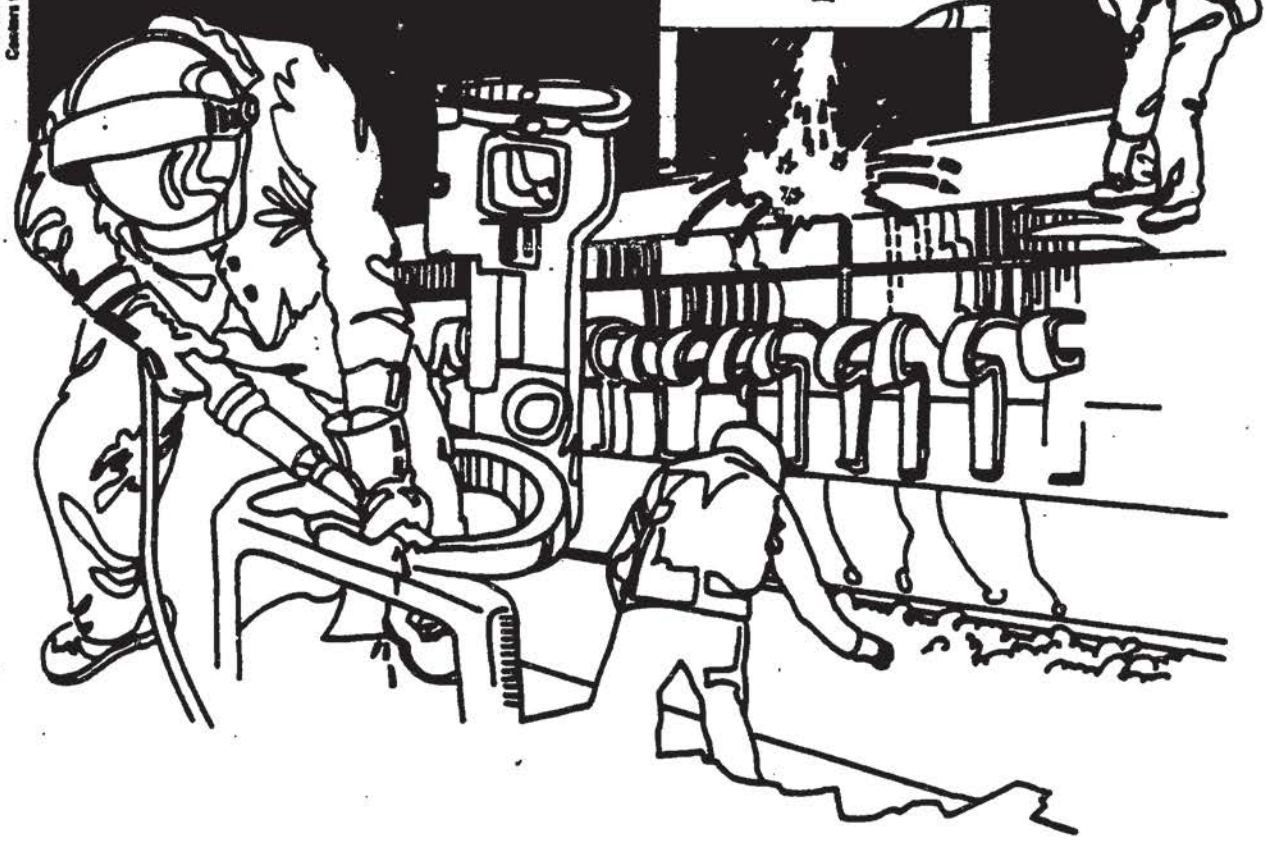
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 84-004-1568
GEORGE WASHINGTON UNIVERSITY
MEDICAL CENTER
WASHINGTON, D.C.

PREFACE

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 or 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.

HETA 84-004-1568
MARCH 1985
GEORGE WASHINGTON UNIVERSITY
MEDICAL CENTER
WASHINGTON, D.C.

NIOSH INVESTIGATORS:
Richard Gorman, C.I.H.
Paul J. Seligman, M.D.

I. SUMMARY

On October 18, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate complaints of eye irritation and occasional respiratory tract irritation among employees working in the Biochemistry Department, George Washington University, Washington, D.C.

On October 18, 1984, NIOSH conducted an initial visit to gather background information and inspect the laboratories; a follow-up visit on February 6-7, 1984 to better define the prevalence, nature, and location of complaints through the administration of a questionnaire; and, a third visit on August 28, 1984, to conduct area air sampling for organic vapors and aldehydes (both are eye and upper respiratory irritants).

The questionnaire was administered to 75 of 82 (91%) employees at the Biochemistry Department and 24 of 40 (60%) employees at the Pharmacology Department where no previous work-related symptoms had been reported.

The questionnaire asked about work-related eye and respiratory symptoms; occupational history; types of worksite exposures; use of eye glasses or contact lenses; and concerns about environmental conditions.

Employees of the Biochemistry Department had a statistically significant excess of complaints related to eye irritation ($p < .01$). Employment on the 5th floor and the use of contact lenses ($p < .01$) were associated with eye irritation.

By the time of the third visit, complaints of eye irritation had resolved. Air sampling was, however, conducted for one day in order to obtain background data for comparative purposes, should complaints start again. The only aldehydes detected were formaldehyde and acetone, at concentrations of 0.02 ppm and less than 0.1 ppm, respectively. Toluene, xylene and several aliphatic hydrocarbons were detected at all the sampling locations, but the total concentrations of these compounds were less than 1 ppm. The air concentration of the aldehydes and organic vapors found are considered "trace" or background quantities and would not be expected to cause ill health effects in most people.

Based on the questionnaire results, employment in the department of biochemistry, particularly the 5th floor, appears to have been associated with eye irritation; however, except for low humidity, which was building-wide, and the use of contact lenses, no causative agents were identified. Complaints subsided in the spring of 1984 with no explanation. Recommendations are given in Section VIII should complaints of eye irritation start again.

KEYWORDS: SIC 2869 (Laboratory Chemicals, Organic), biochemistry laboratory, indoor air quality, contact lenses

II. INTRODUCTION

On October 18, 1983 NIOSH received a request from the Director of the Department of Safety, George Washington University Medical Center, Washington, D.C. for assistance in evaluating complaints of eye irritation and occasional respiratory tract irritation among employees working in the Biochemistry Department. The laboratory researchers in the department were also experiencing problems with the growth and maintenance of tissue cultures used in their research work.

NIOSH investigators made an initial visit on October 18, 1983. A letter summarizing the activities during this visit was forwarded October 31, 1983. A follow up visit was made on February 6-7, 1984 to conduct a questionnaire survey in the building. Results of this survey were forwarded by letter on July 25, 1984. A third survey, which involved air sampling in the laboratory where employees had been complaining and in other areas where there were very few complaints, was conducted on August 28, 1984. August was reported as a time period when complaints were usually more common and symptoms more intense.

III. BACKGROUND

The Biochemistry Department is located on the 2nd and 5th floors of George Washington University Medical Center, Washington, D.C. A staff of approximately 82 people is composed of research scientists, students, and support personnel. A major activity of this laboratory involves the growth of tissue cultures used in support of various cancer research projects. There is potential for exposure to numerous chemicals normally found in this type of laboratory (Tables IV and V). Some are used inside of laboratory hoods and some are used in open containers on bench tops.

The problems with tissue culture growth were first experienced in February 1982. Eye irritation among the staff was reported to the Department of Safety in the fall of 1982. The efforts to identify and correct the problem were extensive and included: discarding all chemicals and starting over with a fresh supply; a thorough cleaning of the laboratory which included the release of paraformaldehyde into the lab; inspection of all ventilation systems; air sampling using techniques to identify organic, particulate and biological contaminants; changing of filters; and a review of housekeeping procedures including the use of cleaning agents and pesticides. These efforts uncovered a number of deficiencies but problems persisted even after corrective actions. Most of the efforts were directed at the tissue growth problems; however it was felt that the eye irritation may be related to this problem in some way.

The only action that helped the tissue growth problem was when the tissue cultures were grown in other parts of the building. All chemicals and personnel were the same, but the environment was changed. The tissue cultures were successfully grown and maintained in all areas of the building except the 5th floor laboratory. However, it was not known if complaints of eye irritation were building-wide or concentrated in the 5th floor biochemistry laboratory.

IV. METHODS AND MATERIALS

A. Initial Survey (October 18, 1983)

Following the opening conference with the staff of the Departments of Safety and Biochemistry, a walk-through of the Biochemistry Department was conducted to obtain information on the normal operating procedures, chemical usage and ventilation systems. An historical account of the sequence of the events since the complaints began in the fall of 1982 was obtained from a biochemist who had kept detailed records.

Since many potential causes had already been evaluated without success we decided to start by collecting information that would more clearly define the problem and determine if complaints were building-wide or just from the 5th floor biochemistry laboratories.

B. First Follow Up Survey (February 6-7, 1984)

A questionnaire was administered to the 2nd and 5th floor, biochemistry staff and the 6th floor, pharmacy staff (where no previous complaints had occurred) to establish the prevalence of complaints and define the factors related to worker symptoms. Questions were asked about duration of employment, department, job title, location of office or lab, types of exposures (chemicals, office machines, smoke, etc.), use of eyeglasses or contact lenses, concerns about environmental conditions (air quality, temperature, humidity, lighting), history of antecedent allergic or respiratory conditions, and work-related eye and respiratory symptoms.

In addition, relative humidity data was collected in the areas where the questionnaire was distributed.

C. Second Follow Up Visit (August 28, 1984)

Based on the results of the questionnaire, air samples were collected in the biochemistry department as well as several other locations to evaluate airborne concentrations of organic vapors and aldehydes, both of which are eye and upper respiratory system irritants.

The organic vapor samples were collected using standard 150 mg charcoal, sorbent tubes at a flow rate of 175 cc/min for a period of 7.5 to 8 hours. The charcoal tubes were desorbed with 1 ml carbon disulfide and screened by gas chromatography (FID). A 30 meter DB-1, bonded-phase, fused, silica capillary column (split-less-mode) was used for all analyses.

Air samples for the aldehyde scan were collected on 150 mg DNPH-coated XAD-2 resin sorbent tubes at a flow rate of 200 cc/min for 7.5 to 8 hours. The samples were desorbed with 2.0 ml of acetonitrile for at least one hour and analyzed using reverse phase HPLC. The analysis included a scan for C_1-C_{10} aldehydes followed by quantitation of the peaks above background. Since there may be a need to repeat this analysis at some later date the specific instrument parameters were as follows:

Instrument:	Varian 5000 liquid chromatograph
Detector:	Varian UV-5 variable detector
Column:	DuPont Instruments Zorbax ODS (4.6 mm x 25 cm)
Wavelength:	365 nm
Flow:	1.5 mL/min
Sample Loop:	10 uL
Attenuation:	1 AUFS or 0.1 AUFS
Mobile Phase:	65/35 CH_3CN/H_2O
Chart Speed:	0.5 cm/min

During the air sampling period, all persons in the 5th floor biochemistry lab were interviewed to determine symptom prevalence for possible correlation with air sampling results.

V. EVALUATION CRITERIA

Since biochemistry personnel use numerous chemicals (Tables IV and V), there are many potential sources of eye irritation. Organic vapors and aldehydes were selected for evaluation due to the fact that they are known mucous membrane irritants. Low relative humidity can also cause mucous membrane and eye irritation.

Good work practices and well-designed and maintained local ventilation systems (lab hoods, etc.) should prevent the buildup of airborne contaminants to the degree that most people should not experience symptoms; however, a small percentage of the population may experience symptoms at concentrations that would not be expected to cause problems for most people.

Employees who wear contact lenses, particularly soft contact lenses, may complain of eye irritation earlier, or to a greater degree than, those not wearing contact lenses. Soft contact lenses contain 30-70% water. The shape of the lense is known to change with variations in ambient relative humidity.[1,2] In addition, because the lenses are hydrophilic, organic solvents readily absorb and concentrate on the lense.[3] Particulates can be trapped behind hard or soft contact lenses and cause irritation. In an atmosphere where there are low concentrations of several gas and vapors in the atmosphere, as well as low humidity (below 25%), there are numerous combinations of potential causative agents for eye and mucous membrane irritation. However, the technology, such as air sampling, used to evaluate such problems, is of limited usefulness due to the fact that the concentrations of airborne contaminants found are usually "background" level for a typical chemistry laboratory which makes any correlations with symptoms difficult.

While not distinguishing between hard and soft contact lenses, one NIOSH study of an office building noted that the "use of contact lenses was positively associated with reported eye irritation (p less than .001)".[4] The investigators felt that persons who wore contact lenses were probably "more sensitive to symptoms of eye irritation", and "more likely to report such symptoms". Since low concentrations of organic vapors were noted, it is possible that the symptoms may have been related to contact lense absorption of these vapors, and/or to the low relative humidity in the building.

VI. RESULTS AND DISCUSSION

A. Medical

During our initial visit, seven employees on the 5th floor of Ross Hall in the Department of Biochemistry were interviewed in regard to work-related symptoms. Of the seven individuals, five gave histories clearly relating eye symptoms to the workplace. These symptoms included dryness, irritation, a gritty feeling, redness, tiredness, and itching. Of interest, four of the seven individuals wore contact lenses at work. No individual gave a history of respiratory irritation.

The medical questionnaire from the February 6-7, 1984 visit was distributed to personnel who worked on the 2nd, 5th and 6th floor. The population selected represented those who worked in the 5th floor biochemistry department where there were complaints of eye irritation, the 2nd floor biochemistry lab, and the 6th floor pharmacology department. The 2nd floor lab used chemicals similar to the 5th floor lab. The pharmacology department generally used different chemicals.

The demographic characteristics of the population surveyed by department and floor are listed in Tables II and III.

Tables IV and V list the chemicals used by respondents working in laboratories by department and floor. The tables were generated by asking individuals to list chemicals they use. The biochemistry department, in particular the 5th floor, reported a greater use of organic solvents like chloroform, toluene, and acetone, consistent with the differences in the types of research conducted by the departments. Chloroform is a known eye irritant.

Questions about symptoms were divided into three symptom complexes; 1) eye irritation symptoms (burning, dryness, redness, itching, irritation) 2) eye strain symptoms (headache, difficulty focusing, blurred vision, difficulty reading) and 3) respiratory symptoms (cough, wheezing, shortness of breath, sore throat, sinus congestion). A report of a symptom was considered significant when the respondent noted that the symptom was experienced "usually" or "always" while at work. The prevalence of reported symptoms was stratified by department, floor, exposure to smoke, allergy history, use of eyeglasses or contact lenses, antecedent medical conditions, and by air handling unit.

Members of the department of biochemistry consistently reported a higher proportion of all symptoms related to the eye irritation symptom complex (dryness, burning, redness, itching). When irritant symptoms were grouped to determine the proportion of multiple complaints related to eye irritation, the employees of the department of biochemistry had significantly more complaints than employees of the pharmacology department. No trends in higher proportions or significant differences in complaints of eye strain or respiratory symptoms were noted between departments. Table VI presents the proportion of symptoms by department.

When symptoms were stratified by floor, the respondents from the 5th floor had consistently higher proportions of complaints related to eye irritation as noted in Table VII.

Questions were asked about environmental conditions within the building including temperature, humidity, lighting, air movement, stuffiness, and smells. There were no differences in environmental complaints by floor or by air handling unit. Table VIII notes the distribution of supply air handling units by room number.

On all floors, multiple complaints about temperature, typically that it is "either too hot or too cold", were noted. Of all the environmental conditions surveyed, only complaints about the lack of humidity were consistently registered on all floors consistent with the low humidity readings noted previously.

Complaints of eye irritation were not associated with allergy history, exposure to cigarette smoke, antecedent medical conditions, or eyeglass use. Of note was that 24 of 99 employees interviewed wore contact lenses while at work. The distribution of contact lens use by department and by floor is described in Table IX. The prevalence of contact use was evenly distributed by department and floor among those interviewed with 20+% of all respondents wearing some form of contact lens at work.

Contact lens use was significantly associated with both individual and grouped symptoms of eye irritation as summarized in Table X. Twenty of 24 contact lens wearers reported using soft contact lenses. With the preponderance of soft lens users among contact lens wearers, the significant association between soft lenses use and irritant symptoms remained. Because of the small number of hard contact lens users, it is impossible to determine whether either soft or hard lenses are more associated with eye irritant symptoms than the other. The prevalence of eye symptoms related to soft contact lens use is also presented in Table X.

Because of the wide variety of cleaning and wetting solutions used by the contact lens wearers, no one brand of solution could be implicated in the frequency of reported eye irritation. Similarly, because of the large number of chemicals, isotopes, and drugs used in these research laboratories, no correlation between symptoms of eye irritation and chemical exposures could be made.

B. Environmental

At the time when the air samples were obtained (August 28, 1984), there were no complaints of eye or respiratory irritation among the 12 staff members interviewed in the 5th floor biochemistry laboratory. There were some changes in personnel since the time the medical questionnaire was administered. However, at least 6 of the 12 workers present on the day of the survey had previously reported eye irritation. Symptoms appeared to subside sometime during the previous winter. No one had any possible explanation.

The results of the air samples for aldehyde vapors are presented in Table XI. Although the analysis included a qualitative scan for C_1-C_{10} aldehydes, only four were detected. These were formaldehyde, acetone, methyl ethyl ketone and isobutryaldehyde.

Only formaldehyde and acetone were detected at the survey site and these a concentrations of 0.02 ppm and less than 0.1 ppm respectively. Adverse health effects would not be expected at these "trace" or background concentrations. Results from the sampling conducted at a separate building for comparison were similiar for formaldehyde and acetone. Trace concentrations of methyl ethyl ketone and isobutryaldehyde were also found.

Several organic vapors were detected; all were present at or below 0.1 ppm. These included toluene, xylene and several aiphatic hydrocarbons. The total concentration of organic vapors at any of the sampling locations was less than 1 ppm and not expected to cause adverse health effects for most people.

Since there were no complaints at the time of sampling, these data should be used for comparison if complaints increase in the future.

VII. CONCLUSIONS

Employment in the Department of Biochemistry, particularly on the 5th floor, appears to have been associated with complaints of eye irritation. The agent responsible for this finding was not clearly identified by this study, although chloroform, among other organic solvents, is a known eye irritant. Relative humidity readings were considerably lower in the building compared with the ambient conditions that existed outdoors in Washington, D.C., on the day of the survey. The relative humidity was low (<15%) throughout the entire building during our February 1984 visit. Organic vapors and aldehyde concentrations were at "background" levels but were obtained during a period when there were no complaints.

The only other factor identified that was significantly related to eye irritation was the use of contact lenses at work, the majority of which were soft lenses. Soft contact lenses are made of a plastic polymer containing up to 70% water by weight. Because of their high water content, manufacturers of the lenses, officials at the Food and Drug Administration responsible for testing the safety of contact lenses, and ophthalmologists are aware of the potential risk posed to the eye by chemical vapors that readily absorb in the lens. The Bausch and Lomb package insert for SOFLENS recommends the following wearing restrictions: "SOFLENS Contact Lenses...when used only for vision correction should be removed before sleeping (unless the patient is on an extended wear schedule) swimming or in the presence of noxious and irritating vapors" (emphasis added). Hydrophilic chemicals are easily absorbed by soft contact lenses and, may be conducted through the soft lens, and held against the cornea.

Many industries make it policy to restrict soft contact lens use in chemical environments. Recent articles in the Journal of Occupational Medicine[5] and in Occupational Safety and Health[6] have renewed attention toward the issue of contact lens use in the workplace. Hard lenses are best avoided in dirty, dusty environments that contain small particulates.[7] Soft lenses, on the other hand, should be prohibited in areas where there are water-soluble chemicals, or hot, low-humidity conditions that could dry the lens.[8]

While the use of contact lenses may account for many of the complaints of eye irritation among users, it cannot account for many of the work-related eye problems noted in this survey by non-contact wearers. Since the prevalence of contacts lens use is similar in both departments and on all three floors, it would appear that other factor(s) related to the quality of the indoor environment may be responsible for the eye problems noted on the 5th floor. Until these factors are identified, it would be impossible to know whether they relate to the difficulties experienced in growing human tissue cultures.

VIII. RECOMMENDATIONS

Should complaints of irritation among the 5th floor biochemistry personnel start again in the future and persist, we recommend the following:

1. Insure that all ventilation systems are working properly.

2. Evaluate if only contact lens wearers are affected. If so, we suggest that they wear regular glasses for at least a week to see if the eye irritation is related to the wearing of the contact lenses.

3. Repeat the air sampling and compare results to those reported herein.

Users of contact lenses in laboratories throughout the university should be made aware of the potential for eye irritation related to soft lense use and exposure to chemicals. Employees experiencing eye irritation who use soft contact lenses should be encouraged to use glasses while at work.

IX. REFERENCES

1. Eng WG, Harada LK, Jagerman LS. The wearing of hydrophilic contact lenses aboard a commercial jet aircraft: I. Humidity effects on Fit. Aviat. Space Environ. Med. 53(3):235-238, 1982.

2. Andrasko G, Schoessler JP. The effect of humidity on the dehydration of soft contact lenses on the eye. International Contact Lens Clinic 7:210-212, 1980.

3. Nilsson SEG, Andersson L. The use of contact lenses in environments with organic solvents, acids or alkalis. Acta Ophthalmologica 60:599-608, 1982.

4. National Institute for Occupational Safety and Health. Health Hazard Evaluation Report, TA 80-122-1117, May, 1982.

5. Mitchell JW. Use of contact lenses in industry. Journal of Occupational Medicine. 26(5):330, 1984.

6. Hirschfelder D. Contact lenses may pose new problems in the workplace. Occupational Health and Safety. pp. 54-58, March, 1984.

7. Novak JF, Saul RW. Contact lenses in industry. Journal of Occupational Medicine. 13:175-178, 1971.

8. Eng WG, Harada LK, Jagerman LS. The wearing of hydrophilic contact lenses aboard a commerical jet aircraft: I. Humidity effects on fit. Aviat. Space Environ. Med., 53(3):235-238, 1982.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Richard Gorman, M.S., C.I.H.
Industrial Hygiene Engineer
Industrial Hygiene Section

Paul J. Seligman, M.D.
Medical Officer
Medical Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

Report Typed By:

Jacqueline Grass
Clerk/Typist
Industrial Hygiene Section

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Department of Safety, George Washington University Medical Center
2. NIOSH, Region III
3. OSHA, Region III

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 I

Relative Humidity

GWU Medical Center - Ross Hall
Washington, D.C.
HETA-84-004

February 6-7, 1984

	Mean Humidity	No.	Range
Outdoors (Washington, D.C.)	48%	1	-
Eye Street Building			
Department of Safety	26%	2	25-27%
Ross Hall			
Department of Biochemistry (5th floor)	14.2%	8	12-16%
Department of Biochemistry (2nd floor)	13.5%	2	13-14%
Department of Pharmacology	11.5%	2	10-13%

Table II

Demographic Characteristics by Department

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

	Biochemistry (N=75)	Pharmacology (N=24)
Number of respondents (response rate)	75 (92%)	24 (60%)
Age (years)	33.8 ± 10.1	36.9 ± 12.5
Duration of employment (years)	5.2 ± 5.6	7.8 ± 9.9
Works in laboratory (% yes)	84%	79%
Exposed to chemicals at work (% yes)	80%	87%
Job titles		
Research associate	54%	29%
Graduate student	16%	33%
Secretary	9%	13%
Lab technician	8%	4%
Professor	4%	21%
Project coordinator	3%	0%
Visiting scholar	3%	0%
Student elective	3%	0%

Table III

Demographic Characteristics by Floor

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

	2nd Floor	5th Floor	6th Floor
Number of respondents (response rate)	20	55	24
Age (years)	34.3 ± 9.6	33.6 ± 10.3	36.9 ± 12.5
Duration of employment (years)	4.4 ± 4.7	5.5 ± 5.9	7.8 ± 9.9
Works in laboratory (% yes)	95%	80%	79%
Exposed to chemicals at work (% yes)	79%	80%	87%
Job titles			
Research associate	75%	46%	29%
Graduate student	5%	20%	33%
Secretary	0%	13%	13%
Lab technician	10%	7%	4%
Professor	0%	6%	21%
Project coordinator	0%	4%	0%
Visiting scholar	10%	0%	0%
Student elective	0%	4%	0%

Table IV

Frequency* of Chemical Use by Floor

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

2nd Floor	5th Floor	6th Floor
acetic acid	methanol	"solvents"
polyacrylamide	chloroform	methanol
phenol	toluene	chemotherapeutic agents
HCl	acetone	NaOH
methanol	acetic acid	ethyl ether
acetone	ethyl ether	toluene
acetonitrile	hexane	acetonitrile
chromic acid	scintillation fluid	HCl
"solvents"	"solvents"	"drugs"
chloroform	DMSO	acetone
toluene	HCl	"isotopes"
NaOH	acetonitrile	mercaptoethanol
isobutyric acid	mercaptoethanol	mitomycin C

* In descending order with most frequently reported chemicals used listed at top.

Table V

Frequency* of Chemical Use by Department

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

Biochemistry	Pharmacology
methanol	"solvents"
chloroform	methanol
toluene	"chemotherapeutic agents"
acetone	NaOH
acetic acid	ethyl ether
ethyl ether	toluene
"solvents"	acetonitrile
HCl	HCl
polyacrylamide	"drugs"
acetonitrile	acetone
"scintillation fluids"	"isotopes"
DMSO	mercaptoethanol
phenol	mitomycin C

* In descending order with most frequently used chemicals listed at top.

Table VI

Frequency of Symptoms by Department

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

Symptoms at Work	Proprotion Affected		Sign.*
	Biochemistry (N=74)	Pharmacology (N=24)	
Eye dryness	26%	8%	N.S.**
Eyes uncomfortable	23%	8%	N.S.
Eye irritation	21%	4%	N.S.
Eye irritation complex (One or more symptoms of burning dryness, redness, itching, irritation)	25%	6%	p <.01
Eye strain complex (One or more symptoms of blurred vision, difficulty focusing, headaches, difficulty reading)	80%	83%	N.S.
Respiratory symptoms (One or more symptoms of sore throat, sinus congestion, cough, wheezing, shortness of breath)	76%	87%	N.S.

* Chi-square test for statistical significance was used for each symptom or symptom complex

** N.S. - not significant at or below the p = 0.05 level

Table VII

Frequency of Symptoms by Floor

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

Symptoms at Work	Proprotion Affected 2nd (N=19)	5th (N=55)	6th (N=24)	Sign.*
Eye dryness	21%	27%	8%	N.S.**
Eyes uncomfortable	16%	25%	8%	N.S.
Eye irritation	15%	24%	4%	N.S.
Eye irritation complex (One or more symptoms of burning dryness, redness, itching, irritation)	15%	41%	6%	N.S.
Eye strain complex (One or more symptoms of blurred vision, difficulty focusing, headaches, difficulty reading)	80%	80%	83%	N.S.
Respiratory symptoms (One or more symptoms of sore throat, sinus congestion, cough, wheezing, shortness of breath)	80%	75%	88%	N.S.

* Chi-square test for statistical significance was used for each symptom or symptom complex

** N.S. - not significant at or below the p = 0.05 level

Table VIII

Air Supply Units by Room

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

Air Handling Unit No.	Rooms Supplied	Number of Employees
No. 6	226, 228, 230 231, 232, 233	18
No. 7, 5th floor	530, 531, 532 533, 534, 536 537, 538, 540 541, 557	20
6th floor	634, 636, 638 639, 640, 641 644	13
No. 8, 5th floor	518	3
6th floor	611, 623	4
No. 16, 5th floor	546, 550, 551 552, 553, 554 555, 556	24
6th floor	650, 653	2
No. 17, 5th floor	526	6
6th floor	618, 619, 624	5

Total employees by air handling unit.

No. 6 - 18
No. 7 - 33
No. 8 - 7
No. 16 - 26
No. 17 - 11

Table IX

Type of Contact Lens Use by Department and Floor

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

	Contact Lens		
	Hard	Soft	Total
Department			
Biochemistry (N=75)	4 (5%)	15 (20%)	19 (25%)
Pharmacology (N=24)	0	5 (21%)	5 (21%)
	4	20	24
Floor			
2nd (N=20)	1 (5%)	3 (15%)	4 (20%)
5th (N=55)	3 (5%)	12 (22%)	15 (27%)
6th (N=24)	0	5 (21%)	5 (21%)

Table X

Frequency of Eye Irritation by Contact Lens Use

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

February 6-7, 1984

Symptoms at Work	Contacts (N=24)	No Contacts (N=74)	Sign.*
Eye dryness	38%	16%	p <.05
Eyes uncomfortable	42%	12%	p <.005
Eye irritation	42%	9%	p <.001
Eye irritation complex (One or more symptoms of burning dryness, redness, itching, irritation)	35%	19%	p <.01

Symptoms	Soft Contacts (N=20)	No Contacts (N=74)	Sign.
Eye dryness	35%	16%	N.S.
Eyes uncomfortable	40%	12%	p <.01
Eye irritation	40%	9%	p <.005
Eye irritation complex (One or more symptoms of burning dryness, redness, itching. irritation)	35%	16%	p <.05

* Chi-square test for statistical significance was used for each symptom or symptom complex

** N.S. - not significant at or below the p = 0.05 level

Table XI

Aldehydes And Ketones[1]

GWU Medical Center - Ross Hall
Washington, D.C.
HETA 84-004

August 28, 1984

Sample Location	Volume	Formaldehyde (ppm)	Acetone (ppm)	Methyl Ethyl Ketone (ppm)	Isobutryaldehyde (ppm)
Room 639, Pharmacy	92.2	.02[4]	0.1	ND	ND
Room 549, Biochemistry	88.0	.02	.02	ND	ND
Room 233, Biochemistry	87.8	.02	.004	ND	ND
Room 704, New Control Facility[2]	81.6	.02	0.12	ND	ND
NIOSH Office Cincinnati, Ohio[3]	75.2	.02	0.08	0.33	.04
NIOSH Lab Cincinnati, Ohio[3]	75.2	.02	0.06	0.13	ND

Note: (1) All samples were area samples. Sampling time was 7-8 hours. Flow rate was 200 cc/min. Therefore, total sample volume was 75-100 liters. All samples were scanned for C_1-C_{10} adkehydes. Only the 4 above were detected.

(2) Room 704 was 100% outside air and taken as a background at site.

(3) The two samples at the NIOSH office were taken as background away from site on 8/30/84.

(4) Number in parenthesis indicates that the quantity on the sample was detectable but below what could be confidently quantitated.