DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Centers for Disease Control
and Prevention
National Institute for Occupational
Safety and Health
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HHE 2021-0139

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Dear Mr. Koch:

On August 12, 2021, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from management (you) and employee representatives of East Carolina University (ECU) located in Greenville, North Carolina regarding cancer cases among employees working in the A-wing of the Brewster Building. Employees were concerned that cancer diagnosis could be related to indoor environmental quality (IEQ) and environmental exposures in the building. This letter summarizes our evaluation and findings and provides recommendations to address these concerns.

Background

The Brewster Building (constructed in 1970) is a complex of four independent wings (A, B, C, and D) that surround a central courtyard and are connected by breezeways. It is approximately 80,000 square feet with 160 office spaces spread out over the four separate wings. Each wing is a four-story building with a concrete slab-on grade foundation. Offices have vinyl composition tile floors and carpet. Floor coverings in hallways are terrazzo on the ground floor and vinyl composition tile on the other floors. Interior partition walls are separated by paper-faced gypsum board (drywall). The exterior walls are brick veneer and structural concrete masonry. The built-up low slope roof was replaced in 1993. The A-wing is (1) the primary office wing for the faculty, (2) contains the offices for the departments of History, Geography, Philosophy, Political Science, Sociology, Economics, Religious Studies, and Women's Studies, and (3) the central location for the reported health concerns. Therefore, this HHE was focused on the A-wing.

Evaluation

The objectives of our evaluation were to (1) evaluate reports of cancer among employees to identify whether an unusual pattern of cancer exists, (2) review the results of environmental sampling that had been previously done to identify potential exposures at Brewster A-wing, and (3) determine if there is evidence that a workplace exposure(s) contributed to cancer diagnoses among employees.

We used the following approach to accomplish these objectives. We began by collecting and reviewing information about employees known to be diagnosed with cancer and information about exposures that may have been present in the workplace environment. We reviewed the results of environmental sampling that had been previously done to identify potential exposures to carcinogenic substances in the workplace. If the pattern of cancer appeared to be unusual and an exposure of concern was identified, additional steps were taken to identify all cases of the cancer of concern, conduct a statistical assessment, and evaluate the association between exposure(s) and the cancer(s) of concern. If the pattern of cancer did not appear unusual or a workplace exposure was not identified, we ended the evaluation. This approach followed the principles outlined in CDC's guidelines for investigating cancer concerns in a community [CDC 2022].

Evaluation of Cancer Concerns

To evaluate concerns about an unusual pattern of cancer among ECU employees, we did the following:

- Spoke with current employees and employee representatives to better understand when workplace cancer concerns began and the scope of the concerns.
- Requested information from the Human Resources Department about the number of employees who currently work in the building and the number who worked in the building in the past.
- Reviewed a list, provided by employee representatives, of cancer diagnosed among current and former employees.
- Requested death certificates from the North Carolina Department of Health and Human Services (NC DHHS) for employees who had reportedly died of pancreatic cancer.
- Contacted NC DHHS to identify any community-based concerns about cancer incidence in the geographic area where Brewster A-wing is located.
- Searched the U.S. Environmental Protection Agency's (EPA's) National Priorities List and Superfund Sites webpage (https://www.epa.gov/superfund/search-superfund-sites-where-you-live) for any locations contaminated with hazardous waste within the same zip code as the Brewster A-wing.

Review of Past Environmental Sampling

To evaluate concerns about IEQ and potential exposures (e.g., asbestos, radon, and pesticides) we reviewed details about the heating, ventilation, and air-conditioning (HVAC) systems; building and HVAC maintenance procedures; housekeeping practices; and previous IEQ assessments. We reviewed the following documents you provided:

- Asbestos Hazard Emergency Response Act (AHERA) Asbestos Management Plan dated August 2014
- Indoor environmental assessment performed by the ECU Environmental Health and Safety office dated September 3, 2019

- Asbestos consulting reports performed by Terracon dated November 4, 2021
- Letter from NC DHHS titled *Review HVAC systems and operations* to ECU dated November 16, 2021
- Letter from ECU to NC DHHS regarding “Occupational Health Concerns in the Brewster Building at East Carolina University” dated November 16, 2021
- Excerpts from written programs and additional information:
    - HVAC preventative maintenance schedules from 2018 to 2021
    - Pest control and housekeeping work orders from 2017 to 2021

Results

Evaluation of Cancer Concerns

Discussions with employees and employee representatives indicated that multiple employees had expressed concern or had heard concerns from other employees about an unusual pattern of cancer among those working in the Brewster A-wing. Employees raised concerns over pancreatic cancer specifically and reported that multiple employees working on the 3rd and 4th floors of the Brewster A-wing had been diagnosed with pancreatic cancer over time. Potential exposures employees were concerned about included asbestos in building materials and drinking water contamination.

Information regarding the cancer diagnoses among employees who had worked in the Brewster A-wing was provided by employee representatives. The available details were compiled and reviewed. The Human Resources (HR) Department also reported that 108 people had a work address in the Brewster A-wing as of November 2021. This included faculty and staff but did not include students and custodial staff who may also work in the building at times.

The list provided by employee representatives included 21 cancer diagnoses among current and former employees. The most common diagnosis reported was pancreatic cancer (n=9), followed by cancer of the breast, kidney, throat, lung, liver, brain, and neuroendocrine system (each with five or fewer diagnoses reported). The primary cancer site was unknown for 1 diagnosis. The date of cancer diagnosis was unknown for all of these employees, except for one who was reportedly diagnosed in 2001. It was reported that 13 of these employees had died from their cancer diagnosis and 8 of these deaths were from pancreatic cancer. The date of death ranged from 2001–2021, with most of the deaths occurring from 2010–2021. Deaths included both current and former employees.

Employees reported to have been diagnosed with cancer had offices throughout the A-wing (eight on the 4th floor, fewer than five employees each on the 3rd and 1st floors, unknown location for six employees). No pattern was evident in the type of cancer reported and the corresponding office location.

For the eight individuals who reportedly died of pancreatic cancer, we requested employment records from HR and death certificates from NC DHHS. HR was able to confirm employment at ECU for seven of these individuals but was only able to provide exact dates of employment for six of them due to record retention policies. HR was able to confirm that five of these employees had an address of record located in the Brewster A-wing.

Death certificates confirmed pancreatic cancer as the cause of death for six individuals. Death certificates could not be located for the other two individuals, possibly because they did not live in North Carolina at the time of death. For the six individuals with confirmed pancreatic cancer, the average age at death was 71 years and the date of death ranged from 2012–2021.

There were three individuals who had both a death certificate confirming pancreatic cancer AND an employment record confirming they worked in the Brewster A-wing at some point in their employment history. For these three individuals, dates of employment ranged from the early 1970s to 2021 (a nearly 50-year period). HR was not able to provide the total number of employees who worked in the Brewster A-wing over the same timeframe as these 3 individuals.

NC DHHS was not aware of any community-based concerns about cancer incidence in the Greenville, NC area where ECU is located. In addition, a search of the EPA's National Priorities List and Superfund Sites did not reveal any known hazardous waste sites under investigation or remediation within the same ZIP code as ECU.

Review of Past Environmental Sampling

We reviewed the ECU Asbestos Management Plan dated August 2014 which (as stated) applied to "all university employees, contractors, and subcontractors who work in or around ACM." ACM is the abbreviation for asbestos-containing materials. The plan calls for all asbestos-related work (including operations and maintenance) to be performed by "accredited off-campus contractors." The plan also calls for all members of facilities services and housekeeping staff who may encounter ACM to receive asbestos awareness training at the time of hire, and annually thereafter.

According to asbestos consulting reports performed by Terracon dated November 4, 2021, ACM identified in Brewster A-wing included (1) mastic and caulk associated with thermal insulation material, (2) vinyl floor tile and mastic, (3) light fixture insulation, and (4) drywall joint compound. Terracon also collected eight ambient air samples for asbestos fibers using NIOSH Method 7402. Two samples were collected on each of the four floors. None were collected outside. The samples were analyzed using transmission electron microscopy, which allows for the positive identification of asbestos fibers. The laboratory reported all samples as none detected. Additionally, Terracon collected four drinking water samples for asbestos using EPA Method 100.2, which consisted of one sample each from a drinking fountain on the 1st and 3rd floors and one sample each from restroom sinks on the 2nd and 4th floors. The laboratory reported all samples as none detected.

Between June and August of 2019, the ECU Environmental Health and Safety office conducted a thorough indoor environmental assessment of Brewster A-wing. The scope of assessment included:

- Walkthrough visual assessment
- Facilities inspection of HVAC and plumbing
- Air quality parameter survey, including carbon monoxide (CO), carbon dioxide (CO_2), temperature (°F), relative humidity (RH), dust, total volatile organic compounds (TVOC), and gamma radiation using a TSI IAQ-CALC and Rae Systems MultiRae pro direct-reading instruments.
- Sampling for volatile organic compounds (VOCs) using EPA method TO-15
- Water quality analysis (inorganic chemical and bacteriological analysis)
- Radon testing
- Employee interviews

The walkthrough visual assessment found "no major issues" and no "visible signs of mold or conditions that could compromise IEQ," but did report dirty offices and HVAC ducts.

The facilities inspections included email communications with the HVAC and plumbing supervisors (both ECU employees). The HVAC supervisor reported on July 16, 2019, "not seeing anything out of the ordinary" and that HVAC filters were currently being changed throughout the Brewster building. The plumbing supervisor reported on July 23, 2019, that they "couldn't seem to find any problems with the plumbing on A-wing."

During the air quality parameters survey, air samples were collected in twelve rooms: five on the 1st floor, none on the 2nd floor, three on the 3rd floor and four on the 4th floor. One additional sample was collected in a hallway (floor not indicated), and one was collected outside. The survey reported:

- CO and TVOC levels were zero parts per million (ppm) both inside and outside the building (below the limit of detection for the instrument).
- VOCs via TOC-15 analyzed for 161 compounds; 145 of them were not detected. The other 16 compounds were "…indicative of background levels that are well below the OSHA and NIOSH exposure limits."
- CO_2 levels ranged from 489 to 544 ppm inside with an outside level of 348.
- Temperatures ranged from 71.7 to 75.4°F inside with an outside temperature of 85.9°F.
- RH ranged from 53.0% to 61.0% inside with an outside RH of 70.4%.
- Gamma radiation levels ranged from 10 to 13 microrems per hour (µrem/hr) inside with an outside level of 11 µrem/hr.

The report compared measured temperature, RH, and CO_2 levels to ANSI/ASHRAE recommended guidelines, and compared the measured gamma radiation levels to the average annual radiation dose per person in the U.S. of 620 millirem (620,000 µrem) from all natural and manmade sources, as reported by the National Council on Radiation Protection and Measurements.

The water quality analysis involved sampling building water for typical drinking water quality parameters. Water was sampled from two locations in Brewster A-wing, one from the men's bathroom on the 1st floor, a second from the men's bathroom on the 4th floor, and a third control sample was collected from the men's bathroom in the Fletcher building. Water samples were collected from sinks, since water fountains have filters and sinks are non-filtered water sources. The samples were analyzed for (1) nitrates and nitrites; (2) total residual chlorine; (3) water hardness; (4) alkalinity; (5) heavy metals such as arsenic, cadmium, chromium, lead, and selenium; (6) metals including copper, iron, and manganese; and (7) total coliforms. All analytes, except copper, were reported as "not detected above required reporting limits." Trace levels of copper were detected in both water samples in the Brewster building (0.097 milligrams per liter [mg/L] in the 1st floor bathroom and 0.150 mg/L in the 4th floor bathroom) as well as in the control sample from the Fletcher building bathroom (0.149 mg/L). These results were well below the reported allowable limit of 1.3 mg/L. The laboratory also reported that total coliforms were not detected. The report did not cite which "limits" it referred to.

Radon sampling in air was performed on August 5, 2019. Sampling consisted of three, 72-hour samples collected in rooms A103, A311, and A402. The results ranged from < 0.3 to 0.6 picocuries per liter of air (pCi/L) plus or minus 0.3 pCi/L, which were less than the U.S. EPA action level for indoor air of 4 pCi/L.

Informal interviews of "a few" employees were conducted. All interviewed employees had been working in the Brewster building A-wing for three years before the interview. A "few" employees felt something at work "triggers their allergies" and one employee reported "dry throat and light headaches previously occurred but that it has stopped." No numbers or statistics were provided.

The report concluded (1) the "visual inspection revealed no significant health issues at the time of the assessment," (2) "HVAC and plumbing supervisors confirmed they did not find issues except for the air handling units that are dusty," and (3) "air sampling results were within normal recommended standards." It recommended occupants follow existing procedures regarding IEQ, housekeeping, HVAC, and other facility issues.

On August 26, 2021, two representatives of the NC DHHS and three representatives of ECU Environmental Health and Safety office conducted a review of HVAC systems and operations in the Brewster building A-wing. The stated purpose was to "evaluate the design and operation of the HVAC systems, understand upgrades and modifications proposed…, and evaluate any visibly obvious conditions that could have an impact on the indoor environment." They reported (1) HVAC mechanical rooms on each floor were in "good order, clean and well kept" and with "no obvious signs of loose/friable insulation," (2) each floor had three thermostats to control temperature, (3) HVAC systems were using Minimum Efficiency Value Rating (MERV) 8 filters, and (4) spot checks for CO_2 levels were "consistently around 600 ppm." They concluded that there were "no obvious conditions that could have negative impacts on the IEQ of Brewster A-wing." The results of this review and site visit were included in a letter from NC DHHS to ECU on November 16, 2021. In the letter, NC DHHS recommended that ECU proceed with an asbestos survey in Brewster A-wing. That survey was performed by Terracon on September 3, 2021. The results were reported to ECU on November 4, 2021 (as discussed above).

On November 16, 2021, NC DHHS wrote to ECU regarding a specific request by ECU for them "to assist with concerns about pancreatic cancer cases and other illnesses among faculty" in the Brewster building A-wing. The letter recounted NC DHHS efforts beginning in July 2021 with "a literature review and summary of what is known about pancreatic cancer risk factors according to the American Cancer Society." The review found most known risk factors for pancreatic cancer were not occupational, except for chemicals associated with dry cleaning and metalworking industries. The letter also provided a review of the IEQ assessment performed by ECU in September 2019. NC DHHS stated the ECU report was "determined to be thorough and comprehensive, with conditions representing a typical building that is 50+ years old and no indication of hazardous operations previously conducted there." NC DHHS recommended ECU contact NIOSH to request an HHE.

A review of the HVAC preventative maintenance schedule from 2018 to 2021 showed that (1) building inspections are performed weekly, (2) air dryers are checked monthly, (3) closed-loop water systems are checked every three months, (4) air filters are changed every four months, (5) exhaust fans are checked every four months, and (6) coils are cleaned every three years.

A review of pest control and housekeeping work orders from 2017 to 2021 shows 24 requests for pest control and 176 requests for housekeeping services in that time period. Reported pesticide usage included:

- Tempo Ultra WP (nine applications)
- Alpine spray (three applications)
- Tempo Ultra SC (two applications)
- Arilon spray (one application)

The safety data sheets for these products listed active ingredients classified as "not likely to be carcinogenic to humans." As human subject data is scarce, this classification is based on carcinogenicity in mice and rats.

Most housekeeping services provided were cleaning (n=55, e.g., office, floor, bathroom), vacuuming (n=27), floor waxing (n=26), carpet shampooing (n=17), floor mopping (n=17). Two of the housekeeping service requests for cleaning were for mold that employees had suspected on a wall near a window and in a bathroom. The remaining entries were labeled "cancelled" or "duplicate," requests for bathroom supplies, reports of birds inside the building, or had no activity entered.

Discussion

Evaluation of Cancer Concerns

Understanding cancer and its occurrence in the general population

Cancer is a group of different diseases that have the same feature, the uncontrolled growth and spread of abnormal cells [CDC 2022; NCI 2020a]. As a group of diseases, cancer is very common and has a major impact on society and on the individuals and families it affects [NCI 2020b]. Approximately 40% of men and women will be diagnosed with cancer at some point during their lifetimes [ACS 2020]. The most common cancers diagnosed during 2020 (excluding non-melanoma skin cancer) were breast cancer, lung and bronchus cancer, prostate cancer, colon and rectum cancer, melanoma of the skin, bladder cancer, non-Hodgkin lymphoma, kidney and renal pelvis cancer, endometrial cancer, leukemia, pancreatic cancer, thyroid cancer, and liver cancer [NCI 2020b].

Most cancers are caused by a combination of multiple factors and each different type of cancer has its own set of contributing causes. Some of these factors include personal characteristics (e.g., age, sex, family history of cancer); personal habits (e.g., diet, smoking, alcohol consumption); underlying medical conditions; and exposure to cancer-causing agents in the environment, including the work environment. These factors may act together or in sequence to cause cancer. Although some risk factors for certain types of cancer are known, the causes of many types of cancer remain unknown. In many cases, people with no known risk factors develop cancer.

What is a cancer cluster and how do we determine if cancer could be related to a common exposure?

NIOSH receives many requests to evaluate workplaces regarding concerns related to cancer clusters. These concerns are understandable, as it can be alarming when employees in the same workplace report developing cancer. However, this does not necessarily mean that the cancer was caused by a workplace exposure.

Cancer often appears to occur in clusters. Scientists define a cancer cluster as “a greater than expected number of the same or etiologically related cancer cases that occurs within a group of people in a geographic area over a defined period of time” [CDC 2022]. A cluster can also occur when groups of individuals who are not expected to develop a particular cancer become ill.

In many workplaces, the number of cancer cases is relatively small. This makes detecting a possible common cause difficult, especially when there are no apparent cancer-causing exposures.

Many factors need to be considered when we assess whether cases of cancer among employees could be related to workplace exposure(s), including:

- Potential for exposure to cancer-causing agents
- Types of cancer reported
- Number of cancer cases reported
- Timing of the cancer diagnosis in relation to the exposure

Cancer clusters potentially related to a workplace exposure usually need to consist of the same type of cancer or etiologically related cancers, because this makes it more likely that a common causal pathway from exposure to disease exists. When several cases of the same type of cancer occur and that cancer is either uncommon in the general population or uncommon in the group of people developing it (for example, breast cancer in men), it is more likely that a workplace exposure may be involved. These issues are discussed below in a series of questions that relate to the evaluation of a reported cancer cluster.

Was exposure to a specific chemical substance or physical agent known or suspected of causing cancer occurring in the Brewster Building A-wing?

In our review of past sampling results and IEQ assessments performed in the Brewster A-wing, we did not identify any exposures to known or suspected carcinogens at sufficiently high levels to cause cancer. In the scientific literature, the relationship between some chemical and physical agents and certain cancers has been well established. For other agents and cancers, the evidence is not definitive, but a suspicion exists. When a known or suspected cancer-causing agent is present and the type of cancer occurring has been linked with that agent in other settings, we are more likely to suspect a connection between the workplace exposure and cancer diagnoses.

Do employees working in the Brewster Building A-wing have an unusual distribution of types of cancer?

Occupational exposure-related cancer is more likely when the same type of cancer has been diagnosed in employees and that type of cancer is not common in the general population. When a group of observed cancers includes multiple types of cancer or multiple cases of a common type of cancer, occupational causes of the observed cancers are less likely. The distribution of cancer among employees working in the Brewster Building A-wing does not appear unusual, because it includes eight different types of cancer and most of them are commonly diagnosed in the United States (including breast, lung, kidney, pancreas, and liver cancer).

Do employees working in the Brewster Building A-wing have more cancer than people who do not work there?

Cancer is a common disease and can be found among people at any workplace. When multiple cases of cancer occur in a workplace, they may be part of a true cluster if the number is greater than we expect compared to the number in other groups of people similar in age, sex, and race. However, small populations can have highly variable disease or tumor rates that rarely match the overall rate for a larger area, such as the state. At any given time, some populations can have rates above or below the overall rate. Even when high rates do occur, it may still be consistent with the expected random variability. Calculations like this make many assumptions that may not be appropriate for every workplace. Comparing rates without adjusting for age, sex, or other population characteristics assumes that such characteristics are the same in the workplace as in the larger population, which may not be true.

It was not possible to calculate a crude incidence rate for cancer among Brewster A-wing employees. This is because we were not able to obtain the total number of employees who have worked in the Brewster A-wing over the same timeframe as the individuals with cancer. This is a common limitation of occupational investigations of cancer concerns, and it is especially challenging to obtain these workforce numbers when the reference timeframe includes an approximately 50-year period, as it does in this investigation. Moreover, it was not possible to obtain age-, sex-, and race-adjusted incidence calculations for this employee population. Therefore, comparisons between employees and the overall North Carolina population were not possible and may not be appropriate.

In the United States, approximately 40% of people will develop some type of invasive cancer in their lifetime [ACS 2020]. Therefore, 21 reported cancer diagnoses among current and former employees does not appear excessive. Additionally, approximately 1%–2% of people in the United States will develop pancreatic cancer in their lifetime [ACS 2020] and pancreatic cancer has a low 5-year relative survival rate (12%) [ACS 2022a]. Of the eight reported deaths from pancreatic cancer, we were able to confirm with HR that five had an address of record in the Brewster A-wing and 6 died from pancreatic cancer according to NC DHHS death certificate records. However, we could only link three of the pancreatic cancer deaths among employees with a work address in the Brewster A-wing.

Even if the number of pancreatic cancer deaths among employees who have worked in the Brewster A-wing ranged from 3–8, that does not appear to be an excessive amount over an approximately 50-year timeframe. Although we cannot calculate a crude incidence rate because the total number of employees over the same timeframe was unavailable, we can estimate that the maximum of 8 pancreatic cancer deaths would not be excessive as long as 400 people have worked in the building over the past 50 years (8/400 =.02 or 2%).

It is likely that there is increased awareness of the pancreatic cancer diagnoses among employees because the survival rate for pancreatic cancer is low, especially when compared to other common types of cancer. It is also likely that more employees have been diagnosed with other types of cancer than those whose information was provided by employee representatives. As employees age, more cases of cancer are expected and will occur, including more cases of pancreatic cancer over time.

For more information about pancreatic cancer, see Appendix A.

Has enough time passed since a potential exposure began for excess cancer rates to be observed in ECU employees working in Brewster Building A-wing?

Latency is the time between first exposure to a cancer-causing agent and clinical recognition of the disease. Latency periods vary by cancer type but are usually a minimum of 10–12 years for solid tumors [Rugo 2004]. Because of this, exposures in the distant past are more relevant than recent or current exposures when determining potential causes of cancers occurring today.

The median number of years between hire at ECU and the reported cancer diagnoses among Brewster A-wing employees is unknown. However, consideration of latency is not of primary concern in this evaluation because there are no apparent cancer-causing exposures in the workplace.

Indoor Environmental Quality

Although IEQ problems or excessive workplace exposures were not evident on the basis of our analysis and review of the information obtained during this evaluation, the following section discusses good practices and strategies for maintaining or improving IEQ.

Heating, Ventilating, and Air-Conditioning

Brewster A-Wing is served by central HVAC systems. The amount of air required to be delivered to a given space by a ventilation system is based on: (1) the number of occupants, (2) the type and amount of equipment used, (3) the nature of work performed, and (4) the overall size of the space [ANSI/ASHRAE 2022]. ANSI/ASHRAE Standard 62-2001 sets criteria for ventilation rates in occupied spaces. It considers various types of environments within a facility to help determine appropriate proportions of airflow per person based on the estimated room demand. ANSI/ASHRAE Standard 52.2 recommends a minimum filtration of MERV 6. The documents provided reported that MERV 8 rated filters, which have slightly greater filtration, are used.

Temperature and Relative Humidity

Most temperature measurements made inside the building were within ANSI/ASHRAE recommendations. Two rooms on the 3rd floor were below the recommended temperature range, potentially indicating inadequate and/or difficulties with thermal control. ANSI/ASHRAE Standard 55-2020, Thermal Environmental Conditions for Human Occupancy, specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable [ANSI/ASHRAE 2020]. Assuming slow air movement and 50% RH, the operative temperatures recommended by ANSI/ASHRAE range from 68.5°F to 76°F in the winter, and from 75°F to 80.5°F in the summer. The difference between the two is largely due to differences in seasonal clothing selection.

Most humidity measurements made inside the building were within ANSI/ASHRAE recommendations. Two rooms on the 4th floor were slightly above the recommended range, indicating that improving humidity control is warranted. ASHRAE Standard 62.1-2022, Ventilation for Acceptable Indoor Air Quality, recommends that RH levels be limited to 65% or less for mechanical systems with dehumidification capability [ANSI/ASHRAE 2022]. The U.S. EPA recommends that RH be maintained below 60% (ideally 30%–50%) to prevent mold growth. Excessive humidity can promote the growth of microorganisms and dust mites. The ASHRAE standard does not specify a lower humidity limit, but very low RH levels may contribute to dry and irritated mucous membranes of the eyes and airways [Wolkoff and Kjaergaard 2007].

Carbon Dioxide

In some HVAC systems, outdoor air is delivered through the ventilation system to dilute indoor air pollutants. Office machines, building materials, furnishings, cleaning products, and the building occupants themselves are all potential sources of various indoor air pollutants. CO_2 is a normal constituent of exhaled breath and is not considered a building air pollutant. However, CO_2 concentrations can sometimes be used as an easily measured surrogate for ventilation rates. As the level of CO_2 increases, the level of indoor contaminants may also be increasing. In this way, CO_2 levels can indicate whether enough outdoor air is being introduced into an occupied space for acceptable pollutant control and comfort. The measured CO_2 levels were only slightly higher than outdoor levels which likely indicates adequate airflow for those conditions, occupation rates, and activities.

Mold

Exposure to microbes is not unique to the indoor environment. No environment, indoors or out, is completely free from microbes. Microbes present in indoor air that are relevant to health include pollen and plant spores coming from outdoors; bacteria, fungi, algae and protozoa from both indoors and outdoors; and microbes and allergens spread from person to person, and from person to environment (including pet dander) [WHO 2009]. No exposure guidelines for mold in air exist, so it is not possible to distinguish between "safe" and "unsafe" levels of exposure. Healthy individuals are usually not vulnerable to infections from airborne mold exposure. However, people with weakened immune systems (e.g., those with diabetes, taking immunosuppressant medications, or with a cancer diagnosis) may be more vulnerable to infections by molds. With the exception of two housekeeping service requests for clean-up of suspected mold, none of the information we reviewed indicated problems with mold growth within the Brewster A-wing.

Volatile Organic Compounds (VOCs)

Many odors come from VOCs, a large class of organic chemicals (containing carbon) that can exist as a gas at room temperature. VOCs can come from many sources, including carpet, fabrics, adhesives, solvents, paints, cleaners, waxes, cigarettes, perfume, deodorants, and combustion sources. Studies in offices have measured widely ranging VOC concentrations in indoor air, as well as wide differences in the types of VOCs present. The VOC measurements in these studies have been consistently well below levels regulated by Occupational Safety and Health Administration (OSHA) for workplace exposures. Currently no guidelines or standards exist for VOCs in non-industrial workplaces like Brewster A-wing. None of the information we reviewed indicated any occupational sources of VOC exposures within the Brewster A-wing.

Radon and gamma radiation

Radon is a radioactive gas that is a product of the breaking down of radioactive elements, such as uranium. These radioactive elements are found naturally in different amounts in soil and rock throughout the world. Radon gas emitted from soil or rock can enter buildings through cracks or other openings in their foundation. Radon levels are typically highest in the basement as this level is closest to the rock or soil that is the source of radon. High levels of radon exposure are more typically observed in workers in industries like uranium processing. Long-term exposure to high levels of radon can cause lung cancer [ACS 2015].

Across the United States, background concentrations of radon in outdoor air range from 0.003 to 2.6 pCi/L and are higher in areas with uranium and thorium deposits or granite formations [DOE 1995]. According to the EPA map of radon zones for North Carolina, the city of Greenville (residing in Pitt County) has "a predicted average indoor radon screening level of less than 2 pCi/L– Low Potential" [EPA 1992].

The EPA recommends taking corrective measures when in-home radon levels exceed 4 pCi/L. However, the recommendations and action levels for indoor radon provided by the EPA are not directly applicable to a workplace environment. For occupational settings, the OSHA permissible exposure limit (PEL) is 100 pCi/L for a 40-hour exposure in any work week of seven consecutive days. When radon testing was performed at Brewster A-wing, all sample measurements were well below the OSHA PEL of 100 pCi/L and below the EPA action level of 4 pCi/L.

Ionizing radiation comes from x-ray machines, cosmic particles from outer space, and radioactive elements. Radioactive elements emit ionizing radiation as their atoms undergo radioactive decay. The US EPA also publishes a guide to common radiation sources (https://www.epa.gov/radiation/radiation-sources-and-doses).

None of the information we reviewed indicated any occupational sources of gamma radiation within the Brewster A-wing and measurement results showed that the levels in the building were similar to those measured outdoors. In addition, the measured levels of 10 to 13 µrem/hr (equivalent to 20 to 26 millirem per work year) were well below the 5000 millirem annual occupational dose limit established by the U.S. Nuclear Regulatory Commission.

Asbestos

Asbestos is a naturally occurring, fire-resistant mineral that has been used as an acoustic insulator, in thermal insulation, in fire-proofing and other building materials, as well as in brake pads and industrial filters. Many products in use today contain asbestos.

Asbestos is made up of microscopic bundles of fibers that may become airborne when asbestos-containing materials are damaged or disturbed. Exposure to airborne friable (easily crumbled) asbestos might result in a potential health risk because persons breathing the air might breathe in asbestos fibers. Continued exposure can increase the number of fibers that remain in the lung. Fibers embedded in lung tissue over time might cause serious lung diseases including asbestosis, cancer of the lung, and mesothelioma. Additionally, there is sufficient evidence in humans that exposure to asbestos may cause cancer of the larynx and ovary [IARC 2012]. Smoking increases the risk of developing lung cancer from asbestos exposure. Diseases associated with asbestos are thought to have a long latency period, which means the development of asbestos-related diseases might take up to 30 years from the time of exposure [ATSDR 2001; NCI 2021].

Asbestos exposure is a well-known health hazard and can cause a great deal of concern to those who occupy buildings with ACM, which are often present in older (pre-1970) buildings. Everyone is exposed to asbestos at some time during their life. Low levels of asbestos are present in the air, water, and soil. However, most people do not become ill from their exposure. People who become ill from asbestos are usually those who are exposed to it on a regular basis, most often in a job where they work directly with the material or through substantial environmental contact [NCI 2021]. Nevertheless, no risk-free level of exposure to airborne asbestos fibers has been established.

In 1986, Congress passed the Asbestos Hazard Emergency Response Act (AHERA). The Act (40 CFR Part 763 Subpart E) required the EPA to enforce regulations requiring educational agencies to inspect their school buildings for asbestos-containing material (ACM), prepare asbestos management plans, and perform asbestos response actions to prevent or reduce asbestos hazards. Detailed information and discussions about various asbestos related federal regulations can be found at https://www.epa.gov/asbestos/asbestos-laws-and-regulations. Additionally, the EPA also published a comprehensive document "Asbestos Frequently Asked Questions" located at https://www.epa.gov/sites/production/files/documents/asbestosfaqs_0.pdf.

AHRERA regulations require that building owners, in addition to informing building workers as required by OSHA, inform occupants and tenants about the location and physical condition of ACM, and stress the need to avoid disturbing the material. Occupants should be notified for two reasons: (1) There may be a potential hazard in their vicinity; and (2) informed persons are less likely to disturb the material and cause fibers to be released into the air. The specific information given to building occupants will vary by need. A two-hour Asbestos Awareness Training course for occupants may address such topics as (1) background information on asbestos, (2) health effects of asbestos, (3) worker protection programs, (4) locations of ACM in the building, (5) recognition of ACM damage and deterioration, (6) the Operation and Maintenance (O&M) program for that building, and (7) who to contact if ACM is damaged or disturbed.

Asbestos must be managed properly to minimize human exposure and environmental releases. AHERA provides guidance for managing ACM in two key documents: the ACM Inventory and the O&M Plan. An ACM Inventory documents the amount, type, location, and condition of ACM in a building. A visual reinspection of all ACM should be conducted at regular intervals as part of the O&M plan to help ensure that any ACM damage or deterioration will be detected, and corrective action taken. An O&M plan outlines the training, cleaning, work practices, and surveillance needed to maintain any ACM in the building in good condition. The goal is to minimize exposure of all building occupants to asbestos fiber. It is acceptable practice to "assume" building materials contain asbestos (and manage them as such) without testing them, provided testing is performed before materials are handled as non-asbestos containing. Based on the information we reviewed, it appears the asbestos inventory and O&M plan are being kept up to date.

Pesticides

The U.S. EPA Agricultural Worker Protection Standard requires any person who applies or supervises the use of pesticides to be certified in accordance with EPA regulations and state, territorial, and/or tribal laws [https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps]. The North Carolina Department of Agriculture & Consumer Services (NCDA&CS) regulates the application of pesticides and requires licensing for commercial applicators applying any type of pesticide for compensation, public operators working for a state or local government who apply pesticides in their course of work, dealers selling restricted use pesticides, or pest control consultants making recommendations for pesticide treatment of pest problems.

There is no mention of training or state certification in the documentation we reviewed; however, we received only pest control work orders and not a written Integrated Pest Management Program (IPM) document. It is very important to ensure that all employees involved in a IPM program (1) know their role, (2) receive sufficient training to perform their role, and (3) communicate their activities to the ECU IPM Manager. When contractors are involved in IPM, it is critical that they and the IPM Manager perform their due diligence to ensure the compatibility and suitability of all pesticides used at a facility.

Conclusions

We found no evidence that the cancers reported by ECU employees working in the Brewster A-wing are associated with a common workplace exposure. No significant hazardous exposures were identified, and employees are unlikely to have any exposure or concerning levels of exposure to cancer-causing substances in the workplace. The distribution of cancer types reported by ECU employees is not unusual and there does not appear to be an excess of cancer.

We do not believe further case finding or investigation would lead to the identification of a cluster or unusual pattern of cancer among employees.

We encourage ECU management to communicate the results of this HHE with all ECU employees. Acknowledging employees' concerns, focusing on transparency, and increasing communication including receiving and responding to questions from all potentially affected employees will provide a consistent and reliable source of information about the safety of the workplace and may reduce occupational health and safety concerns over time.

Recommendations

Based on our conversations and the information provided, we recommend the actions listed below to create a healthier workplace. We encourage management to coordinate with employees when developing an action plan to address these recommendations. Employees directly involved in the work can best set priorities and assess the feasibility of our recommendations for the specific situation in Brewster Building A-wing and other ECU facilities.

1. Inform employees about this evaluation and share this letter with employees. CDC posts general information about occupational cancer at Occupational Cancer | NIOSH | CDC, and information about cancer cluster evaluations at Guidelines for Examining Unusual Patterns of Cancer and Environmental Concerns | NCEH | CDC.

2. Improve communication between managers and employees regarding responses to employee health and safety concerns. A supervisor or manager who is sensitive to the employees' concerns should communicate directly with those who report health and safety concerns. Points to consider include:
    - Actively listening to employees' concerns in a nonjudgmental manner. Employees should feel that their concerns are taken seriously.
    - Regularly informing employees of exactly what steps are being taken to assess the problem, what has been determined, and what remains to be determined. A combination of written reports and face-to-face meetings are valuable.
    - Routinely share information with employees rather than waiting until a cause of the problem is discovered; this will reduce the chance of distorted rumors.

3. Encourage employees to learn more about known cancer risk factors and measures to reduce risk for preventable cancers. Even though cancers among employees are not likely due to their work, employees may still have concerns about their own risk for cancer.
    - Modifiable personal risk factors that are associated with certain types of cancer include tobacco use, high alcohol consumption, a diet low in fruits and vegetables, physical inactivity, and obesity.
    - Employees should discuss available cancer screening programs according to age, sex, or family history with their primary care provider. For some types of cancer,

these programs can lead to earlier detection and earlier treatment, which may increase the chances of curing the disease.

- The American Cancer Society has information about cancer risk factors (What Causes Cancer? | American Cancer Society), as well as additional information that may help address some employee concerns regarding cancer clusters (Cancer Clusters).

4. Encourage employees to seek assessment and treatment from a qualified health professional if they are experiencing work-related symptoms. Occupational medicine physicians can be found through a variety of sources, including the Association of Occupational and Environmental Clinics (http://www.aoec.org/) and the American College of Occupational and Environmental Medicine (http://www.acoem.org/). It may be useful to provide the physician with a copy of this report.

5. Consider providing employees with assistance in modifying personal risk factors for cancer. Options include tobacco cessation programs [NIOSH 2015], nutritional counselling, and exercise programs. Information about the NIOSH Total Worker Health Program can be found here: https://www.cdc.gov/niosh/twh/.

6. Implement a formal (preferably anonymous) system for reporting building concerns to the facilities maintenance manager or a building administrator. This system can be paper or electronic and should include a feedback mechanism to let staff know when and how the problem is fixed.

7. Continue to improve your IEQ management program. If you would like more information on IEQ, including the documents "Building Air Quality–A Guide for Building Owners and Facility Managers" and "Building Air Quality Action Plan" see the NIOSH Topic Page on Indoor Environmental Quality. The basic elements of a good IEQ plan include the following:
    - Properly operating and maintaining the ventilation equipment.
    - Overseeing the activities of occupants and contractors that affect IEQ (e.g., housekeeping, pest control, maintenance).
    - Ensuring effective and timely communication with building occupants regarding IEQ.
    - Educating employees about their responsibilities in relation to IEQ.
    - Proactively identifying and managing projects and renovations that may affect IEQ.

8. We do not recommend additional air sampling for VOCs, mold, or other potential indoor contaminants to address IEQ complaints. These results are unlikely to alter recommendations, such as improving the HVAC systems in the building. In addition, no standardized evaluation criteria exist to assist in the interpretation of the data. Finally, the cost of these tests (both in sample collection and analysis) can be high.

9. Consult with a qualified ventilation contractor to ensure that existing HVAC systems are functioning as designed, are appropriate for the work, and that all occupied spaces are receiving an adequate amount of outdoor air, keeping in mind available guidelines.
    - We recommend a test and balance be performed every five to seven years to ensure HVAC systems continue to operate as designed.
    - We also recommend a test and balance be performed when significant changes occur in the areas these systems serve (e.g.: number of occupants, type/amount of equipment used, nature of work performed, overall size of the space).

10. Update your fragrance-free workplace policy. Ensure the policy addresses perfumes and other scented personal care products, air fresheners, and potpourri.
    - The American Lung Association publishes a sample fragrance-free school policy: http://action.lung.org/site/DocServer/fragrance-free-policy-sample-updated.pdf.

This letter serves as a final report and concludes this health hazard evaluation. NIOSH recommends that employers post a copy of this letter for 30 days at or near work areas of affected employees. We are sending a copy of this letter to the Occupational Safety and Health Administration Region IV Office and the North Carolina Department of Health and Human Services.

Thank you for your cooperation with this evaluation. If you have questions, please contact Karl D. Feldmann (ecz4@cdc.gov) or Emily McDonald (okm3@cdc.gov).

Sincerely yours,

Karl Feldmann -S7

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North Carolina Department of Health and Human Services

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Appendix A

The pancreas is an organ located in the abdomen; it contains two different cell types that accomplish its main functions. Exocrine cells produce enzymes that help with digestion and neuroendocrine cells produce hormones, such as insulin, that help with regulating blood sugar levels. Pancreatic cancer can develop from either of these two different cell types, but pancreatic cancer arising from the exocrine cells is more common [NCI 2022].

Pancreatic cancer usually produces few or no symptoms early in the course of disease and effective screening tools for early detection do not exist currently. As a result, most pancreatic cancer cases are diagnosed at an advanced stage of disease when they are difficult to treat and have a poor prognosis [NCI 2022]. The 5-year relative survival rate for people in the United States diagnosed with pancreatic cancer is 12% overall [ACS 2022a].

Pancreatic cancer is the 11th most common type of cancer in the United States and the 3rd leading cause of cancer deaths [NCI 2020b]. Approximately 62,210 cases of pancreatic cancer will be diagnosed in men and women in the United States in 2022 and the estimated number of pancreatic cancer deaths is 49,830 [Siegel et al. 2022]. The lifetime risk of pancreatic cancer is approximately 1 in 64, or 1%–2%. However, a person's individual risk is affected by a number of risk factors and can be higher or lower than these estimates [ACS 2022b]. Some of these risk factors cannot be changed (e.g., family history), but others are modifiable through behavior changes (e.g., tobacco use).

Well-established pancreatic cancer risk factors include age, sex, family history of pancreatic cancer, tobacco use, obesity, diabetes, chronic pancreatitis from heavy alcohol use or an inherited gene mutation, and certain occupational exposures [ACS 2020]. It is estimated that 12% of pancreatic cancer cases can be attributed to occupational risk factors [Ojajärvi et al. 2000]. Chemicals used in dry cleaning and metal working industries are the most well-established occupational exposures associated with pancreatic cancer [Andreotti and Silverman 2012].