HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT
HETA 89-068-L2039
WICHITA COUNTY DEPARTMENT OF SOCIAL AND REHABILITATIVE SERVICES
WICHITA, KANSAS
APRIL 1990

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies
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WICHITA COUNTY SRS
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I. INTRODUCTION

On December 16, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at the Wichita County Department of Social and Rehabilitative Services Building (SRS), Wichita, Kansas. The request was prompted by complaints of head congestion, pneumonia, blurred vision, allergies, asthma, and headaches among the building's employees. In May 1989, an environmental and medical survey was conducted at the building. During this survey, a questionnaire was distributed to selected employees in the building and worker compensation records were reviewed. In addition, an inspection was made of the buildings heating ventilation and air conditioning (HVAC) systems and environmental samples were collected.

II. BACKGROUND

Wichita County's Department of Social and Rehabilitative Services building is comprised of two sections: a seven story "tower" section, and a four story "core" section. The building was built in the 1940's and used by the Wichita Medical Clinic until September 1, 1985, when it was leased by Wichita County for its SRS facility. The building underwent major structural renovation prior to SRS employees occupying the building in December 1985. This included interior renovation which continued until October 1988. The interior renovation consisted of wall construction, painting, carpet installation, woodwork refinishing, and repair of the boiler room.

The building houses the staff who administer the county's social services programs. Employees working on the 1st and 2nd floors determine if clients qualify for services, a process known as income maintenance. These 2 floors employ approximately 230 people with the following job titles and job descriptions: income maintenance workers-1 (INMW-1), who interview applicants; clerks who provide secretarial support; and income maintenance workers-3 (INMW-3), who provide supervisory support. Employees on these floors are grouped into units composed of 1 supervisor (INMW-3), 4 to 5 INMW-1, and 2 clerical employees. The third floor, which was only partially occupied during the survey, provides space for counselors. The functions, number of employees and square footage of the other floors are listed in Table 1.

Complaints of odors from the renovation work began in January 1986, predominantly from employees on the first 3 floors. Investigation of the complaints was conducted by the Wichita-Sedwick County Department of Community Health in February 1986, and again in February 1987. During the 1986 visit carbon monoxide (CO) measurements were taken in offices on the first floor above the boiler room; no CO was detected. During the 1987 inspection a welding torch being used in the renovation work was suspected as the cause of an odor. It was recommended that the exhaust from this operation be vented to the outside of the building.

Despite completion of remodeling in October 1988, employee complaints of odors and a variety of symptoms continued on the first 3 floors. Another visit to the building was made by the county health department in January 1989. Carbon monoxide (CO) sampling found levels of 4-5 parts per million (ppm) for floors 1-4. No CO was detected on floors 4-7. The NIOSH recommended exposure limit for CO is 35 ppm as an 8-hour time weighted average (TWA).

III. METHODS

A. Environmental

On May 3, 1989, NIOSH employees conducted an environmental and medical survey. The environmental survey consisted of: (1) an examination of the building's heating, ventilation, and air conditioning (HVAC) system, (2) an examination of the building for identifiable contaminant sources, and (3) an assessment of the building's air quality using instantaneous measurements of carbon dioxide (CO_2). 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 ppm. The instrument was calibrated before use and checked against background levels at various intervals throughout the workday. CO_2 measurements were taken from randomly selected offices or rooms on floors 1-3. Measurements were made at 4 distinct times throughout the day: one in the early morning (7 - 8:30 AM), one in the mid-morning (10 - 11:30 AM), one in the early afternoon (1 - 2:30 PM), and one in the late afternoon (3 - 4:30 PM).

Comparing the CO_2 levels between floors was performed using 2 statistical tests: the analysis of variance for "normally" distributed data, and the Kruskal-Wallis test for non-parametric data.[1] These statistical tests provide a mechanism for deciding when differences in CO_2 levels across floors exceed the amount of variability that would be expected by chance. A p-value was calculated from these statistical tests. If these two p-values differed in their "statistical significance" [defined at the probability level (p-value) of 0.05], both p-values will be reported. If the two test have the same "statistical significance", only the Kruskal-Wallis will be reported.

B. Medical

The medical survey consisted of 1) a symptom questionnaire, and 2) a review of the department's worker compensation claims over the past 3 years.

1. Symptom Survey

Employees working in the rooms selected for CO_2 measurements were asked to complete a questionnaire designed to elicit various symptoms. Symptoms were grouped into the following symptom clusters: mucous membrane irritation, respiratory

or flu symptoms, and constitutional symptoms. Work-related mucous membrane irritation symptoms were defined as the following symptoms which occur often or always and improve when not at work: runny nose, stuffy nose, dry eyes, burning eyes, dry throat, and sore throat. Work-related respiratory or flu symptoms were defined as the following symptoms which occur often or always and improve when not at work: cough, wheezing, shortness of breath, chest tightness, fever, aching muscles/joints. Work-related constitutional symptoms were defined as the following symptoms which occur often or always and improve when not at work: headache, fatigue, sleepiness.

As with the CO_2 levels, the distribution of health symptoms and demographic factors between floors of the building were compared using the ANOVA and Kruskal-Wallis statistical tests. If these two p-values differed in their "statistical significance" [defined at the probability level (p-value) of 0.05], both p-values will be reported. If the two test have the same "statistical significance", only the Kruskal-Wallis will be reported.

IV. EVALUATION CRITERIA

A. Ventilation

Neither NIOSH nor OSHA have developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by American Society of Heating, Refrigeration, and Air-Conditioning Engineers (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 cubic feet of air (cfm)/person for general office areas.[2] Where smoking is permitted, ASHRAE Standard 62-1989 recommends an outside air supply rate of at least 60 cfm/person. The 60 cfm/person outside air supply rate is quite high and is usually implemented in isolated smoking lounges which exhaust directly to the outside. 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 rather than promote adequate indoor air quality.

B. Carbon Dioxide

Carbon dioxide is a normal constituent of exhaled breath; its concentration in the indoor air can be used as a indicator of 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. Although the CO_2 is not responsible for complaints such as headache, fatigue, eye irritation, throat irritation, 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.[3]

V. RESULTS

A. Environmental

1. HVAC System Inspection

The building ventilation system consisted of a number of separate air handling units (AHUs), each providing a constant volume of tempered air to the individual work spaces in the surrounding area. Eleven AHUs were identified as supplying air to the SRS workspaces on the building's first three floors. The units were equipped with outside air supply ducts. During the inspection of the individual AHUs, filters were found to be clean, and drip and condensation pans showed no evidence of slime or microbial growth. One "prefilter" located on a outside air intake for an AHU on the second floor was found to be heavily loaded with dirt. Due to its location in the ceiling above the AHU, it was probably being overlooked during the regular servicing of the AHU filters. Since this filter was located on a outside air intake from the roof where a cooling tower was located, the NIOSH investigators recommended during the survey that this filter be regularly changed. In addition, they recommended that the cooling tower also be properly maintained.

During the building inspection, no renovation was taking place in the work areas examined, nor were any strong odors from building materials noted.

2. Carbon Dioxide (CO_2)

Twenty-seven offices and rooms providing workspace for 38 employees were selected for CO_2 measurements: 7 offices on the first floor,

17 offices on the second floor, and 3 offices on the third floor. A summary of the results of the air samples taken for CO_2 are presented in Table 2. On May 3, 1989 the building's CO_2 levels ranged from 475 to 1425 ppm, with ambient (outside) air CO_2 levels ranging from 275 to 300 ppm. The late afternoon measurements had the highest CO_2 levels with a mean of 769 ppm. There were no statistically significant differences in CO_2 readings between floors.

Only two of the readings were found to be above 1000 ppm CO_2, which is used by NIOSH investigators as a measure of indoor air quality. In one instance, a level of 1100 ppm was found in an office on the second floor where three people were meeting with the door closed. The other elevated reading, 1425 ppm, was found in an office on the second floor. Subsequent inspection indicated that no air was coming out of this office's supply air grill. The employee reported that they had shut off the air handling unit for this section of the building because they felt their office was "too warm."

B. Medical

1. Symptom Survey

All 38 employees who worked in the 27 offices and rooms selected for participation agreed to complete the symptom questionnaire. Of the 38 selected employees, 20 (53%) were INMW-1, 13 (34%) were clerical, 3 (8%) were INMW-3, and 2 (5%) were counselors. The mean age was 41 years, with a mean seniority of 10 years. Twenty-nine of the 38 (81%) respondents were female, and 11 of the 38 (29%) were minorities (9 Blacks, 1 Hispanic, and 1 Asian). There were no significant difference between the age, sex, race, or length of employment between floors (Table 3).

Overall, stuffy nose and headaches were the most frequently reported symptoms; 32% and 29%, respectively (Table 4). There were no statistically significant difference in the prevalences of reported symptoms between the floors. In addition, there were no statistically significance differences in the prevalence of grouped symptoms (1 or more from each group) between the floors.

Eighteen (50%) of the respondents reported that a symptom or symptoms reduced their ability to work at least some of the time. Seventeen (45%) workers reported that their symptoms had caused them to stay home from work or leave work early at least some of the time.

Five (13%) reported they had a physician's diagnosis of asthma, however, all cases were diagnosed prior to occupying this building in December 1985. No respondents reported an asthma attack within the past year.

Of the 9 possible sources of mucous membrane or respiratory irritation, paint was the substance most commonly identified at least some of the time (47%), followed by chemicals (glues, "white out") at 34% (Table 5).

2. Comfort Parameters

Within the past year, 26 (68%) respondents wanted to adjust the air movement around their workstation often or always. Twenty (52%) reported too little air movement, while 5 (13%) reported too much air movement.

Within the past year, 30 (79%) respondents wanted to adjust the air temperature around their workstation often or always. Eighteen (47%) reported that the temperature was too hot, while 17 (44%) reported the temperature was too cool.

Within the past year, 15 (40%) respondents wanted to adjust the air's humidity around their workstation often or always. Four (10%) reported that the air was too humid, while 16 (42%) reported the air was too dry.

3. Workers Compensation Claims (WCC)

One WCC for respiratory illness was filed with Wichita's SRS department from 1986 to 1989. This individual was on sick leave during the NIOSH site visit. Reviewing this individual's medical records confirmed a disease process was occurring, however; it is not possible to comment from this information on whether the condition is building or work-related.

VI. DISCUSSION

A. Environmental

While it was not feasible during this survey to directly measure the amount of fresh air supplied to the various workspaces, the CO_2 measurements indicated that levels of carbon dioxide were generally within the guideline of 1000 ppm. This would seemingly indicate adequate air exchange rates within the workspaces monitored. The exceptions to this were the instance where an air handler was turned off by an employee, and a situation where three employees were meeting in an office with the door closed. In both instances the elevated CO_2 readings (above the NIOSH 1000 ppm guideline for indoor air) would not be unexpected since the fresh air supply was being cutoff.

B. Medical

Symptoms with the highest prevalence in this building (stuffy nose, headaches, dry eyes, etc) have been reported in other evaluations of office buildings. Although the symptom prevalences appear "high", we cannot comment on the degree to which the findings are "significant" compared to other buildings. At present, there are no expected or "normal" rates of symptoms in other buildings to compare our results. Likewise, the dissatisfaction with the comfort parameters appear "high"; however; there are no expected or "normal" rates to compare our results.

Attempts to localize particular floors, rooms, or areas with high prevalences of symptoms, or odors complaints were unsuccessful. Although the odors associated with remodeling (paint and new carpet) were two of the most frequently reported sources of mucous membrane and respiratory irritation, other reported sources remain (Table 5). These remaining sources, along with trace levels of contaminants remaining from the remodeling processes, could account for the persistence of building-related symptoms after the renovation was complete.

This survey defined work-related indoor air quality symptoms as occurring "often" or "always" and "usually gets better when not at work". This "case definition" allows the focus to be on symptoms that are recurring rather than occasional, and as such represents a low estimate of symptoms experienced by respondents. We realize employees may experience symptoms "sometimes" that are truly work-related. In addition, we recognize some building-related symptoms do not improve upon immediately leaving the workplace (e.g., muscle pains, delayed hypersensitivity reactions). Another factor which can result in the underestimation of the true symptom prevalence is the "healthy worker" or "survivor" effect. "Survivors" are usually healthier (that is, lacking illness or injury that would interfere with work) than those who have left employment. This "healthy worker" or "survivor" effect has been described in other studies and is an inherent bias of this study's cross-sectional design.[4]

On the other hand, these health symptoms are self-reported and may represent a variety of work-related, general environmental, and non-environmental health effects. None of the 38 participants sought physician evaluation or treatment for their symptoms.

VII. CONCLUSIONS

In general, the building's ventilation system appeared to be providing sufficient fresh air to the buildings occupants. Despite this finding, there were a substantial number of employees reporting symptoms they felt were related to their work in the building. The symptoms reported in this survey are similar to those reported in other evaluations of indoor air quality, however; we cannot comment of whether this represents a "higher than normal" rate. Although the symptoms experienced by respondents did not result in physician evaluation, they did result in substantial time away from work.

The symptoms survey also indicated that several employees on the first three floors of the SRS building felt that there was a problem with inadequate air movement, and problems with maintaining comfortable temperature and humidity levels. While it is not clear what effect these factors would have on employee's symptoms, it would be prudent to maintain these within existing guidelines. Development of a "comfort" chart by ASHRAE presents a comfort zone considered to be both comfortable and healthful. This zone lies between 73° and 77°F (23° and 25°C) and 20 to 60 percent relative humidity.[5]

The symptom survey also indicated that several employees had experienced irritative symptoms which they felt were associated with the past renovation activities. Generally, the contaminants generated from such processes rapidly diminish with time. While the renovation work was completed by the time of the NIOSH survey, it is probable that trace levels of the various volatile components of the construction materials may still be off-gassing. While concentrations of these substances would be expected to be below any occupational criteria, maintaining adequate fresh air exchange rates should help to further reduce the concentrations of these materials.

VIII. RECOMMENDATIONS

1) The building management should continue with its program of preventive maintenance and periodic inspection of the HVAC system and related equipment. Complaints regarding air quality or distribution in specific work areas should be promptly investigated and individual air handling units checked for their proper functioning.

2) Attempts should be made to ensure that air temperature and humidity fall within the ASHRAE guidelines for all of the office areas. Employees should be instructed not to shut of the air handling units for individual temperature control.

3) Drip pans for the cooling coils should be regularly inspected to ensure that no moisture accumulates which might allow for microbial growth.

4) Filters in the air handling units should continued to be changed on a regular schedule. A checklist should be developed so that all filters are included in this change.

5) Areas of renovation, painting, carpet laying, etc., should be isolated from non-construction areas through the use of physical barriers. When possible, such work should be scheduled on weekends and after hours when building occupancy is lowest. Supplying a maximum amount of ventilation to these areas initially on a 24-hour basis can assist in rapid dispersion of contaminant levels.

6) Changes in office layouts should ensure that adequate air flow is still provided to involved areas.

IX. REFERENCES

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Table 1

Size and Occupancy of the SRS Facility by Floor

Wichita Department of Social and Rehabilitation Services
Wichita, Kansas

FLOOR	JOB RESPONSIBILITIES	# EMPLOYEES*	SQUARE FEET**
1	Income Maintenance	100	25,000
2	Income Maintenance	130	20,000
3	Counseling	90*	15,000
4	Youth Social Services	90	14,000
5	Data Control & Entry	25	5,850
6	Administration	25	5,850
7	Adult Social Services	30	5,850

*- Approximate number when fully occupied
** - Estimates

Table 2

Carbon Dioxide Concentrations (parts per million) in Selected Offices by Time of Measurement

Wichita Department of Social and Rehabilitation Services
Wichita, Kansas
May 3, 1989

TIME	TOTAL 25*	1st FLOOR 7*	2nd FLOOR 15*	3rd FLOOR 3*	STATISTICAL SIGNIFICANCE (Kruskal-Wallis)
Early AM (7-9:30AM)					
mean	567	570	566	562	p= 0.70
range	(475-775)	(550-575)	(475-775)	(550-575)	
Mid AM (10-11:30AM)					
mean	691	675	702	675	p= 0.75
range	(500-875)	(575-875)	(500-875)	(675-675)	
Early PM (1-2:30PM)					
mean	687	636	717	658	p= 0.26
range	(500-850)	(500-850)	(500-850)	(650-675)	
Late PM (3-4:30PM)					
mean	769	650	827	723	p= 0.13
range	(550-1425)	(550-775)	(550-1425)	(700-775)	

* = Number of locations

Table 3

Demographics of the 38 Employees Participating in the Symptom Survey by Floor

Wichita Department of Social and Rehabilitation Services
Wichita, Kansas
May 3, 1989

DEMOGRAPHICS	TOTAL 38*	1st FLOOR 11*	2nd FLOOR 24*	3rd FLOOR 3*	STATISTICAL SIGNIFICANCE
AGE (mean in yrs) (range)	41 (26-70)	38 (23-57)	43 (26-70)	46 (28-64)	p = 0.47[a]
GENDER (% female)	81%	82%	79%	100%	p = 0.86[b]
RACE (% minority)	29%	36%	29%	33%	p = 0.91[b]
SENIORITY (mean in yrs) (range)	10 (1-38)	7 (1-16)	13 (1-38)	3 (2-4)	p = 0.10[a]

a - Kruskal-Wallis

b - Mantel-Haenszel

* = Number of participants

Table 4
Prevalence of Work-Related Symptoms by Floor
Wichita County Social & Rehabilitative Services
Wichita, Kansas
May 3, 1989

SYMPTOMS	TOTAL 38*	1st FLOOR 11*	2nd FLOOR 24*	3rd FLOOR 3*	STATISTICAL SIGNIFICANCE (KRUSKAL-WALLIS)
MUCOUS MEMBRANE IRRITATION					
Stuffy nose	32%	36%	33%	33%	p= 0.74
Dry eyes	21%	9%	25%	33%	p= 0.24
Burning eyes	13%	0%	21%	0%	p= 0.31
Dry throat	13%	9%	17%	0%	p= 0.90
Runny nose	11%	0%	13%	33%	p= 0.10
Sore throat	11%	9%	8%	33%	p= 0.50
RESPIRATORY/FLU					
Aching muscles/joints	16%	9%	21%	0%	p= 0.76
Chest tightness	8%	9%	8%	0%	p= 0.12
Shortness of breath	3%	0%	4%	0%	p= 0.67
Fever	3%	9%	0%	0%	p= 0.15
Cough	3%	0%	4%	0%	p= 0.67
Wheezing	0%	0%	0%	0%	---
CONSTITUTIONAL					
Headache	29%	36%	25%	33%	p= 0.64
Fatigue	18%	9%	21%	33%	p= 0.29
Sleepiness	16%	27%	13%	0%	p= 0.18

* = Number of participants

Table 5

Reported Sources of Mucous Membrane or Respiratory Irritation

Wichita County Social & Rehabilitative Services
Wichita, Kansas
May 3, 1989

SOURCES	TOTAL 38*	1st FLOOR 11*	2nd FLOOR 24*	3rd FLOOR 3*
Paint	47%	36%	54%	33%
Chemical (glues, white out)	34%	36%	33%	33%
New carpeting	31%	36%	33%	0%
Pesticides	24%	18%	25%	33%
Photocopying	13%	9%	17%	0%
Cleaning (carpets, drapes, furnishings)	13%	0%	21%	0%
Printing processing	8%	9%	8%	0%
Tobacco smoke	5%	9%	4%	0%
New drapes & furniture	0%	0%	0%	0%

* = Number of participants