HETA 97-0048-2641
Cowlitz County Health Department
Longview, Washington

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PREFACE

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Dr. Yvonne Boudreau of the Hazard Evaluations and Technical Assistance Branch, Division of Surveillance, Hazard Evaluations and Field Studies, Denver Field Office, Denver, Colorado, and by Dr. John Perkner, DO, occupational medicine resident at the National Jewish Center for Immunology and Respiratory Medicine, Denver, Colorado. Desktop publishing by Pat Lovell.

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Health Hazard Evaluation Report 97-0048-2641
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SUMMARY

In November 1996, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Service Employees International Union for a Health Hazard Evaluation at the Cowlitz County Health Department in Longview, Washington. The request was for assistance in investigating employee concerns about adverse health effects possibly related to exposures to toxins and molds. The health concerns included upper respiratory problems, muscle and joint aches, and skin rashes. The building that was the source of these concerns was the site of investigations by health officials in the Cowlitz County area, and was found to be contaminated with mold and fungi, including *Stachybotrys*, *Aspergillus*, and *Penicillium*. These findings, coupled with the employee health concerns, led to the closure of this building prior to the request for a NIOSH investigation.

In response to the request, NIOSH personnel visited Longview to meet with local representatives on February 12, 1997, and returned to conduct private medical interviews and administer a symptom questionnaire on March 26 and 27, 1997. Thirty-seven (76%) of the 49 current and former employees participated in the interview and responded to the symptom questionnaire. There was a statistically significant decreased prevalence in nearly all symptoms after the building was closed.

Fungi such as *Aspergillus* and *Penicillium* are ubiquitous in the environment. *Stachybotrys* is somewhat less common. Fungi in office buildings may be associated with certain employee health concerns, including allergy symptoms, asthma, or hypersensitivity pneumonitis. Mycotoxins, which are chemicals produced by certain fungi, can cause severe illness in high enough doses, but it is unlikely that such exposures would occur in office buildings. Even where illness has been attributed to *Stachybotrys* exposure in homes or workplaces, removal from exposure usually resulted in recovery. Therefore, whatever the cause of Cowlitz County Health Department employees' health problems while they occupied their former offices, it is unlikely that *persistent* symptoms are related to exposures in the former building. Recommendations are offered at the end of this report to address employee health concerns.

Keywords: SIC Code 9431 (Administration of Public Health Programs), molds, fungi, *Stachybotrys*, indoor environmental quality, mycotoxins.

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INTRODUCTION

In November 1996, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Service Employees International Union (SEIU) for a health hazard evaluation (HHE) of the former Cowlitz County Health Department Building (CCHDB) in Longview, Washington. The HHE requesters expressed concern over employees' reports of adverse health effects (including upper respiratory problems, aches and pains in joints and muscles, and skin rashes) possibly related to exposures to toxins and molds in the CCHDB. In response, NIOSH personnel conducted a site visit at the CCHDB on February 12, 1997, and returned to conduct private medical interviews with and administer a symptom questionnaire to CCHDB employees on March 26 and 27, 1997.

BACKGROUND

Since the early 1990's, Cowlitz County Health Department (CCHD) employees have voiced concerns about possible adverse health effects from poor indoor air quality in the CCHDB. CCHD management responded by hiring various consultants to evaluate the building environment, but early reports did not show elevated levels of contaminants.

In response to continued complaints from employees, an informal inspection of the CCHDB was performed by the Washington State Department of Health (WSDOH) in August 1996. Sampling from this inspection revealed the presence of *Stachybotrys* species (most probably *chartarum* [*atra*]) on an interior wall. *Penicillium* and *Aspergillus* species were also identified. The report of this investigation recommended that the building occupants that were exhibiting mold-related symptoms be moved away from known areas of contamination. The report also recommended modifications to the heating, ventilation and air conditioning (HVAC) system and suggested methods to control moisture incursion and prevent potential exposure to toxigenic fungi. In response to this report, representatives of the SEIU, Local 49, served an "Unsafe Condition Notification" to CCHD administrators on October 15, 1996. Three days later, the CCHDB was evacuated, and all employees were moved to temporary space at the Cowlitz County fairgrounds.

After evacuation of the CCHDB, CCHD representatives hired industrial hygiene consultants to perform a microbiological assessment of the CCHDB and to evaluate the building's HVAC system. This investigation was performed on October 23, 1996. Air samples revealed elevated levels (relative to outdoor levels) of bacteria identified as gram-positive cocci and determined not to be *Staphylococcus aureas*. Bulk sampling of suspect contaminated surfaces and materials revealed higher than outdoor levels of aerobic bacteria, yeasts, and molds at several locations. Airborne yeast and mold counts were not elevated relative to the outdoor levels. A robotic video inspection survey revealed numerous problems with the HVAC system, including the presence of a sewer line in the ducting, extensive dirt and debris, indications of moisture, defects in filters, and several mechanical defects. The consultants concluded that, "It might be to the County's advantage to simply sell or demo the facility, as the overall building appears to be in need of extensive repair and or updating." The CCHD decided to seek out a new location for the offices of their employees and not to return to the CCHDB.

A toxicologist from Washington State's Safety and Health Assessment and Research for Prevention (SHARP) program assisted the CCHD in devising a comprehensive mycological sampling strategy, which was conducted in December 1996. Several fungi were identified, including *Stachybotrys*, *Penicillium*, and *Aspergillus.*

During the course of these investigations, SEIU

and employee representatives decided to request NIOSH assistance in assessing whether the contamination problems identified during the environmental investigations were related to the variety of symptoms that some of the employees experienced while working at the CCHDB and since leaving that building. An HHE request was submitted in November 1996.

METHODS

On February 12, 1997, NIOSH representatives met in Cowlitz County with local representatives from various interested parties. In attendance at this meeting were Cowlitz County Health Department employee and management representatives; representatives from the Washington State Department of Health (WSDOH), the Washington State Department of Labor and Industry (WSDLI), and the Service Employees International Union (SEIU); and physicians from Select Care and Kaiser Permanente.

The group discussed the events leading up to the HHE request. The main concerns of the employees were the possible chronic health effects of the various agents that had been identified in the former CCHDB. Those present agreed that, to address the employees' concerns, a questionnaire would be helpful to evaluate prior and ongoing symptoms. After the opening meeting, NIOSH representatives toured the CCHDB. During the tour of the facility, NIOSH representatives noted evidence of water damage and multiple areas of fungal growth on walls.

On March 26 and 27, 1997, NIOSH representatives returned to Longview to conduct private medical interviews with employees of the former CCHDB. Prior to this visit, a memo describing the NIOSH investigation and the plans for the interview was sent by the CCHD administration to all current employees. In addition, union representatives encouraged all current employees to participate in the interview process whether or not they had health concerns related to working in the former building. Former employees who were in contact with union representatives were also informed of the NIOSH investigation and interview, and were invited to participate.

During the interviews, a symptom questionnaire (Appendix A) was administered by a NIOSH physician to each participating employee. The questionnaire included symptoms typically associated with indoor environmental quality problems, as well as other symptoms reported among employees. Employees were asked about the occurrence of symptoms before and after leaving the CCHDB.

EVALUATION CRITERIA

General

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage of workers may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce adverse health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and

mucous membranes, potentially increasing the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs),[2] and (3) the U.S. Department of Labor, OSHA Permissible Exposure Limits (PELs).[3] In July 1992, the 11th Circuit Court of Appeals vacated the 1989 OSHA PEL Air Contaminants Standard. OSHA is currently enforcing the 1971 standards which are listed as transitional values in the current Code of Federal Regulations; however, some states operating their own OSHA approved job safety and health programs continue to enforce the 1989 limits. NIOSH encourages employers to follow the 1989 OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the most protective criteria. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted that employers are legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8-to-10-hour workday. Some substances have recommended short-term exposure limits (STEL) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.[4]

Microbial Contaminants

Microorganisms (including fungi) are normal inhabitants of the environment. The saprophytic varieties (those utilizing non-living organic matter as a food source) inhabit soil, vegetation, water, or any reservoir that can provide an ample supply of a nutrient substrate. Under the appropriate conditions (optimum temperature, pH, and with sufficient moisture and available nutrients) saprophytic microorganism populations can be amplified. Through various mechanisms, these organisms can then be disseminated as individual cells or in association with soil/dust or water particles. In the outdoor environment, the levels of microbial aerosols will vary according to the geographic location, climatic conditions, and surrounding activity. In a "normal" indoor environment, the level of microorganisms may vary somewhat as a function of the cleanliness of the HVAC system and the numbers and activity level of the occupants. Generally, the indoor levels are expected to be below the outdoor levels (depending on HVAC system filter efficiency) with consistently similar ranking among the microbial species.[5,6]

Some individuals manifest increased immunologic responses to antigenic agents encountered in the environment. These responses and the subsequent expression of allergic disease is based, partly, on a genetic predisposition.[7] Allergic diseases typically associated with exposures in indoor environments include allergic rhinitis (nasal allergy), allergic asthma, allergic bronchopulmonary aspergillosis (ABPA), and extrinsic allergic alveolitis (hypersensitivity pneumonitis).[8] Allergic respiratory diseases resulting from exposures to microbial agents have been documented in agricultural, biotechnology, office, and home environments.[9,10,11,12,13,14,15]

Individual symptomatology varies with the disease. Allergic rhinitis is characterized by paroxysms of sneezing; itching of the nose, eyes, palate, or pharynx; nasal stuffiness with partial or total airflow obstruction; and rhinorrhea (runny nose) with postnasal drainage. Allergic asthma is characterized by episodic or prolonged wheezing and shortness of breath in response to bronchial (airways) narrowing. Allergic bronchopulmonary aspergillosis is characterized by cough, lassitude, low-grade fever, and wheezing.[7,16] Heavy exposures to airborne microorganisms can cause

an acute form of extrinsic allergic alveolitis which is characterized by chills, fever, malaise, cough, and dyspnea (shortness of breath) appearing four to eight hours after exposure. In the chronic form, thought to be induced by continuous low-level exposure, onset occurs without chills, fever, or malaise and is characterized by progressive shortness of breath with weight loss.[17]

Some fungi produce mycotoxins, which are non-volatile (not readily vaporized) compounds. These chemicals can produce toxic effects in people. However, the severity of symptoms depends on the level of exposure to the mycotoxin. There are few, if any, documented cases of the direct effect of mycotoxins on the health of occupants of fungal-contaminated buildings. To date, only two fungi, *Stachybotrys atra* and *Aspergillus versicolor* have been implicated as possible sources of mycotoxin exposure in water-damaged buildings.[18]

Acceptable levels of airborne microorganisms have not been established, primarily because allergic reactions can occur even with relatively low air concentrations of allergens, and individuals differ with respect to immunogenic susceptibilities. The current strategy for on-site evaluation of environmental microbial contamination involves an inspection to identify sources (reservoirs) of microbial growth and potential routes of dissemination. In those locations where contamination is visibly evident or suspected, bulk samples may be collected to identify the predominant species (fungi, bacteria, and thermoactinomycetes). In limited situations, air samples may be collected to document the presence of a suspected microbial contaminant. Air sample results can be evaluated epidemiologically by comparing those from the "complaint areas" to those from non-complaint areas, or by relating exposure to immunologic or medical findings.

Biology and Ecology of *Stachybotrys*

Fungi of the genus *Stachybotrys* are found worldwide. *Stachybotrys* is a saprophyte (grows on dead or decomposing matter) known to destroy cellulose.[19] It has been isolated from soil and a wide variety of substances rich in cellulose, such as hay, wood pulp, cotton, grains, various dead plant components, paper, and glue in book bindings.[20]

Stachybotrys species tend to be uncommon in ordinary work or home environments. Several studies of viable mold spore counts using various sampling techniques in homes in southern California revealed a frequency of isolation of *Stachybotrys* ranging from 2.9% to 7.1%. This may vary, however, depending on the local mold flora, weather, and outdoor activity present (e.g., mowing the lawn, landscaping, etc.).[21]

The frequency with which *Stachybotrys* is found in buildings with mold problems varies among different studies. This may be due partly to different sampling techniques. Since *Stachybotrys* spores do not aerosolize well, air sampling may underestimate the presence of the fungus. And since this fungus competes poorly on typical agar media, it may not be detected unless cellulose-based agar or moist filter paper is used for sampling. Studies using Anderson sampling, Rotorods, and moist filter paper have identified *Stachybotrys* in up to 19% of the buildings sampled; higher yields were in buildings with known problems with mold contamination.[21,22]

Various strains of *Stachybotrys* have somewhat different growth requirements; the temperature range for optimal growth is 72-82 degrees Fahrenheit, and the minimum humidity required for spore germination is 96.3% to 98.5%. Buildings where *Stachybotrys* growth problems have been reported typically experienced chronic water damage (e.g., due to leaking roofs or plumbing, floods, air conditioner condensation, etc.) and were kept at a temperature conducive to their growth. Examples of building materials which have been found to be growth substrates for *Stachybotrys* include: water-contaminated jute carpet backing, cold air return ducts containing

moisture, lint and carpet fibers, wood fiber ceiling board, and moist urea formaldehyde foam insulation in contact with gyproc paper.[19,23,24] Other potential sources for fungal growth, all of which maintain a consistent source of moisture, include humidifiers (vaporizers, water spray conditioners), evaporative coolers, self-defrosting refrigerators, air conditioners, and HVAC systems.[25]

Stachybotrys is one of many fungi that produces chemicals called trichothecene mycotoxins. Studies of *Stachybotrys* species have revealed that approximately two-thirds of isolates were found to produce these toxins.[19,26,27,28,29] Sorenson and associates demonstrated that these mycotoxins could be found in the aerosolized spores of this fungus, indicating the potential for inhalation exposure to these compounds.[30]

Veterinary Experience with *Stachybotrys*

Animal disease produced by *Stachybotrys* fungi is called *stachybotryotoxicosis*, and is well known to veterinarians. It has severely affected large and small animals, especially during the early 1900's in Russia and Europe. It was established that the ingestion of mold-contaminated feeds (hay, grains, etc.) was responsible for the resultant disease. Laboratory studies revealed that the severity of the illness was dose-dependent and that the tricothecene mycotoxins elaborated by the fungi were the responsible agents. Eventually, the disease was controlled by improved containment or treatment of animal foodstuffs. It is important to note that these reports all involved substantial exposures.[19]

In animals, several different types of *stachybotryotoxicosis* can be distinguished, depending on the dose of toxin ingested, length of ingestion, and type of animal afflicted. Dermal (skin) manifestations are characterized by ulcerations, hyperemia (redness), edema (swelling), and tissue necrosis (skin death) of varying severity. Systemic toxicity can occur and includes fever, compromise of the immune and blood-forming systems, anorexia, hemorrhage of the internal organs, cardiac arrhythmia, sepsis, neurological abnormalities, and death.[19,20,26]

Human Disease due to *Stachybotrys*

A review of the medical literature revealed no information describing human infection by *Stachybotrys*. The *potential* for human disease caused by *Stachybotrys* includes allergy to the fungus and toxicity (poisoning) from exposure to its products. Data on the allergic and toxic forms of the disease are limited, but several studies and case reports implicate *Stachybotrys* and its mycotoxins as causes of certain human illnesses.

Allergies and allergic asthma

Data on the allergic manifestations of *Stachybotrys* are very limited. Only one case report even suggested allergic disease due to *Stachybotrys*. In this case, a four year-old child with asthma experienced some relief of his symptoms upon removal from his home. Investigation of the home revealed a history of repeated water damage and extensive *Stachybotrys* mold growth on the jute-backed carpet. The authors reported a "dramatic reduction" of this child's asthma symptoms after removal and cleaning of the affected materials and surfaces.[21]

Stachybotryotoxicosis

The toxic manifestations of *Stachybotrys* are caused by the absorption of the toxins produced by the fungus. There are several potential routes of exposure to the tricothecene toxins produced by this fungus, including absorption from skin contact, inhalation, or ingestion. There are reports of local skin irritation due to handling of material contaminated by this fungus, but whether or not systemic effects occur due to skin absorption is unknown.[18] Most sources propose inhalation as the most likely entryway of the spores and their

toxins into the body in occupational exposures. Work sites that provide a *potential* risk for this disease include farms, cottonseed oil plants, grain elevators and facilities used for reprocessing moldy grain, malt grain processors, textile mills using plant fibers, and bindertwine factories. Because occupations at these sites involve close contact with mold-contaminated materials, the affected employees probably received greater exposure to mold spores than would be expected in most non-industrial environments (e.g., homes, offices, schools).

Stachybotryotoxicosis in man is generally uncommon and usually not fatal. The severity of disease is dose-dependent, and symptoms usually resolve with removal from exposure. Initially, patients may experience severe mucous membrane irritation, headaches, dizziness, weakness, vomiting, diarrhea, abdominal pain, fever, sweating, tachycardia (increased heart rate), cyanosis (blue skin coloration due to decreased oxygen in the blood), dry cough, shortness of breath, and chest pain. Late manifestations include suppression of the hematologic (blood) and immune systems leading to petechiae (red spots on the skin), skin necrosis, hemorrhage (bleeding) of the mucous membranes or gastrointestinal tract, and sepsis. If death does not ensue, a gradual recovery occurs over the next several months.[19,20,22,23]

Only one published investigation has described an outbreak of possible stachybotryotoxicosis secondary to mold contamination in a home. A family of five experienced cold and flu symptoms, sore throats, diarrhea, headaches, dermatitis (skin inflammation), patches of hair loss, and fatigue. Medical investigations of their conditions did not reveal any identifiable causes. In their home, a cold air return duct and an area of wood fiber board were contaminated with *Stachybotrys*. When the mold was cleaned up, the family members' symptoms resolved. The authors inferred that mycotoxins from the mold were responsible for the symptoms, although the report does not describe any biological testing for mycotoxins in the people affected.[23]

In November 1994, the Centers for Disease Control and Prevention (CDC) and private physicians and public health officials in Cleveland, Ohio, reported a cluster of eight cases of acute pulmonary hemorrhage/hemosiderosis that had occurred during January 1993-November 1994 among infants in one area of the city.[31] Two additional cases were identified in December 1994. All 10 infants lived within seven contiguous postal tracts in eastern metropolitan Cleveland. Pulmonary hemorrhages recurred in five of the infants after they returned to their homes shortly after hospital discharge; one infant died as a result of pulmonary hemorrhage. A follow-up investigation documented an association between acute pulmonary hemorrhage/hemosiderosis in this cluster of cases and mold/fungal growth in their water-damaged homes. Although the quantity of fungi (including *Stachybotrys*) was higher in the homes of case-infants than in those of controls (Odds Ratio = 1.6; 95% Confidence Interval = 1.0-30.8), the specific cause of the pulmonary hemosiderosis has not been determined. Based on the findings of the case-control study, health authorities in Cleveland recommended prompt clean-up and disposal of all moldy materials in the water-damaged homes and have designed a prevention program focusing on water-damaged homes.[32]

Johanning et al. recently reported findings from a study of workers exposed to *Stachybotrys* in a water-damaged office environment. In this study, air samples were positive for *Stachybotrys*, *Penicillium*, *Cladosporium* and *Aspergillus.* The investigators concluded that prolonged and intense exposure to toxigenic *Stachybotrys chartarum* and other atypical fungi was associated with reported disorders of the respiratory and central nervous systems, reported disorders of mucous membranes, and a few parameters pertaining to the cellular and humoral immune system, suggesting possible immune competency dysfunction.[33]

Aspergillus

Aspergillus is a ubiquitous mold; there are over 600 species in the genus *Aspergillus*. Most *Aspergillus* species are found in soil, although many species can be found on a wide variety of substrates including forage and food products, cotton, and other organic debris. *Aspergillus fumigatus*, the most common species, accounts for most disease attributable to Aspergillus, both allergic and infectious. Groups at risk of exposure to this fungus include farmers; bird hobbyists; workers in sawmills, greenhouses, cane mills or breweries; and people who work around mushrooms, tobacco, or grain.[34,35,36,37,38,39] Workers who deal with compost piles, decomposing haystacks, or moldy grains may develop hypersensitivity responses.[40]

Aspergillus versicolor has the potential to produce sterigmatocystin, a mycotoxin closely related in structure and biological activity to another class of *Aspergillus* mycotoxins known as aflatoxins.[6] Aflatoxins are potent liver carcinogens and represent a risk to those exposed to high concentrations.[22] There are no reported cases of liver cancer associated with exposures to *Aspergillus* in office buildings.

Exposure to *Aspergillus* species may cause a variety of health problems. These include asthma, hypersensitivity pneumonitis, allergic bronchopulmonary aspergillosis, allergic sinusitis, and infection. The clinical manifestations of *Aspergillus*-related asthma are no different from other forms of asthma. The symptoms are cough, wheezing, chest tightness, and dyspnea, and obstructive changes on pulmonary function testing are present during acute attacks.

Hypersensitivity pneumonitis can occur in individuals with repeated exposure to organic dusts containing *Aspergillus* species. Acute symptoms may occur 6-12 hours after exposure. They include myalgias (muscle aches), weight loss, fatigue, chest tightness, cough, and shortness of breath on exertion. Acute episodes are self-limiting, but upon repeated exposure, the condition can become chronic.

Allergic bronchopulmonary aspergillosis (ABPA) is an inflammatory disease caused by an immunologic response to *Aspergillus fumigatus* and other *Aspergillus* species growing in the bronchi of patients with asthma.[41] Allergic fungal sinusitis (AFS) due to *Aspergillus* species typically occurs in allergic immunocompetent patients. Most patients have asthma, and 85% have nasal polyps. Invasive aspergillosis is a very serious infectious disease that typically occurs in immunocompromised patients, most notably those with leukemia or lymphoma.

Penicillium Species

The blue-green molds of *Penicillium* are common contaminants of indoor environments. Exposure to *Penicillium* can occur as a result of contaminated humidifier water and moldy HVAC systems. Inhalation of airborne spores is the major route of entry. These molds are common contaminants of agricultural commodities and some of the mycotoxins produced by these species are also produced by fungi common in house dust.[42] *Penicillium* infections of clinical importance are very rare, although this mold has been associated with asthma and hypersensitivity pneumonitis.[41] Presently, *Penicillium* mycotoxins are not considered to be a serious health threat in water damaged buildings.[18]

RESULTS

Twenty-nine (94%) of the 31 current employees and eight (44%) of approximately 18 former employees participated in the medical interviews and responded to the symptom questionnaire. A comparison of symptom frequency before and after leaving the former CCHDB was performed for all 37 participating employees. The statistical significance of the difference in symptom frequency before and after leaving the building

was evaluated using McNemar's test for correlated proportions.[43] Table 1 lists the symptoms, the number of people who had the symptom before and after leaving the former CCHDB, and the statistical significance of the difference in prevalence before and after leaving the building. Employees reported a decrease in all symptoms after leaving the former building. There was a statistically significant decreased prevalence in all symptoms, except the last four symptoms in the table (muscle aches, vomiting, coughing up blood, and blood in stools).

Table 1
Frequency of reported symptoms in Employees.
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Symptom	*Before	*After	**P-value
Shortness of Breath	13/37 (35%)	5/37 (14%)	P < .01
Wheezing	10/37 (27%)	3/37 (8%)	P < .01
Coughing	15/37 (41%)	7/37 (19%)	P < .01
Watery eyes	22/37 (60%)	10/37 (27%)	P < .01
Runny Nose	19/37 (51%)	10/37 (27%)	P < .01
Sore Throat	18/37 (49%)	3/37 (8%)	P < .01
Sinus Infections	26/37 (70%)	14/37 (38%)	P < .01
Bloody Nose	11/37 (30%)	2/37 (5%)	P < .01
Odors	17/37 (46%)	4/37 (11%)	P < .01
Diarrhea	14/37 (38%)	7/37 (19%)	P < .01
Nausea	9/37 (24%)	5/37 (14%)	P < .05
Skin Rash	12/37 (32%)	6/37 (16%)	P < .05
Flushing	12/37 (32%)	3/37 (8%)	P < .01
Fatigue	30/37 (81%)	11/37 (30%)	P < .01
Anxiety	23/37 (62%)	10/37 (24%)	P < .01
Depression	16/37 (43%)	9/37 (24%)	P < .05
Headaches	24/37 (65%)	10/37 (27%)	P < .01
Memory Loss	2537 (68%)	1237 (32%)	P < .01
Dizziness	17/37 (46%)	6/37 (16%)	P < .01
General Infections	21/37 (57%)	10/37 (27%)	P < .01
Fever, Chills, Night Sweats	13/37 (35%)	3/37 (8%)	P < .01
Muscle Aches	18/37 (49%)	13/37 (35%)	P > .05
Blood in Stool	5/37 (14%)	1/37 (3%)	P > .05
Vomiting	1/37 (3%)	0/37 (0%)	P > .05
Coughing up Blood	1/37 (3%)	0/37 (0%)	P > .05

* "Before" refers to the number of interviewed employees who reported having the symptom before leaving the former CCHDB and "After" refers to the number of interviewed employees who reported having the symptom after leaving the former CCHDB.

** Significance test using McNemar's test for correlated proportions.

DISCUSSION

Stachybotrys is a common fungus in the environment. There is little evidence that the fungus itself is a cause of serious disease, although it may be associated with allergy symptoms or asthma. However, *Stachybotrys* is one of many fungi that produces chemicals called trichothecene mycotoxins, which can cause severe illness in high enough doses. But it is unlikely that such exposures would occur in office buildings. Even where illness has been attributed to *Stachybotrys* exposure in homes or workplaces, removal from exposure usually resulted in recovery.

Aspergillus and *Penicillium* may cause hypersensitivity disease such as asthma and hypersensitivity pneumonitis. Certain species are also capable of producing mycotoxins, although currently, only *Aspergillus versicolor* is thought to be a source of potentially medically significant mycotoxin exposure in water damaged buildings. This mycotoxin closely resembles aflatoxins, which are liver carcinogens. However, there is no evidence of liver cancer being associated with exposures to *Aspergillus versicolor* in office buildings.

A specific cause that could be responsible for the variety of symptoms that CCHD employees have experienced cannot be determined. There are no biological tests available to evaluate whether symptoms are caused by an exposure to a specific fungus or mold. Molds and fungi are common in the environment, so even if a blood test shows that someone has been exposed in the past, this does not indicate where that exposure occurred. However, in this investigation, there was a statistically significant decreased prevalence in nearly all of the employees' symptoms after the former building was closed. This conforms to reports in the literature that have shown that people with illnesses attributable to exposure to certain fungi and molds do recover when they are removed from the exposure. Therefore, whatever the cause of the employees' health problems while they occupied their former offices, it is unlikely that *persistent* symptoms are related to exposures in the former CCHDB.

RECOMMENDATIONS

1. Local health authorities, in cooperation with union representatives, should inspect the new CCHD building when renovations are complete. Focus should be placed on assessing environmental conditions to assure employees that conditions are not similar to those in the former CCHDB. Employees should be informed of the results of this inspection.

2. Employees should see their personal physician for health concerns, and should inform their physician of any problems they feel might be work-related. If possible, an occupational physician should be seen for work-related health concerns.

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Appendix A

Health Survey of Employees at 1516 Hudson St. Cowlitz County Health Department Building

Date_____
ID #_____
Age_____ Gender: M F Occupation_____
Location in prior Building_____(room # or area of primary work space)
Duration of employment in prior Building _____yrs _____months

Please circle or fill in as appropriate:
Average number of hours worked per week in prior building: 0-20 20-40 >40

Environmental concerns in prior Building: heat cold moisture odors visible mold dryness

Do you have now or have you ever had any of the following:

diabetes	yes	no	fibromyalgia	yes	no
HTN	yes	no	bronchitis	yes	no
asthma	yes	no	chronic fatigue syndrome	yes	no

Smoking status: never current former (if former then quit how long ago_____)
if current or former smoker the how many packs per day_____ and for how many years_____

Do you have any sensitivities to any chemicals? Yes No
If yes then what specific chemicals? _____
If yes then what specific symptoms? _____

Do you have any sensitivities to tobacco smoke? Yes No
Do you have any allergies to dusts? yes no
Do you have any allergies to molds? yes no
Do you have any allergies to cats? yes no
Do you have any seasonal allergies? yes no
Do you have any medication allergies? yes no

What medications (prescription and over-the-counter) have you been taking during the last 6 months?
_____
_____

Do you wear contact lenses? Yes No
Do you have pets at home? Yes No
Do you have molds in your house? Yes No

Do you have water damage in your house? Yes No

	While in former building	**While not in building prior to move to present facilities**	**Since leaving building completely**
Have your experienced:			
Constitutional Symptoms			
fever, chills, night sweats	yes no	yes no	yes no
excess fatigue or tiredness	yes no	yes no	yes no
unusual anxiety or tension or irritability or nervousness	yes no	yes no	yes no
unusual feelings of sadness or depression	yes no	yes no	yes no
new onset of or unusual headaches	yes no	yes no	yes no
memory loss or loss of concentration	yes no	yes no	yes no
unusual dizziness or lightheadedness	yes no	yes no	yes no
recurrent infections	yes no	yes no	yes no
Respiratory Symptoms			
New onset cough or unusual cough	yes no	yes no	yes no
onset of shortness of breath	yes no	yes no	yes no
onset of wheezing	yes no	yes no	yes no
onset of coughing blood	yes no	yes no	yes no

ENT Symptoms	**While in former building**	**While not in building prior to move to present facilities**	**Since leaving building completely**
unusual watering of the eyes	yes no	yes no	yes no
unusual runny nose	yes no	yes no	yes no
sinus congestion or sinusitis	yes no	yes no	yes no
unusual bloody nose	yes no	yes no	yes no
unusual odors	yes no	yes no	yes no
unusual sore throat	yes no	yes no	yes no
GI Symptoms			
new onset of diarrhea	yes no	yes no	yes no
new onset of nausea	yes no	yes no	yes no
new onset of vomiting	yes no	yes no	yes no
new onset of bloody stool	yes no	yes no	yes no
Musculo/Derm Symptoms			
new onset of rash	yes no	yes no	yes no
new onset of myalgias/arthralgias	yes no	yes no	yes no
new onset of flushing	yes no	yes no	yes no

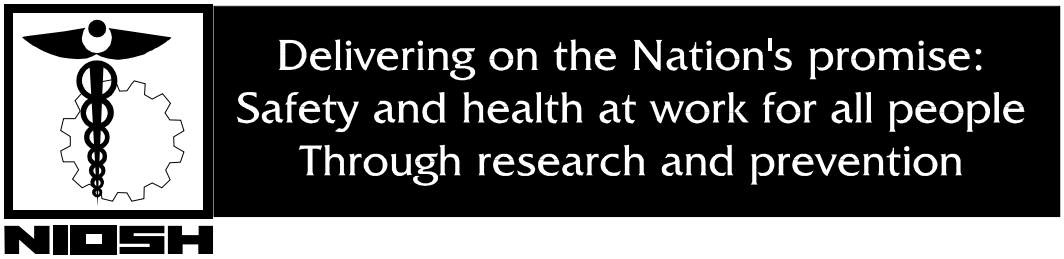
Did you ever seek medical care for any of the above symptoms? yes no

Were you ever hospitalized for any of the above symptoms? yes no

Have you read a report about the environmental conditions in your former building? yes no

Are you satisfied with your employer? yes no

Since leaving the building do you feel: better same worse?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