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 adressing 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*

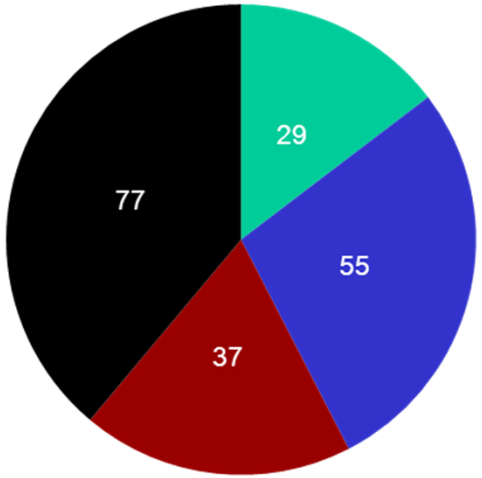
Methodology

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

Survey

- *198 Quebec health professionals completed the survey*

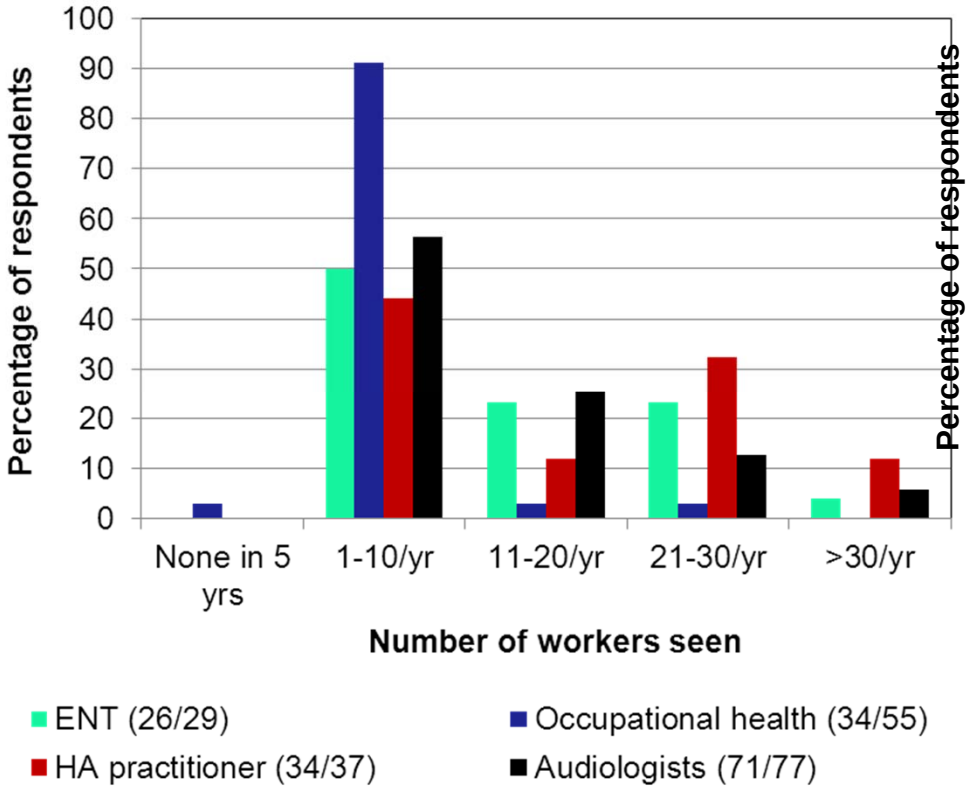
  - *ENT*
  - *Occupational health*
  - *Hearing aid practitioner*
  - *Audiologist*



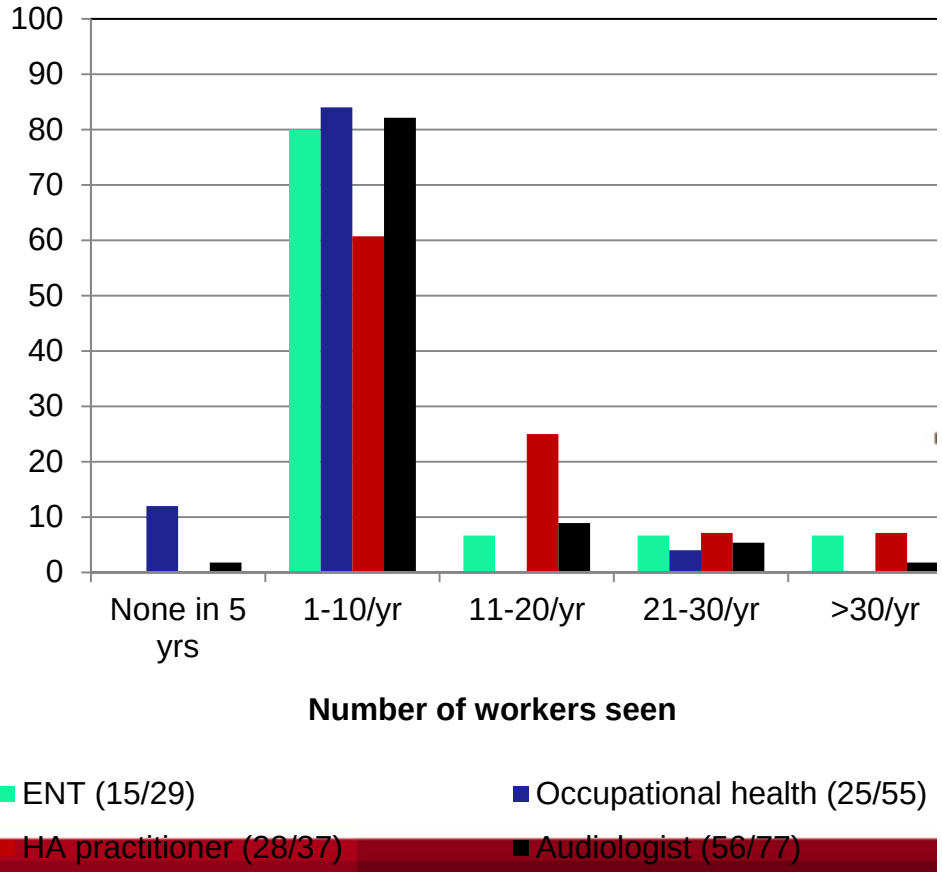
- *84% have seen hearing-impaired (HI) workers who consider wearing (or wonder about the possibility of wearing) HA in a noisy work setting*
- *63% have seen HI workers who wear hearing aids in a noisy work setting*

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



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 ≠ dBA; eardrum ≠ 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

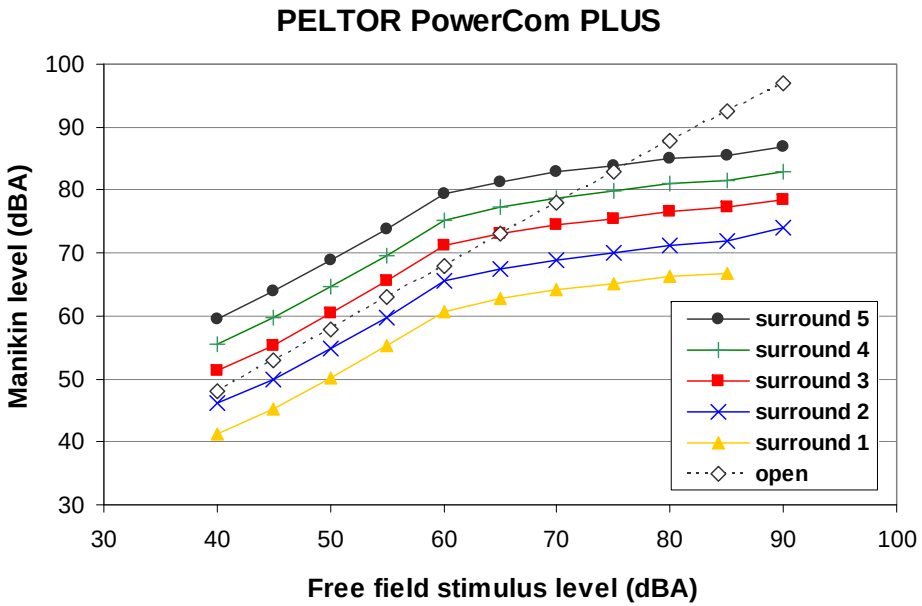
- *Directional benefit (relative to omnidirectional)*
  - **Can reach 15 dB, but most studies report on average a 2-5 dB benefit**
  - **Depends on methodology (noise type, # of noise sources and configuration relative to speech, # of microphones, directional scheme, earmold type)**
  - **Additional 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 adressing 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 amplication and protection at high levels*



Characteristics of powered HPDs

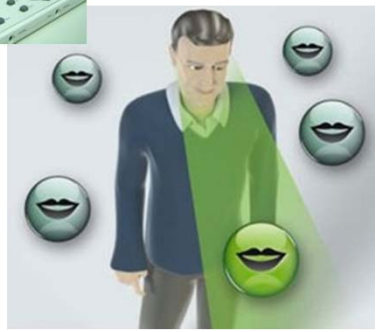
- *Passive attenuation: documented NRR*
- *Compression with gain up to 12-18 dB (depending on model) in relatively quiet conditions*
- *Output limiting with goal to keep levels below 82-85 dBA*
- *Range of options:*
  - **Communication: talk-through, two-way radio, bluetooth, mobile phone, external audio**
  - **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 adjustement (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)*

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Individualized approach to meet safety, communication and protection needs

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