



**TITLE:** Hearing Screening in Preschool Aged Children: A Review of the Clinical Effectiveness and Guidelines

**DATE:** 23 November 2012

## **CONTEXT AND POLICY ISSUES**

In Ontario, approximately 400 infants and preschool children are identified with hearing impairment annually.<sup>1</sup> In a study of 445 preschool children who previously passed newborn hearing screening, 16 had permanent delayed-onset hearing loss after audiologic assessment.<sup>2</sup> Approximately 3 in 1,000 children present with acquired deafness in early childhood,<sup>1</sup> most resulting from otitis media with effusion (OME).<sup>3</sup> Almost 90% of children develop OME prior to school age, and recurrent episodes may cause hearing loss.<sup>4</sup> While hearing screening programs differ across jurisdictions, the objective is to identify children with hearing loss and facilitate early access to sound so that speech, language, cognition and learning are not delayed.<sup>1</sup>

Otoacoustic emissions are an objective, non-invasive test to identify hearing defects in very young children who are unable to cooperate with conventional testing. The primary screening tool tests for the presence of click-evoked otoacoustic emissions (OAE) to identify cochlear and higher-level hearing loss. OAEs are sounds generated by movement of the outer hair cells in the inner ear, or cochlea, in response to an external click or tone.<sup>5,6</sup> Two types of evoked OAEs are used for clinical assessment. Transient evoked OAEs (TEOAEs) are elicited using a click with a broad frequency range or a brief duration of a pure tone stimulus. Distortion product OAEs (DPOAEs) are elicited using a pair of primary tones of a particular intensity. OAEs can be recorded in the ear canals of normal hearing individuals but are absent in individuals with significant hearing loss of 30 dB or greater.<sup>5,6</sup> While TEOAE testing takes less than five minutes to conduct on both ears, it does not determine the cause of hearing loss.<sup>5</sup>

Tympanometry measures the mobility of the tympanic membrane and conduction bones by creating variations of air pressure in the ear canal. The test helps identify fluid and negative pressure in the middle ear but requires specialist equipment and does not assess hearing.<sup>5</sup> The test is performed by inserting a tympanometer probe in the ear. The instrument changes the pressure in the ear, generates a pure tone and measures the eardrum's response to the sound at different pressures.<sup>5</sup>

*Disclaimer:* The Rapid Response Service is an information service for those involved in planning and providing health care in Canada. Rapid responses are based on a limited literature search and are not comprehensive, systematic reviews. The intent is to provide a list of sources and a summary of the best evidence on the topic that CADTH could identify using all reasonable efforts within the time allowed. Rapid responses should be considered along with other types of information and health care considerations. The information included in this response is not intended to replace professional medical advice, nor should it be construed as a recommendation for or against the use of a particular health technology. Readers are also cautioned that a lack of good quality evidence does not necessarily mean a lack of effectiveness particularly in the case of new and emerging health technologies, for which little information can be found, but which may in future prove to be effective. While CADTH has taken care in the preparation of the report to ensure that its contents are accurate, complete and up to date, CADTH does not make any guarantee to that effect. CADTH is not liable for any loss or damages resulting from use of the information in the report.

*Copyright:* This report contains CADTH copyright material. It may be copied and used for non-commercial purposes, provided that attribution is given to CADTH.

*Links:* This report may contain links to other information available on the websites of third parties on the Internet. CADTH does not have control over the content of such sites. Use of third party sites is governed by the owners' own terms and conditions.

A statement from the American Academy of Pediatrics recommends that all children should receive screening for hearing loss at least once during their preschool years.<sup>7</sup> While the American Academy of Audiology recommends that tympanometry in conjunction with pure tone screening be conducted in preschool children<sup>8</sup> currently, there are no universally mandated screening services for preschoolers. Neither of these guidelines described the methods or evidence on which the recommendations were based.

This review evaluates the comparative clinical effectiveness of OAE with tympanometry versus OAE alone for identifying preschool children with hearing impairment. The evidence-based guidelines regarding hearing screening in preschool children were also examined.

## RESEARCH QUESTIONS

1. What is the comparative clinical effectiveness of otoacoustic emissions with tympanometry versus otoacoustic emissions alone for identifying hearing impairment in preschool aged children?
2. What are the evidence-based guidelines regarding the use of otoacoustic emissions in conjunction with tympanometry for identifying hearing impairment in preschool aged children?

## KEY FINDINGS

No clinical evidence or evidence-based guidelines were identified regarding the comparative clinical effectiveness of otoacoustic emissions with tympanometry versus otoacoustic emissions alone for identifying preschool aged children with hearing impairment.

## METHODS

### Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, Medline, The Cochrane Library (October 2012), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 01 2007 and October 26 2012.

### Selection Criteria and Methods

One reviewer screened the titles and abstracts of the retrieved publications and evaluated the full-text publications for the final article selection, according to selection criteria presented in Table 1.

**Table 1: Selection Criteria**

<b>Population</b>	Preschool children (aged 18 months to 5 years)
<b>Intervention</b>	Screening tests involving otoacoustic emissions (OAE) with tympanometry
<b>Comparator</b>	Screening tests involving OAE only
<b>Outcomes</b>	Effectiveness, hearing status accuracy Best practices, current evidence recommendations
<b>Study Designs</b>	Health technology assessments, systematic reviews, meta-analyses, RCTs, non-randomized studies, evidence-based guidelines

**Exclusion Criteria**

Studies were excluded if they did not meet the selection criteria, were duplicate publications or were published prior to 2007.

**SUMMARY OF EVIDENCE**

**Quantity of Research Available**

The process of study selection is outlined in the PRISMA flowchart (Appendix 1). The literature search yielded 555 citations. Upon screening titles and abstracts, 11 potentially relevant studies were retrieved for full text review. Two potentially relevant reports were also retrieved from grey literature searching. Of the 13 potentially relevant reports, one contained an irrelevant population, nine contained irrelevant interventions, one contained an irrelevant comparator, one contained an irrelevant outcome, and one guideline was not based on identifiable evidence. Of the reports excluded based on an irrelevant intervention, two were questionnaire-based, one was a program evaluation, five reports did not contained tympanometry with otoacoustic emissions, and one report evaluated distortion product otoacoustic emissions versus transient evoked otoacoustic emissions and then compared the pass fail rates with that from tympanometry.

Overall, no health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies or evidence-based clinical practice guidelines were identified regarding the comparative clinical effectiveness of OAEs with tympanometry versus OAEs alone. However, one systematic review and a non-randomized study that did not meet our inclusion criteria but may provide further information are included in Appendix 2.

**CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING**

No conclusions can be drawn regarding the best practice on whether to conduct OAE with tympanometry or to perform OAE alone to identify hearing loss in preschool aged children as no clinical evidence or guidelines were found.

**PREPARED BY:**

Canadian Agency for Drugs and Technologies in Health

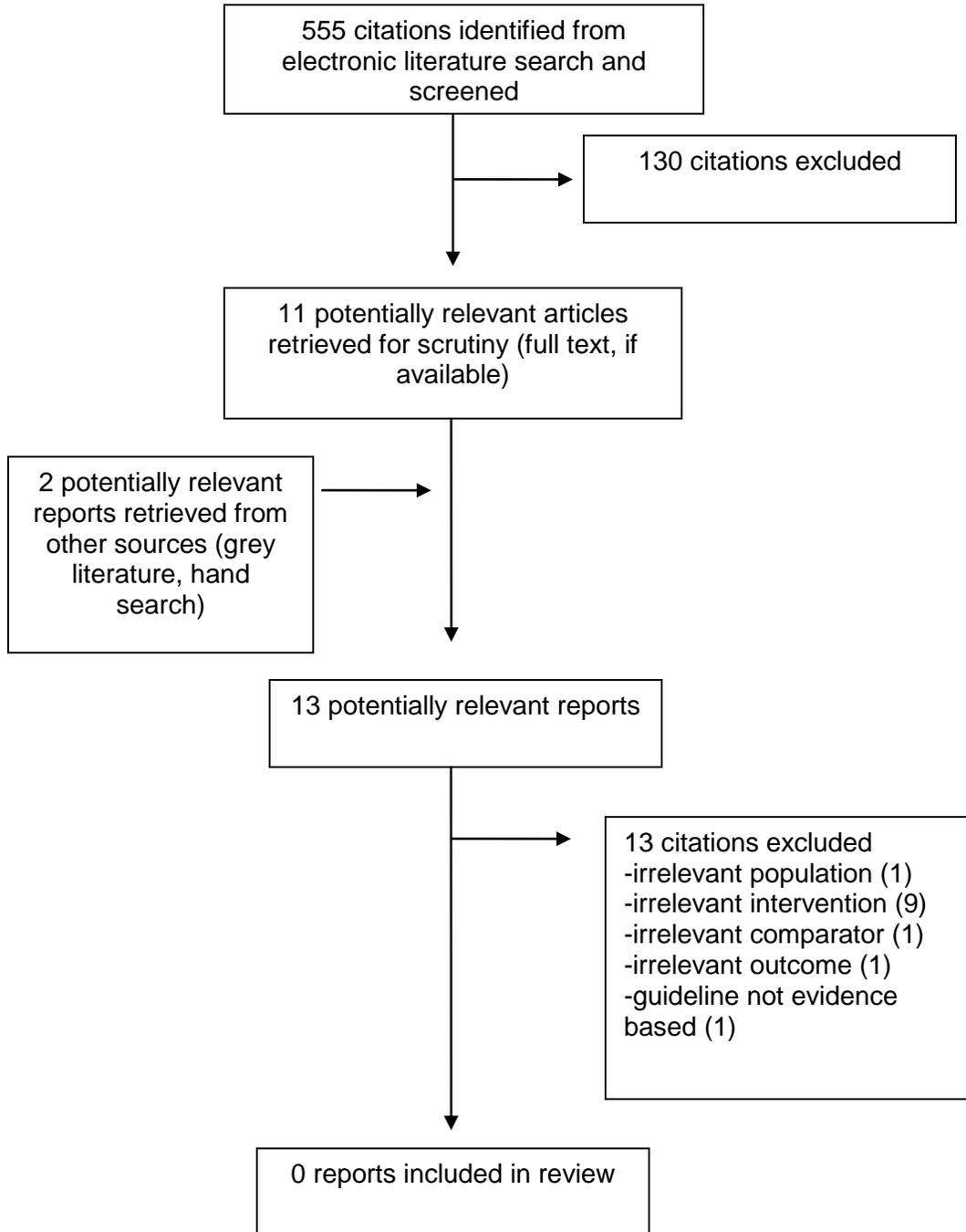
Tel: 1-866-898-8439

[www.cadth.ca](http://www.cadth.ca)

## REFERENCES

1. Bagatto M, Scollie SD, Hyde M, Seewald R. Protocol for the provision of amplification within the Ontario infant hearing program. *Int J Audiol* [Internet]. 2010 Jan [cited 2012 Nov 15];49(Suppl 1):S70-S79. Available from: [http://www.dslio.com/docs/7\\_Ontario\\_HA\\_Fitting\\_Protocol\\_Bagatto\\_et\\_al.pdf](http://www.dslio.com/docs/7_Ontario_HA_Fitting_Protocol_Bagatto_et_al.pdf)
2. Lu J, Huang Z, Yang T, Li Y, Mei L, Xiang M, et al. Screening for delayed-onset hearing loss in preschool children who previously passed the newborn hearing screening. *Int J Pediatr Otorhinolaryngol*. 2011 Aug;75(8):1045-9.
3. Eiserman WD, Shisler L, Foust T, Buhrmann J, Winston R, White K. Updating hearing screening practices in early childhood settings. *Infants & Young Children* [Internet]. 2012 [cited 2012 Nov 14];21(3):186-93. Available from: <http://www.infanthearing.org/ncham/publications/Infants%20&%20Young%20Children%20article.pdf>
4. Serpanos YC, Jarmel F. Quantitative and qualitative follow-up outcomes from a preschool audiologic screening program: perspectives over a decade. *Am J Audiol*. 2007 Jun;16(1):4-12.
5. Alaani A, Bulmer N, Hodgkins C, Raut V. Methods of hearing assessment in children. *Br J Hosp Med (Lond)*. 2010 Apr;71(4):195-9.
6. Institute of Health Economics. The Safety and efficacy/effectiveness of using automated testing devices for universal newborn hearing screening: an update [Internet]. Edmonton: The Institute; 2012. [cited 2012 Nov 15]. Available from: <http://www.ihe.ca/documents/Newborn%20Hearing%20Screening.pdf>
7. Harlor AD, Jr., Bower C, Committee on Practice and Ambulatory Medicine, Section on Otolaryngology-Head and Neck Surgery. Hearing assessment in infants and children: recommendations beyond neonatal screening. *Pediatrics* [Internet]. 2009 Oct [cited 2012 Nov 14];124(4):1252-63. Available from: <http://pediatrics.aappublications.org/content/124/4/1252.full.pdf+html>
8. American Academy of Audiology. Childhood hearing screening guidelines [Internet]. Reston, VA: The Academy; 2011. [cited 2012 Nov 14]. Available from: [http://www.cdc.gov/ncbddd/hearingloss/documents/AAA\\_Childhood%20Hearing%20Guidelines\\_2011.pdf](http://www.cdc.gov/ncbddd/hearingloss/documents/AAA_Childhood%20Hearing%20Guidelines_2011.pdf)

**APPENDIX 1: Selection of Included Studies**



## APPENDIX 2 – Further Information:

### Systematic Reviews

#### *Included Studies Did Not Contain Tympanometry with Otoacoustic Emissions*

1. Bamford J, Fortnum H, Bristow K, Smith J, Vamvakas G, Davies L, et al. Current practice, accuracy, effectiveness and cost-effectiveness of the school entry hearing screen. *Health Technol Assess.* 2007 Aug;11(32):1-168.  
[PubMed: PM17683682](#)

### Non-Randomized Studies

#### *Pass Fail Rates from Otoacoustic Emissions Versus Tympanometry Alone*

2. Dille M, Glatke TJ, Earl BR. Comparison of transient evoked otoacoustic emissions and distortion product otoacoustic emissions when screening hearing in preschool children in a community setting. *Int J Pediatr Otorhinolaryngol.* 2007 Nov;71(11):1789-95.  
[PubMed: PM17870187](#)