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UNIVERSITY OF UTAH MEDICAL CENTER
SALT LAKE CITY, UTAH

NIOSH INVESTIGATOR:
Charles McCammon, Ph.D., CIH

I. SUMMARY

On January 2, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Department of Public Safety of the University of Utah to conduct a health hazard evaluation (HHE) at the University Medical Center in Salt Lake City, Utah. The requestor was seeking assistance with indoor air quality concerns in nine areas within two adjoining buildings in the Medical Center.

On April 3-5, 1991, an evaluation of the University Medical Center was conducted. Completed questionnaires from employees in the affected areas of the hospital and heating, ventilation, and air-conditioning (HVAC) plans for each of the affected areas were reviewed in advance of the site visit. Since few questionnaires had been returned from two of the areas initially of concern, the onsite investigation concentrated on the seven remaining areas. A thorough inspection of all the HVAC air handling units serving the seven areas was conducted. Carbon dioxide (CO_2), temperature, relative humidity, and smoke tube tests were conducted to evaluate the HVAC systems. Limited bulk air samples were collected to measure volatile organic compounds in one area. Selected employees from each of the seven areas were interviewed.

The HVAC systems in all areas were found to be well maintained and functioning as designed. Many of the areas with a high percentage of complaints had variable volume, constant temperature ventilation systems. During colder periods of the year or day, when the thermostats on these systems are turned up to provide heat, the actual result is the shutdown of the system with no air being provided into these spaces. Such a case (high CO_2) was seen in a conference room with a high occupant load. Other than this one case, the CO_2 levels ranged from 400-700 ppm (outside levels averaged about 300 ppm). Likewise, temperature and humidity measurements were quite consistent throughout both buildings, ranging from 74N to 77NF and 20% to 22% RH. These values fall within the guidelines of the 73N to 77NF temperature range and the 20 to 60 percent relative humidity range recommended by ASHRAE. Carbon monoxide (CO) levels were measured throughout the areas of concern and were found to be less than 2 ppm. The CO levels were also measured outside near the air intakes adjacent to the heliport when a helicopter landed. The levels did not exceed 5 ppm.

A bulk air sample was collected on a charcoal tube in the Personnel Department and compared with a bulk air sample collected outside. No unusual organic compounds were noted on the gas chromatography/mass spectrometry analysis. The total organic concentration was less than 1.0 milligrams per cubic meter (mg/M^3).

Based on the environmental monitoring results, the investigator was unable to identify an airborne contaminant which would constitute a health hazard. However, the questionnaire results indicated the presence of upper respiratory symptoms among a high percentage of employees. Therefore, recommendations are made to help alleviate some of the employee complaints.

KEYWORDS: SIC 8062 (General Medical and Surgical Hospitals), indoor air quality, indoor air pollution.

II. INTRODUCTION

On January 2, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Department of Public Safety of the University of Utah to conduct a health hazard evaluation (HHE) at the University Medical Center in Salt Lake City, Utah. The requestor was seeking assistance with indoor air quality concerns in nine areas within two adjoining buildings in the Medical Center. Most of the employee complaints were consistent with poor indoor air quality, i.e., runny nose, itchy eyes, sneezing, headache, cough, etc.

On April 3-5, 1991, an evaluation of the University Medical Center was conducted. Completion of questionnaires from employees in the areas of concern were coordinated through the University Industrial Hygienist in advance of the visit. Since few questionnaires had been returned from two of the areas initially of concern, the onsite investigation concentrated on the seven remaining areas. Heating, ventilation, and air-conditioning (HVAC) plans for each of the areas were also received in advance. A thorough inspection of all the HVAC air handling units (AHUs) serving the seven areas evaluated was conducted. Carbon dioxide, temperature, relative humidity, and smoke tube tests were conducted to evaluate the HVAC systems. Limited bulk air samples were collected to measure volatile organic compounds in one area. Carbon monoxide levels were also measured since one of the items of concern was helicopter exhaust. Selected employees from each of the seven areas were interviewed.

III. BACKGROUND

There were two buildings of concern: the School of Medicine (Building 521), and the University of Utah Hospital (Building 525). Building 521 is the old hospital built about 1965, and now is used for clinics, research laboratories, and classrooms. The area of concern in Bldg. 521 was the Ophthalmology Center located on the A level. The Ophthalmology Center is a series of offices and labs located in an L-shaped area separated by fire doors from the rest of the floor and located across the hall from the Linen Service Department. This area is ventilated by air handling unit #4. The employees in the Ophthalmology Center are the only group supplied by AHU #4 who have complained of problems. The Center was moved into the space in June of 1988 and problems began shortly after that. The workers complained of sneezing and stuffy noses plus a lack of air movement. Occasionally cigarette smoke would be smelled even though smoking is not allowed in the building.

Building 525 is a 425-bed, patient care hospital built in 1982. It is a 6-story building of approximately 25,000 square feet. Ventilation in the hospital is provided by 15 AHUs and 4 air conditioners (ACs). Complaints had been received on six different floors, covering seven different areas and four different AHUs. A description of the location and areas served by the various AHUs is provided in Table 1. Table 1A is a summary of the various areas in the hospital plus information on questionnaire response.

IV. MATERIALS AND METHODS

The NIOSH evaluation consisted of: (1) an assessment of questionnaire results from seven of the areas of concern, (2) an examination of the building's heating, ventilation and air conditioning (HVAC) system, (3) an examination of the building for identifiable contaminant sources, (4) interviews with representatives from the building management

and building employees; (5) and an environmental survey designed to assess key parameters related to the building's air quality. The specific measurements and types of samples collected in the environmental survey are detailed below.

A) Instantaneous measurements of carbon dioxide (CO_2) concentrations were made at several different times and locations throughout the building and outdoors. These measurements were made using a GasTech (Model RI 411) portable direct-reading CO_2 analyzer capable of measuring CO_2 concentrations from 50 to 5000 parts per million (ppm). The instrument was calibrated before use and checked against outdoor levels at various intervals throughout the workday.

B) Measurements of dry bulb temperatures and relative humidity were made at several different times and locations throughout the building and outdoors using an Extech Instruments Digital Humidity and Temperature Meter.

C) Concentrations of carbon monoxide (CO) were measured using a Draeger Model 190 Datalogger. This is a direct-reading electrochemical instrument which is specific for CO.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week, for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a preexisting medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus, such contact may increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of air contamination criteria generally consulted include: (1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), (2) the American Conference of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values (TLVs), (3) the U.S. Department of Labor (OSHA) federal occupational health standards, and (4) the ventilation standards developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The first three sources provide environmental limits based on airborne concentrations of substances to which workers may be occupationally exposed in the workplace environment for 8 to 10 hours per day, 40 hours per week for a working lifetime without adverse health effects. The ASHRAE guidelines specify recommended outside air ventilation rates needed to

maintain acceptable indoor air quality for the majority (at least 80%) of a building's occupants.

The industrial criteria for the substances evaluated in this survey are presented in Table 2. A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures. A discussion of the substances evaluated in this survey and the ASHRAE comfort and ventilation guidelines is presented below.

A. Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath, and, if monitored in the indoor air, can often be used as a screening technique to evaluate whether adequate quantities of fresh outdoor air are being introduced into a building or work area. The outdoor, ambient concentration of CO_2 is about 350 ppm. Typically the CO_2 level is higher inside than outside (even in buildings with few complaints about indoor air quality). However, if indoor CO_2 concentrations are more than 1000 ppm (3 to 4 times the outside level), the building may be receiving inadequate outside air, or the air may be poorly distributed by the HVAC system. Under these conditions, complaints such as headache, fatigue and eye and throat irritation may frequently be reported. Although the CO_2 is not responsible for these complaints, a high level of CO_2 does indicate that other contaminants in the building may also be increased and could be responsible for symptoms among building occupants.[1]

B. Carbon Monoxide

Carbon monoxide can occur as a waste product of the incomplete combustion of carbonaceous fuels. Sources of carbon monoxide in indoor environments include tobacco smoke, malfunctioning or improperly vented heating systems, and the introduction of contaminated air from outside sources such as loading docks. Carbon monoxide exposure in sufficient concentrations can result in headache dizziness, drowsiness, nausea, vomiting, collapse, coma, and death.[2]

C. Temperature and Relative Humidity

The majority of references addressing temperature and humidity levels as they pertain to human health frequently appear in the context of assessing conditions in hot environments. Development of a "comfort" chart by ASHRAE presents a comfort zone considered to be both comfortable and healthful. This zone lies between 73N and 77NF (23N and 25NC) and 20 to 60 percent relative humidity.[3]

D. Ventilation

Neither NIOSH nor OSHA have developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by ASHRAE. Until recently, the ASHRAE Ventilation Standard 62-73 (1973) was utilized, but recommendations were based on studies performed before the more modern, air-tight office building became common. These older buildings permitted more air infiltration through leaks and cracks around windows and doors, and through floors

and walls. Modern office buildings are usually much more airtight and permit less air infiltration. Due to the reduced infiltration, ASHRAE questioned whether the 1973 minimum ventilation values assured adequate outdoor air supply in modern, air-tight buildings.

The minimum rate of outside air permitted under the new ASHRAE Standard 62-1989 is 20 cfm/person for general office areas.[4] Where smoking is permitted, ASHRAE Standard 62-1989 recommends an outside air supply rate of at least 60 cfm/p. The basis of the outside air supply rates recommended by ASHRAE is for maintaining an indoor air quality that is considered acceptable by at least 80% of the building's occupants. However, unless referenced or specified by local building codes, building owners are not legally required to comply with these ASHRAE Standards. Most building codes refer to an earlier version of this standard (ASHRAE Standard 62-73) which was intended to conserve energy more so than promoting adequate indoor air quality.

VI. RESULTS AND DISCUSSION

A. HVAC System Inspection

All the HVAC systems which supply air to the areas of concern were inspected. The intake vents were observed to insure they were open and to determine if any contaminant sources were located near the intakes. All systems were well maintained including frequent replacement of filters, upgrading of filters for higher efficiency, and cleaning of areas around the intake filters. Those units (AHUs #1, 3 and 5 for Building 525) that had outside air intakes located near the helicopter landing pad had been recently equipped with charcoal filters on the outside air intakes to respond to employee complaints about helicopter exhaust and fuel odors. AHU #2 is also located near the heliport but had not yet been equipped with charcoal filters. Most of the AHUs were equipped with water spray humidification systems which had not been used for a number of years.

The AH units were set-up to run with 100% outside air when the exhaust fans were on. However, some of the units could mix outside air with return air. Units #3, 11, and 14 ran with only 100% outside air. Units 1-3, 5-11, and 13-15 were equipped with a 40% efficient prefilter followed up by a 85-95% efficient bag filter. Units #4 and 12 had only the 40% efficient prefilters. Supply of tempered air to the work spaces was generally through a variable flow, constant temperature system which provided air that was tempered to 55NF with no local reheat capability. If the occupants were too cool and turned the thermostat up, the system responded by shutting air off until the set point was reached, then 55NF air would be supplied to the space. The patient rooms were generally on constant flow systems with reheat units located in each zone (room).

The ventilation ducts were insulated with fiberglass material on the inside with a meshed, metal barrier over the top of the insulation. The insulation appeared to be in good condition with no deterioration. No sources of water damage could be found in or around the ventilation ducts. Heating and cooling in the HVAC was provided through enclosed hot or cool water systems. No leaks were seen around these systems.

B. Environmental Survey Results

The carbon dioxide (CO_2) levels ranged from 400 up to 700 ppm throughout both buildings throughout the day (April 4). Outside levels stayed fairly constant at 275 to 300 ppm of CO_2. The highest CO_2 levels were measured in a conference room in the 6th floor North in the Orthopedics area. Four people were sitting in the conference room and the thermostat had been turned up fairly high. Before the ventilation system reached the set point, the CO_2 levels reached 950 ppm. This reading was illustrative of the variable volume, constant temperature system operation and that occasionally a lack of outside air could occur. It would be expected that the worse case for lack of outside air would occur in the winter and during the night when occupants would be demanding less cooling. However, no CO_2 levels were measured above 1000 ppm throughout the hospital or the School of Medicine.

Likewise, temperature and humidity measurements were quite consistent throughout both buildings, ranging from 74N to 77NF and 20% to 22% RH. These values fall within the guidelines of 73N and 77NF temperature range and the 20 to 60 percent relative humidity range recommended by ASHRAE.[3]

Carbon monoxide (CO) levels were measured in all spaces listed in Table 1 and in all AHU rooms and were found to be less than 2 ppm. The CO levels were measured outside near the air intakes for AHUs #1, 2, 3, and 5 when a helicopter landed. The levels did not exceed 5 ppm.

A bulk air sample was collected in the Personnel Department and compared with a bulk sample collected outside. No unusual organic compounds were noted on the gas chromatography/mass spectrometry analysis. The total organic content was less than 1.0 mg/M3.

C. Results of Interviews, Questionnaires, and Investigation of Areas

Prior to NIOSH's arrival, questionnaires had been circulated by the University of Utah's Industrial Hygienist. The questionnaires used were those contained in the NIOSH Guidance for Indoor Air Quality Investigations.[1] The results of these questionnaires are summarized by area in Tables 3-9. A summary of the questionnaires, interviews with employees and observations of the specific areas is given below.

1. Orthopedics, 6th N

Fifty-eight percent of the employees on this ward returned questionnaires, and 83% of the respondents had complaints about the air in the hospital. The primary health complaint consisted of sneezing (43%), stuffy or runny nose (43%), and itchy eyes (39%) (see Table 3). The other consistent complaint was for employees that worked at night; 6 out of 7 or 86% complained that it was too cold at night. This is probably due to the variable flow system (referred to as a V-box system), and a smaller staff (generating less heat) combining to result in a cooler office environment. This also means that the employees would be setting the thermostat higher which would result in less fresh air in the area. The other complaints were about the cleaning products

used, specifically the carpet shampoo, the lack of air in the break room, and occasional cigarette smoke from patient rooms. The lack of fresh air in the break room could again be related to the V-box system. It was on this floor that the CO_2 levels were seen to rise from 700 ppm to 950 ppm in about 10 minutes because the set-point on the thermostat was above 80N F, there were several people gathered in the conference room conducting employee interviews, and no air was being provided by the ventilation system.

2. Personnel Department

The personnel offices were redesigned and occupied in November of 1989. They consist of an open office area with 6-foot partitions for most of the 20 people in the department and are surrounded by the managers' private offices. The primary complaints were about a lack of air or stuffy feeling (73%) and odors (80%) (see Table 4). The odor complaints centered around the helicopter exhaust and fuel smells. The AHU providing air to this space was recently equipped with carbon filters and most employees thought that this had helped the odor problem. There had been a problem with a lack of sufficent return air ducts but this had been very recently corrected. Ventilation for the perimeter offices and the front area of the personnel offices was provided by constant volume units. The central space was on the V-box system. The offices were quite close together, were fully occupied, and often had additional visitors so it is unlikely that the V-box units shut-down very often.

The only health complaint of note was of headaches (67%) except that many people complained that they seemed to be constantly sick. In general, the employees did not like their new offices, and thought they were too crowded and cramped. The managers were concerned about the number of health related complaints and the increased amount of sick leave since the department moved into the new offices. ASHRAE recommends[8] a maximum occupancy of 7 people per 1000 square feet (ft^2) which translates to about 140 ft^2 per person. This would mean that each person in an office should have a space of about 10 ft by 14 ft (not including aisles). The offices in the personnel department were much smaller than this plus there were a number of people coming in for applications, counseling, etc.

3. Medical Cardiology, 4th N

The complaints from this floor (see Table 5) centered around a lack of air circulation (41%) and odor complaints (38%). The odor complaints were predominantly about the spraying, vacuuming, and shampooing of carpets. The primary health complaint was of a runny or stuffy nose (43%) while 16% complained of itchy/runny eyes, sneezing and headaches. Once again, of those people that complained that it was too cold, 6 out of 8 said that it happened at night. The only association between the runny nose/sneezing/eye irritation and any event was with care of the carpets (spaying, cleaning, vacuuming).

4. Medical Surgery, 6th S

The complaint profile from this area (Table 6) was similar to that on 4th, N and 6th, S: a large percentage of the respondents complained of lack of air

circulation (76%), too cold at night, and odors (67%); the major health complaints were stuffy/runny nose (76%), eye irritation (52%), headache (33%), and sneezing (29%). The odor complaints centered on cleaning products and shampoo. The physical design of the wards on 6th N and S, 3rd N are all identical. The 6th floor and the 3rd floor have different AHUs, yet the complaint profile is consistent for these three areas. The health problems in all these areas is consistent with an allergic response to some material. The only contaminant which could be found common to these areas was the cleaning products used for carpet shampooing.

5. Ophthalmology, A Level Building 521

This space was first occupied by the Ophthalmology group in June of 1988. Employee complaints started at this time. All employees in this area had some complaint about the indoor air (Table 7). Lack of air circulation (83%) was the major complaint, followed by the air being too cold, odors, and dusts (all 58%). The odor complaints described a burnt smell from the Linen Service across the hall, helicopter exhaust/fuel smells, and cigarette smoke. Across the hall a short distance from the entrance to this space, there is a set of double doors which lead to a loading dock area. Immediately outside the doors is a picnic table where employees go to smoke since smoking is not allowed in the building. When these doors are open, cigarette smoke, vehicle exhaust (if there is a vehicle in the loading dock area), and exhaust from the Linen Service area can all be carried into the building and into the Ophthalmology area. While the site investigation was going on, workmen were installing a second set of double doors to this entrance which should cut down on the amount of cold air and odors that can get into the hallway and thus into the Ophthalmology area. A new vent system was also planned for the Linen Department. Completion of this system should reduce the amount of odors getting into the hospital from the Linen area.

The health complaints from this area included sneezing (50%), stuffy/runny nose (33%), and eye irritation (33%). The general complaints were of increased numbers of colds and allergy-like problems since moving into the building. The office areas were noted not to have any return air vents and that it was intended that the office doors remain open to provide a return air path. The occupants were advised of this information. A corner office reportedly had occasional cigarette smells. Based on the HVAC design, the only way cigarette smoke could get into this area would be from entrainment from a space upstream on the same ventilation system since the room was under positive pressure to the surrounding spaces. This possibility was to be investigated if the odors were again noticed.

6. Pediatric Adolescent Care, Rm 5103, Bldg. 525

This is a small group of workers (five) that all share a small room. Usually no more than three people are ever in the office at one time, but the office is only about 150 ft^2. The employees complained about being too crowded, the room being too stuffy, and that they had been suffering from very frequent upper respiratory diseases and a sudden onset of dizziness and fatigue. The health problems listed were headache (100%), eye irritation (50%), coughing and

runny nose (25%) (see Table 8). This area has a V-box ventilation system so it is possible that there may be times when there would be a lack of outside area if the fan was not running. Also, return air efficiency would require that the door always be kept open to serve as a path for the return air. The sudden dizziness is difficult to explain. It may be that when the ventilation is shut-off, the room gets very stuffy and this may contribute to the dizzy feeling.

7. Administration, Bldg 521

Analysis of the questionnaire results (Table 9) suggests that there are few problems in this area. Only 36% of the people had a complaint, and those centered on lack of air circulation (27%) and dust in the air (27%). The only health problem of note was coughing (27%). Much of the problem, or perceived problem, centered on one individual who had experienced a chronic cough for quite some time. This person was not convinced that the problem was building related.

VII. CONCLUSIONS

Measurements of ventilation system parameters (i.e., CO_2, temperature, and relative humidity) revealed the system to be supplying sufficient quantities of adequately tempered air to the various workspaces on the days examined. However, the use of the variable volume, constant temperature ventilation system opens the possibility of periods when the system is shut off and no air is being delivered to these areas. The possibilty of this happening would be greatest during the cold months and in the night.

Three of the areas in the hospital had similar complaints related to allergenic type responses. The only item which was commonly complained about was the carpet shampoo. One evening, this operation was observed. The cleaning employees had been well trained about how to use the products and what the proper dilutions were. Carpets were cleaned either by a bonnet shampooer (most commonly used) or an extraction system. The bonnet shampooer is a rotary shampooer which has a removeable rag head which is rinsed in the cleaning solution periodically. The cleaning product contains 1% each of two similar quaternary ammonium compounds which is then diluted in a ratio of 1/64. The quaternary ammonium compounds are known to be mild irritants to the skin and mucous membranes. One employee mentioned that his hands developed a mild rash if he rinsed the shampooer head in the cleaning solution without wearing gloves. The cleaning product also contains a blend of six fragrances to give it a marker of when it had been applied. Many of the complaints on the different floors centered around the odor of the cleaning materials. The cleaning crews also used an aerosol spot remover which was later determined to contain 60% 1,1,1 trichloroethane (methyl chloroform) and 35% perchloroethylene.

VIII. RECOMMENDATIONS

1) Since there have been so many complaints related to the carpet shampoo, it is recommended that a different product be tried. The Environmental Service Department had already been contemplating the use of another product. The composition of this product, Insure, has been checked through the manufacturer and it appears to contain low toxicity ingredients. It also contains no fragrancies.

Information on toxicity testing of the product was provided by the manufacturer which bears out the low toxicity of the ingredients.

2) Since the spot cleaner Misty Solvent Spot Cleaner contains perchloroethylene, a suspected human carcinogen, it is recommended that another spot remover be used.

3) The HVAC systems were in excellent condition. The routine maintenance program should be continued.

4) Relative to the Ophthalmology area in building 521, the occupants should be advised to keep their doors open in order to provide a good path for return air; the double doors across the hall should be kept closed (the new addition of the extra set of doors should help); and the stray cigarette odors should be further investigated if they occur again (check for smoking in adjacent spaces, entrainment from outside smoking areas, and any smoking around the negative pressure side of the AC #4).

5) The Personnel Department appears to be over-crowded according to the ASHRAE guidelines. An effort should be made to alleviate this problem. In the meantime, since the most crowded areas are provided air by variable volume, constant temperature ventilation, the amount of outside air should be checked during the colder periods of time when the system may be shutting down. This recommendation applies to all areas where the V-box system is in place. In addition, the night shifts also present a time when the fans may shut off due to cooler temperatures, lower numbers of employees, and less activity. The Maintenance Engineer recommended that in the winter the constant temperature in the ventilation system could be raised which would result in the fan continuing to run longer.

6) The Hospital should utilize the communications tools in place, such as the Newsletter, Safety Committee Meetings, etc., to publicize the efforts being made to alleviate problems in the hospital. This should include all the efforts to-date by the University (e.g., addition of charcoal filters, inspection by the University Industrial Hygienist, the efforts by the Environmental Services Department to research new, safer cleaning products, etc.), the NIOSH survey, and any follow up action that is taken. The immediate supervisors and the affected employees are the target group for this information.

7) In the event that employee complaints continue, a formal log should be maintained which notes the date, time, and type of complaint noted. Such a log could help isolate specific work areas or times of the year when employee complaints are highest. Consideration should be given to the inclusion of specific data in the personnel records system which would allow for the rapid determination of absentee rates by work location. References such as "Absenteeism, definitions and statistics of" published by the International Labour Office,[5] should be consulted for more detailed information on the collection and use of such information.

IX. REFERENCES

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5. International Labour Office. "Absenteeism, definitions and statistics of", Encyclopedia of Occupational Health and Safety, Volume 1, Third Revised Edition. Geneva, Switzerland, International Labour Office, 1983.

X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By: Charles S. McCammon, Ph.D., CIH
Regional Consultant for Occupational Health
Denver Regional Office
Denver, Colorado

Originating Office: Hazard Evaluation and Technical Assistance Branch (HETAB)
Division of Surveillance, Hazard Evaluations and Field Studies

Secretarial Work By: Marile DiGiacomo
NIOSH
Denver, Colorado

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3. U.S. Department of Labor/OSHA - Region VIII.
4. NIOSH, Region VIII
5. Utah State Health Department, Salt Lake City Utah

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

TABLE 1.
BUILDING #525 AIR HANDLERS
UNIVERSITY OF UTAH HOSPITAL
SALT LAKE CITY, UTAH
MAY, 1991

UNIT #	LOCATION	AREAS & DEPARTMENTS SERVED
A.H. #1	B Level, Equipment Fan Room #1. Stack by Heliport. Charcoal filter.	"B" level - From hallway B-200, North. Includes Radiation Therapy & Main Corridor. "A" Level - West Pharmacy - Purchasing. "B" Level Mezzanine - Radiation Therapy Offices. 1st Floor Lobby Entrance around windows.
A.H. #2	B Level, Fan Room #2. Stack by heliport.	"A" Level - Central Service. Level #1 Lobby & adjacent corridors, Gift Shop, Sandwich Shop, Admitting, Nursing Offices, Nursing Administration, Cashier, Outpatient Pharmacy, Outpatient Lab, Billing & Credit and Orthopedic Clinic #10.
A.H. #3	A Level, Equipment Fan Room. Stack by heliport.	"A" Level South - Surgical Pathology, Clinical Labs, Histology Lab, Anatomic Pathology. Blood Donor and Pheresis Center.
A.H. #4	2nd Floor, Fan Room #5. Intake on 2nd floor, NE.	Level 1 North - Telephone Exchange, Administration and Clinics #1, 2 & 3.
A.H. #5	A Level, Fan Room #4 Stack by heliport. Charcoal filter.	Level 1 South - Radiology, A Level T.V. Shop and E.R. Stairwell heat.
A.H. #6	Level 4, East Fan Room #6. Intake on Bldg. Roof.	Level 1 Northeast - E.R. Level 2 Northeast - Health Sciences Admin. Community Relations, Respiratory Therapy, 2 East Corridor (#2500), Corridor (#2501). & South Northeast - Surgical I.C.U.
A.H. #7	Level 2, East Fan Room #7. Stack on 2nd NE, corner off 2nd roof.	2 South - Newborn I.C.U. and Labor & Delivery.
A.H. #8	Penthouse #7, Fan Room #9. Intake on Penthouse Roof.	5 North - Northwest, Nurses Station 9 and 6 North Nursing Station, Patient Care. South-east - Pediatric and Adolescent Care. 6 North-Patient Care Pod Rooms 5 North and 6 North.
A.H. #9	Penthouse #7, Fan Room #9. Intake on Penthouse Roof.	2 North - Nurses Station 2 North and 3 North. Maternity and Infant Care. 3 North - Ambulatory Surgery, Pain Management Clinic

and C.V.U. 4 North Patient care & Nurse

Station

TABLE 1 (Continued)

UNIT #	LOCATION	AREAS & DEPARTMENTS SERVED
A.H. #10	Penthouse #7, Fan Room #9. Intake east Section Corridor #4199,	2 North - Southeast 1/4 Infant Care. 3 North Section 3199 Main Corridor. 4 North - South- on Penthouse roof. Cardiology, Pulmonary Lab.
A.H. #11	Penthouse #7, Fan Room #9. Intake on Penthouse roof.	Primary Induction Air. Perimeter Rooms. 2 North - Maternity and Infant Care. 3 North - Patient Care and C.V.U. 4 North - Patient Care 5 North - Patient Care. 6 North - Patient Care "Only supplies induction unit air."
A.H. #12	Level B, Fan Room #3. Intake >6 ft., A level courtyard.	"A" North - Stores and Receiving. Personnel
A.H. #13	Roof 5th, Floor Fan Room #8. Intake on Penthouse roof.	3 South - Post Anesthesiology, Recovery, Anesthesiology Workroom.
A.H. #14	Roof 5th, Floor Fan Room #8. Intake on Penthouse roof.	3 South - O.R. 100% outside air.
A.H. #15	Roof 5th, Floor Fan Room #8. Intake on Penthouse Roof.	4 South - Burn Unit, O.R., Burn Trauma Center Laser Surgery, C.C.U., POD Rooms #11 and #12. Nurses Station.
AC #1	Central Plant above Chillers	Central Plant
AC #2	B-241 "525" Equipment Room	B-241 Equipment Room
AC #3	B Level "525" Vault Room	Facilities Engineer Office and B Level Vault Room.
AC #4	A Level Vault Room by TV Shop	A - Level Vault Room

TABLE 1A
NUMBER OF QUESTIONNAIRES AND AREAS OF CONCERN IN MEDICAL CENTER
UNIVERSITY OF UTAH MEDICAL CENTER
SALT LAKE CITY, UTAH
MAY, 1991

Building	Area	Name	Air Handler	Total # Employees*	Percent Positive on Questionnaire**
School of Medicine (521)	A Level	Ophthalmology	AC 4	14 (86%)	86
Hospital (525)	Lobby	Administration	4	12 (92%)	25
	A Level	Personnel	1	20 (75%)	65
	4th N	Medical Cardiac	9	72 (51%)	45
	Rm 5103	Ped. Adol. Care	8	5 (80%)	80
	6th S	Medical Surgery	8	44 (42%)	50
	6th N	Orthopedics	8	48 (58%)	40

*Number in parenthesis is the percentage of employee responding to survey.

**Number of employees in each area with a comfort/health complaint.

Table 2
ENVIRONMENTAL CRITERIA FOR SELECTED SUBSTANCES

SUBSTANCE	OSHA PEL	NIOSH REL	ACGIH TLV
Carbon Dioxide	10,000 ppm 8-hr TWA	10,000 ppm* 8-hr TWA	5,000 ppm 8-hr TWA
	30,000 ppm STEL	30,000 ceiling (10 min)	30,000 ppm STEL
Carbon Monoxide	35 ppm 8-hr TWA	35 ppm 8-hr TWA	50 ppm 8-hr TWA
	200 ppm ceiling (no minimum time)	200 ppm ceiling (no minimum time)	400 ppm STEL
	STEL	STEL	

Abbreviations and Key
TWA - Time-weighted average concentration
ppm - Parts of contaminant per million parts of air
STEL - Short-term exposure limit; 15-minute TWA exposure
*1000 ppm is used as a guideline for availability of fresh air in office environments.

TABLE 3
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, ORTHOPEDICS, 6TH N
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=23)	Percentage
Yes, I have a complaint	19	83
Temperature too cold	7	30
Temperature too hot	1	4
Lack of air circulation	7	30
Noticeable odors	7	30
Dust in the air	4	18
Disturbing noises	2	9
Other-cleaning products	3	13
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	9	39
Stuffy, runny nose	10	43
Sneezing 10	43	
Headache	5	22
Coughing	4	18
Sore throat	1	5
OCCURRENCE		
All day/daily	7	30
No trend 3	13	
Nights	6	26
Afternoon	2	9
OTHER FACTORS		
Smokers	2	9
Allergies 6	26	
Contact wearers	5	22
VDT users	0	

COMMENTS

Response rate was 23/48 workers or 58%.

Predominant complaints were that it was too cold on nights, cigarette smoke from patients rooms, and carpet cleaning materials.

TABLE 4
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, PERSONNEL DEPARTMENT
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=13)	Percentage
Temperature too cold	3	20
Temperature too hot	4	27
Lack of air circulation	11	73
Noticeable odors	12	80
Dust in the air	3	20
Disturbing noises	1	8
Other-helicopter exhaust	4	27
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	2	16
Stuffy, runny nose	1	8
Sneezing		
Headache	10	77
Coughing	1	8
Sore throat	1	8
OCCURRENCE		
All day/daily	4	27
No trend 5	33	
Morning	0	0
Afternoon	2	16
OTHER FACTORS		
Smokers	0	0
Allergies 3	20	
Contact wearers	6	41
VDT users	9	69

COMMENTS

Response rate was 13/20 or 65 %.

Predominant complaint was about helicopter exhaust or fuel odors.

TABLE 5
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, MEDICAL CARDIOLOGY, 4TH N
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=37)	Percentage
Yes, I have a complaint	26	70
Temperature too cold	11	30
Temperature too hot	7	19
Lack of air circulation	15	41
Noticeable odors	14	38
Dust in the air	4	11
Disturbing noises	8	22
Other-very dry	1	3
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	6	16
Stuffy, runny nose	16	43
Sneezing 6	16	
Headache	6	16
Coughing	0	0
Sore throat	4	11
OCCURRENCE		
All day/daily	13	35
No trend 4	11	
Nights	2	6
Afternoon	1	3
OTHER FACTORS		
Smokers	1	3
Allergies 6	16	
Contact wearers	6	16
VDT users	3	9

COMMENTS

Response rate was 37/72 workers or 51%.

Predominant complaints were that it was too cold on nights, vacuuming, and carpet cleaning materials (spraying of cleaning material).

TABLE 6
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, MEDICAL SURGERY, 6TH S
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=21)	Percentage
Yes, I have a complaint	21	100
Temperature too cold	10	48
Temperature too hot	7	33
Lack of air circulation	16	76
Noticeable odors	14	67
Dust in the air	9	43
Disturbing noises	4	19
Other	0	0
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	11	52
Stuffy, runny nose	16	76
Sneezing 6	29	
Headache	7	33
Coughing	3	14
Sore throat	3	14
OCCURRENCE		
All day/daily	12	57
No trend 7	33	
Nights	3	14
Afternoon	1	4
OTHER FACTORS		
Smokers	2	9
Allergies 9	43	
Contact wearers	9	43
VDT users	2	9

COMMENTS

Response rate was 21/44 workers or 42%.

Predominant complaints were that it was too cold on nights and didn't like the cleaning materials (shampoo mentioned).

TABLE 7
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, BLDG 521, OPHTHALMOLOGY, A LEVEL
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=12)	Percentage
Yes, I have a complaint	12	100
Temperature too cold	7	58
Temperature too hot	6	50
Lack of air circulation	10	83
Noticeable odors	7	58
Dust in the air	7	58
Disturbing noises	0	0
Other-linen, helicopter	2	16
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	4	33
Stuffy, runny nose	4	33
Sneezing 6	50	
Headache	1	8
Coughing	2	16
Sore throat	0	0
OCCURRENCE		
All day/daily	9	75
No trend 3	25	
Nights	0	0
Afternoon	0	0
OTHER FACTORS		
Smokers	0	0
Allergies 6	50	
Contact wearers	2	16
VDT users	2	16

COMMENTS

Response rate was 12/12 workers or 100%.

Predominant complaints were that it was too stuffy and got smells from the linen service across the hall, cigarette smells, and helicopter exhaust.

TABLE 8
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, PEDIATRIC ADOLESCENT CARE, RM 5103
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=4)	Percentage
Yes, I have a complaint	4	100
Temperature too cold	0	0
Temperature too hot	0	0
Lack of air circulation	0	0
Noticeable odors	0	0
Dust in the air	0	0
Disturbing noises	0	0
Other-crowded, stuffy	2	50
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	2	50
Stuffy, runny nose	1	25
Sneezing 0	0	
Headache	4	100
Coughing	1	25
Sore throat	0	0
OCCURRENCE		
All day/daily	2	50
No trend 0	0	
Nights	0	0
Afternoon	0	0
OTHER FACTORS		
Smokers	0	0
Allergies 0	0	
Contact wearers	0	0
VDT users	0	0

COMMENTS

Response rate was 4/4 workers or 100%.

Predominant complaints were that it was too stuffy, crowded, personnel had sudden onset of fatique and dizziness, and numerous illnesses (seemed to have decreased resistance to illness).

TABLE 9
RESULTS OF SELF ADMINISTERED QUESTIONNAIRE FOR INDOOR AIR
UNIVERSITY OF UTAH HOSPITAL, ADMINISTRATION
SALT LAKE CITY, UTAH
MAY 1991

COMPLAINTS	Number (n=11)	Percentage
Yes, I have a complaint	4	36
Temperature too cold	0	0
Temperature too hot	0	0
Lack of air circulation	3	27
Noticeable odors	2	18
Dust in the air	3	27
Disturbing noises	0	0
Other-helicopter fumes	2	18
HEALTH PROBLEMS OR SYMPTOMS		
Watery, burning, itchy eyes	0	0
Stuffy, runny nose	1	9
Sneezing 1	9	
Headache	0	0
Coughing	3	27
Sore throat	0	0
OCCURRENCE		
All day/daily	2	18
No trend 2	18	
Nights	0	0
Afternoon	0	0
OTHER FACTORS		
Smokers	1	9
Allergies 0	0	
Contact wearers	1	9
VDT users	2	18

COMMENTS

Response rate was 11/12 workers or 92 %.

Predominant complaints were that it was stuffy, occasions odors from the helicopter and some of the people had persistent cough. Only 4 out of the 11 people answering the questionnaire reported that they had any complaints.