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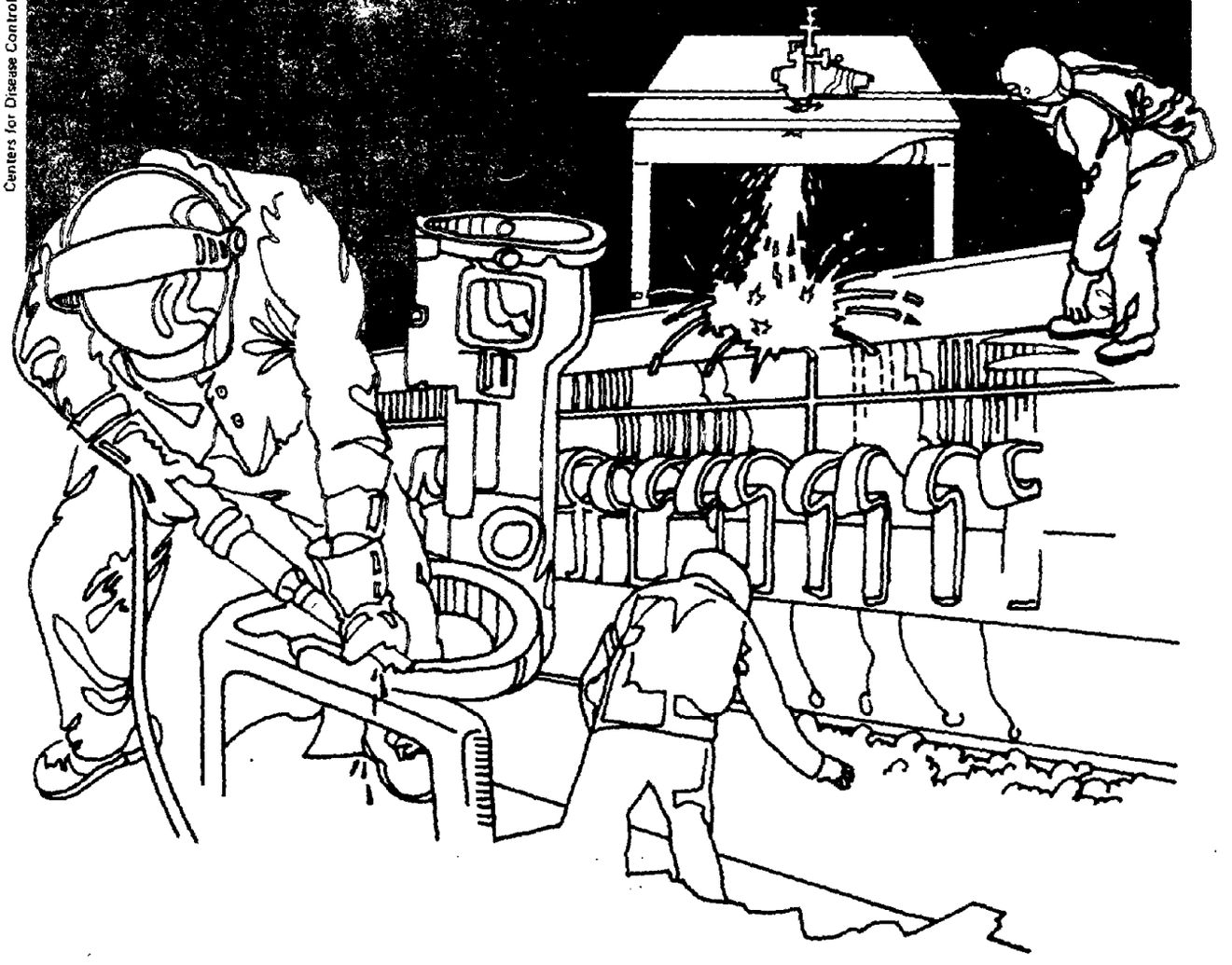

Health Hazard Evaluation Report

HETA 81-142-392
MCKEESPORT HOSPITAL
MCKEESPORT, PENNSYLANIA

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.

HE 81-142-892
June 1981
McKeesport Hospital
McKeesport, Pennsylvania

NIOSH Investigator:
Walter J. Chrostek,IH

I. SUMMARY

On January 5, 1981, NIOSH received a request from the Assistant Administrator of the McKeesport Hospital, McKeesport, Pennsylvania, for a health hazard evaluation of the Histology and Cytology Laboratories in the Kelly Building and of the Gross Histology Laboratory in the Crawford Building. The request stated that the Medical Technologists, Histologists and Cytologists were complaining of skin and eye irritation, fatigue, burning sensation in the throat, gastric upsets, headaches, dizziness and nasal congestion. The suspect agents were xylene, isopropanol, ethanol and formaldehyde.

Environmental air sampling was conducted on February 24, 1981. Analysis of six samples collected in the Histology and Cytology Laboratories showed that there was no overexposure to the organic solvent vapors, viz. ethanol, isopropanol, and xylene, as calculated by the formula for mixtures. The results ranged from 0.01 to 0.22 permissible limit which is unity (1).

Analysis of five environmental air samples collected in the Gross Histology Laboratory for formaldehyde gas showed no exposures which exceeded the OSHA standard of 3.6 milligrams per cubic meter of sampled air (mg/M^3). The sample results ranged from 2.3 to 2.8 mg/M^3. The exposures exceeded the NIOSH criteria of 1.2 mg/M^3 for a 30 minute ceiling, based upon the irritant effects of formaldehyde.

On the basis of data obtained in this investigation, NIOSH determined that a hazard from overexposure to organic solvent vapors (ethanol, isopropanol, and xylene did not exist in the Histology and Cytology Laboratories. However, exposures to formaldehyde gas exceeded NIOSH criteria in the Gross Histology Laboratory. Because of recent toxicological studies, NIOSH further recommends that formaldehyde be treated as a potential carcinogen, and that exposures be reduced to their lowest feasible level. Recommendations have been incorporated into this report to control exposure to formaldehyde gas in the Gross Histology Laboratory.

KEYWORDS: SIC 80-62 (General and Medical Hospital) formaldehyde, ethanol, isopropanol, xylene, skin and eye irritation, fatigue, burning sensation in throat, gastric upsets, headaches, dizziness and nasal congestion.

II. INTRODUCTION

On January 5, 1981, a request was submitted by the Assistant Administrator of the McKeesport Hospital, McKeesport, Pennsylvania, expressing concern about the solvent toxicity.

III. BACKGROUND

McKeesport Hospital is a general medical hospital. Human tissue, removed during an operation, is examined visually and sent to the laboratories where it is mounted on slides and examined microscopically for tissue and cellular structure. The areas of concern were the Gross Histology Laboratory, where tissue is preserved in a 10 percent formalin solution prior to visual examination, and the Cytology and Histology Laboratories where organic solvents are used in the preparation of slides for microscopic evaluation.

During the NIOSH health hazard evaluation that had been conducted previously on October 21, 1980, in the Microbiology Laboratory, the employees met with the industrial hygienist and complained about adverse health effects viz. skin and eye irritation, fatigue, burning sensation in the throat, gastric upsets, dizziness and nasal congestion.

IV. EVALUATION DESIGN AND METHODS

Four personal breathing air samples were collected in the Histology Laboratory and a general air and personal air sample were collected in the Cytology Laboratory for organic vapors. The samples were collected on charcoal utilizing personal sampling pumps operating at 0.2 liter per minute. The samples were subsequently analyzed for ethanol, isopropanol, and xylene, which were the solvents in use in the above laboratories, by NIOSH method P&CAM 127[1].

Five personal breathing air samples were collected in the Gross Histology Laboratory for formaldehyde gas. Two personal breathing air samples were collected on specially treated charcoal utilizing personal sampling pumps at 0.05 liter per minute. These samples were analyzed by NIOSH method P&CAM 318[2]. Three short-term breathing air samples of approximately ninety minutes were collected in impingers containing one percent $NaHSO_3$ solution and personal sampling pumps operating at one liter per minute. These samples were analyzed by NIOSH method P&CAM 125[1].

Ventilation measurements were made in the Histology and Cytology Laboratories utilizing an Alnor velometer.

V. EVALUATION CRITERIA

Substance	OSHA[3]	NIOSH Recommended Criteria
Ethanol	1900*	1900
Isopropanol	980	980
Xylene	435	435
Formaldehyde[4]	3.6	1.2**

* Denotes milligrams of contaminant per cubic meter of air sampled (mg/M3).
**Denotes milligram of formaldehyde for any 30-minute of sampling period.

In order to determine if there were overexposures to mixtures of organic solvents, the following formula was used:

$$\frac{C^1}{T^1} + \frac{C^2}{T^2} + \ldots \frac{Cn}{Tn}$$

where C^1 is the observed atmospheric concentration and T^1 the corresponding threshold limit value. If the sum of the fractions exceeds unity (1), then the threshold limit of the mixture should be considered as being exceeded. The formula is only used when the chief effects are in fact additive, which they were in this case.

VI. TOXICITY

A. Ethanol[5]

Local - Mild irritation of eye and nose occurs at very high concentrations. The liquid can defat the skin, producing a dermatitis characterized by drying and fissuring.

Systemic - Prolonged inhalation of high concentrations, besides the local effect on the eyes and upper respiratory tract, may produce headache, drowsiness, tremors, and fatigue. Tolerance may be a factor in individual response to a given air concentration.

B. Isopropanol[5]

The vapors are mildly irritating to the conjunctiva and mucous membranes of the upper respiratory tract.

No cases of poisoning from industrial exposure have been recorded. Isopropanol is potentially narcotic in high concentrations.

C. Xylene[5]

Local - Xylene vapor may cause irritation of the eyes, nose, and throat. Repeated or prolonged skin contact with xylene may cause drying and defatting of the skin which may lead to dermatitis. Liquid xylene is irritating to the eyes and mucous membranes, and aspiration of few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Repeated exposure of the eyes to high concentrations of xylene vapor may cause reversible eye damage.

Systemic - Acute exposure to xylene vapor may cause central nervous system depression and minor reversible effects upon liver and kidneys. At high concentrations xylene vapor may cause dizziness, staggering, drowsiness, and unconsciousness. Also at very high concentrations, breathing xylene vapors may cause pulmonary edema, anorexia, nausea, vomiting, and abdominal pain.

D. Formaldehyde[4,5,6]

Local - Formaldehyde gas may cause severe irritation to the mucous membranes of the respiratory tract and eyes. The aqueous solution splashed in the eyes may cause eye burns. Urticaria has been reported following inhalation of gas. Repeated exposure to formaldehyde may cause dermatitis either from irritation or allergy.

Systemic - Systemic intoxication is unlikely to occur since intense irritation of upper respiratory passages compels workers to leave areas of exposure. If workers do inhale high concentrations of formaldehyde, coughing, difficulty in breathing, and pulmonary edema may occur. Ingestion, though usually not occurring in industrial experience, may cause severe irritation of the mouth, throat, and stomach.

The National Institute for Occupational Safety and Health (NIOSH) recommends that formaldehyde be handled as a potential occupational carcinogen and that appropriate controls be used to reduce worker exposure. These recommendations are based primarily on a Chemical Industry Institute of Toxicology (C I I T) study in which laboratory rats and mice exposed to formaldehyde vapor developed nasal cancer, and are supported by a New York University study where rats exposed to a mixture of formaldehyde and hydrochloric acid vapors developed nasal cancer. Formaldehyde has also been shown to be a mutagen in several short-term laboratory studies.

VI. RESULTS

A. Histology Laboratory

Four personal breathing air samples were collected during the performance of various operations (microtomy, imbedding, etc.). The solvents predominantly used in the laboratory were ethanol, isopropanol, and xylene. Ethanol vapors exposures ranged from 5.0 - 13.4 mg/M^3 Isopropanol exposures ranged from 1.3 - 4.5 mg/M^3. Xylene exposures ranged from 4.7 - 31.1 mg/M^3. This data was then used to evaluate whether the cumulative exposure was exceeded. This determination was made by using the following formula:

$$\frac{C^1}{T^1} + \frac{C^2}{T^2} + \ldots \frac{Cn}{Tn}$$

If this value exceeded unity, then there was an over-exposure. The levels for mixtures in the Histology Laboratory ranged from .02-.08 (Table II). These values were below unity.

Ventilation is supplied by two portable, charcoal filtered, air recirculated hoods and one stationary local exhausted hood which is located over one laboratory bench. Ventilation readings taken with a velometer at the face of the portable hood showed exhaust velocities of 125 feet per minute. Ventilation readings taken in the work area at the stationary local exhaust ventilation hood were non-existent. Make-up air to this laboratory is supplied through the open doors.

B. Cytology Laboratory

One personal air sample and one area sample were collected in the Cytology Laboratory. Analysis of the personal air sample showed that exposures to ethanol, isopropanol, and xylene were 14.4, 2.4, and 52.8 mg/M^3 respectivelv. The area sample was 2.5 - 0.3, and 2.3 mgs/M^3 respectively. Both mixture calculations were below unity (.01 and 0.22).

There is one laboratory type of local exhaust ventilation hood, however it is not used by the operator when cover slipping the slides. The chief complaint from the employees was that it produces a draft when it is operating. Ventilation readings were 100 feet per minute with the door fully open and 150 feet per minute with the door half open. Make-up air is supplied through open doors.

C. Gross Histology Laboratory

Both long and short-term personal and area environmental air samples were collected in the Gross Histology Laboratory. The long-term samples were collected on chemically treated charcoal tubes at a rate of 0.05 liter per minute. The short-term samples were collected in impingers containing one percent $NaHSO_3$ solution at a rate of one liter per minute. Analysis of the three long-term samples showed formaldehyde gas concentrations ranged from 2.3-2.5 milligrams per cubic meter of air. The time-weighted average (8 hours) ranged from 1.3-1.9 milligrams per cubic meter of air. The two short-term personal air samples ranged from 2.3-2.8 milligrams per cubic meter of air. The two area environmental air samples were collected in the immediate vicinity of the pathologist and histo technologist. Employee exposures to formaldehyde gas in the Gross Histology Laboratory did not exceed OSHA standards, however the levels found exceeded NIOSH criteria.

Exhaust ventilation in this laboratory is supplied by a 18-inch window fan. During the visit of October 21, 1980, the window exhaust fan was inoperable. A new fan was installed prior to this visit. However the pathologist claims the fan noise interferes with her dictation. As a result, the window fan was not used during this evaluation as it appears to be in the normal method of operation.

VIII. DISCUSSION

The location of the pathologist in relation to the window fan would tend to be conducive to high exposure to formaldehyde. Any contaminant that is generated would be drawn into the breathing zone of the individual.

During the visit of October 21, 1980, specimens brought into the Gross Histology Laboratory were large in size and placed in lidded pans. During the evaluation of January 5, 1981, the specimens were much smaller in size and placed in tightly covered pint size plastic containers. This practice greatly reduces exposure to formaldehyde.

IX. CONCLUSION

A. Histology Laboratory

The location of the permanent local exhaust ventilation hood (approximately five feet over the table top) makes it ineffective in capturing hood contaminants. This hood should be lowered as much as possible to the table top.

During this evaluation there was a solvent spill during the transfer of materials into smaller containers. Solvent transfers should be done in well ventilated local exhaust areas.

In order to get effective control of solvent vapors when working at the portable air recirculated hoods, the work should be done in the hood.

B. Cytology Laboratory

Work involving the use of solvents was performed on a desk top though an efficient laboratory hood was available. The chief complaint from the personnel in this laboratory was that when the hood was in operation, it

produced a draft which affected the employees working adjacent to it. Relocating the laboratory hood so that it does not affect the employees would aid in the effective use of the hood and discontinue the draft complaints.

C. Gross Histology

During the visit of October 21, 1980, the window fan was inoperable. The specimens were also large and necessitated large containers. This fan was replaced during the visit of January 5, 1981. During the examination of the specimens, the pathologist must use a dictation machine. Since the window fan is noisy and interferes with the voice recording, it is seldom used. The window fan is located so that the formaldehyde gas is drawn into the breathing zone of the employees. A discussion was held with management on the desk relocation so that exposures are minimized and also that the present fan be replaced with a quieter fan so that it can be utilized when working with formaldehyde.

X. RECOMMENDATIONS

Histology and Cytology Laboratories

1. Establish a maintenance program on all local exhaust ventilation hoods. The air flow should be 125-150 feet per minute at the face of the booth.

2. Establish a program of periodic replacement of the charcoal filter in portable local exhaust ventilation unit. The frequency of replacement will depend on the amount of solvents used.

3. Wipe cloths and tissue should be immediately disposed into tightly sealed safety cans. At the present there is one can in the Histology Laboratory and the wipes are allowed to accumulate on the desk until the work is finished and then disposed. Additional trash cans are necessary.

4. The canopy hood in the Histology Laboratory should be lowered and sides enclosed so as to increase local exhaust ventilation to 125-150 feet per minute.

5. Relocate the laboratory hood in the Cytology Laboratory and enforce its use.

6. All solvent measurements should be done in the hood.

Gross Histology Laboratory

7. The work bench in the Gross Histology Laboratory should be so placed so that the formaldehyde gas is exhausted away from the breathing zone of the employees. The best method of controlling employee exposures to formaldehyde gas would be to perform this operation in ventilated laboratory hoods provided with a wash down system.

8. Dilution of concentrated formalin solution shall be done in a local exhaust ventilated hood or well ventilated area.

9. Medical surveillance shall be made available to all workers subject to occupational exposure to formaldehyde. These should include:

   Comprehensive medical and work histories with special emphasis on any evidence of chronic inflammatory reaction of the respiratory tract, of skin reaction or hypersensitivity , or of such other allergic conditions as asthma or hayfever.

XI. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Industrial Hygiene Assistance	Frank A. Lewis Industrial Hygienist

XII. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, OH 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, VA. 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. McKeesport Hospital, McKeesport, Pennsylvania
2. Employee Representative
3. OSHA, Region III
4. NIOSH, Region III

For the purpose of informing the ten employees of the results of the McKeesport Hospital survey, the employee shall promptly "post" for a period of 30 calendar-days the Determination Report in a prominent place(s) near where employees work.

XIII. REFERENCES

1. NIOSH Manual of Analytical Methods, Vol. 1, (NIOSH) Publication #77-157A.
2. NIOSH Manual of Analytical Methods, Vol. 6, (NIOSH) Publication #80-125, August 1980.
3. U.S. Department of Labor, Occupational Safety and Health Administration, Federal Register, Vol. 39, No. 125, June 27, 1964, (Revised Nov. 7, 1978).
4. NIOSH Criteria for a Recommended Standard, Occupational Exposure to Formaldehyde, Publication #77-126, December 1976.
5. Occupational Diseases: A Guide to Their Recognition, USPHS, CDC, NIOSH, Publication #77-181, Revised June 1977.
6. NIOSH Current Intelligence Bulletin 34, December 23, 1980.

TABLE I

MC KEESPORT HOSPITAL
MC KEESPORT, PENNSYLVANIA

February 24, 1981

Results of Personal and General Air Sampling for Formaldehyde

Sample No.	Job Description	Sample Period	Airborne Concentrations*		Remarks
9	Lab Technician	10:44-15:08	2.4	(1.8)**	Area Sample
7	Pathologist Bench	9:02-15:30	2.5	(1.9)**	Area Sample
10	Lab Technician	10:44-15:08	2.3	(1.3)**	Operators' Exposure
11	Histo Technician	13:38-15:04	2.8		Operators' Exposure
12	Pathologist	13:38-15:08	2.7		Operators' Exposure

* Denotes milligrams of contaminant per cubic meter of air sampled.
**Denotes time weighted average

	Evaluation Criteria	
Substance	OSHA	NIOSH
Formaldehyde	3.6	1.2 (for any 30-minute sampling period)

TABLE II

MC KEESPORT HOSPITAL
MC KEESPORT, PENNSYLVANIA

HHE 81-142

RESULTS OF SAMPLING FOR ORGANIC VAPORS
February 24, 1981

Sample No.	Area	Sample Period	Airborne Concentrations* Ethanol	Isopropanol	Xylene	Level** for Mixtures
1	Histology (Personal)	08:18-15:15	6.1	4.2	31.1	.08
2	Histology (Personal)	08:19-15:15	6.7	3.9	26.4	.07
3	Histology (Personal)	08:20-12:55	13.4	4.5	16.7	.05
4	Histology (Personal)	08:20-14:04	5.0	1.3	4.7	.02
5	Cytology (Area Sample)	08:27-15:15	2.5	0.3	2.3	.01
6	Cytology (Personal)	08:25-10:30	14.4	2.4	52.8	.22

* Denotes milligrams of contaminant per cubic meter of air sampled.
**Denotes that if the sum of the following fractions $\frac{C^1}{T^1} + \frac{C^2}{T^2} + \ldots \frac{Cn}{Tn}$ exceeds unity, then the acceptable level of the mixture should be considered as being exceeded where:
C^1 = observed atmospheric concentration
T^1 = threshold unit value.

EVALUATION CRITERIA

Substance	NIOSH	OSHA
Ethanol	1900	1900
Isopropanol	980	980
Xylene	435	435