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

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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

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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

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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

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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

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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

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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

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New technologies to enhance communication while limiting exposure

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

![Graph showing performance of PELTOR PowerCom PLUS](image)

**PELTOR PowerCom PLUS**

![PELTOR PowerCom PLUS headset](image)
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)

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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

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