**Screening for Lung Cancer in Asbestos and Other Occupationally-Exposed Cohorts:**

**A Basis for Consideration for Implementation in the Americas**

**Prepared by: University of Maryland WHO Collaborating Center in Occupational Health, Stella E. Hines, MD, MSPH, Tyler Hinshaw, DO**

**Background:**

PAHO Priorities for Occupational Cancer Reduction, including Asbestos-Related Disease

Currently about 125 million people in the world are exposed to asbestos at the workplace. In 2004, asbestos-related lung cancer, mesothelioma and asbestosis from occupational exposures resulted in 107,000 deaths and 1,523,000 Disability Adjusted Life Years (DALYs) (WHO 2020). Asbestos exposure remains a significant exposure risk in the Americas. A 2014 PAHO workshop focused on Establishing National CAREX Programs in Latin American and the Caribbean (LAC) found that asbestos exposure was a significant concern among member nations, with concerns , where asbestos exposure was estimated to affect 1-26 % of workers in Columbia and Peru (PAHO 2014 poster). The 2017 PAHO Third International Workshop for Building Capacity for National CAREX Projects in LAC determined that asbestos exposure was a significant concern among 3 of 8 member nation participants, as well as concerns for occupational cancers in construction workers, who are often exposed to asbestos, among 5 of 8 nations. One of the most lethal health effects related to asbestos exposure is lung cancer. According to the World Health Organization (WHO), lung cancer is the most frequent form of occupational cancer, and occupational exposures account for an estimated 8% of lung cancer (WHO 2009). Cancer is the second cause of death in Latin America and the Caribbean (LAC), and occupational exposures to carcinogens are estimated to contribute approximately to 15-32% of this burden (PAHO/WHO CAREX 2017 Report).

In August 2019, PAHO Collaborating Centers in Occupation Health met in Washington D.C. During meetings focused on strategies to eliminate silica-related disease and in greater assessing the burden of occupational cancers in the Americas, an emerging body of literature focused on utility of lung cancer screening using low-dose chest CT (LDCT) in occupationally-exposed cohorts was discussed. Participants wanted to learn more about current strategies and to consider whether these might be feasible options in their member nations.

The PAHO Strategic Plan of Action on Worker Health 2015-2025 includes the following Strategic Lines of Action to guide actions related to prevention of occupational cancers:

* Strategic Line of Action 2: Identify, evaluate, prevent, and control hazardous conditions and exposures in the workplace
	+ 2.3 Advance with programs to prevent occupational diseases, in particular those related to asbestos, silica, carcinogenic agents, ergonomic stressors, and psychosocial risks

Rationale for Occupational Lung Cancer Screening

In 2018, there were an estimated 9.6 million deaths from cancer worldwide of which 1.76 million deaths were from lung cancer. Similarly, in 2018 lung cancer was one of the most common cancers globally at 2.09 million cases (WHO 2018). Similarly, lung cancer is common in the US. In the US, the second most common cancer for men and women is lung cancer. In 2020, there were 116,300 lung cancer cases in men along with 112,520 lung cancer cases in women. Further, there were 72,500 lung cancer deaths in men and 63,220 lung cancer deaths in women in the US in 2020 (ACS 2020). Screening is important because it allows for detection of lung cancer at an early stage while a patient may still be asymptomatic (Ollier, Chamoux et al. 2014).

Asbestos exposure is associated with an increased risk of lung cancer. Smoking and asbestos exposure further increases the risk of lung cancer. Asbestos exposure is also associated with the development of mesothelioma along with cancer of the larynx, pharynx, stomach, colon, rectum, and ovaries (ACS 2020). Asbestos exposure can also lead to scarring in the lung called asbestosis resulting in declining lung function (OSHA). With the harmful effects of asbestos known, many countries have medical surveillance programs for workers who may be potentially exposed. In the US, OSHA has a medical surveillance program for asbestos exposed workers. The OSHA program includes a baseline medical exam to include a chest x-ray and pulmonary function test prior to working in asbestos exposed work areas. The OSHA program further requires an annual exam with periodic chest x-rays to be read by a B-reader based on years since first exposure to asbestos and age of employee. Finally, the OSHA programs includes a termination medical exam once a worker finishes employment (OSHA). The US EPA also is involved in worker protection from asbestos exposure by allowing for state and local employees to be covered by the OSHA standards for asbestos (EPA). Similarly, asbestos exposed workers in Canada per jurisdiction may also have required medical monitoring to include medical exams, baseline/periodic chest x-rays, and pulmonary function tests (CCOHS 2015 ). Globally, the WHO has a similar interest in worker protection from asbestos and provide some guidance on how countries can set up programs to reduce disease related to asbestos (WHO 2007 ) . Thus, there is precedent for using diagnostic modalities to evaluate for asbestos-related lung disease more broadly.

Prior screening methods for lung cancer have been attempted such as with CXR with or without sputum cytology. Multiple randomized control trials with CXR screening with or without sputum cytology have been performed and were not found to significantly reduce lung cancer mortality or all-cause mortality (Usman Ali, Miller et al. 2016).

With advancement in technology, LDCT has become more available for screening purposes. LDCT has subsequently been found to reduce mortality by 20% in heavy smokers through early lung cancer detection (Ollier, Chamoux et al. 2014). It is important, though, to screen a high-risk population using age and tobacco use. Traditionally, key risk factors of increased age and tobacco use have been incorporated into eligibility for screening. The largest lung cancer screening trials include the National Lung Screening Trial (NLST) in the US (Tammemagi, Katki et al. 2013), PanCan study in Canada (Tammemagi, Schmidt et al. 2017), ITALUNG in Italy (Sverzellati, Silva et al. 2016), DANTE in Germany (Infante, Lutman et al. 2008), and NELSON in the Netherlands (Yousaf-Khan, van der Aalst et al. 2017). Other risk factors such as occupation may need to be accounted for as well in lung cancer screening programs (Brims, Kong et al. 2020).

An increasing number of studies have incorporated occupational risk for lung cancer, including asbestos exposure, as inclusion criteria for lung cancer screening. Notably, prevalence for lung cancer or nodules suspicious for being cancerous in these populations appear similar to that detected only based on advanced age and significant tobacco smoke exposure. In order to inform guidance on whether lung cancer screening incorporating LDCT could be incorporated to evaluate populations with high asbestos exposure, existing literature has been summarized and compared below.

**TABLE: Summary of Publications on Lung Cancer Screening via Low Dose Chest CT (LDCT) Scanning in Asbestos-Exposed Cohorts**

[**https://drive.google.com/drive/folders/1A8Nd4xGtgPXZmfWNr8HOsR-yy1abJ4eX?usp=sharing**](https://drive.google.com/drive/folders/1A8Nd4xGtgPXZmfWNr8HOsR-yy1abJ4eX?usp=sharing)

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| **Reference** | **Setting** | **Asbestos Exposure** | **Smoking****Exposure** | **Average Latency Between Exposure and Imaging** | **Prevalence of Suspicious Nodules/Lung Cancer** | **Mortality Impact** |
| Ollier (2014) | Meta-analysis of seven studies concerning CT screening and asbestos exposed worker | Average of 17-30 years | Varied from 20-97% current smokers across studies | 20-50 years | Lung cancer prevalence of 1.1% | Likely similar to NLST, given similar prevalence |
| Markowitz (2018) | US, Retired DOE nuclear site workers | Used Standard Occupational Codes (SOC) to determine prior exposure at job. CXR showing asbestos-related disease. | Current/former smokers mean 29 pack-years. 20.4% current smokers and 75% had quit 15 years prior at least | About 30-60 years | 0.83% prevalence of lung cancer at baseline screening | Similar prevalence to NLST for subpopulation of participants that met same screening criteria |
| Welch (2019) | US, Retired DOE constructions workers | Average of 12 years at DOE site. Average overall construction work 26 years. | 36 pack years average. 72.6% past smoker and 24.6% current smoker | Average of 30-50 years | 1.6% prevalence of lung cancer at baseline screening.Suspicious nodules baseline 5.9%.Indeterminate nodules baseline 11.9%. | Likely similar to NLST, given similar prevalence |
| Loewen (2019) | Libby amphibole asbestos exposed workers and residents of mining area | Average of 20-60 years | 30% current smokers70% former smoker42 mean pack years | 20-50 years | Lung cancer prevalence of 1.9% | Likely similar to NLST, given similar prevalence |
| Brims (2020) | Australia, two cohorts. Cohort 1: Ex-miners and ex-residents of crocidolite asbestos mining areaCohort 2: Construction and manufacturing industry workers, mixed asbestos type exposures | Cohort 1:Avg of 15.5 fibers per milliliter-yearcumulative exposureCohort 2:Avg of 2.9 fibers per milliliter-yearcumulative exposure | Cohort 1:70% ever smokers, avg pack years 37.5Cohort 2:73% ever smokers, avg pack years 28.1 | Cohort 1:Average of 41 yearsCohort 2:Average of 50 years | Cohort 1:Prevalence of:Pleural plaque 20%Asbestosis 27%Lung cancer 5.5%Cohort 2:Prevalence of:Pleural plaque 45%Asbestosis 38%Lung cancer 3.7% | Increased lung cancer risk with greater cumulative exposure to both asbestos and cigarettes |

**Summary**

These results support lung cancer screening using LDCT as a viable method to improve detection of lung cancer in asbestos and other occupationally-exposed populations. **With accurate exposure assessment**, cancer detection yield can occur at rates **at least as high** as that occurring in populations with high tobacco exposure risk, without accounting for occupation risk.

A Key Indicators proposed by the PAHO Plan of Action on Worker Health 2015-2025 is documentation of:

* 2.3.3 Number of countries implementing asbestos related disease prevention programs.

Additionally, 2019 priorities for activities of PAHO LAC contributors to the CAREX initiative included efforts to “Promote prevention programs to reduce the burden of occupational cancer in Latin America and Caribbean countries (PAHO July 2019 Meeting Report).”

With increasing availability of CT scanners, use of LDCT may be considered a useful tool for screening of asbestos and other occupationally-exposed workers in the Americas for lung cancer. By doing so, the burden from mortality and morbidity from occupational cancers in LAC countries may be reduced.

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