

HEARING AIDS IN NOISY WORKPLACES

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Background

- ❑ *Hearing aids (HA) frequently prescribed to improve hearing and communication in workers with noise-induced hearing loss*

- ❑ *Concerns for use in noisy work settings*
 - **Conditions for use or not in the workplace?**
 - **Safety (e.g. sound localization)**
 - **Overexposure leading to worsening of preexisting hearing loss**

- ❑ *Few studies specifically addressing these concerns*

Objectives

- ❑ *Document tools used by health professionals and the needs of workers*
- ❑ *Review effects of HA on speech perception in noise and sound localization*
- ❑ *Identify new technologies to enhance communication while limiting exposure*

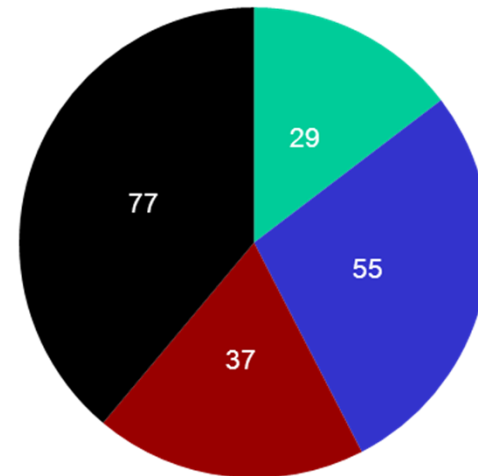
Methodology

- ❑ *Survey*
- ❑ *Focus group discussions*
- ❑ *Literature reviews*

Survey

□ 198 Quebec health professionals completed the survey

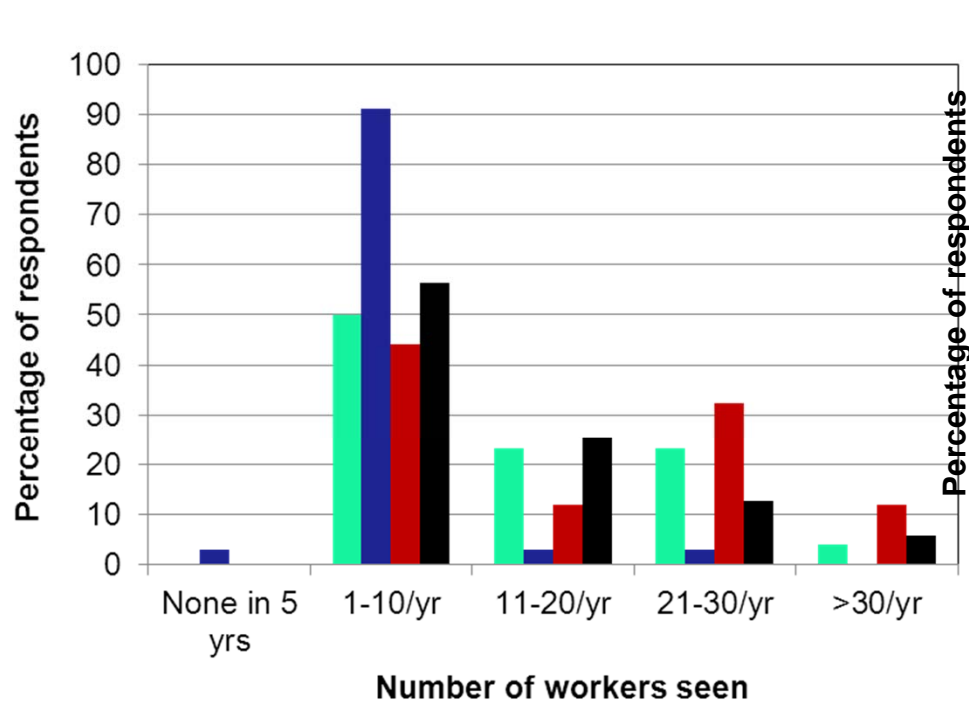
- ENT
- Occupational health
- Hearing aid practitioner
- Audiologist



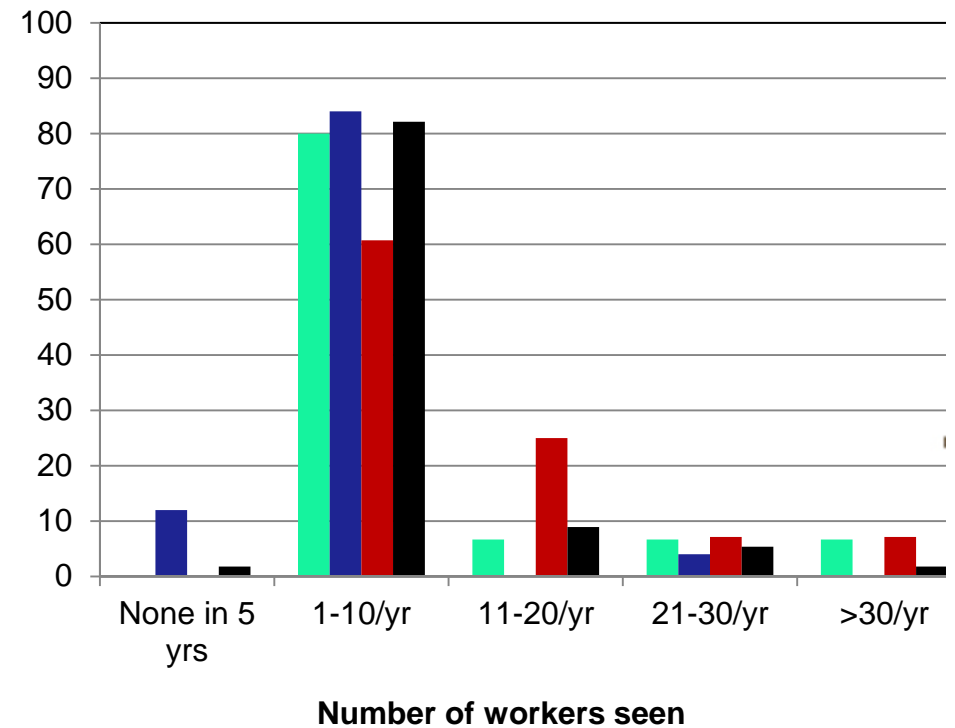
- 84% have seen hearing-impaired (HI) workers who consider wearing (or wonder about the possibility of wearing) HA in a noisy work setting
- 63% have seen HI workers who wear hearing aids in a noisy work setting

Survey

Frequency of HI workers who consider wearing (or wonder about the possibility of wearing) HA in a noisy work setting



Frequency of HI workers who wear hearing aids in a noisy work setting



■ ENT (26/29) ■ Occupational health (34/55)
■ HA practitioner (34/37) ■ Audiologists (71/77)

■ ENT (15/29) ■ Occupational health (25/55)
■ HA practitioner (28/37) ■ Audiologist (56/77)

Focus group discussions – HA practitioners

- ❑ *Feel a limited coordination and communication amongst various concerned health professionals*
 - **Feel that there is a lack of unified and global vision**
- ❑ *Confident in HA output limiting to protect workers*
 - **Recognition that dB SPL \neq dBA; eardrum \neq soundfield (e.g. 85 dBA)**
- ❑ *Protection is #1 priority, as often repeated to workers*
 - **Informed workers know best whether or not HAs should be used in the workplace, or when they should be used during the work day**
 - **No reliance on noise reduction algorithms for protection**
 - **Venting; seal issues**
- ❑ *Limited knowledge but wish to be more informed about augmented protection and communication devices*

Focus group discussions – Audiologists

- ❑ *Largely concerned about safety and overexposure*
- ❑ *Lack of clear guidelines and protocols to assess risks*
 - **Unsure about what should be specifically included in protocols**
- ❑ *Lack of information about the workplace (work conditions, tasks, exposure levels, etc.)*
- ❑ *Can HA processing strategies (directional mics, noise reduction) reduce exposure to safe levels or limit exposure (MPO and other output limiting)?*
- ❑ *Those working in rehab do work station adaptation but only see a minor proportion of workers who could actually benefit from such services*

Focus group discussions – Occupational health

- ❑ *Mainly occupational health nurses*
- ❑ *Mostly tell workers not to wear HAs in noisy workplace*
- ❑ *Feel caught “between a rock and a hard place”*
 - **Workers advised differently = anxiety and broken trust**
 - **Affects worker-practioner relationship**
 - **Intervention might result in job termination (if concerns about safety and/or overexposure are identified)**
- ❑ *Different course of action for follow-up of HI workers*
 - **Personal hearing loss (with medical follow-up) vs noise-induced hearing loss screened at work**
 - **Indemnisation by Quebec Workers Compensation Board (CSST)**

Focus group discussions – Workers

- ❑ *Issues with wearing HAs at work*
 - **Discomfort (physical and loudness), dust**
 - **Lack of training, information and clear directives regarding use, but often told not to wear HAs at work**
- ❑ *Notable safety concerns = hypervigilance*
- ❑ *Communication needs often hindered by HPDs and HL*
 - **Disciplinary action if communication breakdown**
 - **Misuse of HPDs to allow better communication**
- ❑ *Lack of information regarding other available technologies*
- ❑ *Relationship with health professionals*
 - **Limited knowledge of respective roles of each professional**
 - **Often no recollection of having been asked about their communication needs at work**

Focus group discussions – Summary

- ❑ *Lack of tools, guidelines and uniform protocols*
 - **In doubt, nonuse is often recommended = safety tradeoff?**
 - **Case-by-case approach; decision-tree?**
- ❑ *Current disparities for personal HL vs acquired NIHL*
- ❑ *Limited consideration of individual communication needs, workplace conditions and work tasks*
- ❑ *Poor communication and information exchange amongst various professionals involved - no clear message*
- ❑ *Consider other solutions, including new technologies*
- ❑ *Need for greater worker access to rehabilitation services*
 - **Increase awareness regarding services**
 - **Train audiologists to offer more extensive rehabilitation services and/or to consider job tasks during intervention**

Effects of hearing aids on speech perception and sound localization

1. Effect of noise reduction algorithms (NRA) on speech perception in noise

- ❑ *No reported benefit in most studies; however, does not seem to negatively impact speech perception in noise*
- ❑ *Some studies show improved listening comfort*
- ❑ *Could reduce overall levels by about 4-7 dB compared to the same HA without NRA activated (Chung et al. 2009)*

2. Effect of directional microphones on speech perception in noise

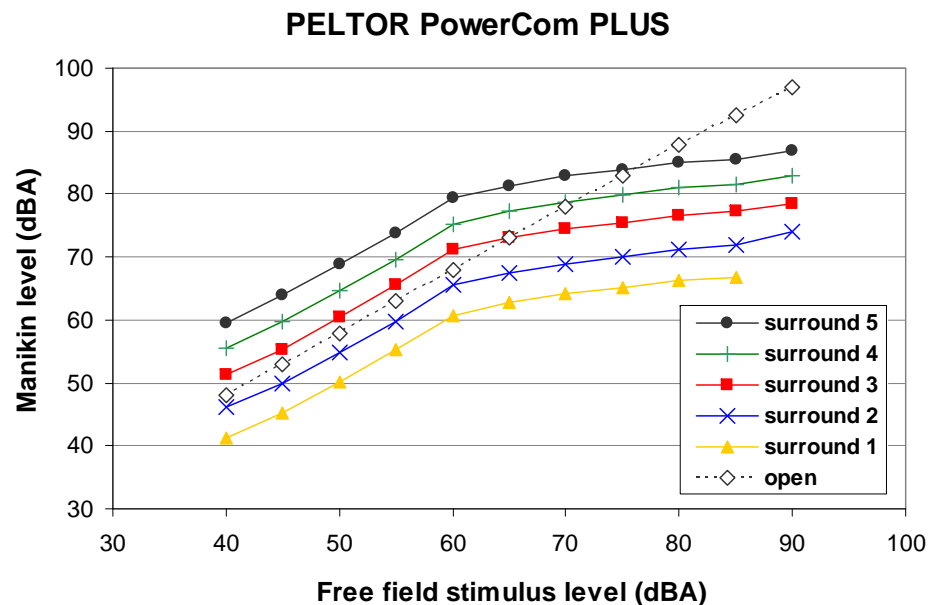
- ❑ *Directional benefit (relative to omnidirectional)*
 - **Can reach 15 dB, but most studies report on average a 2-5 dB benefit**
 - **Depends on methodology (noise type, # of noise sources and configuration relative to speech, # of microphones, directional scheme, earmold type)**
 - **Additional advantage of about 2 dB for adaptive vs fixed directionality when noise is not diffuse**
 - **Open fittings reduce benefit relative to closed fittings**
- ❑ *Subjective appreciation*
 - **Preference for directionality when faced with a variety of different listening conditions and in the presence of noise vs omnidirectional for sound localization**

3. Effect of hearing aids on sound localization

- ❑ *Overall better unaided than aided (particularly for Front/Back), and bilateral better than unilateral*
- ❑ *Inconclusive effect of microphone position*
- ❑ *Directional mics can prove better than omnidirectional mics (depends on stimuli and directional properties)*
- ❑ *Difficult to draw conclusions relative to many processing strategies (compression, noise reduction, etc.):*
 - **Few studies specifically addressing a single parameter; complex interaction amongst various parameters; various methodologies used**
- ❑ *Acclimatization to HAs*
 - **Initial differences across processing strategies can disappear after acclimatization**
 - **Can also be beneficial to reduce F/B confusions**

New technologies to enhance communication while limiting exposure

- ❑ *Range of powered HPDs combining low-level amplification and protection at high levels*



Characteristics of powered HPDs

- ❑ *Passive attenuation: documented NRR*
- ❑ *Compression with gain up to 12-18 dB (depending on model) in relatively quiet conditions*
- ❑ *Output limiting with goal to keep levels below 82-85 dBA*
- ❑ *Range of options:*
 - **Communication: talk-through, two-way radio, bluetooth, mobile phone, external audio**
 - **Passive and/or variable attenuation**
 - **ANR for added LF attenuation**
 - **Volume control**
 - **Frequency shaping (limited)**

Current limitations of powered HPDs for use with hearing-impaired workers

- ❑ *Limited frequency shaping to accommodate for individual loss – mostly flat and/or fixed gain curve*
- ❑ *Often no possibility of independent L/R gain adjustment (unilateral or asymmetric loss)*
- ❑ *Limited fitting options (programming) and no common platform*
- ❑ *Limited microphone options (directional)*
- ❑ *Limited standards for technical specifications (unlike HA industry) – ANSI S12.42 (protection)*



Future work

- ❑ *Further integration of HA technologies into HPDs*
- ❑ *Better tools for the selection, fitting and verification of powered HPDs, especially for workers with hearing loss*
- ❑ *Better protocols involving the stakeholders (ENT, audiologist, HA practitioner, occupational health)*



Individualized approach to meet safety, communication and protection needs

Acknowledgment

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