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DAUPHIN COUNTY PRISON
HARRISBURG, PENNSYLVANIA**

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Summary

On February 23-24, 1994, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at the Dauphin County Prison in Harrisburg, Pennsylvania, to evaluate possible health problems related to working in a specific area of the prison. The health problems listed in the request included rash, elevated blood pressure, increased heart rate, headache, and throat irritation.

The medical portion of the HHE consisted of reviewing medical records for 17 employees, interviewing 30 employees, and examining the skin of three workers. The industrial hygiene evaluation consisted of: a visual inspection of accessible parts of the heating, ventilation, and air conditioning (HVAC) system, the collection of bulk samples from the HVAC interior acoustical lining for microbial content analysis, and the measurement of carbon dioxide (CO₂) concentration, temperature (T), and relative humidity (RH).

Results of medical record reviews and interviews revealed employees with symptoms in the general category of irritative or allergic symptoms of the skin, the mucosal surfaces, and/or upper airway. In addition employees complained of problems with thermal comfort and high stress in the workplace. Skin examinations revealed one individual with urticaria (hives or wheals).

Inspection of the HVAC system revealed several environmental deficiencies. The CO₂ concentrations, T, and RH levels were within the acceptable ranges. The outdoor air requirements for ventilation were not satisfied. The bulk samples collected revealed the presence of fungi (Penicillium and Yeast), bacteria, and thermoactinomyces.

No definitive source of the employees' symptoms was found. The pattern of symptoms is consistent with poor indoor environmental quality (IEQ). Recommendations include: continued medical evaluation of medical complaints, improving communication channels in the workplace, establishing a non-smoking environment, removing all contaminated acoustical lining, evaluating the HVAC system to assure that it is adequately sized and designed for the current application, and establishing a preventive maintenance (PM) schedule for the HVAC system.

KEYWORDS: SIC 9223 (Correctional institutions), indoor environmental quality, ventilation, bioaerosols, mucosal irritation, allergy, urticaria

Introduction

On February 23-24, 1994, NIOSH conducted a health hazard evaluation (HHE) at the Dauphin County Prison in Harrisburg, Pennsylvania, to evaluate possible health problems related to working in the J and K cell blocks and the K control area of the prison. The health problems of correctional officers listed in the HHE request included rash, elevated blood pressure, increased heart rate, headache, and throat irritation. Specifically, NIOSH was asked by prison management and representatives of the Chauffeurs, Teamsters, and Helpers Local Union No. 776 to determine if some contaminant in the prison could be producing these symptoms.

Background

The Dauphin County Prison consists of the main prison and the attached Spring Creek facility. The main prison was built in the 1950's and currently holds 500 male prisoners. The Spring Creek facility was opened in 1986 and holds 142 minimum security male prisoners and 72 female prisoners.

The prison is staffed by 162 correctional officers (rank of sergeant and below), 17 supervisory officers, 67 other staff members, 21 contractors, and nine maintenance personnel. The correctional officers work on scheduled shifts, and the choice of shift and work assignment areas are based upon a seniority bidding process. Thirty-six correctional officers and two supervisors are assigned to the first and second shifts (6 a.m. to 2 p.m. and 2 p.m. to 10 p.m., respectively). Twenty six correctional officers and two supervisors work the third shift (10 p.m. to 6 a.m.). Officers are issued uniforms and carry pouches with alcohol pads, gloves, and cardiopulmonary resuscitation masks. Only the shift commander carries a hand-held mace canister.

Medical care for prisoners is provided by contract nurses in a triage room in the Spring Creek facility and in an exam room at the main facility. These nurses also provide first aid for prison employees, but most medical care for employees is provided by an outside clinic.

The J and K cell blocks and the K control area are located in the Spring Creek facility. This area will be referred to as the J-K area. The cell blocks house female prisoners and are staffed by three officers on each of the shifts. This women's wing was designed to hold 35-40 prisoners but has been routinely housing 75-80 prisoners. The officers are responsible for monitoring activities on the cell blocks and for manning the K control area. A variety of prisoner activities occur on the cell blocks during first and second shifts. Lights are turned off in the cell blocks during the third shift.

Cell block J is a two story structure with an open activity area, a laundry room, a lavatory complex, two storage rooms, and four separate sleeping areas (Figure 1). The cell block is serviced by an independent heating, ventilating, and air-conditioning (HVAC) package unit system, air handling unit (AHU-2), which is located in the Spring Creek mechanical room. AHU-2 is a constant air volume (CAV) system that operates 24 hours per day. Outside air and return air mix inside AHU-2, and the mixed air is filtered through low efficiency air filters. The filtered, mixed air passes through the cooling and heating coils and is delivered to the cell blocks via the duct work. Return air from the cell blocks is ducted (interior fiberglass insulation) to AHU-2. Also, there is a return air grille located in the wall between the Spring Creek mechanical room and the open activity area in J block. The return air is ducted to AHU-2. The outdoor air damper is controlled with a manually operated rheostat.

Cell block K is a two-story structure with an open activity area, two storage rooms, a utility room, a segregation room, a shower area, and twenty individual cells (Figure 1). The cell block is serviced by an independent HVAC package unit system, AHU-3, that is located in K mechanical room. AHU-3 is a CAV system that operates 24 hours per day. The K mechanical room serves as the mixing plenum for return air from the cell blocks and the open activity area. Return air from the cell blocks is ducted to K mechanical room while air from the open activity area enters K mechanical room through a return air grille in the adjoining wall. The air enters AHU-3, mixes with outdoor air, is filtered through low efficiency washable filters, and is ducted to the open activity area. The outdoor air damper is controlled with a manually operated rheostat.

The connecting corridor between cell blocks J and K is approximately sixty feet long with eight feet ceilings. There are two fan coil package units located above the dropped ceiling which provide conditioned air to the corridor, K control, and K segregation areas. The 100% recirculated air is filtered through low efficiency air filters. The filtered air passes through the heating and cooling coils and is delivered to the areas mentioned above via the air ducts (exterior fiberglass lining). Air returns to these ventilation systems through the plenum.

According to a report issued by an engineering and planning consulting group (Gannett Fleming Engineers and Planners), at approximately 1:30 a.m. on January 30, 1993, four officers working in the J and K blocks and K control experienced a sudden onset of symptoms that included: a raised skin rash, itching, headache, eye irritation, dry throat, nausea, abdominal pain, and dizziness. These officers were evaluated by the prison nurse and were subsequently transported to Harrisburg General Hospital Emergency Department. Three officers working the same 10 p.m. to 6 a.m. shift on the two following nights (January 30-31, January 31-February 1) had similar symptoms, as did two officers working the day shift on February 1. The engineering consultants were called in to investigate the situation on February 1 and they noted that three more officers had symptoms. The J-K area was vacated on February 1

because of unexplained symptoms experienced by officers.

The Pennsylvania Department of Health conducted a site visit on February 2 and conducted interviews on February 4. From February 6-11, the J-K area underwent cleaning with a high-pressure hot water wash with cleaning additives, scrub brushes, mops, and rags. A cinder block was removed to increase air circulation into the K mechanical room and the connecting corridor. The J-K area was reoccupied by officers and prisoners on February 12.

In March 1993 the K control area and the corridor were made non-smoking areas. Smoking is allowed on J and K cell blocks, near the Spring Creek control room, and in the lunch room. Symptoms recurred among officers in April and May 1993. The Health Department returned for another evaluation on May 3, 1993. From May 1993 until February 1994, officers continued to intermittently experience a variety of symptoms while working in the J-K area.

Previous Evaluations

Previous evaluations were conducted by Gannett Fleming Engineers and Planners of Harrisburg, Pennsylvania, and by the Pennsylvania Department of Health. A report of the February 1-12 investigation by Gannett Fleming Engineers and Planners was issued on March 4, 1993. The report noted the following:

1. A faint sweet odor in J block on February 1;
2. Tobacco smoke odors in K block and K control;
3. Elevated temperatures in K block and K control with no notable air movement in K block;
4. The air intake for the ventilation system in J block was close to the exhaust stacks for gas fired boilers and a hot water heater;
5. The corridor fan coil unit had a dirt layer and a potential area of moisture deemed sufficient for growth of micro-organisms; the corridor had no supplied outside makeup air;
6. Monitoring for organic vapors, carbon dioxide, and carbon monoxide showed no increased levels in J block, K block, K control, or the corridor.

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According to the report, a definite cause for the sudden outbreak of illness among officers was not established but deemed to be "an unknown airborne substance within J and K blocks, in most probability occurring near K control."

The Pennsylvania Department of Health issued a report in February 1993. Investigators used a case definition of:

1. raised or itchy rash, or systemic symptoms (headache, abdominal pain, vomiting, diarrhea), plus
2. allergic symptoms (including non-raised itchy rash, itchy eyes).

Twenty four of 32 employees who had noted symptoms were interviewed. Twenty three of the 24 (17 females and 6 males) met the case definition. The first ill worker noted that symptoms appeared at approximately 1 a.m. on January 27; and, the last affected person noted symptoms at 8 p.m. on February 2. Most individuals had symptoms begin on January 30; 16 of the 23 noted that the symptoms began in the J-K area, and one noted symptoms minutes after leaving this area. The median onset time was one hour after entering the J-K area. The mean symptom resolution time was two hours after leaving the area. Cases were scattered through all three shifts, and symptoms occurred in different locations of the J-K area. The report lists no definite cause of the symptoms, but states: "The outbreak seems to have been caused by airborne exposure to something in the K and/or J cell areas..." The report also noted that "prisoners did not seem to be affected much, if at all (according to prison officials)..." and this "would seem to locate the main focus of the problem in the K control area," which is used by officers and not by prisoners.

Methods

Medical Investigation

Prior to the site visit, medical records were obtained for all officers who had sought medical care or had been referred to medical professionals for evaluation of work-related problems commencing in January 1993. The medical portion of the on-site investigation consisted of a walk-through survey of the Spring Creek facility, including the J-K area, and confidential interviews with correctional officers, supervisors, and staff who worked in the J-K area. The interview consisted of the following questions: name, age, current job, assigned shift, amount of time spent in J-K area, years at job, work-related complaints or medical problems, allergy history, smoking history, job stress assessment, perception of workplace odors and temperature comfort levels, medical care sought, and current medications. Skin examinations were conducted for individuals complaining of skin problems.

Environmental Investigation

On February 23, 1994, a walk-through survey of the Spring Creek facility was conducted. The following day a visual inspection of accessible parts of the ventilation systems was conducted,

including the outside air intake, mixed air plenum, filters, heating coils, cooling coils, and condensate pans. Further, bulk samples from both HVAC systems' interior acoustical lining were collected and sent to a laboratory to be characterized for microbial content. In addition to collecting the information described above, indicators of occupant comfort were measured. These indicators were carbon dioxide (CO₂) concentration, temperature (T), and relative humidity (RH).

Real-time CO₂ concentrations were measured using a Gastech Model RI-411A, portable CO₂ indicator. This portable, battery-operated instrument uses a non-dispersive infrared absorption detector to measure CO₂ in the range of 0-4975 parts per million (ppm), with a sensitivity of ±25ppm. Instrument zeroing and calibration were performed prior to use with zero air (free of CO₂) and a known concentration of CO₂ span gas (800 ppm).

Real-time temperature and humidity measurements were made using a Vaisala, Model HM 34, battery-operated meter. This meter is capable of providing direct readings for dry-bulb temperature and RH, ranging from, -4 to 140°F and 0 to 100%, respectively. Instrument calibration is performed monthly using primary standards.

Evaluation Criteria

Standards specifically for the non-industrial indoor environment do not exist. NIOSH, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH) have published regulatory standards or recommended limits for occupational exposures.¹⁻³ With few exceptions, pollutant concentrations observed in non-industrial indoor environments fall well below these published occupational standards or recommended exposure limits. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation design criteria and thermal comfort guidelines.^{4,5} The ACGIH has also developed a manual of guidelines for approaching investigations of building-related complaints that might be caused by airborne living organisms or their effluents.⁶

Measurement of indoor environmental contaminants has rarely been helpful in determining the cause of symptoms and complaints except where there are strong or unusual sources, or a proven relationship between contaminants and specific building-related illnesses. The low-level concentrations of particles and mixtures of organic materials usually found are difficult to interpret and usually impossible to causally link to observed and reported health symptoms. However, measuring ventilation and comfort indicators such as CO₂, T, and RH, has proven useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems. The basis for measurements made during this evaluation are listed below.

Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath and, if monitored, may be useful as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. The ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, and 15 cfm/person for reception areas, and provides estimated maximum occupancy figures for each area.⁴

Indoor CO₂ concentrations are normally higher than the generally constant ambient CO₂ concentration (range 300-350 ppm). When indoor CO₂ concentrations exceed 1000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated CO₂ concentrations suggest that other indoor contaminants may also be increased.

Temperature and Relative Humidity

The perception of comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. ANSI/ASHRAE Standard 55-1981 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally comfortable.⁵

Microbiological Contaminants

Microorganisms (including fungi and bacteria) 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 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 particles or water droplets. 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, where there is no unusual source of microorganisms, 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.^{7,8}

Acceptable levels of airborne microorganisms have not been established, primarily due to the lack of research addressing the dose-response relationship of health effects and allergen exposure and the varying susceptibilities of individuals. As such, relationships between health effects and environmental microorganisms must be determined through the combined contributions of medical, epidemiologic, and environmental evaluation.⁶ The current strategy for on-site evaluation involves a comprehensive inspection of the problem building to identify sources of microbial contamination and routes of dissemination.

Results

Medical Record Review

According to prison officials 18 individuals had recently sought medical care as a result of symptoms that the individuals felt were related to working in the J-K area. Medical records were obtained for 17 individuals, in some cases from multiple health care providers.

Medical record review revealed that during the initial incident in January 1993, 13 officers were seen in the Harrisburg Hospital Emergency Department over a period from the early morning hours of January 30 through the early morning of February 5. Four employees had two or more visits to the emergency department during this time span. Three employees sought emergency medical care in the early morning of January 30, one was seen on January 31, three were seen on February 1, ten were seen in the late morning/afternoon of February 2, and one was seen on February 5. Three employees were evaluated in the emergency

department on May 26-27. Eight employees were subsequently followed up for medical care at the Hershey Medical Center, and ten employees had followup care with a variety of health care professionals.

Review of emergency department records and the records of subsequent evaluations revealed no specific etiology of the health complaints. Physical examinations of most individuals revealed no relevant abnormalities. Some abnormal findings were related to chronic non-work-related medical problems. Other emergency department findings and diagnoses are listed in Tables 1 and 2. Routine laboratory data obtained in the emergency department were not helpful in determining an etiology.

Overall, the emergency department medical records identified a variety of non-specific medical conditions and did not suggest a specific cause of the incidents in January and May 1993. In addition, medical record of followup evaluations also revealed a variety of medical conditions with undetermined diagnoses and causes.

Medical Interviews

Forty eight officers and staff of the Dauphin County Prison were scheduled by prison officials for medical interviews with the NIOSH medical officer. These included all individuals who had a record of work-related health complaints or had questions about their health or the work environment. Four additional officers or staff requested to be interviewed during the site visit. Thirty of the 52 scheduled individuals were interviewed, for a response rate of 58%. Of the other 22,

14 were either scheduled to be off of work or could not make it in because of the snowy weather, and 8 did not participate in the interviews for unknown reasons.

Of the 30 individuals interviewed, 23 were officers, 5 were staff, and 2 were contract nurses. The respondents included 14 individuals from the first shift, 10 from the second, and 6 from the third shift. Of the 30 respondents, 18 were female and 12 male. The age range for respondents was 26-70 years, with a mean of 37. Years worked at the prison ranged from 1.5 to 22, with a mean of 6.

Of the 30 respondents, 7 had no contact with the J-K area, 16 were in this area less than twice a week, and 7 were in the J-K area more than twice a week. Nineteen (63%) stated that they had no current work-related symptoms. The others reported a variety of current symptoms listed in Table 3. Twenty three of the respondents had a variety of symptoms during the incident in January 1993 which are listed in Table 4. Nine of the respondents had a recurrence of symptoms in April or May of 1993.

Sixteen of the respondents had a history of allergies. Twenty seven complained of feeling either too hot or too cold while working in the prison. Of the 23 officers, 14 noted that working in the

J-K area was more stressful than working in other areas of the prison, based upon the difficulty of working with the prisoners and the fear of allegations of sexual misconduct. Twelve individuals had sought medical care from a health professional for possible work-related problems.

Skin Examinations

During the site visit, one individual presented with an eruption consistent with generalized urticaria (hives or wheals). One individual had dermatographism (a condition characterized by the development of hives on an area of skin that is scratched; often this is a sign of hypersensitivity). One individual had adult acne vulgaris. There were no other distinct skin eruptions seen on skin examination.

Environmental Results and Observations

Inspection of the ventilation systems revealed several environmental deficiencies. K mechanical room, which is the return air plenum for AHU-3, was very dirty. Dust and lint were observed on all surfaces, and standing water was found on the floor. It is important to note that the dryer located in J laundry room was exhausted directly into K mechanical room. This allows water vapor, lint, and odors to be entrained with the return air into AHU-3. Inside the HVAC system, the washable low efficiency air filters were clean. The heating and cooling coils were also clean; however, an accumulation of dry scaly debris was observed in the condensate pan. The acoustical lining downstream of the coils was very dirty, and the existence of biological growth was evident. Subsequent laboratory analysis of the bulk material collected from the acoustical liner confirmed amplification of biological material in the HVAC system. The manually operated damper control, which regulates outdoor air intake, was set at 75% outdoor air; however, the outdoor air damper was completely closed. Further observation identified a pneumatic cylinder that was not operating. Maintenance logs indicate that the air filters were inspected monthly and washed if needed.

In general, the Spring Creek mechanical room, which houses AHU-2, was clean and in good condition. Inside AHU-2 the low efficiency air filters and the heating and cooling coils were clean. Dry scaly debris were observed in the condensate pan downstream of the coils, and the acoustical lining was dirty. Maintenance logs indicate that the air filters were inspected monthly and changed if needed. The manually operated damper control was set at 0% outdoor air. According to maintenance personnel, outdoor air is used to "free-cool" the building during the winter. However, when occupants complain about thermal comfort, the outdoor air dampers are shut. Further observation demonstrated the system was fully functional.

Inside fan coil unit #5, the low efficiency air filters were clean and fit tight in the filter frames. An accumulation of dust was observed on the heating and cooling coils, and the condensate pan had a noticeable buildup of dry scaly debris. The interior acoustical lining was very dusty and

dirty. The supply air grilles in K control and K segregation were very dirty. According to the maintenance logs, the filters were checked every three months and changed if needed. A cinder block was removed from the wall adjoining K mechanical room and the corridor to increase the movement of air in the corridor. As a result, air containing environmental tobacco smoke from K-block was introduced into the corridor (a non-smoking area) and an accumulation of lint material was observed on the pipes and ceiling tiles above the dropped ceiling.

Figure 1 is a floor plan of the evaluated area with sample locations designated by numbers. The results of CO₂ measurements are presented in Figure 2. Carbon dioxide levels ranged from 725 to 925 ppm during the morning (~8:45 to 9:10 a.m.) and from 700 to 950 ppm during the afternoon period (~1:15 to 1:40 p.m.). The CO₂ concentrations in the evaluated areas were below the ASHRAE recommendations of 1,000 ppm on the day of the evaluation; however, the outdoor air requirements for ventilation specified in ASHRAE 62-1989 were not satisfied. The outdoor CO₂ concentration was 350 ppm (within the normal range for outdoors).

Temperatures ranged from 72 to 75°F during the morning period and from 74 to 76°F during the afternoon period. The outdoor temperature ranged from 40 to 46°F between these time periods. Temperatures measured during both time periods reached the upper end of the ASHRAE acceptable ranges for operative temperature for the winter.

The relative humidity (RH) on the day of the evaluation ranged from 30 to 40% (outdoor RH was 23%). These measurements are within the acceptable comfort range proposed by ASHRAE.

The two bulk samples collected were analyzed for microbial content. Sample 1 was collected from the AHU-2 return air duct located in the storage room adjacent to the Spring Creek mechanical room. Sample 2 was collected from AHU-3 approximately one foot downstream of the coils. All of the fungal taxa identified are normal constituents of the environment. The fungi identified in samples 1 and 2 were *Penicillium* and Yeast, respectively. The predominance of yeast colonies signifies the presence of moisture. While yeasts have not been documented to cause immunologic problems, their existence and the quantity present in this case indicates an environment favorable for the growth of microorganisms. The bacteria, which were only detected in sample 1, were identified as *Bacillus megaterium* (50%), *Bacillus insolitus* (25%), and *Pseudomonas fluorescens* (25%). *Thermoactinomyces* were detected in both samples. The actinomycetes (both mesophilic and thermophilic) are unusual in nonfarm, indoor environments.

Discussion

Like the previous investigations, NIOSH investigators could find no definitive source of the employees' symptoms during the incidents of January or May 1993. Many of the symptoms that employees associated with working in the J-K area fall in the general category of irritative or allergic symptoms of the skin, the mucosal surfaces, and/or upper airway. Many things can cause these symptoms, including environmental particulates/dusts. Dusts may produce mechanical effects and irritant skin eruptions.⁹ Airborne particles may also induce mucosal or airway irritation. Mold spores are known to induce a variety of health effects including respiratory and mucosal symptoms.^{10,11} In genetically predisposed individuals, allergic symptoms can occur with exposure to dusts, molds, and many other inhalants.¹²

The bulk samples analysed for microbial content revealed the presence of actinomycetes. Although actinomycete contamination is unusual in the nonfarm, indoor environment, its presence does not imply an etiology of the employees' symptoms. None of the illnesses were suggestive of hypersensitivity pneumonitis, the disease associated with thermophilic actinomycetes.

Some individuals complained of a skin reaction called urticaria. Urticaria, also called hives or wheals, are red, raised lesions on the skin that come and go and last, by definition, less than 24 hours. Acute urticaria is common and occurs at least once in 15-20% of adults, usually those with an atopic or allergic history. Unfortunately, the exact causes of the urticaria, as in this case, can be difficult to determine. The list of causes are extensive and include antibiotics and other medicines, a variety of foods, infections, pollens, mold spores, animal danders, pressure, vibration, cold, heat, water, and other contactants.¹³

During the incidents in 1993, a few individuals had evidence or complaints of hypertension (elevated blood pressure). Only a few occupational chemical exposures can cause hypertension. None were found in this worksite.

Twenty seven officers complained of problems with thermal comfort in the workplace. Fourteen correctional officers stated that working in the J-K area of the prison was more stressful than working in other areas. Repeating themes included relative difficulties working with female prisoners and the fear of sexual harassment or misconduct allegations. Such stressful work environments can play a role in or amplify work-related health complaints.

The diverse symptoms experienced by employees in this worksite are not suggestive of any particular medical diagnosis or readily associated with a specific causative agent or environmental condition. In general, symptoms improved when employees were out of the building. Although this pattern of symptoms is consistent with an acute work-related health effect, efforts to identify environmental contaminants that could explain these symptoms have been generally unsuccessful.

Inspection of the HVAC system revealed several environmental deficiencies, including the accumulation of dusts, lint, and debris. The CO₂ concentrations, T, and RH levels were within the acceptable ranges. The outdoor air requirements for ventilation were not satisfied. Analysis of the acoustical liner of the HVAC system revealed the presence of fungi (Penicillium and Yeast), bacteria, and thermoactinomyces. These environmental deficiencies were noted, although they may not necessarily be related to the health complaints.

Previous investigations have revealed that health complaints in non-industrial work environments may be related to poor indoor environmental quality (IEQ) due to ventilation system deficiencies, overcrowding, tobacco smoke, microbiological contamination, outside air pollutants and volatile organic chemicals from furnishings, machines, and structural components of the building and contents. Other factors may include comfort problems due to improper temperature and relative humidity conditions, poor lighting, and unacceptable noise levels; adverse ergonomic conditions; and job-related psychosocial stressors. In most cases, however, these problems could not be directly linked to the reported health effects.

RECOMMENDATIONS

The following recommendations are based upon findings and observations made during the site visit of February 23-24, 1994. Many of these recommendations address environmental deficiencies which may not necessarily be related to the health complaints.

1. Any employee with work-related health complaints should be evaluated by a health care provider. Symptoms should be documented and the employees should be examined for the presence of any abnormalities on examination.
2. Better communication channels should be established between management and staff. This can help bring work-related health complaints and work-related stress to the attention

of management. In addition, better communication channels can foster a sense of shared responsibility for maintaining a safe and comfortable work environment, and assure that workplace concerns are communicated between everyone concerned. A proactive approach to recognize and negate potential problems is very important.

3. NIOSH recommends that workers should not be involuntarily exposed to tobacco smoke.¹⁴ Exposure to environmental tobacco smoke (ETS) may be responsible for irritant symptoms and can exacerbate allergic symptoms. Further, NIOSH has determined that ETS poses an increased risk of lung cancer and possibly heart disease to occupationally exposed workers.¹⁴ The best method for controlling worker exposure to ETS is to eliminate tobacco use from the workplace and to implement a smoking cessation program. Until tobacco use can be completely eliminated, the employer should make efforts to protect nonsmokers from ETS by isolating areas where smoking is permitted. Restricting smoking to designated areas outside the building (away from entrances, air intakes, and operable windows) or to separate enclosed indoor smoking areas with dedicated ventilation are two ways to do this. Air from smoking areas should be exhausted directly outside and not recirculated within the building or mixed with the general dilution ventilation for the building. ASHRAE recommends 60 cubic feet per minute (cfm) per person of outside or transfer air be supplied to the smoking area. A negative pressure in the smoking area relative to adjacent locations should be provided to prevent airflow back into the non-smoking workplace.^{4,14}
4. Based on the results of the microbial analysis, the acoustical lining in AHU-3 and in the return air duct of AHU-2 requires remediation efforts. Any other visible or suspected microbial contamination also requires remediation efforts. Remediation should include removal of the contaminated material and/or clean up with a high efficiency particulate air filter (HEPA) vacuum and decontamination with an effective chemical agent (5 to 10% solution of bleach). Removal should be limited to those materials not conducive to clean-up (i.e., porous building components). Remediation personnel should be appropriately equipped with personal protective equipment (HEPA-filtered respirators, clothing, gloves, etc.). For respirator use, the Occupational Safety and Health Administration requires a respiratory protection program.¹⁵
5. A qualified HVAC firm should be contracted to conduct a mechanical system audit of the ventilation systems serving the Spring Creek complex to verify that the system is adequately sized and designed for the current application. According to ASHRAE 62-1989 (Ventilation for Acceptable Indoor Air Quality), the amount of outside air delivered to the cells and guard stations should be a minimum of 20 cfm per person and 15 cfm per person respectively. The outdoor air supply should be a minimum of 10%.
6. The dryer in J laundry room should be exhausted directly outside instead of into K mechanical room. The dryer exhaust contains water vapor, lint, and odors which can be entrained with the return air into AHU-3.

7. The coils and condensate pans of both HVAC systems and fan coil units should be thoroughly cleaned and disinfected with a biocide (5 to 10% solution of bleach); the supply and return air grilles should be vacuumed with a HEPA filter. K mechanical room, the mixing plenum for return air, should be thoroughly cleaned, and standing water should not be allowed to accumulate on the floor.
8. The cinder block removed from the wall between K mechanical room and the corridor should be replaced. The HVAC system was not designed to supply the corridor with ventilation, and ETS is introduced into the corridor (a non-smoking area).
9. The low efficiency air filters used in both HVAC systems and fan coil units should be upgraded to the maximum efficiency possible without affecting the performance of the ventilation system. ASHRAE recommends using air filters with a minimum dust spot efficiency rating of 35 to 60%. Some current ventilation designs use filtration systems of 85% efficiency according to the ASHRAE dust spot test.
10. All components of the HVAC systems and fan coil units should be placed on a preventive maintenance (PM) schedule. This schedule should include: policing of units for debris accumulations; checks on systems to ensure proper operation; checks on the filters for air bypassing and general condition; yearly cleaning and calibration of control systems; monthly inspection and cleaning of coils, condensate pans and drains. Equipment manufacturers should initially be consulted for recommended PM practices and time frames for other components. Eventually, experience will dictate a time frame for PM functions that is applicable to the building's mechanical systems.

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1. Dauphin County Prison
2. Chauffeurs, Teamsters and Helpers Local Union No. 776
3. Pennsylvania Department of Health

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1
 Medical Record Review
 Emergency Department Findings
 January and May 1993

Emergency Department Findings	Number of employees
non-specific dermatitis	3
wheezing/bronchitis	2
folliculitis/acne	1
rhinitis	1
urticaria/hives	1
erythematous (red) throat	1
conjunctival (eye) irritation	1

Table 2
 Medical Record Review
 Emergency Department Diagnoses
 January and May 1993

Emergency Department Diagnoses	Number of employees
possible fume inhalation	6
possible exposure to toxin/toxic exposure	5
suspect tight building syndrome/sick building syndrome	4
"hysteria"	3
acute hyperventilation syndrome	1
exposure to allergen, undetermined etiology	1
exposure to unknown chemical	1

Table 3
 Medical Interviews of February 1994

Reported Current Work-Related Symptoms

Current Symptoms	Number of employees
throat irritation and itchy skin	3
itchy rash on exposed skin	3
urticaria/hives	2
respiratory irritation	2
itchy skin	1

Table 4
Medical Interviews of February 1994
Reported Symptoms During Incident in January 1993

January 1993 Symptoms	Number of employees
itchy rash on exposed skin	9
eye/nose/throat irritation	6
urticaria/hives	4
respiratory irritation	3
itchy skin	3
blood pressure elevation	2
red, irritated skin	2

HEALTH HAZARD EVALUATION
REPORT

HETA 93-0926-2472

DAUPHIN COUNTY PRISON
HARRISBURG, PENNSYLVANIA

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer and authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.