

## OVERVIEW OF OCCUPATIONAL NOISE MANAGEMENT IN MALAYSIA

NORAIDAH ISMAIL, PhD (CORRESPONDING AUTHOR)

DEPARTMENT OF AUDIOLOGY & SPEECH LANGUAGE PATHOLOGY, KULLIYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, BANDAR INDERA MAHKOTA CAMPUS, JALAN SULTAN AHMAD SHAH, 25200 KUANTAN, MALAYSIA  
[noraidah@iium.edu.my](mailto:noraidah@iium.edu.my)

SARAH RAHMAT, PhD

DEPARTMENT OF AUDIOLOGY & SPEECH LANGUAGE PATHOLOGY, KULLIYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, BANDAR INDERA MAHKOTA CAMPUS, JALAN SULTAN AHMAD SHAH, 25200 KUANTAN, MALAYSIA  
[sarahrahmat@iium.edu.my](mailto:sarahrahmat@iium.edu.my)

### ABSTRACT

**Introduction:** This paper aims to synthesize available literature on occupational noise in Malaysia and to relate this to the current noise management practices and control. The review focuses on several main scopes; i) history of occupational noise management in Malaysia; ii) legislative developments and legal precedents of occupational noise in Malaysia; and iii) the hearing conservation programs (HCP) and hearing loss prevention programs (HLPP). **Design:** Narrative review and synthesis **Method:** Related publications and references were identified through several ways: i) by structured searches in PubMed, Google scholar, Web of Knowledge and Science Direct using the combinations of 'occupational noise', 'noise induced hearing loss; 'hearing', 'knowledge', awareness', 'hearing conservation program', 'hearing protection devices' as key words ii) by inspecting the reference lists of relevant articles. **Results:** The number of publications within the audiology which address this topic, is rather limited. All the above mentioned scopes were discussed and synthesis of literature from other related fields such as medical, health and occupational safety and health were also referred to facilitate the discussion. **Conclusion:** This paper concludes that there are an emerging trend for the studies of occupational noise Malaysia in the literature. However, the effectiveness of HCP in Malaysia, and to what extent it is accepted and being implemented is yet to be investigated.

**KEYWORDS:** Occupational noise management in Malaysia; Noise regulations; Hearing conservation Programmes

### INTRODUCTION

Types of occupations that are commonly associated with high noise exposure of more than 85 dB(A) in the developing countries are carpentry, construction, textiles, metal artisans, motor vehicle repairs, corn-mills, sugar-cane crushers and farm jobs (Kumar et al, 2008a; Amedofu & Fuente, 2008; Ashraf et al., 2009; Fuente & Hickson, 2011). These high workplace noise levels are not always accompanied by protection (Concha-Barrientos, Campbell-Lendrum, & Steenland, 2004; Kumar et al., 2008a; 2008b). Factors such as poor knowledge and awareness among workers, senior management and healthcare professionals and lack of enforcement from the governing bodies were highlighted as the reasons to the risk of occupational hearing loss among workers, known as noise induced hearing loss (NIHL) (Timmins & Granger, 2010; Fuente & Hickson, 2011).

Noise induced hearing loss is a permanent hearing impairment resulting from prolonged exposure to high levels of noise. Prevalence of NIHL in Asia was high, ranging from 18% to 89%. A review by Fuente and Hickson (2011) revealed that India has the highest prevalence of NIHL (89%), followed by Pakistan with 66%, while Japan has been reported to have the lowest prevalence of NIHL among Asian countries (18%). Data from Malaysia was not reported in the analysis. However, recent studies showed an alarming prevalence, incidence and burden of NIHL among Malaysian workers. Study by Tahir, Aljunid, Hashim & Begum (2015) estimated that 103,000 workers were potentially affected by NIHL in Malaysia, with projected incidence (new case) of 8% out of 100,000 manufacturing workers. Highest risks of NIHL was estimated among workers in motor vehicle parts industry (32%), followed by tobacco industry and infabricated metal industry (23% respectively). Therefore, it can be concluded that NIHL is a serious health problem in Asia generally, and in Malaysia specifically, due to the large number of affected workers and its developing economies where access to health services and preventive programmes are limited (Fuente & Hickson, 2011; Tahir, Aljunid, Hashim & Begum, 2015).

To understand and further elaborate the scenario of occupational NIHL in Malaysia, the current paper is aimed at highlighting the history of occupational noise management and issues related to occupational safety and health in Malaysia. Related publications and references were identified through several ways: i) by structured searches in PubMed, Google scholar, Web of Knowledge and Science Direct using the combinations of 'occupational noise management', 'noise induced hearing loss', 'noise regulations', 'factory and machinery act in Malaysia', 'hearing conservation program', 'hearing protection devices' as key words ii) by inspecting the reference lists of relevant articles. The past research publications on noise induced hearing loss (NIHL) from Malaysia are also discussed in the following results. The discussion will include the overview on i) history of occupational noise management in Malaysia; ii) the legislative developments of occupational noise management in Malaysia, and iii) the hearing conservation programs (HCP) and hearing loss prevention programs (HLPP).

## HISTORY OF OCCUPATIONAL NOISE MANAGEMENT IN MALAYSIA

Over the years, Malaysia has made tremendous progress in improving the safety, health and welfare of the workforce at the work place and also in protecting others against risks to safety or health at work. Occupational, safety and health issues have been given attention by the government and many companies have increasingly showed their interest in this area, partly due to the costs of occupational accidents resulted from improper management of occupational, safety and health issues (Rampal, 2002; Rampal et al., 2006; Ratnasingam & Ioras, 2010; Masilamani, 2010).

Workplace accidents as reported by the Social Security Organization (SOCSCO) increased from 57,639 workers in 2010 to 63,331 in 2014 as shown in Table 1 (SOCSCO, 2016). Occupational diseases were more likely to happen in the non-metal based manufacturing industry as compared to other industries. Among the highest incident rate of occupational diseases was hearing impairment. The high incidence of occupational diseases was associated with the increasing number of workers in the manufacturing sectors such as microelectronics, chemical and mineral based industries, and later textile and automobile industries (Abas et al., 2008; 2011).

**Table 1** Work accidents reported to the Social Security Organization (SOCSCO), 2010–2014

Details	Year				
	2010	2011	2012	2013	2014
Number of accidents reported	57,639	59,897	61,552	63,557	63,331
Number of industrial accidents reported*	35,603	35,088	35,296	35,898	35,294

\*refers to accidents happened at workplace including occupational disease.

Source: Social Security Organization (SOCSCO), Statistics Report, at <http://www.perkeso.gov.my> (2016)

In another report, fatality rates are highest for construction, transportation and mining and quarrying compared to other economic activities (Rampal, Aw, & Jefferelli, 2002). However incidence of work-related diseases is small compared to occupational accidents. Underreporting may be due to failure to recognize the work-relatedness of medical diagnoses, non-reporting of diagnosed occupational diseases to the appropriate agencies, and failure to capture occupational morbidities occurring among workers in small and medium sized industries and informal economy (Hashim, Amin, & Khalid, 2005; WHO, 2005). This is consistent with the worldwide trend where work-related diseases appear to be underestimated (or unknown) and in prevention activities, focus is more often on occupational accidents than on work-related diseases (Hamalainen, Saarela & Takala, 2009). The nature of work-related diseases normally occurs at the later stage of the individual's life which has made it difficult to measure or recognize at the early stages of the disease.

## **LEGISLATIVE DEVELOPMENTS AND LEGAL PRECEDENTS OF OCCUPATIONAL NOISE IN MALAYSIA**

Historically, occupational safety and health in Malaysia came into existence at the beginning of the 20<sup>th</sup> century when the country was under British rule. The emergence of the tin mining industry with the extraction of tin ores, and the use of steam boilers as prime movers in the industry caused concern for safety. Legislations to control boiler operation were enacted by different states (Singh, 2004; Che Man & Musri, 2005). The Selangor Boiler Enactment in 1892 was the first legislation to address industrial safety issues. In 1913, the Machinery Ordinance was enacted to ensure safety of machinery including boiler and internal combustion engines.

The Machinery Ordinance 1913 was updated in 1932 (Machinery Enactment 1932) with additional provisions on registration and inspection of machinery installation. The Machinery Ordinance 1953 superseded all previous legislation related to industrial safety, and was enforced in 11 states of Malaya under the jurisdiction of Machinery Department, Ministry of Labour. In early occupational safety and health (OSH) legislation, the Federated Malay States Mining Enactment of 1962 and the Rump Labour Code of 1933 included public health provisions. Both these legislations required the provision of accommodation, sanitation, medical care and services, decent working conditions and livable wages for mine and estate workers (DOSH, 2011).

Currently, in order to reduce fatal accidents, injuries, illnesses and hazards at the workplaces, all organizations have to comply with the regulations in two Acts: the Factories and Machinery Act 1967 (FMA 1967) and the Occupational Safety and Health Act 1994 (OSHA, 1994). A revised version of FMA was enacted in 1974, which then gave rise to Factories and Machinery (Noise Exposure) Regulations 1989. The FMA act was to be implemented in factory & industry sector. In February 1994, a more comprehensive Occupational Safety and Health Act (OSHA) was introduced. This act was established in response to the need to cover a wider employee base and newer hazards introduced in the workplace (not limited to just factories and industries). However, there was no specific noise regulation is mentioned under OSHA, thus any issue related to occupational noise should be governed by the FMA (Noise Exposure) 1989.

Regulations, guidelines and codes of practice have been drawn up to support both Acts. In Malaysia, the OSH Act must be approved by Parliament while the OSH regulation must be endorsed by the Human Resource Ministry. Guidelines were endorsed by the General Director of Department of Occupational Safety and Health (DOSH). In general, the OSHA focuses on management issues while the FMA 1967 tackles the technical issues (Sirat, Shaharoun & Hassan, 2011). The evolution of legislation pertaining to noise management will be discuss in a great detail in the following discussion.

## **THE FACTORIES AND MACHINERY ACT (FMA) 1967**

The FMA act is enforced by the Factories and Machinery Department, under purview of Ministry of Health (in 1967), and before it was later put under the jurisdiction of Ministry of Labour (in 1971). Since 1967, the Department has been carrying out safety promotional activities such as producing safety and health guidelines and posters, as well as giving talks and shows on the occupational safety awareness to people involved in specific industries. The Factories and Machinery Act (FMA) 1967 came into force in 1970 to strengthen the regulations found in Machinery Ordinance 1953, that the 1953 Ordinance was abrogated. The Act was enacted to manage safety and health problems associated with manufacturing in Malaysia. Whereas in East Malaysia, Sabah and Sarawak, enforcement of the Act was brought about in 1980.

The FMA Act and the regulations within it were seen as a great improvement over previous legislations (Machinery Ordinance 1953) and could be seen as a cornerstone for OSH improvement for the next three decades before the introduction of the Occupational Safety and Health Act 1994 (Singh, 2004; Che Man & Musri, 2005; Soehod & Laxman, 2007). Although the FMA Act was an improvement over earlier legislations, it had some limitations. The FMA Act is only limited to manufacturing industry and factories, mining and quarrying, and construction; while other industries and workforces were not covered. In the scope of this Act, factories refer to places where individuals are employed in manual labor related to making, altering, repairing, cleaning and similar activities carried out for the purposes of trade or business (FMA, 2011). The FMA Act does not apply to premises used for housing vehicles where only minor cleaning and repairs are carried out, or to any premises that employ 5 or less persons. Thus it covers 23% of the workforce in Malaysia. Furthermore, the improvements prescribed by the Act were seen as overly dependent on the effectiveness of enforcement agencies.

In the 1970's and 1980's a number of regulations were introduced to further strengthen the FMA 1967. The regulations are shown in Table 2. Some of the regulations under the FMA are still in force but they are continuously phased out and replaced by regulations of Approved Code of Practice enacted under OSHA (Che Man & Musri, 2005). In 1984 to 1989, regulations addressing specific health hazards in the workplace -lead, asbestos, noise and mineral dust, were introduced. These regulations, in connection to the consideration by the Factory and Machinery Department of Malaysia were of the importance of industrial hygiene activities to be conducted as an essential tool to determine exposure to health hazards, to characterize risks and to plan appropriate control measures in the workplace. With regard to these roles, the hygiene unit later was upgraded into a division. As the unit developed into a division, hygiene activities were systematically planned and more qualified officers were trained.

Other hygiene surveys including noise level measurements, heat stress evaluation, and monitoring for air pollution such as that occurring in the asbestos and silica industries were conducted. Together with these surveys, medical surveillance was also conducted to complement the data gathered. The surveys involved data collection of lung function and audiometric testing of workers in selected factories. The surveys were carried out over a period of 5 years, from 1983 to 1988, involving 45,974 factory workers from 302 workplaces in Klang Valley. The data of the surveys were significant in the promulgation of the national standards for exposure in the workplace. Following the findings of these extensive surveys conducted by the Factory and Machinery Department, several other regulations were enacted. These regulations were the Factory and Machinery (Asbestos Process) Regulations 1986, the Factory and Machinery (Noise Exposure) Regulations 1989, and Factory and Machinery (Mineral Dust) Regulations 1989 (Rampal & Nizam, 2006). These legislations stressed the provisions for assessing exposure at the workplace, establishing permissible exposure level (PEL), control measures including medical and health surveillance provisions, together with competence and training.

**Table 2** List of Regulations made under the Factories and Machinery Act, (FMA) 1967 (Act 169)

Regulations	Year Enacted
Certificate of Competency Examination	1970
Electric Passenger and Goods Lift	1970
Fencing of Machinery and Safety	1970

Notification of Fitness and Inspections	1970
Person-In-Charge	1970
Safety, Health and Welfare	1970
Steam Boiler & Unfired Pressure Vessels	1970
Administration	1970
Compounding of Offences	1978
Compoundable Offences	1978
Lead	1984
Asbestos Process	1989
Building Operation and Works of Engineering Construction (Safety)	1986
Noise Exposure	1989
Mineral Dust	1989
Notification, Certificate of Fitness and Inspections (amendment)	2004

**THE FACTORIES AND MACHINERY (NOISE EXPOSURE) REGULATIONS 1989**

The first act related to noise management was introduced by FMA. The Factories and Machinery (Noise Exposure) Regulations 1989 was enacted and came into force on the 1<sup>st</sup> February 1989. These regulations are applied to all factories in which persons are employed in any occupation involving exposure to excessive noise level in the workplace. The first part of these regulations explains the duty of employers and the obligations of every employee to comply with these regulations. These regulations consist of 34 regulations, divided into ten parts and appended with two schedules. In general the ten parts of these regulations are shown in Table 4.

These regulations describe the obligations of employees to co-operate with the management by wearing a noise dosimeter during employee exposure monitoring, wear and make full and proper use of the hearing protection device provided for their use, attend or undergo audiometric testing or any medical examination or test arranged by the occupier and attend employee information and training programs conducted by the occupier.

The permissible noise exposure level (PEL) was set at 90 dB(A) for 8 hours and allowed to change by 5 dB(A) (or referred to as a 5 dB(A) ER (or exchange rate) for every doubling or halving of time (Refer to table 5). The standard also set maximum exposure level for continuous noise at 115 dB(A), regardless of duration, and no employee shall be exposed to impulsive noise exceeding a peak sound pressure level of 140dB. Based on Malaysia’s noise legislation, the criterion level for hearing conservation program (HCP) is 85 dB(A), and when the noise level reaches 90 dB(A), noise controls should be implemented.

**Table 4** The Factories and Machinery (Noise Exposure) Regulations 1989

Part	Regulations
I	Interpretation of the terms used in the regulations.
ii	Permissible exposure limit
III	Exposure monitoring
IV	Methods of compliance

V	Hearing protection devices
VI	Audiometric testing program
VII	Employee information and training
VIII	Warning signs
IX	Record keeping
X	Miscellaneous

**Table 5** Permissible Noise Exposure Level

Sound Level (dB A)	Duration/Day (Hrs)
90	8
92	6
95	4
97	3
100	2
102	1
105	1
110	½
115	¼ or less

\* *Factories & Machinery Act 1967 [16]*

\* *Factories & Machinery (Noise Exposure) Regulations 1989 [17]*

All the legislation described by different act discussed above gave rise to the occupational noise management in Malaysia. This is done through the implementation of hearing conservation programs (HCP), hearing loss prevention programs (HLPP), and noise control policy which will be discussed in detail in the following.

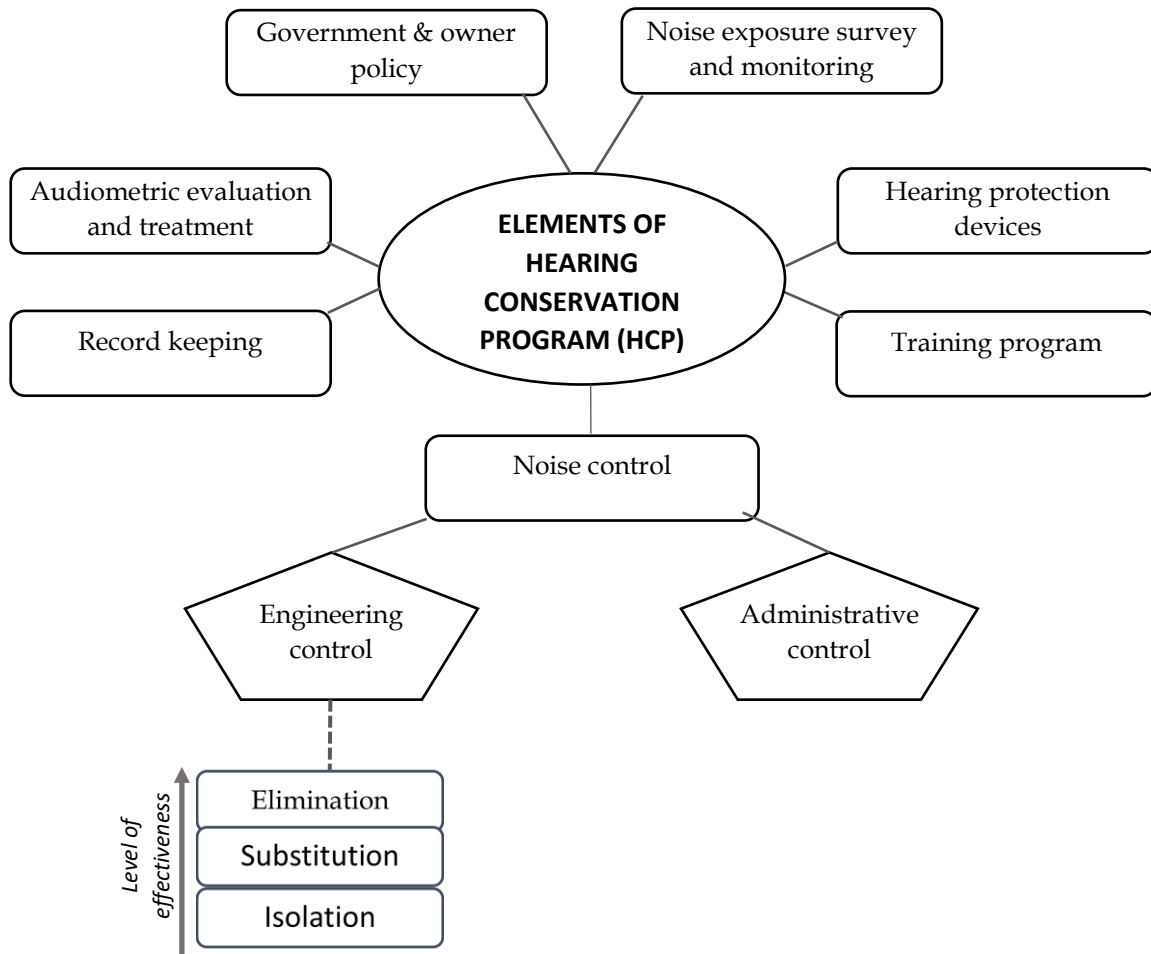
### **HEARING CONSERVATION PROGRAMS (HCP) AND HEARING LOSS PREVENTION PROGRAMS (HLPP)**

The terms “hearing conservation programs (HCP)”, “hearing loss prevention programs (HLPP)”, and “noise management program” are referred to the effort to reduce the occurrence of NIHL among exposed workers (Berger, 2003). The difference between the programs were their approaches but the primary purpose was similar - to reduce NIHL.

#### **Hearing Conservation Programs (HCP)**

Hearing conservation program (HCP) is designed to protect workers in noisy occupational settings from developing occupational noise induced hearing loss (Accident Compensation Corporation, 2006). In most legal jurisdiction worldwide, employers are responsible to establish a HCP when the daily noise exposure exceeds the permission exposure level (listed in table 5). In Malaysia, with the enactment and enforcement of FMA (Noise Regulations) 1989, HCP has been made as a mandatory for all employers in the factory and machinery

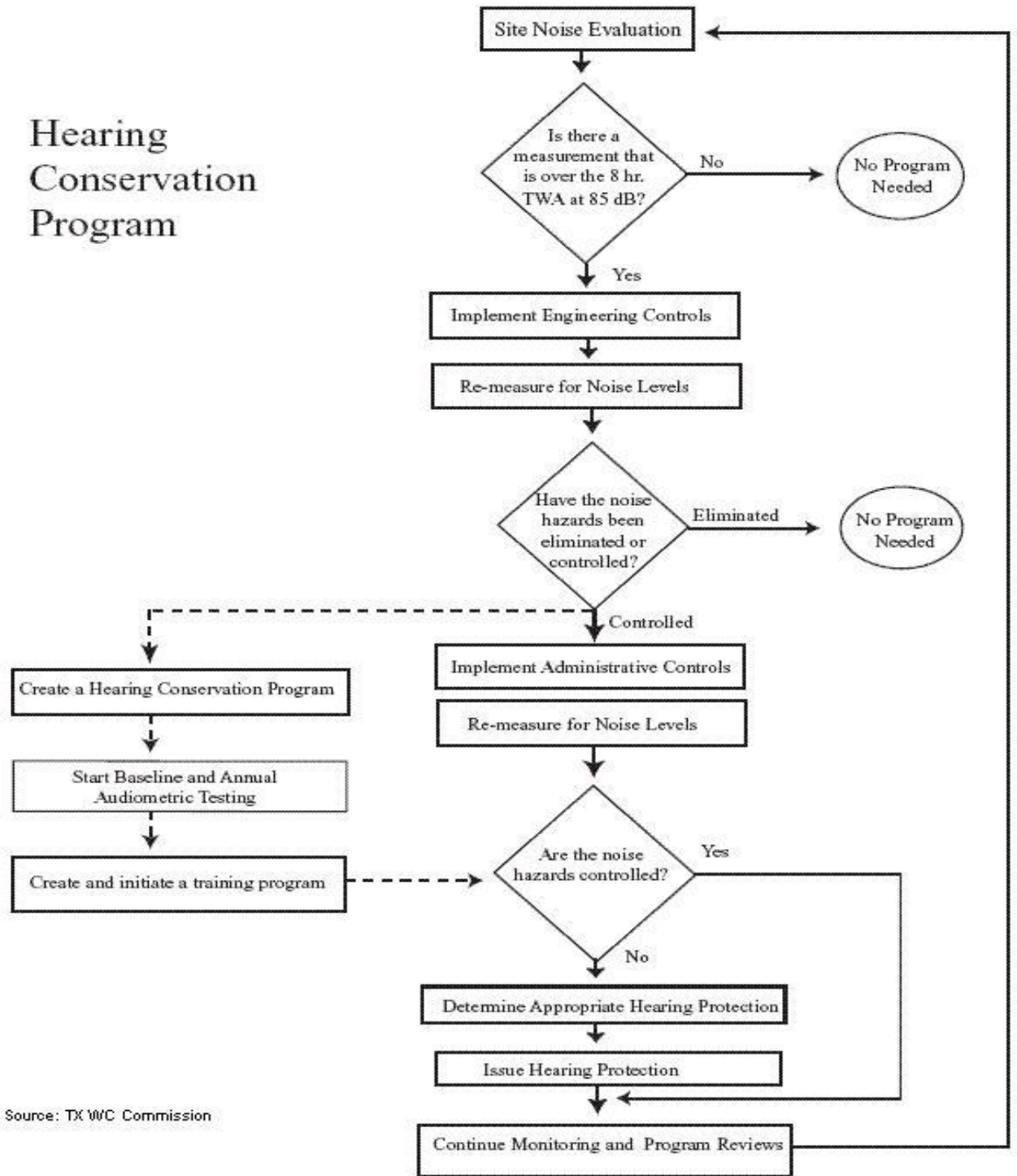
industries. HCP is a formal program that is carried out with the aim of protecting and maintaining the hearing of employees.



**Figure 1** Seven elements of Hearing Conservation Program (HCP). There are two sub-elements under element of noise control. The hierarchy of effectiveness for different strategies of engineering control is shown.

Typically, the HCPs include seven elements with an objective to protect employees from noise exposure and preventing the occurrence of NIHL. The typical seven elements of HCP are; i) government policy and owner policy on the hearing conservation program, ii) noise exposure survey and monitoring, iii) noise control, iv) hearing protection devices, v) audiometric evaluation and treatment, vi) training program, and vii) record keeping (Stewart, 1988; Royster & Royster, 1991). Figure 1 shows the seven elements.

# Hearing Conservation Program



Source: TX W/C Commission

**Figure 2** The flow of HCP establishment. Figure was taken from Table 3 in Workers' Health and Safety (n.d.)



Generally, HCP consists of a noise survey of a workplace to establish exposure levels and hazard areas. According to the Factories and Machinery (Noise Exposure) Regulations 1989, a HCP must be established if the workplace is found to have significant hazardous level (i.e. 85 dB A). The flow of establishing the HCP is shown in Figure 2.

The HCP is a teamwork approach and its effectiveness depends on the cooperation of all workers from management level to supervisors and workers of each department in the plant. In other words, to effectively manage an HCP requires an understanding of disciplines involving administration, hygiene, occupational medicine and/or audiology, occupational safety and health departments, noise measurement, risk assessment, employee education and training, engineering control, and hearing protection (Driscoll, 2015).

The owner of a plant or factory should have a written noise management policy signed by the chief officer of the company and disseminate to employees at all levels. An audit system should also be implemented to examine the effectiveness of the program at all stages (Franks, Stephenson, & Merry, 1996). To control high noise level is by a strict adherence to the noise hierarchy of controls that include engineering and administrative control as shown in Figure 1. The implementation of noise control reduction should also include assessment of noise exposure and hearing, education with respect to risks, solutions and responsibilities, and training on noise control and personal protection and maintaining good record keeping (Timmins & Granger, 2010). It is beyond the scope of this paper to discuss in details each of these elements.

If the control measures through engineering control are still unable to reduce the noise to the permissible exposure levels (PEL) (i.e. less than 85 dB A), employers are allowed to implement the administrative controls. The objective in administrative control is to prevent unnecessary noise exposure to workers by reducing the time of exposure, and minimizing the number of workers exposed to high noise levels. The steps may include the rescheduling of job operations involving high levels of noise or machines; cultivating a safe work culture among the workers and providing on-going education to create awareness on the effects of high noise levels on human hearing.

Finally, if all of these technical means do not result in a reduction of noise to permissible levels, the last line of defence is the use of hearing protection devices (HPDs). In implementing a HCP, baselines and annual audiometry for exposed workers are required (Nelisse, Gaudreau, Boutin, Voix, & Laville, 2011; Daniell et al., 2002). The Acoustical Society of America (2002) recommends that audiometric testing should be administered annually wherever possible at no more than two yearly intervals elsewhere. More frequent audiometric testing is recommended at high noise exposures (e.g. 8 hour averages in excess of 100 dB A), where workers are exposed to impulse noise or where job conditions change frequently (AS/NZ, 2005; AS/NZ, 2014).

A strong commitment from the management and full cooperation from workers at all levels are required to achieve the success of any HCP. Since NIHL is a completely preventable occupational injury, efforts should involve all levels of workers, managerial, authority bodies and the government as the enforcer of currently existing regulations. The Acts and regulations that were promulgated since many years ago should have been strictly enforced in order to ensure that they benefit everyone in the workplace. Berger and Royster (1987, p. 40.) stated that, "In large part, what is needed is not the development of new solutions, but rather the broad dissemination of existing techniques plus the education and motivation of management and labor alike to speed the implementation of effective programs".

However, the effectiveness of HCP in reducing NIHL among exposed workers has been questioned by many researchers (Melnick, 1984; Waugh, 1993; Lipscomb, 2005; Suter, 2009). In principal, the 7 elements (as shown figure 1) should be implemented in HCP. However, most of the HCPs rely solely on the usage of HPDs and give less commitment to noise control (engineering control), training, and enforcement that is necessary to make this program work (Berger, 2003; Franks & Burks, 1998; Morata et al., 2005; Nor Saleha & Noor Hashim,

2006; Williams et al., 2008; Timmins & Granger, 2010). Overreliance on HPD usage has made the HCPs unsuccessful in reducing NIHL among workers.

Currently in Malaysia, occupational noise management only includes HCP, but not HLPP. A hearing conservation program was established in order to comply with the Factories and Machinery (FMA) (Noise Regulations) 1989. The hearing conservation became mandatory for all employers in Malaysia whose employees (as stated in the policy) are exposed to excessive noise levels. The regulations are applied to all industries except those in the armed forces and in merchant shipping as separate regulations and law are applied to these two sectors. Based on the (FMA) (Noise Regulations) 1989, all employers are required to have a hearing conservation program if the noise levels is 85 dB(A) or higher and, to utilize noise controls if feasible, and administrative control or both if the employee full-shift average exposures reach 90 dB(A). The enforcement is under the authority of the Department of Occupational Safety and Health (DOSH).

### **Hearing Loss Prevention Programs (HLPP)**

As an alternative to HCP is a hearing loss prevention program (HLPP) as defined by NIOSH in the United States (Franks et al., 1996; NIOSH; 1998), or “noise management program” or a “noise control program” as it is known in Australia and New Zealand, were proposed (Berger, 2003; Accident Compensation Corporation, 2006; Timmins & Granger, 2010). The HLPP or noise management/control incorporates a wider approach and more emphasis was given to noise elimination or isolation at the source and less reliance on hearing protection devices (Accident Compensation Corporation, 2006). The principal of the noise control programs is to reduce noise, ideally to the point where hearing conservation program would be unnecessary (Waugh, 1993). This approach is believed to be more comprehensive than that used in a HCP. While the HCP runs by a health professional, the noise control program involves engineers and technicians. However, HLPP is yet to be conducted in Malaysia.

### **CONCLUSION**

In conclusion, this review discussed the overview of occupational management in Malaysia. The statistic on occupational noise incidence and prevalence in Malaysia has been presented in earlier part of this review. Although the statistics may not represent the entire Malaysia population, it can be concluded that NIHL is a serious problem in Malaysia and affecting large number of workers. The review continues with the history of occupational noise legislative development in Malaysia. There are two current regulations controlling the occupational safety and health issues, namely FMA and OSHA. However, there was no specific noise regulation is mentioned under OSHA, thus any issue related to occupational noise should be governed by the FMA (Noise Exposure) 1989. The implementation of occupational noise management can be achieved by establishing a HCP and/ or a HLPP. The components of a HCP can be referred in figure 1, and the flow of HCP implementation can be found in figure 2. Meanwhile, the HLPP was discussed in brief, as it is yet to be implemented in Malaysia.

In general, the data available on occupational noise management in Malaysia are still limited. Another challenge in Malaysia’s context is in getting the basic information as to whether these programs exist in all industries in Malaysia as stipulated by the noise legislation, this gap, however, has disadvantaged the Malaysian workforce. Therefore, the compilation of history on occupational noise management and the related legislation in Malaysia will give an overview of this area and could be a future reference particularly for hearing-related-professionals in Malaysia. To date, the effectiveness of HCP in Malaysia, and to what extent it is accepted and being implemented is yet to be investigated. Thus, future work in this area is warranted.

**ACKNOWLEDGEMENT**

This study was funded by Research Initiative Grant Scheme (Grant no: RIGS 16-136-0300).

**REFERENCES**

- Abas, A. L., Said, A. R. M., Mohammed, M. A. A., & Sathiakumar, N. (2008). Occupational disease among non-governmental employees in Malaysia. *International Journal of Occupational Environmental Health*, 14, 263-271.
- Abas, A. L., Said, A. R. M., Mohammed, M. A. A., & Sathiakumar, N. (2011). Non-fatal occupational injuries among non-governmental employees in Malaysia. *International Journal of Occupational Environmental Health*, 17(1), 38-48.
- Accident Compensation Corporation. (2006). Best practice in noise-induced hearing loss management and prevention: A review of literature, practices and policies for the New Zealand context. In: N. Reid, P. Thorne, S. Ameratunga, W. Williams, S. Purdy & G. Dodd (Eds.). Auckland: Accident Compensation Corporation, ACC.
- Acoustical Society of America. (2002). Evaluation to the effectiveness of hearing conservation programs through audiometric data base analysis: ASA S12.13 TR-2002 (R2016).
- Amedofu, G. K., & Fuente, A. (2008). Occupational hearing loss in developing countries. In: B. McPherson & R. Broulillette (Eds.), *Audiology in Developing Countries*. New York: Nova Science Publishers, Inc.
- Ashraf, H., Younus, M., Kumar, P., Siddiqui, T., Ali, S., & et al. (2009). Frequency of hearing loss among textile industry workers of weaving unit in Karachi, Pakistan. *Journal of Pakistan Medical Association*, 59(575-576).
- AS/NZ -Australia/New Zealand Standard 1269. 4 (2014). *Occupational noise management Part, 4 Noise Control*, Standards Association of Australia, North Sydney.
- AS/NZ- Australia/New Zealand Standard 1269. 2 (2005). *Occupational noise management Part, 2 Auditory Assessment*, Standards Association of Australia, North Sydney.
- Berger, E. H. (2003). Noise control and hearing conservation: Why do it? In: E. H. Berger, L. H. Royster, J. D. Royster, D. P. Driscoll & M. Layne (Eds.), *The Noise Manual* (pp. 1-17). Fairfax VA: America Industrial Hygiene Association (AIHA).
- Berger, E. H., & Royster, J. D. (1987). The development of a National Noise Strategy. *Sound and Vibration*, 21(1), 40-44.
- Che Man, A. B. (1996). Occupational safety and health in Malaysia. In: K. G. Rampal & N. H. Ismail (Eds.), *Perspective of occupational safety and health legislations in Malaysia*. Bangi: National Institute of Occupational Safety and Health.
- Che Man, A. B., & Musri, M. (2005). Occupational safety and health system and programme in Malaysia. *Asian-Pacific Newsletter on Occupational Health and Safety*, 12, 30-35.

- Cocha-Barrientos, M., Campbell-Lendrum, D., & Steenland, K. (2004) Occupational noise. Assessing the burden disease from work-related hearing impairment at national and local levels. Geneva: WHO Document Production Services.
- Daniell, W. E., Swan, S. S., McDaniel, M. M., Stebbins, J. G., Seixas, N. S., & S, M.M. (2002). Noise exposure and hearing conservation practices in an industry with high incidence of worker's compensation claims for hearing loss. *American Journal of Industrial Medicine*, 42, 309-317.
- Daniell, W. E., Swan, S. S., McDaniel, M. M., Camp, J. E., Cohen, M. A., & Stebbins, J. G. (2006). Noise exposure and hearing loss prevention programmes after 20 years of regulations in the United States. *Occupational Environmental Medicine*, 63, 343-351.
- DOSH. (2006). Guidelines on occupational safety and health Act 1994 (Act 514). Kuala Lumpur: Ministry of Human Resources Malaysia.
- DOSH. (2011). Annual Report. Kuala Lumpur: Department of Occupational Safety and Health (DOSH).
- Driscoll, D.P. (2015). The evolution of hearing conservation programs. In Dobie, R.A. (Ed). *Medical-Legal Evaluation of hearing loss*. 3<sup>rd</sup> Ed. San Diego. Plural Publishing.
- FMA (2011). Factory and Machinery Act and Regulations 1967 Act 139, retrieved from <http://www.dosh.gov.my/index.php/en/legislation/regulations-1/regulations-under-factories-and-machinery-act-1967-act-139>
- Franks, J., & Burks, A. (1998). Engineering noise controls and personal protective equipment. Control of workplace hazards for the 21st century-setting the research agenda. Cincinnati, OH: National Institute for Occupational Safety and Health, NIOSH.
- Franks, J. R., Stephenson, M. R., & Merry, C. J. (1996). Preventing occupational hearing loss: A practical guide. Cincinnati, Ohio: NIOSH Retrieved from [http://www.who.int/occupational\\_health/publications/noise11.pdf](http://www.who.int/occupational_health/publications/noise11.pdf)
- Fuente, A., & Hickson, L. (2011). Noise induced hearing loss in Asia. *International Journal of Audiology*, 50, S3-S10.
- Hamalainen, P., Saarela, K. L., & Takala, J. (2009). Global trend according to estimated number of occupational accidents and fatal work-related disease at region and country level. *Journal of Safety Research*, 40, 125-139.
- Hashim, S. B., Amin, F. B., & Khalid, H. M. (2005). Malaysia country report. Paper presented at the WHO/ILO Meeting on Strengthening Occupational Safety and Health, Kuala Lumpur.
- Kumar, G. P., Dewangan, K., & Sarkar, A. (2008a). Noise exposure in oil mills. *Indian Journal of Occupational and Environmental Medicine*, 12(1), 23-28.
- Kumar, G. P., Dewangan, K., Sarkar, A., Kumari, A., & Kar, B. (2008b). Occupational noise in rice mills. *Noise & Health*, 10(39), 55-67.
- Lipscomb, D. M. (2005). An exercise in futility: Frustrations or a hearing conservationist (An Historical Review and Summary of Hearing Conservation Issues), Retrieved from [http://www.audiologyonline.com/articles/arc\\_disp.asp?id=1371](http://www.audiologyonline.com/articles/arc_disp.asp?id=1371) (Assessed on 2-2-2012).

- Masilamani, R. (2010). Recent development in occupational health services in Malaysia. *Malaysian Journal of Public Health Medicine*, 10(2), 1-5.
- Melnick, W. (1984). Evaluation of industrial hearing conservation programs: a review and analysis. *American Industrial Hygiene Association Journal*, 45(7), 459-467.
- Morata, T. C., Themann, C. L., Randolph, R. F., Verbsky, B. L., Byrne, D. C., & Reeves, E. R. (2005). Working in noise with a hearing loss: Perceptions from workers, supervisors, and hearing conservation program managers. *Ear and Hearing* 26, 529-545.
- Nelisse, H., Gaudreau, M. A., Boutin, J., Voix, J., & Laville, F. (2011). Measurement of hearing protection devices performance in the workplace during full-shift working operations. *Annals of Occupational Hygiene*, 56(2), 221-232.
- NIOSH. (1998). Criteria for a recommended standard: Occupational noise exposure. (DHHS (NIOSH) Publication No. 98-126). Cincinnati, OHIO: Retrieved from <http://www.nonoise.org/hearing/criteria.htm>.
- Nor Saleha, I. T., & Noor Hassim, I. (2006). A study on compliance to hearing conservation program among industries in Negeri Sembilan, Malaysia. *Industrial Health*, 44, 584-591.
- OSHA (1994). Occupational Safety and Health Act 1994.
- Rampal, K. G. (2000). Current developments and future directions of occupational health in Malaysia. *Medical Journal Malaysia*, 55(3), 295-298.
- Rampal, K. G., Aw, T.C., & Jefferelli, S. B. (2002). Occupational health in Malaysia. *Occupational Medicine*, 17(3), 409-425,iv.
- Rampal, K. G., & Nizam, J. M. (2006). Developing regulations for occupational exposures to health hazards in Malaysia. *Regulatory Toxicology and Pharmacology*, 46, 131-135.
- Ratnasingam, J., & Ioras, F. (2010). The safety and health of workers in the Malaysian wooden furniture industry: An assessment of noise and chemical solvents exposure. *Journal of Applied Sciences*, 10, 590-594.
- Royster, L. H., & Royster, J. D. (1991). Hearing conservation programs. In C. M. Harris (Ed.), *Handbook of acoustical measurement and noise control* (3rd ed.). New York: McGraw-Hill.
- Singh, H. (2004). Decades of occupational safety and health in Malaysia. Bangi: National Institute of Occupational Safety and Health, Malaysia.
- Sirat, R. M., Shaharoun, A. M., & Hassan, S. A. H. S. (2011). The influence of ergonomics on occupational safety and health (OSH) legislation in Malaysia. *International Conference on Industrial Engineering and Operations Management*, retrieved from <http://www.iieom.org/ieom2011/pdfs/IEOM129.pdf>
- Social Security Organization (SOCSO) (2016). Statistics Report, Retrieved from <http://www.perkeso.gov.my> (Assessed on 4-9-2017).
- Soehod, K. B., & Laxman, L. K. P. (2007). Law on safety and health in Malaysia. Malaysia: Universiti Teknologi Malaysia.

- Stewart, A. P. (1988). *The comprehensive hearing conservation program*. In D.M. Lipscomb (Ed.), *Hearing conservation in industry, school, and the military*. Boston: MA: Little Brown and Co.
- Suter, A. H. (2009). The hearing conservation amendment: 25 years later. *Noise & Health*, 11(42), 2-7.
- Tahir, N., Aljunid, S. M., Hashim, J. H., & Begum, J. (2015). Burden of noise induced hearing loss among manufacturing industrial workers in Malaysia. *Iranian Journal of Public Health*, 43(3), 148-153.
- Timmins, P., & Granger, O. (2010). Occupational noise-induced hearing loss in Australia: Overcoming barriers to effective noise control and hearing loss prevention. *Safe Work Australia*, Barton ACT.
- Waugh, D. (1993). Do hearing conservation programs really work? Paper presented at the *National Seminar on Noise Management in the Workplace*, Melbourne, Australia.
- Workers' Health and Safety (n.d.). Hearing Conservation: Texas Department of insurance, retrieved from <https://www.tdi.texas.gov/pubs/videoresource/wphearing.pdf>
- WHO. (2005). Malaysia environmental health country profile. WHO-Western Pacific Regional Office, Manila, Philippines: World Health Organization.
- Williams, W., Kyaw-Mint, S., Crea, J. & Hogan, A. (2008). Occupational noise management: What's happening in industry? *Journal of Occupational Health Safety -Aust NZ*, 24(4), 299-307.