REVIEW

CHALLENGES IN THE DEVELOPMENT OF A MEDICAL SURVEILLANCE SYSTEM FOR PNEUMOCONIOSES AND OTHER ASBESTOS-RELATED DISEASES IN THE PHILIPPINES

Vivien Fe F Fadrilan-Camacho[1], Romeo R Quizon[1], Dina V Diaz[2] and Angelica Noelle P Manaloto[1]

[1]Department of Environmental and Occupational Health, College of Public Health; [2]Department of Physiology, College of Medicine, University of the Philippines Manila, Philippines

Abstract. Pneumoconiosis is recognized as one of the most common occupational diseases globally. Although industries with occupational exposure to mineral dusts are documented in the Philippines, cases of pneumoconioses and other asbestos-related diseases remain undiagnosed and underreported. Development of a surveillance system for these conditions shall provide policy direction to promote health and safety of workers who are exposed to mineral dusts. The study aimed to identify challenges in the development of a medical surveillance system for pneumoconioses and other asbestos-related diseases in the Philippines. Literature search was conducted to identify existing international medical surveillance systems for pneumoconioses and other asbestos-related diseases. The identified challenges in the development of a medical surveillance system mainly stems from the lack of an enabling policy environment and the general lack of awareness on pneumoconioses and other asbestos-related diseases in the country. The development of a medical surveillance system for pneumoconioses and other asbestos-related diseases remain a challenging process in the Philippines. Improved occupational health and safety policies, education and training will effectively facilitate the development and implementation of the proposed medical surveillance systems for such conditions.

Keywords: asbestos-related diseases, monitoring, pneumoconioses, surveillance system, Philippines

Correspondence: Vivien Fe F Fadrilan-Camacho, Department of Environmental and Occupational Health, University of the Philippines Manila, 770 Pedro Gil St, Malate, 1004 Metro Manila, Philippines.
Tel: +63998 8864138, +632 5247102
E-mail: vffadrilancamacho@up.edu.ph

INTRODUCTION

Occupational lung diseases (OLDs) are a major public health concern especially among the industrial workforce. Among these diseases, pneumoconiosis is particularly known to be one of the major contributors in the morbidity and mortality of the industrial workforce in

the developing countries as well as some developed countries (Wagner, 1996). The US Centers for Disease Control and Prevention (CDC, 2011) defines pneumoconioses as "a group of interstitial lung diseases caused by the inhalation of certain dusts and the lung tissue's reaction to the dust" while the International Labour Organization (ILO, 2011) defines such conditions as "the accumulation of dust in the lungs and the tissue reactions to its presence." The primary pneumoconioses are asbestosis, silicosis and coal workers' pneumoconioses.

These pulmonary diseases are characterized by granulomatous and fibrotic changes in the lungs after the inhalation and deposition of mineral dusts usually found in the workplace such as asbestos fibers, respirable crystalline silica and coal dust (ILO, 2011). Asbestos-related diseases (ARDs) include an interstitial lung disease termed asbestosis, and pleural-based abnormalities such as diffuse pleural thickening, benign plaques, benign pleural effusions and malignant mesothelioma. Asbestos exposure significantly increases the risk of developing lung cancer. Smoking is also known to exacerbate these conditions. Early recognition of pneumoconiosis and other asbestos-related diseases is difficult because of its long latency period, which is approximately 10 years or more.

The high-risk occupations for these conditions include those in the mining, rock grinding and crushing, sandblasting, ceramic, construction and manufacturing industries. According to World Health Organization (WHO), an estimated number of 125 million people in the world are exposed to asbestos at the workplace (Concha-Barrientos *et al*, 2004). Moreover, according to Occupational Safety and Health Administration (OSHA, 2013), around 2.2 million US workers are exposed to respirable crystalline silica in their workplaces and the majority of these workers (about 1.85 million) are in the construction industry. In the Philippines, it is estimated that 5,289 and 30,000 workers have direct and indirect exposure to asbestos, respectively (Villanueva *et al*, 2014). Number of workers with silica and coal dust exposure in the Philippines has not yet been established.

Adverse health effects of mineral dusts are well recognized globally. Pneumoconioses cases are well documented in developed countries such as the United States, United Kingdom, Finland, and Germany (Wagner, 1996). Global estimates of annual deaths due to asbestos-related diseases such as asbestos-related lung cancer, mesothelioma and asbestosis increased from 90,000 in 2006 (WHO, 2006) to 107,000 in 2014 (WHO, 2014). Each year more than 200 US workers die from silicosis and hundreds more become disabled (NIOSH, 2006).

Respiratory diseases, such as tuberculosis and lung cancer, are well documented in the Philippines. According to World Health Organization (WHO, 2012) estimates, there are 260,000 incident tuberculosis (TB) cases in the country and 28,000 die from the disease annually. The Philippines also lists TB as the 6th leading cause of mortality and has one of the highest tuberculosis (TB) burden in the world (DOH, 2012). In addition, lung cancer is the top cause of cancer-related mortality among men and the third cause of cancer deaths among women (after breast and cervical cancer) in the Philippines (IARC, 2012). However, there is a paucity of statistical data regarding the number of workers diagnosed with pneumoconioses and other asbestos-related diseases despite the documented number of industries with

mineral dust processes in the country.

In line with this, the ILO and the WHO developed the National Programme for the Elimination of Asbestos-Related Diseases (NPEAD), which intends to address health issues in countries that still use asbestos (ILO-WHO, 2007). Consequently, the Department of Health (DOH) adapted and developed NPEAD for the Philippines (WHO, 2012). One of the objectives of NPEAD is the development of a medical surveillance program specific for asbestos-related diseases. In the development of a medical surveillance program, DOH has included pneumoconioses in addition to the asbestos-related diseases for surveillance. WHO defines public health surveillance as *the continuous, systematic collection, analysis and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice* (WHO, 2016). A surveillance system is needed to properly assess workers with mineral dust exposure and to detect changes in trends or distributions over time for the proper allocation of resources to guide targeted interventions (CDC, 2012).

We therefore reported the findings from the review of related literature to identify challenges in the development of surveillance system for pneumoconioses and other asbestos-related diseases and to identify common good practices of international surveillance systems in order to formulate recommendations in the development of a surveillance system for such conditions in the Philippines.

MATERIALS AND METHODS

Sources of data

To identify and review existing international medical surveillance systems for pneumoconioses and other asbestos-related diseases, a literature search was conducted through the National Center for Biotechnology Information, websites of ILO, National Institute of Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA) and related databases. Abstracts were checked for initial relevance and then full papers were obtained. References to other reports in the identified articles were also examined to supplement the initial search. Content analysis was utilized to review the collected data.

RESULTS

Developed countries such as the United Kingdom (UK), United States (US), Canada and Germany have legally mandated screening programs and surveillance systems of occupational lung diseases ranging from pneumoconioses to chronic bronchitis, occupational asthma, emphysema and smoking-related diseases (Wagner, 1996).

Surveillance of Work-Related and Occupational Respiratory Disease (SWORD) has been ongoing in UK since 1988. SWORD is based on voluntary reporting of occupational lung diseases by members of the British Thoracic Society and the Society of Occupational Medicine. Respiratory diseases reported include occupational asthma, benign and malignant pleural disease, mesothelioma, lung cancer and pneumoconiosis (University of Manchester, 2010). Moreover, Health and Safety Executive (HSE) has legally mandated and enforced the screening and surveillance programs of pneumoconioses, primarily asbestosis, pleural changes related to asbestos and other pneumoconiosis (Wagner, 1996).

In the US, the surveillance of occupational lung diseases is led by the National

Institute for Occupational Safety and Health (NIOSH) (Takahashi *et al*, 1998). It is characterized by direct surveys specifically designed for detecting occupational risks such as the Sentinel Event Notification System for Occupational Risks (SENSOR) and Coal Worker's X-ray Surveillance Program (CWXSP), combined with indirect surveys of existing federal data sources designed for purposes such as death certificates and hospital discharge.

New cases of occupational lung diseases in Finland are registered based on the law that requires physicians to report every case of occupational disease. In case of difficulty in diagnosis of pneumoconioses, a national mesothelioma panel was set up at Finnish Institute of Occupational Health in 1989. All university hospitals in Finland have also established expert groups in pneumoconioses that can be consulted in difficult cases (FIOH, 2014).

Exposures being monitored for the screening and surveillance systems vary in each country based on exposures that create a significant health risk among workers. In UK, US and Poland, diseases caused by exposures to the most notable mineral dusts such as asbestos, silica and coal dust are monitored (Wagner, 1996). This is in contrast to selected monitored mineral dust exposures such as coal mine and silica dust exposure in New South Wales, Australia and silica and asbestos dust exposure in Quebec Province of Canada (Wagner, 1996).

The common assessment tools performed in the international screening program and surveillance systems for pneumoconioses and other asbestos-related diseases are questionnaire which includes a medical and work history, physical examination; chest X-ray (according to ILO standards) and pulmonary function testing particularly spirometry (Wagner, 1996). However, some countries have different tests performed depending on the mineral dust exposure. For example, in Germany and UK, tests for exposures to mineral dusts such as coal, silica and asbestos vary for every program (Wagner, 1996). For coal workers, chest X-ray and spirometry are the only examinations done. For silica workers, chest X-ray, pulmonary function testing, questionnaire and physical examination are used for assessments. For asbestos workers, a comprehensive medical examination is done which includes medical and occupational history, questionnaire, chest X-ray, pulmonary function testing (FEV1, FVC) (Wagner, 1996).

In Asia, well-documented occupational lung disease surveillance system are seen in China, Japan and Korea (Wagner, 1996). China has a legally mandated screening and surveillance programs for all forms of pneumoconioses, particularly for workers with exposures to coal mine, silica and asbestos dust (Wagner, 1996). Workers exposed to mineral dust or those with a history of dust exposure are eligible for participation in the screening and surveillance program.

Japan runs a national disease surveillance scheme headed by the Hazard Evaluation and Epidemiology Research Group under the Japan National Institute of Occupational Safety and Health (JNIOSH). The agency is in-charge of practical intervention studies for surveillance studies for work-related diseases and occupational exposures, epidemiological analyses of occupational diseases and injuries as well as epidemiological studies of mortality among asbestos-exposed workers (JNIOSH, 2009). Epidemiological studies such as the prevalence and incidence of asbestosis, mesothelioma and lung cancer is well established by Japan's

vital statistics and other researchers (Furuya *et al*, 2013).

Occupational disease surveillance systems have been established by Korea Occupational Safety and Health Agency (KOSHA) to monitor occupational diseases in South Korea. Two types of surveillance systems are being operated: the regional based programs for monitoring occupational hazards at the local level and the nationwide occupational surveillance system for specific diseases, namely malignant mesothelioma, occupational lung cancer and occupational asthma (Rhee and Choe, 2010). The surveillance systems help in capturing unclaimed cases for compensation that were not included in the national statistics, as well as claimed cases (Lee and Kim, 2010). Table 1 contains the summary of existing international surveillance systems for pneumoconiosis and occupational lung diseases.

In the Philippines, one of the existing surveillance systems is the Philippine Integrated Disease Surveillance Response (PIDSR) System which is generally for immediate and weekly notifiable diseases, syndromes, health-related events and conditions. The PIDSR System, introduced in 2007 by the Public Health Surveillance and Informatics Division of the National Epidemiology Center (NEC), is the Department of Health's strategy to harmonize all existing disease surveillance systems in the country for the purpose of strengthening the capacity of local government units (LGUs) in performing disease surveillance and response. Data were obtained from NEC's Regional Offices through its Disease Reporting Units (DRUs) such as the Regional Epidemiology and Surveillance Units (RESUs), Municipal Epidemiology and Surveillance Units (MESUs) and Provincial Epidemiology and Surveillance Units (PESUs) (NEC, 2013).

Data on asbestos-using companies and establishments in the Philippines is available. According to the National Asbestos Profile of the Philippines, there are 143 companies in the Philippines where asbestos exposure of workers in the workplace is present (DOH-UPM, 2013). There are also other large and small-scale silica and coal mining companies in the Philippines. According to the Department of Energy (DOE, 2015), there are 43 small-scale coal-mining operators in the country.

The Bureau of Working Conditions under the Department of Labor and Employment (BWC-DOLE) in the Philippines utilizes the Employer's Work Accident/ Illness Report (WAIR) form as part of the DOLE reportorial requirements among companies and establishments. Furthermore, the Annual Medical Report (AMR) is also part of BWC-DOLE's reportorial requirements, which includes a report of the total number of pneumoconioses cases in the establishment. However, there is low compliance rate on the AMR report due to lack of cooperation of industries.

From 1992 to 1996, the Lung Center of the Philippines conducted an Asbestos Screening Program of shipyard workers at the Subic Naval Facility. Out of the 1,542 workers screened, 58.75% demonstrated asbestos-related interstitial lung or pleural disease (Diaz, 2009).

Currently, there is no ongoing surveillance system specific for pneumoconioses and asbestos-related diseases in the Philippines. However, the groundwork for the monitoring and reporting of asbestos-related diseases in the Philippines has been established in 2009 through the Philippine National Program on the Elimination of Asbestos-Related Diseases (PNPEAD), in cooperation with the Department of Health and World Health Organization. One of the aims of the surveillance sys-

Table 1
Summary of existing global surveillance systems for occupational lung diseases (Wagner, 1996).

	Australia (New South Wales)	Canada (Quebec Province)	China	Germany	Poland	United Kingdom	United States
Exposures that are creating a risk	Coal mine, silica dust	Silica, asbestos dust	Coal mine, silica, asbestos dust	Coal mine, silica, asbestos dust	Coal mine, silica, asbestos dust	Coal mine, silica, asbestos dust (including chrysotile, crocidolite, and amosite)	Coal mine, asbestos dust
Occupational lung diseases being monitored	Chronic bronchitis, asthma exacerbated by dust, pneumoconioses, emphysema, smoking-related diseases	All forms of dust-related diseases	All forms of pneumconioses	Coal/silica workers: Pneumoconiosis, chronic obstructive bronchitis, emphysema in coal workers Asbestos workers: Asbestosis, asbestos-related pleural disease, mesothelioma, and bronchial cancers	Coal workers: Pneumconiosis, chronic bronchitis and silicosis Asbestos workers: asbestosis, asbestos-related malignancies	Coal workers: Pneumoconiosis, impaired pulmonary function Silica workers: Silicosis Asbestos workers: Asbestosis, pleural changes related to asbestos	Coal workers: Pneumoconiosis, particularly progressive massive fibrosis Asbestos workers: Asbestosis and asbestos-related malignancies
Workers eligible for participation	Current and retired workers in the New South Wales coal mining company	Exposed workers in designated industrial sectors	Workers exposed to mineral dust; Workers with a history of dust exposure	Coal/silica workers: Underground coal miners and ex-underground minders of coal ore, iron, uranium, etc. Workers exposed to silica dust Asbestos workers: Workers with at least 3 months exposure to asbestos dust	Current and retired workers exposed to silica dust or dust-containing silica; underground coal miners and those exposed to coal dust on the surface; those exposed to asbestos-containing dust	Coal workers: Underground coal miners and those exposed to coal dust on the surface; ex-British Coal employees Silica workers: Exposed workers Asbestos workers: Workers exposed over a continuous 12-week period	Coal workers: Underground coal miners Asbestos workers: Workers with exposure to more than 0.1 fibre/ml as an 8-hour time-weighted average, or above 1 fibre/ml averaged over a 30-minute sampling period
Worker participation in the surveillance program	Mandatory preplacement screening; subsequent health screenings a condition of service	Mandatory, with a special emphasis on workers in mines and quarries	Voluntary	Coal/silica workers: Mandatory Asbestos workers: Mandatory	Mandatory for initial and periodic examinations	Coal workers: Voluntary Silica workers: Voluntary	Coal workers: Initial testing mandatory; with subsequent testing voluntary

						Asbestos workers: Mandatory	Asbestos workers: Voluntary; however, for many employers, participation a condition of employment
Tests performed in the surveillance program	Questionnaire, physical examination, spirometry and chest X-ray	Questionnaire, work history, physical examination, chest X-ray, and measures of lung function	Preplacement examination: Questionnaire, including medical history, smoking habits and allergic history; physical examination Periodic examinations: Questionnaire, including work history, exposure conditions and symptoms; chest X-ray, pulmonary function testing, other tests as necessary	Coal/silica workers: Physical examination, work history, questionnaire, lung function testing, chest X-ray Asbestos workers: Preplacement examination, including physical examination, medical and work history, chest X-ray, spriometry	Medical history, physical examinations, chest X-ray, spirometry	Coal workers: Chest X-ray and spirometry Silica workers: Chest X-ray, pulmonary function testing, questionnaire, physical examination often used Asbestos workers: Medical examination, including medical and occupational history, questionnaire, chest X-ray, pulmonary function testing	Coal workers: Periodic chest X-ray and brief employment history Asbestos workers: Preplacement examination, including medical and work history, physical examination, questionnaire, chest X-ray, spirometry, other tests as necessary; follow-up tests include questionnaire, chest X-ray, spirometry

tem is to address gaps in prevalence data, reporting and surveillance of asbestos-related diseases.

The proposed program is an active case finding of high-risk asbestos industries in the Philippines which is structured to collect baseline on the incidence of asbestos-related diseases. The surveillance program has two components based on the involvement of particular sectors particularly the industry-based surveillance and sentinel health care provider-based or physician-based surveillance. The proposed surveillance system has yet to be implemented due to several limitations.

DISCUSSION

Generally, monitoring and reporting of occupational disease is a challenging process. Work-related injuries are often more easily identified and reported compared to occupational diseases that are usually multifactorial (Kendall, 2005). Numerous occupational diseases caused by work-related exposure can also be caused by non-occupational exposures, and these cannot usually be distinguished on clinical grounds (Kendall, 2005).

This is the reason why currently available information on occupational disease is generally quite poor. Furthermore, surveillance of pneumoconioses is more difficult to screen due to its long latency period and the limited medical knowledge of the health problem from mineral dust exposure.

Review of literature reveals some of the best practices of the screening and surveillance systems for pneumoconioses and other asbestos-related diseases globally. Other developed countries such as the United Kingdom, US, Canada and Germany have legally mandated surveillance system for the reporting of pneumoconiosis (Wagner, 1996). Hence, comprehensive and updated epidemiological data for the said conditions are available in these countries.

Although companies and establishments in the Philippines are required to submit medical reports on occupational disease and injuries as part of Department of Labor and Employment's reportorial requirements, the country still has insufficient data on pneumoconioses and asbestos-related cases due to the low compliance rate of industries involved. Less than 5% of establishments submit their medical reports to the central agency responsible for the database of occupational diseases (Villanueva *et al*, 2014).

Pneumoconioses may not be detected because of the long latency period of the disease (approximately 10 years or more) from the time of exposure to the appearance of the symptoms. The surveillance system may need some way of tracking the individual from one workplace to the other. Other countries such as Australia (New Wales) and Poland include retired workers who were exposed to mineral dusts in the medical surveillance program (Wagner, 1996). However, it is difficult to monitor retired workers with previous exposure in the Philippines due to lack of resources and monitoring mechanism. Generally, workers are lost to follow-up once employment in mineral dust-using industries and establishments has been terminated (Villanueva *et al*, 2004).

Due to lack of general occupational health and safety (OHS) awareness, underrecognition and underreporting among physicians in the Philippines, especially on the adverse health effects of mineral dust exposure and inadequate experience in reading chest X-ray films, are identified. The lack of high index of suspicion among physicians in the Philippines has affected the diagnosis and reporting of pneumoconioses and other asbestos-related diseases among industries involved, as reflected by the limited data collected on morbidity and mortality cases of the said conditions. Considering the alarming numbers of tuberculosis and lung cancer cases in the country, misdiagnosis of pneumoconioses is possible among these cases. A retrospective approach in which data on occupational history of patients diagnosed with tuberculosis and lung cancer can be reviewed.

Since physicians are the front liners of the surveillance system, OHS awareness can be strengthened and can be started during medical training. Training of physicians and technical readers, in coordination with local professional medical organizations, DOH, DOLE and international agencies such as ILO, will improve screening and surveillance of workers exposed to mineral dusts. These trainings can be utilized to raise awareness regarding adverse health effects of exposure to asbestos, silica and coal dust and proper case diagnosis of pneumoco-

nioses and other asbestos-related diseases. Diagnostic capability of radiologists and technical readers using the ILO classification should be strengthened.

An additional issue that may arise during the conduct of the surveillance system is the poor quality of chest radiographs due to differences in X-ray plates and spirometry testing techniques. Standardization of the diagnostic process through accreditation of laboratories and diagnostic centers is suggested to ensure the quality of the diagnostic processes. Multisectoral collaboration in terms of technical, financial and manpower resources to implement the surveillance system is also recommended.

Owing largely to the few studies and surveys done that might make up what can be called prevalence data on asbestos-related diseases from 1992 to 1996 in the Philippines (Diaz, 2009), there is even less or no data collected to assess the economic burden of these diseases. Because there is limited data on the magnitude of the problem caused by pneumoconioses and asbestos-related diseases in the country, policy makers and industries are hesitant to allocate resources for occupational health programs that can address these diseases. Therefore, more epidemiological research, including Key-Informant Interviews (KIIs) on these conditions is recommended to justify the development of programs for these diseases.

Medical surveillance system for pneumoconioses and other asbestos-related diseases remains a challenging process in the Philippines that will benefit from multisectoral collaboration and standardization of approach and techniques. Integration of the proposed medical surveillance system for the said diseases with existing local public health surveillance systems and occupational health and safety policies is suggested to conserve technical and financial resources and to improve compliance rate of the industries involved. To reduce misdiagnosis of pneumoconioses and other asbestos-related diseases, training and evaluation of knowledge and skills of diagnosis among physicians and other technical personnel should be done. Strengthening of occupational health and safety policies will facilitate the development and implementation of the proposed medical surveillance systems for pneumoconioses and asbestos-related diseases.

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REFERENCES

Centers for Disease Control and Prevention (CDC). (Updated 2012 Aug 21). NIOSH workplace safety and health topic: pneumoconioses. Atlanta: CDC, 2011. [Cited 2016 Feb 18]. Available from: http://www.cdc.gov/niosh/topics/pneumoconioses/

Centers for Disease Control and Prevention (CDC). [Updated 2015 Dec 11]. NIOSH program portfolio: surveillance: program description. Atlanta: CDC, 2012. [Cited 2016 Feb 18]. Available from: http://www.cdc.gov/niosh/programs/surv/

Concha-Barrientos M, Nelson DI, Driscoll T, *et al*. Selected occupational risk factor. In: Ezzati M, Lopez AD, Rodgers A, Murray CJL, eds. Comparative quantification of health risks: global and regional burden of diseases attributable to selected major risk factors. Ch 21. Geneva: World Health Organization, 2004: 1651-801.

Department of Energy (DOE). Coal. Manila: DOE, 2015. [Cited 2016 Feb 18]. Available from: http://www.doe.gov.ph/fossil-fuels/coal

Department of Health (DOH). The 2011 Philippine health statistics. Manila: DOH, 2012. [Cited 2016 Feb 18]. Available from: http://www.doh.gov.ph/sites/default/files/publications/PHS2011_edited.pdf

Department of Health–University of the Philippines Manila (DOH-UPM). National asbestos profile of the Philippines. Manila: DOH-UPM, 2013.

Diaz DV. Asbestos-related diseases in the Philippines: the Lung Center of the Philippines Asbestos Screening Program. *Acta Med Philipp* 2009; 43: 64-9.

Finnish Institute of Occupational Health (FIOH). Prevention and management of asbestos-related diseases in Finland. Helsinki: FIOH, 2014: 14 pp.

Furuya, S, Takahashi, K, Movahed, M, Jiang Y. National asbestos profile of Japan. Kitakyashu: UOEH, 2013. [Cited 2016 Feb 18] Available from: http://envepi.med.uoeh-u.ac.jp/NAPJ.pdf

International Agency for Research on Cancer (IARC). GLOBOCAN 2012: estimated cancer incidence, mortality and prevalence worldwide in 2012. Lyon: IARC, 2012. [Cited 2016 Feb 18]. Available from: http://globocan.iarc.fr/Pages/fact_sheets_population.aspx

International Labour Organization (ILO). Pneumoconioses: definition. Geneva: ILO, 2011. [Cited 2016 Feb 18]. Available from: http://www.ilo.org/iloenc/part-i/respiratory-system/item/415-pneumoconioses-definition

International Labour Organization (ILO)-World Health Organization (WHO). Outline for the development of national programmes for elimination of asbestos-related diseases. Geneva: ILO, 2007. [Cited 2016 Feb 18]. Available from: www.who.int/occupational_health/publications/Out_NPEAD_ENG.pdf

Japan National Institute of Occupational Safety and Health (JNIOSH). Hazard evaluation and epidemiology research group. Tokyo: JNIOSH, 2009. [Cited 2016 Feb 18]. Available from: http://www.jniosh.go.jp/en/group/hazard/index.html

Kendall N. International review of methods and systems used to measure and monitor occupational disease and injury. *NOHSAC Tech Rep* 2005: 3.

Lee HE, Kim HR. Occupational respiratory cancer in Korea. *J Korean Med Sci* 2010; 25 (suppl): 94-8.

National Epidemiology Center (NEC). Philippine integrated disease surveillance and response. Manila: NEC, 2013. [Cited 2016 Feb 18]. Available from: http://nec.doh.gov.ph/index.php?option=com_content&view=article&id=24:phil-integrated-disease-surveillance-and-response&Itemid=37

National Institute for Occupational Safety and Health (NIOSH). Silicosis–working with cement roofing tiles: a silica hazard. Atlanta: NIOSH, 2006. [Cited 2016 Feb 18]. Available from: http://www.cdc.gov/niosh/docs/2006-110/

Occupational Safety and Health Administration (OSHA). OSHA fact sheet: overview of OSHA's proposed crystalline silica rule. Washington, DC: OSHA, 2013. [Cited 2016 Feb 18]. Available from: https://www.osha.gov/silica/factsheets/OSHA_FS-3683_Silica_Overview.pdf

Rhee KY,Choe SW. Management system of occupational diseases in Korea: statistics, report and monitoring system. *J Korean Med Sci* 2010; 25 (suppl): 119-26.

Takahashi K, Sekikawa A, LaPorte RE, *et al*. Occupational lung diseases and global occupational health on the Net. *Occup Med-(Lond)* 1998; 48: 3-6..

University of Manchester, Center for Occupational and Environmental Health. Surveillance of work-related and occupational respiratory disease (SWORD). Manchester: University of Manchester, 2010. [Cited 2016 Feb 18]. Available from: http://www.

population-health.manchester.ac.uk/epidemiology/COEH/research/thor/schemes/sword/

Villanueva MBG, Granadillos NG, Cucueco MS, *et al*. Asbestos in the Philippines: country report. Quezon City: Occupational Safety and Health Center, 2014.

Wagner GR. Screening and surveillance of workers exposed to mineral dust. Geneva: WHO, 1996. [Cited 2016 Feb 18]. Available from: http://www.who.int/occupational_health/publications/oehmineraldust.pdf

World Health Organization (WHO). Elimination of asbestos-related diseases. Geneva: WHO; 2006. [Cited 2016 Feb 18]. Available from: http://www.who.int/occupational_health/publications/asbestosrelated-diseases.pdf

World Health Organization (WHO). Philippine tuberculosis profile. Geneva: WHO, 2012. [Cited 2016 Feb 18]. Available from: http://www.wpro.who.int/philippines/areas/communicable_diseases/tb/phil_country_specific_tb_reports.pdf?ua=1

World Health Organization (WHO). Asbestos: elimination of asbestos-related diseases. Fact sheet 343. Geneva: WHO, 2014. [Cited 2016 Feb 18]. Available from: http://www.who.int/mediacentre/factsheets/fs343/en/index.html

World Health Organization. Public health surveillance. Geneva: WHO, 2016. [Cited 2016 Feb 18]. Available from: http://www.who.int/topics/public_health_surveillance/en/