conduction; 0.5KHz-4KHz range) and Whisper Voice Test were carried out. Hearing loss was defined according with the international criteria of Ventry and Weinstein. Whisper test was developed using the common phrases “What’s your name?” and “How old are you?” (Galician language used if necessary). Audiometric data and voice test results were compared.

Results: overall, the modified whisper voice test shows a high sensitivity and specificity in both ears tested. Positive predictive and negative predictive value reaches more than 80% and 85% respectively (both ears).

Conclusion: the use of the whisper voice test by general practitioners of nursing homes could contribute on early detection of hearing loss and identification of untreated auditory deficits among nursing homes residents.

116 - DUAL SENSORY LOSS AND COGNITIVE IMPAIRMENT: A STUDY AMONG GALICIAN OLDER PEOPLE

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Prevalence of hearing, visual and cognitive impairments increased with age and has a negative impact on quality of life of older people. Recent investigations reveal an association between both individual sensorial impairments and cognition. However, the effect of DSL on cognition remains unclear. 15.465 seniors are living in Galicia nursing-homes, and cognitive state in one of the main causes of admission. At the same time, previous data reveals the high prevalence of vision and hearing loss among Galician older people, especially in nursing-homes.

Purpose: To evaluate the impact of dual sensory deprivation (vision and hearing loss) on cognition of Galician older people.

Methodology: we evaluate a sample of 546 Galician older adults (range age from 60 to 99 years old). Functional vision (presenting visual acuity, far distance) and hearing thresholds (liminal tonal audiometry; air conduction) were established. Mini-Mental State Examination test (Spanish validated version) was used to evaluate cognition. Data analysis was performed using SPSS 17.0 program (SPSS Inc, Chicago, Illinois).

Results: logistic regression shows, after adjusting for age and sex, that the risk of cognitive impairment increases significantly in those subjects with DSL (OR: 3,55; p= 0.000) respect older people with no DSL or single deficits (OR: 2,40; p=0.008).

Conclusion: These findings confirm the importance of functional vision and hearing on cognition. It is necessary that audiologists and optometrists work together due to the roll of DSL on healthy aging. Next step is to determine the contribution of both singles deficits on cognitive decline.
HEARING AID USE

117 - HEARING AID COVERAGE ACROSS THE WORLD
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Recent data on hearing aid sales per country is used to estimate hearing aid coverage of the impaired population in major market areas. The data is analyzed with regards to various dimensions such as GDP and subsidy level. Coverage varies considerably across countries and certainly also within Europe. The coverage goes as high as 55% in the most advanced countries. Several factors seem to contribute and will be presented. The coverage data from hearing aid sales is compared to coverage data from surveys (Eurotrak) and the differences are commented. The observations made can be used to form recommendations to increase hearing aid coverage.

118 - DURATION OF HEARING AID APPLICATION AFTER FIRST AUDIOLOGICAL ASSESSMENT ACCORDING TO HEARING LOSS DEGREE IN İNFANTS
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Background: Success of newborn hearing screening has also been demonstrated by the decrease in age of hearing aid fitting. Early confirmation of hearing loss leads to early fitting of hearing aids on infants and age at fitting of amplification is predictive of speech perception, speech production, and spoken language skills. One of the most important factors in hearing aid use is the family perception and acceptance of the hearing loss and the necessity of using hearing aids. It was hypothesized that the age of hearing aid application is associated with hearing loss degree.

Objectives: The current study was designed to study the association between the degree of hearing loss and the time between the first audiological assessment and the fitting of hearing aids.

Material Methods: 84 babies were included in this retrospective study. It was analyzed hearing loss degree which is divided into four groups from moderate to profound according to ANSI 1996 classification and duration of receiving hearing aid after first audiological assessment.

Results: Kruskal Wallis was used for the statistical analysis. Although first audiological assessment age, diagnosis age, fitting of hearing aid age as other variables aren't statistically significant ($P>0.05$) among four groups our findings reveal that babies with moderate hearing loss receive hearing aids later than babies with profound hearing loss ($p<0.05$).

Conclusion: In the light of our findings, families having babies with profound hearing loss have a higher level of awareness about the problem and have a higher tendency to obtain and make use of HA in their infants in the earlier phases when compared with the families having children with moderate hearing loss. Thus, raising the awareness of the society about this issue and informing the families with children having mild and moderate hearing loss is vitally important.
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