

REPORT OF PROJECT DESIGN AND PRELIMINARY FINDINGS TO THE TEXAS DEPARTMENT OF STATE HEALTH SERVICES

PARKLAND HEALTH & HOSPITAL SYSTEM
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BACKGROUND

The WR Grace/Texas Vermiculite plant operated from 1953-1992, at the corner of West Commerce Street and Manila Road in Dallas, Texas. The plant processed vermiculite, a mineral containing asbestos, into a variety of products, including fire retardant and insulation materials. Ambient air testing performed by the US Occupational Safety and Health Administration as far back as the mid-1970's showed that plant operations put airborne asbestos fibers into the air. Although the plant was able to lower asbestos particulate counts to levels which were within the legal limits through several rounds of tightening regulations, it eventually closed down. The plant was dismantled sometime during 2001 or 2002, under heightened safety regulations reflecting the amount of risk from asbestos fibers at the site. The plant was located less than a mile from the RSR lead smelter, which became a Superfund cleanup site and a notorious local and regional public health concern.

During its years in operation WR Grace/Texas Vermiculite had had several hundred employees. Nearby structures included other light industrial and warehouse facilities, several blocks of residences, and, less than ¼ mile away, Thomas Edison Middle School. A little over ¼ mile away was the southern edge of the sprawling Dallas Housing Authority apartments, now demolished. L.G. Pinkston High School was about ½ mile from the site. Both schools are still in use.

The vermiculite the plant used was mined at the Libby, Montana mine. The Libby mine (at one time also owned by WR Grace) sold vermiculite to over 200 manufacturers in the United States. Increasing health concerns gradually shut down operations at the Libby mine and at many of its customers. The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) is currently conducting a National Asbestos Exposure Review (NAER), including an extensive investigation into the health impacts of the Libby mine on local citizens. The study of Libby mine/plant workers, their families, and the people of the town of Libby, Montana, revealed evidence of asbestos-related disease, primarily among mine or processing plant workers. Of 6,668 people in the Libby site study, 18% had scarring of the lining of the lungs (pleural or parenchymal changes) on x-ray. Former mine or plant employees were at higher risk of pleural or parenchymal changes, and also of having severely restricted lung function (5.5%)¹. A study of plant employees from a Marysville, Ohio, plant which received vermiculite from the Libby mine found that 26%

of plant employees had chest wall scarring (pleural plaques) typically associated with asbestos exposure².

As part of its National Asbestos Exposure Review, the ATSDR issued a health consultation report on the Former W.R. Grace & Company/Texas Vermiculite Site in Dallas on Sept. 22, 2005.³ This report alerted the public that certain categories of people may have been put at risk of asbestos-related disease by the plant when it was in operation. The report stated that those at risk included former workers at the plant, their family members, any children who played on or around the piles of waste rock and anyone who received or worked with waste rock. The report also stated that people who lived “within a few blocks” of the site could also possibly have been at risk.

In response to this report, State Senator Royce West, and State Representatives Rafael Anchia and Terri Hodge held a series of town hall meetings in West Dallas during 2005-6 to alert people in the area about the report, and to ask the public how they would like to see government agencies respond. The elected officials then worked with the Texas Department of State Health Services to secure grant funding, and asked Parkland Health & Hospital System to organize an effort to get people examined for the health effects of asbestos exposure and referred for treatment.

EXPOSURE PATHWAYS, ELIGIBILITY CRITERIA, AND DISEASE RISKS FROM ASBESTOS

This project was designed to examine individuals for asbestos-related lung diseases. Those invited to join the project included former workers and family members, and residents who lived near a vermiculite plant in West Dallas (2651 Manila Road, Dallas, TX). This project was conducted by Parkland Health and Hospital System (PHHS) in association with The University of Texas Health Sciences Center at Tyler (UTHCT).

The ATSDR’s health consultation report identified three exposure pathways by which people could have been exposed to Libby vermiculite contaminated with asbestos. These pathways were:

1. Occupational: Former workers who worked in the facility from 1953-1992
2. Household Contact: Family members of the former workers
3. Community: Community members who lived near the plant (inhaling asbestos fibers from plant emissions, while playing in (children) or disturbing piles of contaminated vermiculite/ waste rock, while using this waste material at home for gardening, driveways or fill materials)

Though the plant ceased operation in 1992 and the buildings were demolished at some time during 2001 and 2002, multiple potential pathways of environmental exposure may have been ongoing. In its clinical screening guidelines for asbestos-related lung disease, ATSDR recommends screening workers who had been involved in manufacturing or using asbestos containing products or had direct contact with asbestos containing waste or dust emissions, as well as people living in the vicinity of asbestos related industries such as the vermiculite processing plant or who had direct contact with asbestos-containing waste or dust emissions.⁴

In accordance with these guidelines and recommendations, eligibility criteria were developed to invite subjects to enroll in this screening project. Specifically, these criteria included subjects who, between 1953 and 1992, had either:

- worked at WR Grace/Texas Vermiculite Plant
- lived in the household of someone who worked in the plant
- lived, worked or went to school within 1/2 mile of the Texas Vermiculite Plant or
- attended Thomas Edison Middle School or LG Pinkston High School.

Inhalation is the primary route of entry for asbestos fibers. The non-malignant processes affecting the lungs from asbestos exposure are largely fibrotic. Asbestosis is a pneumoconiosis characterized as diffuse interstitial fibrosis of the lungs caused by the inhalation of asbestos fibers. All fiber types are considered to be fibrogenic although there may be some differences in potency. The most common non-malignant pleural changes are lesions referred to as pleural plaques. These are discrete areas of collagen deposited on the pleural surface. Diffuse thickening and fibrosis of the pleura may also occur, as can benign pleural effusions and rounded areas of atelectasis.⁵

It is now well accepted that asbestos can lead to increased risk of lung cancer and pleural mesothelioma.⁶ Bronchogenic malignancies are the most common asbestos related cause of death among exposed workers.⁷ Malignant mesothelioma is an uncommon cancer that typically involves the pleura and less frequently occurs in the peritoneum or in other locations such as the pericardium and tunica vaginalis. Mesothelioma is most often associated with exposure to amphibole forms of asbestos, but may occur after chrysotile exposure. Mesothelioma risk increases even with low-level exposure.⁸

As the development of asbestosis is based on an exposure-response relationship, an exposure history with focus on environmental and occupational exposures is an important part of evaluation for asbestos related health problems. Using the International Labor Organization (ILO) classification, the chest x-ray is the traditional screening modality for asbestosis and in a study, chest x-rays demonstrated interstitial findings in approximately 80% of persons with asbestosis.⁹

DESIGN OF THE SCREENING PROJECT

This community project was designed to include a two step process to best utilize the available resources on behalf of the maximum number of participants. The first step was administration of a brief survey questionnaire, primarily focused on the individual's exposure and smoking history, and a chest radiograph (two views, posterioranterior and lateral, digital radiography). It was determined that available resources would permit chest radiographs for about 400 persons. Based upon the eligibility criteria, the target population was invited to register for this first tier examination. Those who had chest radiograph findings consistent with asbestos related disease underwent additional testing, which consisted of a detailed exposure history, other pertinent medical history, a targeted physical examination (using best evidence), and a pulmonary function test (spirometry).

In the first wave of recruitment, more than 600 letters were mailed out by PHHS to invite the eligible subjects to register for the first tier of screening. About 70 eligible

individuals came for registration and of these 70 registered subjects, about 58 persons came for chest radiographs (25 persons had chest radiographs done on July 07/08, 2007 and 33 persons had chest radiographs done on July 14/15, 2007). As a limited number of participants registered during the first wave of screening, another invitation was “sent” to the target audience using a media press release issued by PHHS. Subsequently, another wave of first tier screening was done on July 21/22, 2007. In total, 378 subjects had chest radiographs done during the first tier screening of this project and a waiting list of about 400 subjects was developed by PHHS for those subjects who were unable to get the first tier screening done during this initial project timeframe.

These 378 chest radiographs done at PHHS facilities were transported to UTHCT in the format of digital images in a secure fashion. These chest radiographs were read and interpreted by Dr. David Finlay, M.D., Professor and Chair of Radiology at UTHCT and a NIOSH certified B-reader. A chest x-ray report was generated for each set of radiographs and an ILO (International Labor Organization) form for classification for pneumoconiosis was completed for each set/ individual. Each of these 378 reports and ILO forms were individually reviewed by Dr. David Coultas, M.D., Professor and Chair, Dept. of Medicine, Dr. Jeffrey Levin, M.D., M.S.P.H., Professor and Chair, Dept. of Occupational Health Sciences and Dr. Amanpreet Dhillon, M.D., M.S., Assistant Professor, Dept. of Occupational Health Sciences at UTHCT. Radiographs with reports suggestive of a potential asbestos related exposure or other significant findings of note were reviewed. A summary letter, addressed to Dr. Susan Spalding, Principal Investigator at PHHS, was generated based upon the review of these chest radiograph reports and ILO forms, and the findings were classified into one or more of four general categories (as outlined below) and specific recommendations were also made for the further evaluation, treatment and/or follow-up for the suspected normal/ abnormal findings.

Classification Categories:

1. Normal/unremarkable for asbestos disease. Recommended that the subject should continue to undergo periodic x-ray surveillance with his/ her personal physician.
2. Abnormal for findings suggestive of asbestos exposure. Recommended that the subject should make an appointment with the Parkland Health and Hospital System for a follow-up evaluation, i.e., second tier screening.
3. Abnormal showing a possible nodule/suspected malignancy. Recommended that the subject should see his/her personal physician concerning these x-ray findings as soon as possible and to rule out suspected malignancy. When the nodule has been diagnosed and treated as necessary, the subject should contact the Parkland Health and Hospital System to determine if a follow-up evaluation is necessary.
4. Abnormal showing findings consistent with other acute/ chronic lung disease/s, incidental findings or other disease processes. Recommended that the subject should see his/ her personal physician concerning these abnormal findings as soon as possible or in the near future based upon the severity of findings.

PRELIMINARY FINDINGS OF FIRST TIER EXAMINATION

Table 1 shows the number of subjects in each category and percentage of total subjects for each category. Of note, the three abnormal categories are not mutually exclusive as some subjects had radiographic findings, which fell into more than one abnormal category (e.g., chest radiographic findings consistent with asbestos exposure as well as a possible nodule or a possible nodule and other lung abnormalities, etc.). PHHS informed the subjects of the results of the first tier examination, generally on the basis of these recommendations.

Of the 19 individuals who had chest radiographic findings suspicious for a possible nodule and/or suspected malignancy, 3 were current smokers, 10 were ex-smokers who do not smoke currently, 2 had second hand passive smoke exposure, 3 had never smoked and the smoking history was unknown for one individual. These individuals were advised to seek medical care as soon as possible for further workup to rule out malignancy.

Table 1: Findings for first tier chest radiographs

Category	Number of subjects	Percent of total
Total chest radiographs done	386	100 %
Normal chest radiographs	227	58.8 %
Chest radiographic findings consistent with asbestos related disease (pleural and/or parenchymal changes)	20	5.2 %
Chest radiographic findings consistent with a possible nodule/suspected malignancy	20	5.2 %
Abnormal chest radiographic findings suspicious for other acute/chronic lung diseases, incidental findings or other disease processes*	143	37.0 %

*Some examples of abnormal findings include granulomas, abnormalities of the spine, left ventricular hypertrophy, tracheal/mediastinal displacement of unknown cause, possible emphysema and possible subsegmental atelectasis.

Table 2 shows the summary of pleural or parenchymal changes consistent with asbestosis on chest radiograph, by exposure categories.

Table 2: Odds of Pleural or Parenchymal Changes on Chest X-ray, by Exposure

Exposure	Cases (Pleural or Parenchymal Changes on CXR) of Total in Group	Libby, MT prevalence rate (NAER)	Chi-squared test and p value	Mantel-Haenszel Odds Ratio and 95% CI
Former WR Grace/TX Vermiculite Employee	4 of 22 (18.2%)	51%	8.06 (0.005)	4.85 (1.47, 15.99)
Not a former employee	16 of 365 (4.4%)	6.7%		
Family Member of WR Grace/TX Vermiculite Employee	3 of 74 (4.1%)		0.23 (0.630)	0.74 (0.21, 2.58)
Not a family member	17 of 313 (5.4%)			
Attended Thomas Edison Middle School ¹	1 of 41 (2.4%)		0.35 (0.56)	0.49 (0.04, 5.60)
Did not attend	2 of 41 (4.9%)			
All participants	20 of 387 (5.2%)			

¹History of middle school attendance was not available on all subjects

Nineteen participants were found to have possible nodules on chest x-ray, which the radiologist considered suspicious for malignancy. Because chest x-ray and the other diagnostic tests performed in this project are not sufficient to definitively diagnose cancer, as of this writing we do not know the cancer diagnosis status of most project participants. Two of these 19 project participants with nodules on chest x-ray had already been diagnosed with lung cancer prior to joining this project (one of which has a history of recent mastectomy), and another was being followed for suspicious nodules on chest CT without plans for a biopsy for confirmation. A mail survey is currently underway to follow up with those individuals whose chest x-rays were suggestive of lung cancer.

Smoking status was available on 320 participants. Smoking is thought to interact with asbestos exposure to increase the risk of lung cancer above that of either risk factor in isolation. Linear regression procedures that regressed nodules on chest x-ray as the dependent variable, against various combinations of plant employment, being a family member of a plant employee, years smoked and years living with a smoker did not yield a statistically significant model. For all of the analyses regarding apparent nodules, it is possible that the number of cases is too small to detect a significant difference. Table 3 shows the summary of findings of nodules consistent with lung cancer on chest radiograph, by exposure categories.

Table 3: Odds of Apparent Nodules on Chest X-ray, by Exposure

Exposure	Cases (Apparent Nodules on CXR)	Chi-squared test and p value	Mantel-Haenszel Odds Ratio and 95% CI
Former WR Grace/TX Vermiculite Employee	2 of 22 (9.1%)	0.726 (0.394)	1.92 (0.42, 8.87)
Not a former employee	18 of 364 (4.9%)		
Family Member of WR Grace/TX Vermiculite Employee	3 of 74 (4.1%)	0.237 (0.627)	0.73 (0.21, 2.57)
Not a family member	17 of 312 (5.4%)		
Attended Thomas Edison Middle School ¹	3 of 41 (7.3%)	0.213 (0.644)	1.54 (0.24, 9.73)
Did not attend	2 of 41 (4.9%)		
Ever smoked in lifetime ²	13 of 175 (7.4%)	4.162 (0.041)	3.11 (0.99, 9.74)
Never smoked in lifetime	4 of 159 (2.5%)		
Current smoker ²	5 of 74 (6.8%)	0.185 (0.667)	1.26 (0.44, 3.61)
Not a current smoker	14 of 275 (4.6%)		
All participants	20 of 387 (5.0%)		

¹History of middle school attendance was not available on all subjects

²Smoking status was not available on all participants

A cancer cluster study by the Texas Cancer Registry, using data from 1995-2002, found that the Standardized Incidence Ratio for lung cancer in both females and males in this ZIP code (75212) narrowly missed being statistically significantly elevated, compared with a race- and age-matched Texas control population¹⁰. Table 4 shows the results of that cluster investigation.

Table 4. Number of Observed and Expected Cancer Cases and Race Adjusted Standardized Incidence Ratios, Selected Cancers, Zip Code 75212, Dallas, TX, 1995–2002¹¹

Males				
Site	Observed	Expected	SIR ¹	99% CI ²
Lung and Bronchus	75	54.0	1.4	1.0 – 1.9
Brain/CNS	6	4.7	1.3	0.3 – 3.3

Females				
Site	Observed	Expected	SIR ¹	99% CI ²
Lung and Bronchus	48	33.1	1.5	1.0 – 2.1
Brain/CNS	4	4.1	1.0	0.2 – 3.1

¹The SIR (standardized incidence ratio) is defined as the number of observed cases divided by the number of expected cases. The latter is based on race-, sex-, and age-specific cancer incidence rates for Texas during the period 1995–2004. The SIR has been rounded to the first decimal place.

²A significance level of $p < 0.01$ is the standard for significance testing in the cancer cluster investigation literature.

No cases of mesothelioma were detected among the patients evaluated in this project. The Texas Cancer Registry reports one fatal mesothelioma case in this ZIP code in the past few years. According to plant employee information supplied by the ATSDR this was a WR Grace/Texas Vermiculite employee.

FINDINGS OF SECOND TIER TESTING

The 19 individuals who had chest radiographic findings of pleural or parenchymal changes were invited for the second tier examination. As outlined earlier, the second tier examination was primarily comprised of a detailed exposure, occupational and other pertinent medical history, a targeted physical examination and pulmonary function tests (spirometry). Pulmonary function tests generally show restrictive patterns in subjects with asbestos related disease¹², even though obstructive patterns can also occur in asbestosis, especially with concomitant cigarette smoke exposure.

Of the 19 subjects who were invited to receive second tier testing, 16 came for follow-up and completed a detailed history questionnaire (with assistance of a trained health care worker), underwent a physical exam by a health care provider and had pulmonary function tests performed at PHHS. The physical examination was focused on the pulmonary and cardiovascular systems. This information was entered into a computer database by PHHS personnel and sent in this format to UTHCT. This information was reviewed by the UTHCT physicians for each of these 16 subjects, including the interpretation of spirometry results. The three individuals who were unable to come for second tier screening within the project timeframe are in the process of making alternate arrangements to get further work up, primarily through PHHS. The results of this second tier testing are shown in tables 5 and 6.

As shown in table 6, the individuals with interstitial abnormalities on their chest radiographs had a profusion score of at least 1/0 or more. American Thoracic Society's updated 2004 criteria for diagnosis and initial management of nonmalignant diseases related to asbestos uses a profusion of irregular opacities at the level of 1/0 as the boundary between normal and abnormal in the evaluation of the chest radiograph film.¹³

Table 5: Demographic Information for Participants in Second Tier Testing.

IDN	Age	Sex	Race ¹	WR Grace Employee	Employee Family ²	WR Grace Community ³	Other Occ. Exp. ⁴	First Exp. ⁵	Smoking History ⁶
1	54	F	AA	N	N	Y	N	1953	U
2	54	M	AA	N	N	Y	Y	U	N
3	52	M	AA	N	N	Y	N	1959	C
4	50	F	AA	N	N	Y	N	1957	C
5	63	F	H	N	N	Y	N	1965	E
6	69	M	C	Y	N	Y	N	1955	E
7	71	M	AA	N	N	Y	N	1969	E
8	52	M	AA	N	N	Y	N	1975	C
9	63	M	AA	N	N	Y	Y	1960	N
10	53	M	H	N	N	Y	N	1965	E
11	54	F	AA	N	N	Y	N	U	N
12	45	M	C	Y	Y	Y	N	1978	C
13	53	M	H	Y	N	Y	N	1977	E
14	66	M	H	Y	N	Y	N	1971	N
15	77	M	H	N	N	Y	N	1962	U
16	46	F	AA	N	N	Y	N	U	E

¹Race: AA=African American; H: Hispanic; C: Caucasian.

²Employee Family: Family members of former workers.

³WR Grace Community: lived/ worked/ or went to school within 1/2 mile of the Dallas Vermiculite Plant or attended Thomas Edison Middle School or LG Pinkston High School.

⁴Other Occ. Exp.: Occupational exposure to asbestos at sites other than WR Grace plant.

⁵First Exposure: The approximate year when exposure to asbestos started; U=Unknown year of first exposure.

⁶Smoking History: C: Current smoker; N: Never Smoked; E: Ex-smoker; U: Smoking History is unknown.

Table 6: Second Tier Testing Participants: Radiographic, Physical Examination and Spirometric findings

IDN	Par. Abn. ¹	Prof. Score ²	Small Opacity Pri./Sec. ³	Pleural Abn. ⁴	Lower Lung Inv. ⁵	Nodule/ Mass on CXR ⁶	Rales ⁷	Clubbing ⁸	Spiro. Pattern ⁹	Comments
1	Y	2/3	t/t	N	Y	Y	N	N	M	Possible other causes of Chest X-ray Findings: History of Sarcoidosis
2	N	N/A	N/A	Y	N/A	N	N	N	R	
3	Y	2/1	t/t	Y	Y	Y	N	N	R	
4	Y	1/2	t/t	Y	Y	N	N	N	M	
5	Y	1/1	s/t	Y	Y	N	N	N	R	
6	Y	1/0	s/t	Y	Y	Y	Y	N	R	
7	Y	1/2	s/t	N	Y	N	N	Y	N	
8	N	N/A	N/A	Y	N/A	Y	N	N	R	
9	Y	1/2	s/t	N	Y	Y	N	N	R	
10	N	N/A	N/A	Y	N/A	N	N	N	N	
11	Y	2/2	t/q	N	Y	N	N	N	R	Possible other causes of Chest X-ray Findings: History of Sarcoidosis
12	Y	1/1	s/t	Y	Y	Y	Y	N	N	
13	Y	1/0	s/s	Y	Y	N	N	N	O	
14	Y	1/0	s/t	Y	Y	N	N	N	N	
15	Y	3/3	t/u	Y	Y	N	N	N	R	
16	Y	2/1	s/t	N	Y	Y	N	N	R	

¹Par. Abn.: Parenchymal abnormalities noticed on the chest radiograph and as noted on the ILO form by the B-reader.

²Prof. Score: Profusion Score Category for the small parenchymal opacities as noted on the ILO form by the B-reader; N=No parenchymal abnormalities noted.

³Shape and Size of primary/secondary parenchymal opacities as noted on the ILO form by the B-reader.

⁴Pleural Abnormalities noted on the chest radiograph as noted on the ILO form by the B-reader.

⁵Parenchymal abnormalities involving the lower lung fields as noted on the ILO form by the B-reader.

⁶Possible Nodule or Mass noted on the chest radiograph.

⁷Rales/Crackles noticed on the individual's physical examination of the chest/ lungs.

⁸Clubbing noticed on the individual's physical examination of the extremities.

⁹Pattern seen on the spirometry test and interpreted by the pulmonologist: O=Obstructive; R=Restrictive; M=Mixed; N=Normal.

Eleven of 16 participants evaluated by pulmonary function test were found to have an abnormal breathing pattern characterized as either Restrictive or Mixed (Restrictive plus Obstructive). Of the four former WR Grace/Texas Vermiculite employees who attended the second tier examination, one had a Restrictive breathing pattern, one had an obstructive breathing pattern and two had a normal breathing pattern.

DISCUSSION

In the present project the rate of WR Grace/Texas Vermiculite employees with pleural or parenchymal changes on x-ray (18.2%) was statistically significantly higher than the rate among non-employees. The rate of pleural or parenchymal changes in employees was lower than those found in similar populations in the Libby, Montana (51%) and Marysville, Ohio (26%) projects. Like the NAER study of Libby, Montana, we also found the highest prevalence rates among plant employees, and prevalence rates of pleural or parenchymal changes in the community that were only slightly higher than national population estimates. Neither of the other risk factors (family member of a plant

employee, attended Thomas Edison Middle School) was significantly associated with pleural or parenchymal changes on chest x-ray. Evaluation of the participants found to have nodules suggestive of lung cancer on x-ray did not reveal any apparent association with employment at WR Grace/Texas Vermiculite, being a family member or attending Edison Middle School or smoking status, although the number of cases available may not have been sufficient to detect significance in the population. Pulmonary function testing showed that the majority of patients with pleural or parenchymal changes who came to the second tier examination had a Restrictive or Mixed breathing pattern, while only four had a normal breathing pattern.

Future community surveillance work in this population should focus first on the remaining WR Grace/Texas Vermiculite employees who were not part of the present project. This is the segment of the population who are most at risk of pleural or parenchymal changes and breathing difficulties. A second issue of concern in this population is the incidence of lung cancer as reported by the Texas Cancer Registry. While this project did not reveal any link between lung cancer and asbestos exposure in this population, further study is warranted.

Conducting more diagnostic workups including chest x-rays for members of high risk groups in this population could serve multiple purposes: checking for pleural or parenchymal changes from asbestos, detecting early-stage lung cancer, and elucidating the possible risk factors for lung cancer in this population. With the press coverage that the present project received, we now have a list of over 400 people who would be interested in receiving a diagnostic workup and chest x-ray because of perceived asbestos exposure. Several of these are former WR Grace/Texas Vermiculite employees.

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