Occupational Health Clinics for Ontario Workers

Centre de Santé des Travailleurs(ses) de l'Ontario

PREVENTING OCCUPATIONAL DISEASE BY PREVENTING EXPOSURES TO NOISE

SUBMISSION TO THE

MINISTRY OF LABOUR

REGARDING:

CONSULTATION ON EXTENDING NOISE PROTECTION REQUIREMENTS TO ALL ONTARIO WORKERS UNDER THE OCCUPATIONAL HEALTH AND SAFETY ACT

AND

CONSULTATION ON IMPROVING OCCUPATIONAL HEALTH PROTECTIONS FOR ONTARIO CONSTRUCTION WORKERS

SUBMITTED TO: ***ONTARIO MINISTRY OF LABOUR (DECEMBER 29, 2014)***

PREPARED BY: ***OCCUPATIONAL HEALTH CLINICS FOR ONTARIO WORKERS***

Executive Summary:

We thank the Ontario Ministry of Labour (MOL) for the opportunity to comment on the proposed changes to the noise regulation based on the "Consultation on Extending Noise Protection Requirements to all Ontario Workers under the Occupational Health and Safety Act", and, the "Consultation on Improving Occupational Health Protections for Ontario Construction Workers".

The Occupational Health Clinics for Ontario Workers (OHCOW) has broad experience with helping workers and workplaces deal with exposures to noise and the health effects associated with such exposures. We have also submitted previous recommendations (OHCOW, 2004 specifically and all other OHCOW OEL update submissions since then) asking the MOL to recognize the risks associated with noise exposures beginning at an $L_{ex,8}$ of 80 dBA. The following is a summary of the recommendations we are proposing to the Ministry of Labour in response to its invitation to comment on the two noise initiatives:

1. The evidence is clear that the burden of illness due to noise exposure is clearly under-estimated by the statistics supplied by workplace compensation systems – NIHL in older workers is particularly masked by presbycusis which in turn is accelerated in the presence of noise exposure. Recognition of this is important for prevention purposes.
2. The scientific evidence clearly demonstrates that noise-induced hearing loss (NIHL) begins at noise exposures of $L_{ex,8}$ of 80 dBA. If the MOL is truly serious about preventing NIHL it is imperative to reduce the exposure limit to an $L_{ex,8}$ of 80 dBA.
3. Simultaneous exposures to ototoxic chemicals are a very important risk factor to consider when evaluating worker risks for NIHL. Given the prevalence of such co-exposures, this should provide even further impetus to reduce the noise exposure criteria to an $L_{ex,8}$ of 80 dBA.
4. We recommend the regulation include a provision to allow pregnant workers to not be exposed to more than 80 dBA Lex,8.
5. Non-auditory health effects are also contribute significantly to the burden of illness associated with noise exposure and some health effects such as cardiovascular disease is recognized as continuing even after the exposure ceases. These effects are often associated with exposures well below an $L_{ex,8}$ of 80 dBA.
6. We certainly agree that all workers in Ontario should be protected by the regulation and would recommend that noise be regulated along the designated substance pattern of regulations. Included in such a regulation should be the requirement to provide workers with audiometric screening as an essential part of a hearing loss prevention program.
7. There is strong evidence to show that government enforcement has a large effect in motivating workplaces to comply with existing legislation and to take actions to prevent hearing loss. We strongly recommend more aggressive enforcement.
8. There are a number of standard (best) practice standards (e.g. ASHRAE ventilation noise standards, NRCC's COPE design standards, ANSI acoustic standards for classrooms, and DEFRA's (UK) standards for resolving low frequency noise issues) dealing with the non-NIHL effects of noise that should be recognized in legislation to help workplaces prevent the non-NIHL health effects associated with noise exposure well below the $L_{ex,8}$ of 80 dBA.

Again, we thank the Ministry of Labour for the opportunity to comment on the intended changes to the noise legislation and we trust that you will accept our recommendations and supporting materials in the spirit of preventing all occupational diseases associated with workplace noise exposures.

OHCOW Background and Clinical & Field Experience with Noise:

The Occupational Health Clinics for Ontario Workers Inc. is a team of health professionals committed to promoting the highest degree of physical, mental and social well-being for workers and their communities. At six clinics in Ontario, a team of nurses, hygienists, ergonomists and physicians see patients and identify work-related illness and injuries, promote awareness of health and safety issues, and develop prevention strategies. First established in 1989, the clinics have seen thousands of individual patients and visited hundreds of workplaces helping to identify unhealthy and unsafe conditions, and provided advice to workplace parties on the prevention of occupational diseases

As per our mandate, the Occupational Health Clinics for Ontario Workers (OHCOW) strives to prevent occupational disease by primary, secondary and tertiary prevention (preventing harmful exposures, screening for early signs of occupational disease and recognizing cases of work-related disease).

OHCOW also has extensive clinical experience with workers who have suffered illness or injury due to noise exposures in the workplace. Obviously we have seen many workers with noise induced hearing loss (NIHL). Often we find cases in patients who come in for other occupational health issues but during our review of their exposures, we deduce significant noise exposures. Workers who have issues with hand-arm vibration suggest a high level of clinical suspicion of also having NIHL. We have also seen workers with problems with tinnitus associated with NIHL which can have severe psychological implications and greatly affect the worker's quality of life. Recently we have also seen a number of teachers who have voice problems related to having to strain their voices due to poor classroom acoustics. We have also had many enquiries from workers who work in call centres regarding the headsets they use and popping noises within the headsets. In one workplace we were asked to investigate symptoms related to inner ear and balance issues along with temporary "lapses of consciousness". Our findings were that a low frequency noise (around 63 Hz at 80 dB) was causing a resonating frequency in the skull cavities of the occupants of the building – the effect was noticeable even to visitors to the building (Oudyk, 2009). Thus, OHCOW has experience across a wide assortment of workers' health effects associated with workplace noise exposures.

The Clinics have also visited many workplaces and answered many enquiries about assessing and control noise exposures in the workplace. Clinic representatives have also participated in the Occupational Health and Safety Council of Ontario (OHSCO) working group on noise who produced guides on assessing workplace noise, a booklet describing practical suggestions for noise control and a video describing the experience and implications of noise induced hearing loss. The Clinics have also done presentations on noise for workplaces with questions and concerns. We were also involved in providing comments to the CSA on their proposed Hearing Loss Prevention Program standard (Z1007). Thus, among our staff of doctors, nurses, occupational hygienists and ergonomists we have extensive experience in helping workers and workplaces deal with exposures to noise and the health effects associated with such exposures.

Past Submissions Regarding Noise:

Over the years, OHCOW has submitted a number of submissions regarding the updating of the OEL's. A point that we have included in these submissions is the fact that the 85 dBA $L_{ex,8}$ is recognized in the

ACGIH documentation for the noise TLV as being associated with a lifetime risk of 10% of exposed workers developing noise-induced hearing loss (NIHL).

In a previous OHCOW submission (2004) we cited a paper by Stekelenburg, (1982) which claims that an exposure to noise of 80 dBA for 40 years produces moderate hearing loss which in more than 10% of the exposed population will result in a difficulty in understanding speech after 10 years of retirement.

Scope of the Noise Induced Hearing Loss Problem:

In the consultation paper, the Ministry of Labour states that in the "last five years, the annual costs for noise induced hearing loss claims for all sectors in Ontario exceeded $50 million per year," (MOL 2014)

Rabinowitz (2012) suggests that NIHL is underdiagnosed and represents a significant public health issue. Nelson et al (2005) illustrate the global magnitude of the problem in terms of disability-adjusted life years, estimating that 18% (varying between 7-21% across sub-regions and being higher for men and workers in developing countries) of the burden of disabling hearing loss was attributable to noise exposure.

It is difficult to access publically reliable data regarding the extent of the noise induced hearing loss (NIHL) problem in Ontario. The online WSIB 2013 Statistical Supplements show a total of 43 allowed claims (for each year up to March 31st of the following year) "disorders of ear including deafness" in 2005 and 31 "disorders of ear including deafness" in 2009 (WSIB, 2014). In contrast, in 2011, the WSIB in a report to the Harry Arthurs Review showed a steady increase in NIHL registered claims from 3653 claims in 2005 to 5416 claims in 2009 (WSIB, 2011). This discrepancy may be due to the fact that for the purpose of compiling the Statistical Supplements, the WSIB only counts claims accepted by Mar 31st of the following year. Most occupational disease claims take much longer than that to settle.

In a paper published last year, Masterson et al. (2013) found 18% of 1,122,722 worker audiograms collected from the NIOSH OHL Surveillance Project which met the NIOSH criteria for NIHL (>25 dB in either ear averaged over the 1, 2, 3, and 4 kHz frequencies). The data from this study is available online and when we applied the Ontario WSIB criteria (without making the adjustment for presbycusis) to the NIOSH data, the prevalence of Ontario WSIB-defined NIHL was 6% in this population. Obviously, the prevalence of NIHL is very dependent on the definition of NIHL applied to the data.

There is an additional problem of presbycusis masking the NIHL problem for workers older than 55 years old. Mahboubi et al., (2013) recently noted that, "A limitation with almost all of NITS studies is that the presence of presbycusis will efface the notch, …" (page 463), thus the "notch" in the audiogram of a worker with noise induced hearing loss will be masked by presbycusis resulting in the under-estimation of the prevalence of NIHL among older workers. Furthermore, a complicating factor associated with distinguishing between age-related hearing loss (AHL) and noise-induced hearing loss (NIHL) is the fact that noise exposure is cited as one of the four risk categories of AHL (Yamasoba, 2013).

Given the focus of the application of the noise regulation on the construction industry, it is worthwhile to note a number of recent studies of NIHL among construction workers (Leesen et al., 2011; Seixas et al., 2012; Leesen et al., 2014). Seixas et al. (2012) found in a prospective study of construction workers that:

> "The study provides evidence of noise-induced damage at an average exposure level around the 85 dBA level. The predicted change in HTLs was somewhat higher than would be predicted by standard hearing loss models, after accounting for hearing loss at baseline." (page 643)

Another researcher (Caciari et al., 2013) also noted a possible effect of air pollution on the hearing of workers working outdoors:

> "During their working activity, outdoor and indoor workers are exposed to different noise levels LEX < 80 dB(A). At mid–low frequencies (250–2000 Hz), the results show significant differences in the average values of hearing threshold between the two groups in both ears and for all age classes; there are no significant differences between the two groups at higher frequencies. The outdoor noise levels measured are not usually ototoxic and the hearing loss at mid–low frequencies is not characteristic of the exposure to industrial noise. For these reasons the Authors hypothesize that the results may be due to the combined effect of the exposure to noise and to ototoxic air pollutants. The impairment of speech frequencies is disabling and involves the risk of missed forensic recognition." (page 302)

In summary, for the sake of prevention, it is important to recognize the scope of unrecognized noise induced hearing loss, and thus as a recommendation we would make the following recommendation:

> **Recommendation #1:** The evidence is clear that the burden of illness due to noise exposure is clearly under-estimated by the statistics supplied by workplace compensation systems – NIHL in older workers is particularly masked by presbycusis which in turn is accelerated in the presence of noise exposure. Recognition of this is important for prevention purposes.

Preventing Noise Induced Hearing Loss:

As mentioned above, in 1982 Stekelenburg noted that "even if 80 dBA is taken as a time weighted average limit - … - 10% of the exposed population will not be protected against impaired social hearing caused by noise." (page 408).

More recently, NIOSH describes the risks of NIHL associated with noise exposure as follows:

> "… the 1997 NIOSH analysis of those frequencies likely to be affected by noise (1, 2, 3, and 4 kHz; …) demonstrates 1 in 4 workers (25%) will become hearing impaired at exposures to 90 dBA. By comparison, 1 in 12 workers (8%) are at risk of becoming hearing impaired at exposures to 85 dBA. The risk does not approach zero until exposures approximate 80 dBA." [Accessed at http://www.cdc.gov/niosh/programs/hlp/risks.html, on December 16, 2014]

These estimates are based on work that was published by Prince et al., in 1997 and became the basis of the NIOSH Criteria for a Recommended Standard - Occupational Noise Exposure (NIOSH, 1998).

While the NIOSH definition of NIHL is different from the Ontario WSIB's definition (NIOSH: 25 dB averaged over 1, 2, 3, and 4 kHz, whereas for the WSIB: 22.5 dB averaged over 0.5, 1, 2, and 3 kHz), the point is quite obvious that if we want to prevent noise-induced hearing loss the noise exposure criteria should be lowered to 80 dBA $L_{ex,8}$.

Recommendation #2: The scientific evidence clearly demonstrates that noise-induced hearing loss (NIHL) begins at noise exposures of $L_{ex,8}$ of 80 dBA. If the MOL is truly serious about preventing NIHL it is imperative to reduce the exposure limit to an $L_{ex,8}$ of 80 dBA.

Rabinowitz et al., (2007), reviewed the 10 year experience of a large industrial cohort and concluded:

> "In this modern industrial cohort, hearing conservation efforts appear to be reducing hearing loss rates, especially at higher ambient noise levels. This could be related to differential use of hearing protection. The greatest burden of preventable occupational hearing loss was found in workers whose noise exposure averaged 85 dBA or less. To further reduce rates of occupational hearing loss, hearing conservation programmes may require innovative approaches targeting workers with noise exposures close to 85 dBA." (page 53)

The European Union Directive 2003/10/EC (which is over 10 years old) has a lower action level of 80 dBA $L_{ex,8}$ at which exposure employers must provide information and instruction, hearing protectors are to be made available, and, workers have a right to a preventive audiometric exam if a noise assessment indicates the possibility of a risk to hearing.

Furthermore, it is now well recognized that certain chemical exposures may induce ototoxic reactions making the worker more sensitive to NIHL (ACGIH, 2006).

The Nordic Expert Group (Johnson & Morata, 2010) classified three categories of ototoxic chemicals based on the strength of the evidence:

> "1) Human data indicate auditory effects under or near existing OELs. There are also robust animal data supporting an effect on hearing from exposure.
>
> 2) Human data are lacking whereas animal data indicate an auditory effect under or near existing OELs.
>
> 3) Human data are poor or lacking. Animal data indicate an auditory effect well above existing OELs." (page 143)

Category 1 chemicals include, styrene, toluene, carbon disulphide, lead, mercury, and carbon monoxide. Category 2 chemicals include, para-xylene, ethylbenzene, and hydrogen cyanide.

Thus workers working with exposures to these chemicals (some of which are quite common in industrial work environments), imply a higher risk for workers exposed to noise between 80-85 dBA.

The evidence is quite clear, if we are serious about preventing NIHL, the $L_{ex,8}$ needs to be lowered to 80 dBA.

Recommendation #3: Simultaneous exposures to ototoxic chemicals are a very important risk factor to consider when evaluating worker risks for NIHL. Given the prevalence of such co-exposures, this should provide even further impetus to reduce the noise exposure criteria to an $L_{ex,8}$ of 80 dBA.

Non-Auditory Effects of Noise Exposure:

In a recent review published in the Lancet, Basner et al., (2014) describe a number of non-auditory effects associated with noise exposures which include: sleep disturbance, annoyance, ischaemic heart disease, and tinnitus. They also mention the contribution of noisy working conditions to accidents and falls in association with undiagnosed hearing loss.

Similarly, Seidman and Standring (2010) characterized the non-auditory effects of noise as follows:

> "The psychological effects of noise are usually not well characterized and often ignored. However, their effect can be equally devastating and may include hypertension, tachycardia, increased cortisol release and increased physiologic stress. Collectively, these effects can have severe adverse consequences on daily living and globally on economic production." (page 3730)

Bluhm & Eriksson, (2011), reviewed the results of two environmental noise studies in Sweden and concluded:

> "Two national studies have been performed on the cardiovascular effects of aircraft noise exposure. The first one, a cross-sectional study assessing self-reported hypertension, has shown a 30% risk increase per 5 dB(A) noise increase. The second one, which to our knowledge is the first longitudinal study assessing the cumulative incidence of hypertension, found a relative risk (RR) of 1.10 (95% CI 1.01 – 1.19) per 5 dB(A) noise increase." (page 2011)

Sweden has an environmental noise guideline of 55 dB(A). These are studies that document the health effects of noise 24 hour exposure levels which would be well below an equivalent $L_{ex,8}$ of 80 dBA.

In a collaboration between Canadian and Dutch researchers, Davies and van Kamp (2012), reviewed the more recent literature regarding the association of noise and cardiovascular disease and concluded that "the weight of evidence clearly supports a causal link." (page 287). Girard et al., (2014), looked at the cardiovascular health of retired workers who had been exposed to occupational noise and found that the cardiovascular effects continued even after exposure ceased.

There is also good evidence (Nurminen & Kurppa, 1989) to be concerned for the fetus inside pregnant workers exposed to noise. In Germany, there is legislation to protect pregnant workers from exposures above 80 dBA $L_{ex,8}$ (http://www.hsu-hh.de/download-1.5.1.php?brick_id=24WmusAUzZDTR2OC accessed December 16, 2014).

> **Recommendation #4:** We recommend the regulation include a provision to allow pregnant workers to not be exposed to more than 80 dBA $L_{ex,8}$.

Annoyance associated with noise is recognized as a major factor in the stress-related health effects of noise exposure. The annoyance associated with tonal sounds is recognized by ISO standard ISO:1996 2007 which provides a mechanism for penalizing noise measurements for the presence of tonal sounds. The standard defines a tonal noise as a 1/3rd octave measurement that is at least:

- 5 dB higher than the average of its neighbouring octaves (for >500 Hz),
- greater than 8 dB for 125-500 Hz octaves and
- greater than 15 dB for octaves <125 Hz

In summary, the non-auditory effects of noise also represent a significant burden of disease which is most often unrecognized and whose effects begin at exposure levels below the levels generally associated with NIHL.

> **Recommendation #5:** Non-auditory health effects are also contribute significantly to the burden of illness associated with noise exposure and some health effects such as cardiovascular disease is recognized as continuing even after the exposure ceases. These effects are often associated with exposures well below an $L_{ex,8}$ of 80 dBA.

Hearing Loss Prevention Program (HLPP):

Traditionally known as hearing conservation programs, a Hearing Loss Prevention Program (HLPP) is universally recognized as an essential part of a comprehensive program to identify losses in hearing at an early stage – allowing for interventions to stop the trends identified. In the EU and the US, such programs are mandatory and include provisions for screening audiometry, however, this has never been legally required in Ontario. The educational and instructional value of a screening audiometric test along with the accompanying review of noise exposures (both occupational and non-occupational), the review of hearing protection practices, and, the counselling/referrals regarding arising medical concerns, cannot be over-estimated.

In BC, the Industrial Health and Safety Regulation requires annual hearing tests of workers exposed to hazardous noise in January 1978. An industry-funded program for paid hearing tests was introduced in 1987. The program requires annual audiometry of workers in the construction industry, with the results submitted to Worksafe BC. To assist employers in complying, WorkSafeBC established a central computer registry of hearing test results, a "Record of Hearing Test" card for each worker, and a program to pay hearing testers. They also developed standards for testing facilities and technicians. The central, computerized, audiometric system enables viewing of audiogram histories, as well as analysis of trends for individuals and within groups. The program has demonstrated that the number of workers reporting consistent use of hearing protection increased considerably after its inception (http://www2.worksafebc.com/pdfs/hearing/hearing_conservation_construction.pdf, accessed December 19, 2014). They have also identified a decrease in expected NIHL loss claims despite a 50% increase in the number of workers. It has also been documented that 27% of workers under the age of 21 report not using hearing protection. This is more than double the number of workers over 21 who report the same. The audiometric test process also provides the opportunity for valuable education and assessment of behaviour motivators.

The CSA recently posted a proposed HLPP standard (CSA Z1007) which incorporates the requirement of conducting audiometric testing. Unfortunately, the CSA Committee decided to conform its recommendations in the proposed standard to existing Canadian legislation and thus is suggesting that audiometric screening only begin at exposures above an $L_{ex,8}$ of 85 dBA. In the EU workers have a right to access audiometric services if the level of exposure exceeds an $L_{ex,8}$ of 80 dBA and a risk assessment determines the presence of a risk to hearing. As the evidence provided above shows, if the objective is to identify the early signs of hearing loss, $L_{ex,8}$ exposures between 80-85 dBA must be included in an HLPP. Therefore the trigger for an HLPP should be no higher than an $L_{ex,8}$ of 80 dBA.

Recommendation #6: We certainly agree that all workers in Ontario should be protected by the regulation and would recommend that noise be regulated along the designated substance pattern of regulations. Included in such a regulation should be the requirement to provide workers with audiometric screening as an essential part of a hearing loss prevention program.

Practical Prevention Measures:

The current (and proposed) noise regulation in Ontario rightly puts the emphasis on the hierarchy of controls (the first priority being stopping exposure at the source, next along the path, and only at the worker through protective equipment or administrative controls if the other options for control are not practicable). However, in the Clinic's experience the actual practice is often the opposite. Often when workplaces realize that workers are exposed to levels of noise that could damage their hearing, the first response is to provide hearing protective devices. Unfortunately the proposed CSA standard (Z1007) while stating its adherence to the hierarchy of controls, in practice devotes about 7 times the amount of pages to PPE as compared to the pages dealing with controlling noise at the source or along the path (engineering controls).

This experience was echoed in an analysis of the experience in Washington State after 20 years of noise regulation (Daniell et al., 2006). The conclusions of this evaluation were:

> "The findings raise serious concerns about the adequacy of prevention, regulation, and enforcement strategies in the United States. ... Most companies gave limited or no attention to noise controls and relied primarily on hearing protection to prevent hearing loss; yet 38% of employees did not use protectors routinely. Protector use was highest when hearing loss prevention programmes were most complete, indicating that under-use of protection was, in some substantial part, attributable to incomplete or inadequate company efforts." (page 343)

One cannot under-estimate the value of government inspections and enforcement with respect to motivating workplaces to deal with noise issues. In a study reported by Björkdahl et al., (2008) a comparison was done between 1721 workplaces that were inspected for noise compliance during a 2 day blitz compared to matched workplaces that were not visited. In a subsequent follow-up survey, workplaces that were inspected were five times more likely to take action against noise than the workplaces that were not inspected. Inspected workplaces averaged 2.5 types of actions against noise whereas workplaces that were not inspected averaged 0.8 types of actions. The vast majority of inspected workplaces (88%) reported that their motivation for making the changes with respect to noise was the direct result of the government inspection. This report clearly shows the value of government inspections in reducing noise exposures in workplaces.

Recommendation #7: There is strong evidence to show that government enforcement has a large effect in motivating workplaces to comply with existing legislation and to take actions to prevent hearing loss. We strongly recommend more aggressive enforcement.

There is no shortage of excellent materials available on the web for instruction and motivation with respect to reducing noise exposures and using PPE. These materials include excellent videos, recordings

to illustrate what NIHL sounds like, instructional presentations on what noise is and the range of health implications. The Occupational Health and Safety Council of Ontario (OHSCO) working group on noise have produced guides on assessing workplace noise, a booklet describing practical suggestions for noise control and a video describing the experience and implications of noise induced hearing loss. These tools have been under-utilised and not well presented on the WSIB web-site (http://www.wsib.on.ca/cs/idcplg?IdcService=GET_FILE&dDocName=WSIB011468&RevisionSelectionMethod=LatestReleased). These materials could also be up-dated to include the use of smartphone apps to screen for noise exposure (not to mention the possibility of doing a screening audiogram and testing room reverberation). The "Noise Control Tool" booklet in particular is an extremely valuable tool in helping workplaces identify practical noise control interventions. This booklet is particularly useful and under-utilized.

New prevention possibilities are opening up via new technology such as smartphones and tablets. NIOSH (Kardous & Shaw, 2014) recently reviewed a number of noise measurement apps and found some that performed reasonably well compared to traditionally used, type 2 sound level meters. RevMeter Pro (Schorer, 2014) is an app that allows the estimation of reverberation times in rooms to evaluate the acoustics. Such an app would especially be useful in assessing whether classrooms meet the ANSI/ASA S12.60-2000 criteria for acoustics in the classroom. The following is a description of an app which allows the self-audiometric screening:

> "ShoeBOX is the first interactive iPad audiometer with regulatory approvals for hearing screening by audiologists, physicians, speech-language pathologists and other healthcare professionals. Users screen themselves with results delivered in formats that can be used by experts and general practitioners alike." https://itunes.apple.com/us/app/shoebox-audiometry/id873272921?mt=8 (accessed Dec 18, 2014)

While these new technologies may not produce as rigorous assessments as the traditional methods would, they do raise awareness among users and can perform with sufficient accuracy for screening purposes. As such they have the potential of initiating interventions which otherwise might not have been contemplated due to lack of expertise, equipment, or, financial resources willing to be allocated to more formal assessments. While the Ministry of Labour should maintain the "gold standard" for methods of assessments, it would be helpful to recognize the value of these new technologies of preliminary screening assessments – if disputes in interpretation/accuracy emerge, referral to the "gold standard" techniques and sampling strategies could be used to resolve such differences. This approach is also consistent with Malchaire's recommendations of appropriate levels of expertise being deployed to resolve workplace noise concerns and engaging worker participation in hazard identification and prevention (Malchaire, 2000 & 2004).

There are also other recognized standards for dealing with the non-NIHL aspects of noise. The American Society for Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has a standard for controlling the distracting noise (annoyance) associated with heating/ventilation and air conditioning (HVAC) systems. These are similar to criteria specified by the National Research Council of Canada's Cost-effective Open Plan Environments (COPE) project (Newsham et al., 2003). As mentioned earlier, there is an ANSI standard (ANSI/ASA S12.60-2010) which specifies the acoustics criteria for classrooms and is freely available online (http://acousticalsociety.org/about_acoustics/acoustics_of_classrooms). In the UK, Moorhouse et al., (2005) have developed criteria for resolving complaints associated with low

frequency noise. As we ourselves have experienced in investigating such concerns (Oudyk, 2009) and has been reported in the trade literature (Schwartz, 2008), the health effects of low frequency noise often goes unrecognized and is attributed to indoor air quality concerns. All these standards are very useful in dealing with the non-NIHL health effects.

> **Recommendation #8:** There are a number of standard (best) practice standards (e.g. ASHRAE ventilation noise standards, NRCC's COPE design standards, ANSI acoustic standards for classrooms, and DEFRA's (UK) standards for resolving low frequency noise issues) dealing with the non-NIHL effects of noise that should be recognized in legislation to help workplaces prevent the non-NIHL health effects associated with noise exposure well below the $L_{ex,8}$ of 80 dBA.

Summary: While we applaud the long over-due initiative to extend the noise regulations to all workers in Ontario, we also caution the MOL to realize that the scope of noise induced hearing loss is even greater than the WSIB statistics show. If the MOL is truly serious about prevention noise induced hearing loss, the 8 hour equivalent noise exposure criteria needs to be reduced to 80 dBA. The commonly found presence of ototoxic chemicals in many workplaces, further reinforce the need to lower the $L_{ex,8}$.

In order catch noise induced hearing loss at an early stage, it is imperative to use screening audiometry as is required in many other comparable jurisdictions (US and EU). As evidence has clearly shown, a strong government enforcement practice is a very effective motivator for workplaces to take action on noise in their workplaces.

The non-auditory effects of noise are also important to recognize and prevent. The mother of a fetus in the workplace should be protected from noise levels above 80 dBA. It is now clearly recognized that noise exposure also implies cardiovascular risks which continue even when exposure ceases. There are a number of standards available to deal with issues of acoustics, low frequency noise and annoyance which will improve work performance and prevent the non-auditory noise-related health effects.

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