European Metrology Research Programme

Delivering Impact

# Better infant hearing tests

Three in every 1000 babies are born with hearing impairment, which hampers development of language skills. Rapid identification is key for early intervention, so many national health authorities have hearing testing programs for babies. However the headphones used for hearing tests are set up using ear simulators designed for larger adult ears. Tailoring these to smaller ear sizes will improve the accuracy of assessments of hearing loss in young children.

**Europe's National Measurement Institutes working together**

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

# Challenge

Hearing defects in a child's early years leads to language development problems, so national health authorities run programmes to identify affected babies and young children. Testing uses small headsets to provide a known sound stimulation, then measures the response in the infant's ear or brain.

The small headsets currently used for infant testing are calibrated using the same ear simulators used for much larger adult headphones. This mismatch between the adult ear simulator and the smaller infant ear leads to differing sound intensities from the same test sound; just as an alarm clock would be heard differently in a small box compared to across a large room. The smaller size and shape of an infant's ear, which changes as they rapidly grow, requires a range of small ear simulators to ensure the correct sound intensity is being used in testing.

Calibration methods for infant hearing test headsets therefore need to be modified to reflect the difference in perceived sound intensity resulting from changing infant ear sizes and shapes. The current use of adult sized ear simulators provide inadequate calibrations for the smaller headsets used in infant hearing assessments. New smaller ear simulators are required to help improve the diagnosis of hearing impairment in infants.

# Solution

The EMRP Project, *Metrology for a universal ear simulator and the perception of non-audible sound* developed a prototype infant ear simulator for calibrating the headsets used to test hearing in babies.

Through extensive sound testing and modelling, the project identified the most important factors needed to design better ear simulators, and produced a series of specifications for ear simulators to match ear shapes from birth to young adult.

# Impact

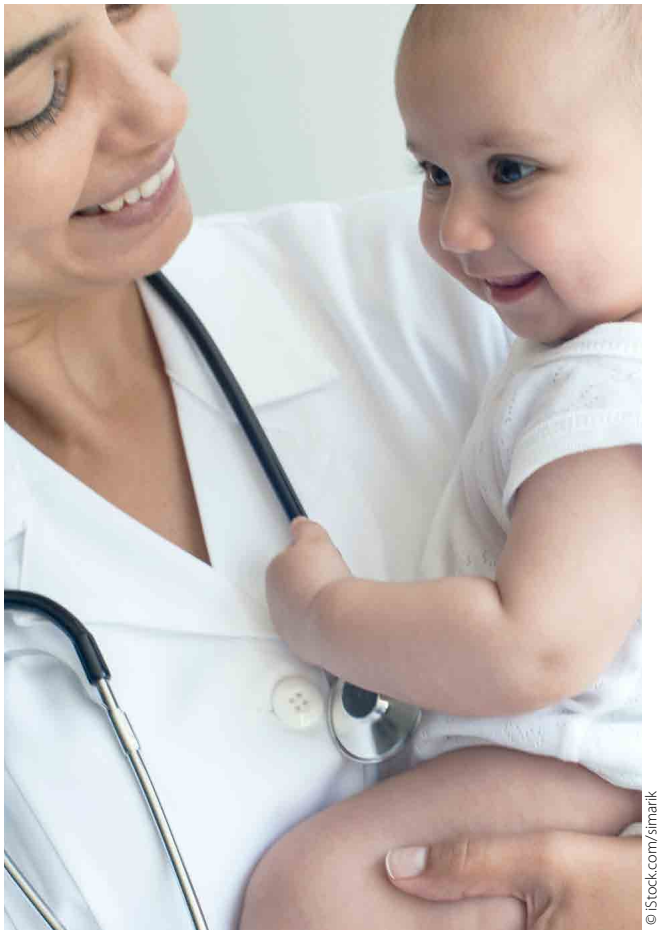
Acoustic Metrology Ltd (AML), a UKAS accredited calibration laboratory, evaluated the prototype ear simulator developed by the project, confirming that they were suitable for calibrating the small headsets used for infants. By using existing calibration set-ups, AML demonstrated that current equipment and methods could be easily adapted to make use of the new ear simulator.

Before these ear simulators are used for routine infant headset calibrations, the relevant IEC standards used by hearing calibration services need to be updated. A new IEC working group has been set up to review the current standard with a view to incorporating the use of infant sized ear simulators developed in this project, as well as other improvements to child hearing assessment testing.

Once an agreed international standard exists, national testing programmes can mandate its use in headset calibrations and so ensure uniform standards are applied across health authorities. Through using ear simulators designed to match the ear being tested, diagnosis of hearing impairment in infants can be improved and earlier interventions started to enable development of key language skills.

## Metrology for hearing health

The EMRP project *Metrology for a universal ear simulator and the perception of non-audible sound* addressed two aspects of human hearing. The first part of the project improved the quality of hearing impairment diagnosis, particularly for neonates and children, through the development of new instrumentation for calibrating the acoustic stimuli used in clinical hearing assessments. The second combined methods from audiology and brain imaging to better understand physiological responses to sound outside of the conventional frequency range of hearing, and used this to create a basis for new guidance on the hazards presented by infrasound and ultrasound.





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