

ShoeBOX Audiometer in Canada's North: a portable and cost-effective method for hearing screening

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Methods

Pediatric Automated Mobile Play Audiometer App

How the audiometry App works

- > The App is a hearing screening test disguised as a game
- > The child is presented with different objects that appear on the tablet, and is asked to sort them, according to whether they produce a sound or they are silent. An example of an object is an egg where the child is asked to deliver it to a chicken coop if a sound is detected and to an egg carton if the egg is silent. (Figure 1)
- > Each object produces a warble-tone at 500, 1000, 2000 or 4000 Hz. Once all frequencies are tested at different intensities in each ear, a standard audiogram is generated.
- > This App has been accurately validated (ANSI standards) and is reliable for testing in a screening setting. [9]

Population

- Hearing testing was performed on 218 students, ages 5-11, attending one of three elementary schools in Iqaluit, Nunavut.
- Any child who was unable to follow the game was excluded from the study

Study Design

A prospective, cross sectional study design was used.

- 1) Students were instructed on how to use the audiometer app by an Otolaryngology resident, teacher, or teaching assistant.
- 2) The children who were found to display HL on the tablet hearing screening test were later seen by an audiologist who tested them using traditional sound booth audiometry.
- 3) Those with HL on the confirmatory test were referred to an Otolaryngologist for further medical follow-up.

Outcome Measures

- HL was defined at ≥ 30 dB at any of the frequencies, in one or both ears; ≥ 30 dB is considered disabling in children where developmental delay may occur. [1]

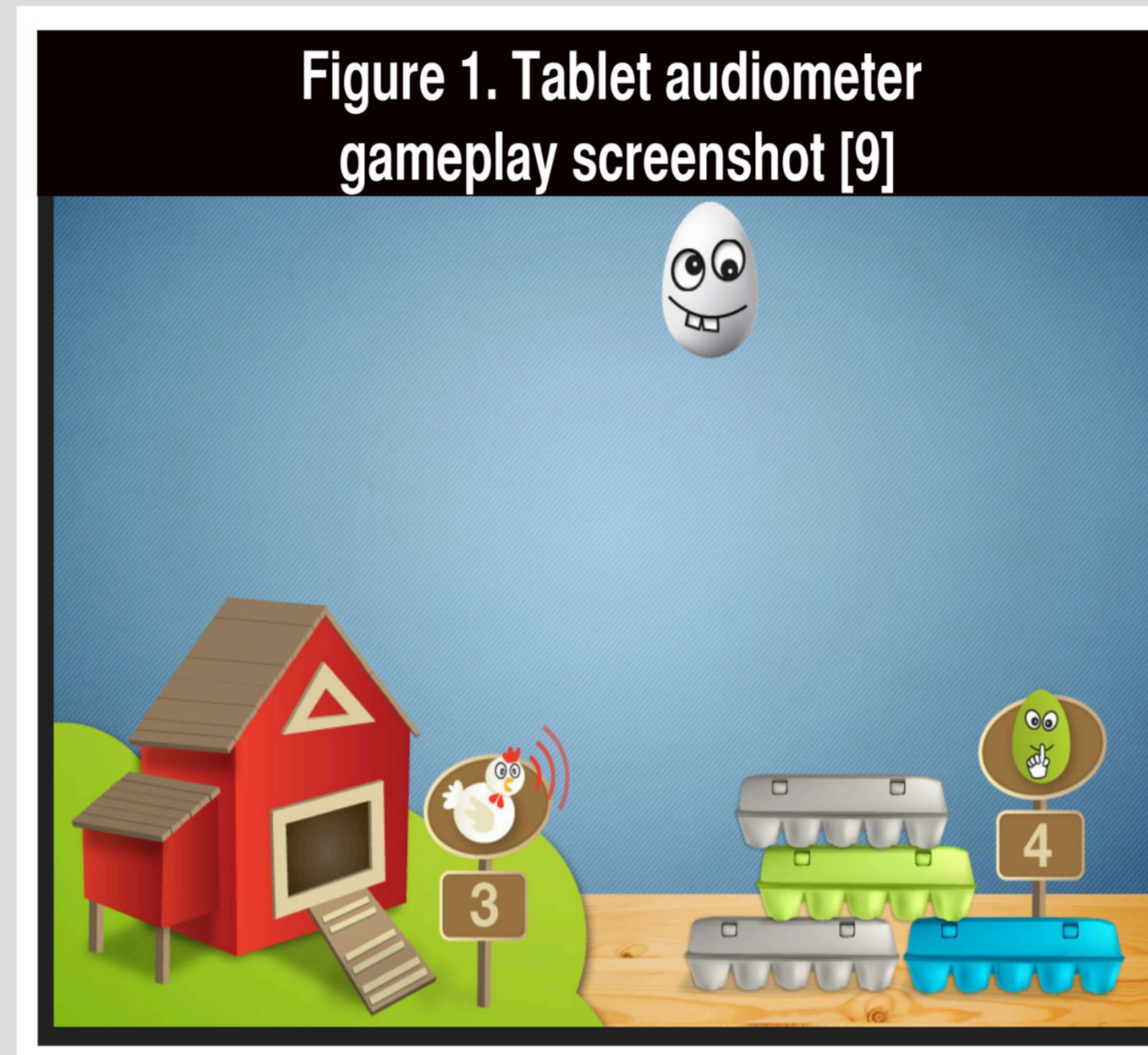
Background

- > Development of speech and communication skills in children is largely dependent on having adequate hearing. Hearing loss (HL) can impede normal **social**, **emotional** and **cognitive development** and is often undetected. [1]
- > The WHO estimates that **32 million** children live with disabling HL and 50% of these cases can be prevented. Early detection and intervention would have provided profound benefits to many of these children. [2]
- > The majority of undiagnosed and untreated HL occurs in countries with low to middle income economies. HL has also been reported to be highly prevalent among **Canadian Aboriginal children**. [2]
- > It is estimated that the total economic burden of HL in Canada is **\$18 billion** per year. [3]

Table 1. Previous studies - HL prevalence in children

	Criteria for HL	Location of Study	% HL in Children
Hobb et al. (1987) [4]	≥ 25 dB	Kuujuarapik, Quebec	23%
Ayukawa et al. (2004) [5]	> 20 dB	Inukjuak, Quebec	20%
Baxter (1999) [6]	-	Baffin Island, Nunavut	30%
Mehra et al. (2009) [7]	> 20 dB	USA	3.1%

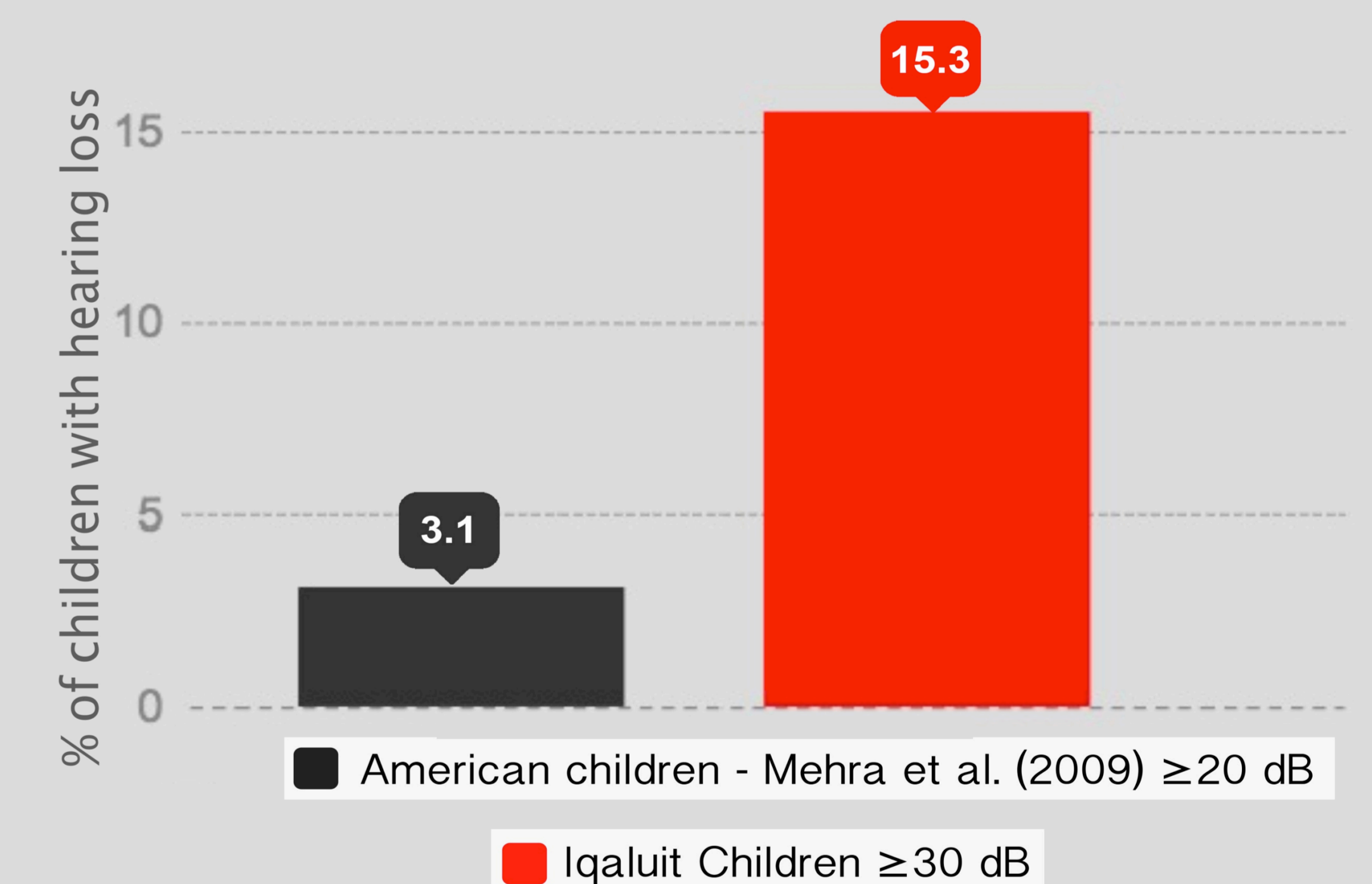
- > Traditional hearing tests in children is often challenging, labour intensive, time consuming and require trained personnel. Many regions in rural and Northern Canada have **limited** access to such resources [8].
- > An new interactive audiometer entitled "**ShoeBOX Audiometry**" (Clearwater Clinical Limited) uses a **tablet** (ie. Apple iPad®) to present a user-friendly, inexpensive and portable medium to perform interactive hearing testing in children.



Preliminary Results

- > Preliminary analysis reveals a hearing loss prevalence of **15.3%**
- > These children then received standard testing by an audiologist using standard sound booth audiometry and the results will be analyzed.
- > A cost-benefit analysis will assess the use of the tablet audiometry in this remote location, as well as similar settings across Canada.

Prevalence of Hearing Loss Among Iqaluit Children Compared to the General Population



Conclusion

This is the first study in over 30 years assessing the hearing of children in this region and the first interactive audiometer screening test in Canada. This novel testing proves to be valuable as it provides an easily accessible method to test hearing in high-risk populations in rural and remote areas at an affordable cost.

Objectives

- (1) Determine the prevalence of hearing loss in children in Iqaluit, Nunavut, using our iPad® audiometer App.
- (2) Demonstrate the use of asynchronous tele-audiometry
- (3) Conduct a cost-benefit analysis of the tablet audiometry in the Canadian Arctic.

Future Directions

- (1) Determine the prevalence of hearing loss in children in Iqaluit, Nunavut, using our iPad® audiometer App.
- (2) Demonstrate the use of asynchronous tele-audiometry.
- (3) Conduct a cost-benefit analysis of iPad® audiometry in the Canadian Arctic.

References

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