A Comparison and Analysis of Early Childhood and School Aged Hearing Screening Protocols

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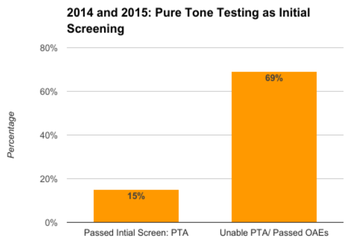
OAEs - Overview

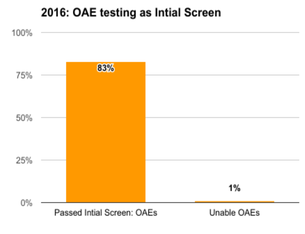
An overall trend of increased prevalence in hearing loss has been noted in the school age population. According to the American Academy of Audiology (AAA), 1 to 3 per 1,000 children are identified with hearing loss at the time of birth; however, by the time children are school-aged, it is expected to increase to 9 to 10 per 1,000 children. These children who are identified at this age are diagnosed with permanent hearing loss due to late-onset, progressive, or noise-induced hearing loss. Both the Colorado Department of Education hearing screening protocol (2001) and the AAA Childhood Hearing Screening Guidelines (2011) suggest that OAEs should only be utilized when pure tone screenings are not developmentally appropriate. The Colorado protocol does not distinguish at what age, only that pure tones should be completed if possible. It also states that screening infants and children requires considerable expertise, technological sophistication, and should be designed and implemented by an ASHA certified audiologist (Colorado Department of Education, 2001; American Academy of Audiology Childhood Screening Guidelines, 2011). Halloran, Wall, Evans, Hardin, and Woolley (2005) found that in primary care settings, only 55% of 3 years olds could complete the pure tone screening and 93% of 4 year olds. 7% of all the children tested in that study could not complete the pure tone screening. A study conducted by James Hall (2016) suggests that using OAEs as a first level screen may provide many benefits in a screening program in which preschool children are included and tested by non-audiologists.

Methods & Results

Retrospective data analysis of population-based screening was conducted through the **Marion Downs Center Kidscreen** program. Analysis of 3-year old screens was complete for 248 children. 80 students were included from 2014-2015, when pure tone screening was the first level screen and 168 students were included from 2016, when OAEs were the first level screen. All children were screened at schools in the Denver area.

Kidscreen Protocol, 3 years old
- Passing criteria for 2014-2015 data: if student passed OAEs then testing was complete. If student referred on OAEs, tympanometry was performed.





Conclusions

The data from 2014-2015 when pure tones were used as the initial screen, indicated that a majority of students (69%) were not able to condition when asked to participate in pure tone testing. Further, the students then had to complete OAE testing. The data from 2016 when OAEs were used as the initial screen, indicated further screening steps were eliminated making testing effective and more time efficient.

Pure-tones - Overview

One in six adolescences is affected by noise-induced hearing loss (Sekar et al., 2016) which is often missed by school screenings do to the varying protocols utilized nationwide. Protocols commonly exclude the high frequencies such as 3,000, 6,000, and 8,000 Hz which are frequencies commonly associated with noise induced hearing loss. As of 2012, 20 states included screening protocols for adolescents (Sekar et al., 2013) and only six states were discussing implementation of 6,000 and or 8,000 Hz. Out of these states Kansas and Colorado were the only two states that required implementation of these frequencies (Sekar et al., 2013). A majority of states are screening at 20 dB for frequencies 1,000, 2,000, and 4,000 Hz (Sekar et al., 2016) with the second highest number of states including 500 Hz (Bright et al., 2011). Research demonstrations that there is a high incidence of the adolescent population with noise induced hearing loss and confirms that a majority of school screening protocols are missing these children.

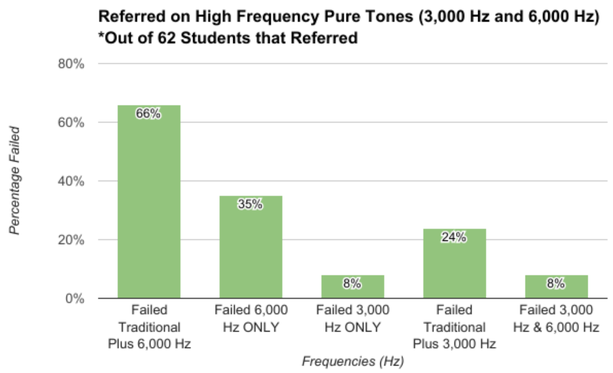
Methods & Results

Retrospective data analysis of population-based screening was conducted through the **Marion Downs Center Kidscreen** program. Total analysis of 610 students, 6th grade and above, were screened at various schools in the Denver area.

Kidscreen Protocol, 6th grade and up:
- Passing criteria is 20 dB at 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz and 25 dB at 6000 Hz

Using Kidscreen protocol (1000, 2000, 3,000, 4000, & 6000 Hz)
- **62 out of 610 students referred– 10%**

Using traditional school screening protocol (1000, 2000, & 4,000 Hz)
- **13 of 610 students referred– 2%**



In this data-set, 35% failed at 6,000 Hz only and 8% failed at 3,000 Hz only. Out of the 62 students that referred, 8% failed 3,000 and 6,000 Hz.

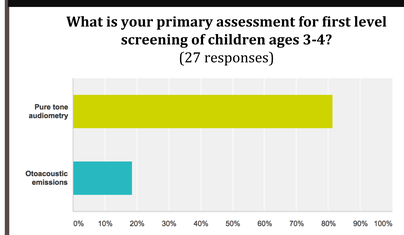
Conclusions

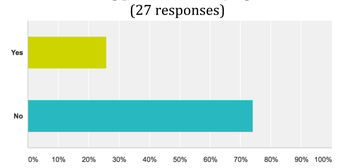
The data indicated that 8% of students who failed the initial screen would have been missed had 3000 and 6000 Hz not been included in this screening protocol. In this data-set, 35% failed at 6,000 Hz only and 8% failed at 3,000 Hz only. Out of the 62 students that referred, 8% failed 3,000 and 6,000 Hz. In an ideal screening protocol, the goal is to separate those with normal hearing sensitivity from those with hearing loss. It would be beneficial to utilize high frequencies in the typical test battery.

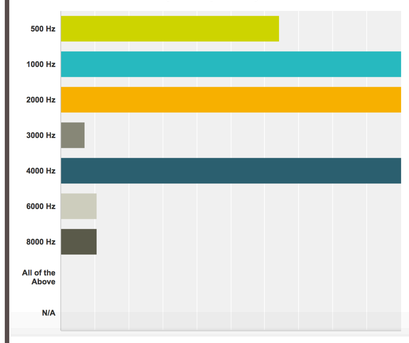
Survey - Overview

It is important to consider current clinical practice and evidence based decisions when considering optimal school screening protocols. It was beneficial to survey audiologists involved in screenings programs to investigate protocol variations, by age, being implemented in the US.

Results







- 83% stated their state/district had written their own protocol, the remaining 17% indicated that they used the AAA/ASHA guidelines
- AAA states in their protocol, "Some screening programs for older students may choose to add 6000 Hz at 20 dB HL in order to identify possible high-frequency hearing loss consistent with damage from noise exposure."
- 81% indicated they use pure tones, 18% indicated they use OAEs
- Respondents stated that OAEs would be beneficial to include in the protocol for "difficult to test patients, suspected malingering, and as a more efficient screening program."
- Of the 28 response, only 3 indicated they test 6000 Hz and only 2 indicated they test 3000Hz.
- Furthermore, 74% stated that they do not include 3000 or 6000 Hz in their protocol for school screenings for any age group but would find it beneficial in order to assess for a high frequency hearing loss due to noise exposure.

Overall Conclusions

The aim of this study was to investigate the current status of school hearing screening protocols and to focus on two particular age groups, age 3 and 6th grade and above. Current state protocols reflect a wide variety of recommendations all with the goal of identifying children missed in newborn hearing screenings and children with progressive or late onset-hearing loss. Evidence suggests that the ability to identify and diagnose hearing loss at birth has been significantly improved by the advent of universal newborn hearing screenings. However, early-childhood hearing screenings are not universal. The protocols and techniques used in early childhood and school-aged screenings may not be efficient at identifying all children with hearing loss.

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