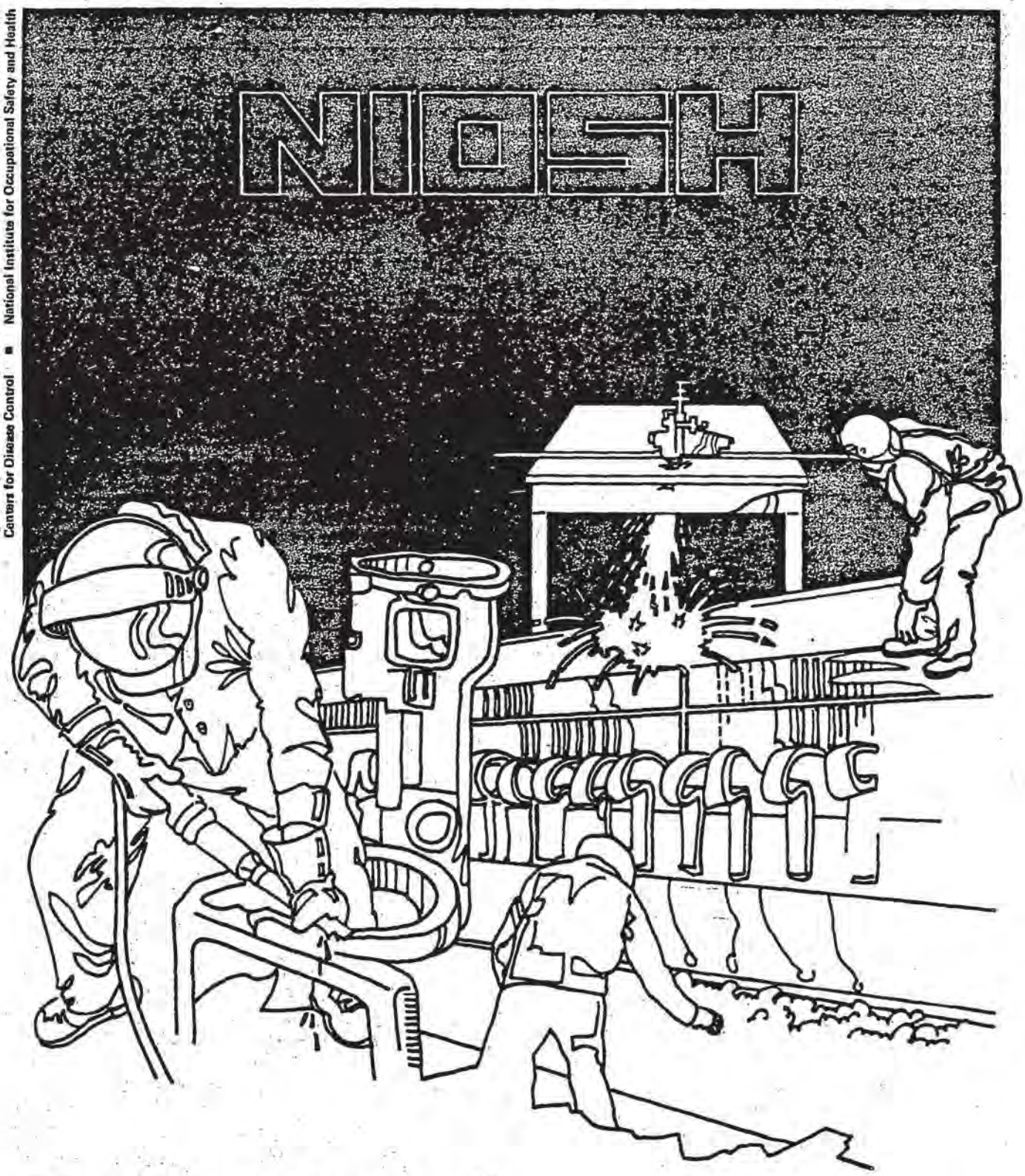
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-211-984
U.S.P.H.S. HOSPITAL
SAN FRANCISCO, CALIFORNIA

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.

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

HETA 81-211-984
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U.S.P.H.S. Hospital
San Francisco, California

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I. SUMMARY

In March 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the U.S. Public Health Service Hospital, San Francisco, California concerning the potential health hazard to employees working in the kidney dialysis unit (kidney wash area). The requestor was concerned that the ventialtion system recently installed was not adequate to prevent occupational exposures to formaldehyde vapors.

NIOSH conducted an initial environmental survey on March 16 and 20, 1981. Ten personal breathing zone and general area air samples (time weighted average) were collected from the dialysis room, isolation room and the kidney wash area. Formaldehyde vapor concentrations ranged from below the limit of detection to 0.9 ppm (parts of a vapor or gas per million parts of air). A follow-up environmental survey was conducted July 13, 1981 to determine when peak formaldehyde vapor concentrations occur. Seven personal breathing zone air samples were collected during central system purging and kidney flushing. No formaldehyde vapors were detected as a result of the newly initiated kidney wash-out procedures. The Federal Occupational Safety and Health Administration standard for formaldehyde is 3 ppm and NIOSH recommends in its current Intelligence Bulletin No. 34 (April 1981) to limit exposure to lowest feasible limit because of carcinogenic potential.

Non-directive medical questionnaires were administered to the dialysis unit employees. The workers most frequent complaints were of eye and nose irritation during kidney rinsing. Workers' irritant symptoms were reported to disappear once they left the kidney wash area.

Workers at the dialysis unit reported symptoms (eye, nose, and throat irritation, cough and headache) which are consistent with formaldehyde vapor exposure even though environmental air concentrations were below the Federal Standard. Based on the new work procedures and the environmental data collected during the follow-up survey, it is believed that the workers' previous symptoms should not recur. Recommendations are incorporated in Section VII to prevent worker exposure to formaldehyde vapors.

KEYWORDS: SIC 8081 (OUTPATIENT CARE FACILITY). Dialysis Unit, Formaldehyde, Artificial kidney sterilization

II. INTRODUCTION

A request for technical assistance was submitted to the National Institute for Occupational Safety and Health (NIOSH) by the Chief of Environmental Health at the U. S. Public Health Service Hospital at San Francisco, California. The requestor was concerned that the ventilation system recently installed in the Renal Unit (kidney wash area) was not adequate to remove formaldehyde vapors.

NIOSH conducted an initial environmental survey on March 16 and 20, 1981, and a follow-up environmental survey on July 13, 1981. A non-directed medical questionnaire was administered to employees working in the treatment room, and the kidney wash area.

III. BACKGROUND

The USPHS Hospital dialysis unit has been operational since 1968. The dialysis unit consists of a treatment room, an isolation room and a kidney wash area. Ten employees (3 technicians and 7 nurses) staff the two shift (5:30am - 2pm, 2:00pm - 10:30pm) operation. Two technicians and four nurses work day shift, (Monday through Saturday) and 1 technician and 3 nurses work the swing shift (Monday through Friday). Approximately 21 patients are treated at the unit with heaviest patient loading being, Monday, Wednesday and Friday. The treatment room has six consoles and two portable units and the isolation room has one portable unit.

Patients are connected to the dialysis console for three to five hours depending on the patients' diet, the condition of the artificial kidney being used and other medical factors. Once the patient is disconnected from the artificial kidney, the technician and occasionally the nurse take the artificial kidney to the wash area. The kidney is purged with water and tested to determine whether or not the kidney can be reused. If it is reusable, it is purged (15-20 seconds) and stored with a 6 percent formalin solution until the patient returns for their next treatment. Prior to reusing a kidney, the formalin solution is drained and two liters of a heparinized saline solution are purged through the dialysate compartment for 30 minutes. A drain line is connected from the kidney to the sink drain and water is run to dilute the formalin solution.

At the end of swing shift or after the last patient of the day, the central system dilutes a 37 percent formalin solution to 1.5 percent to sterilize the console units. The formalin solution remains in the lines overnight. At the beginning of the next shift, the central system is purged with purified water for about 45 minutes. During this time, the technician prepares the artificial kidneys for the morning shift patients.

Formalin solutions used to sterilize the kidneys are prepared by the technicians about once per month. The technicians pour the 37 percent formalin solution from the 5 gallon carboy into a graduated cylinder. The technicians wear rubber gloves whenever handling the carboy of formalin.

IV. HAZARD EVALUATION DESIGN

A. EVALUATION CRITERIA AND HEALTH EFFECTS

Occupational exposure criteria have been developed to evaluate worker's exposure to chemical substances. Two sources of criteria were used to assess the workroom concentrations: (1) NIOSH Current Intelligence Bulletin No. 34, and (2) Federal Occuaptional Safety and Health Administration (OSHA) Standards. These values represent concentrations to which it is believed that nearly all workers may be exposed for up to an 8 hour day, 40 hour work week throughout a working lifetime without experiencing adverse health effects. The NIOSH Criteria Document (77-126) recommended a criteria of 0.5 ppm based on its irritative effects; however, the NIOSH Current Intelligence Bulletin No. 34 (April 1981) recommends that occupational exposure be controlled to lowest feasible limit based on its carcinogenic potential.

SUBSTANCE	PERMISSIBLE EXPOSURE LIMIT 8 HOUR TIME-WEIGHTED AVERAGE	CEILING VALUE
Formaldehyde (NIOSH)	-	Lowest Feasible Limit
Formaldehyde (Federal)	3 ppm	10 ppm (30 min/8 hrs)

ppm - parts of a vapor or gas per million parts of air.

B. TOXICOLOGICAL EFFECTS

Formaldehyde is best known for its use by embalmers and morticians to preserve dead bodies and tissues. It has a sharp odor which can be smelled at very low levels (less than 1 ppm). At concentrations ranging from 0.1 to 5 ppm, formaldehyde makes the eyes burn, tearing may occur and general irritation of the upper respiratory passages. Low levels of 0.3 - 2.7 ppm have also been found to disturb sleep and to be irritating to a smaller number of people (3). Higher exposures (10 - 20 ppm) may produce coughing, tightening in the chest, palpitation of the heart.

Formaldehyde has induced a rare form of nasal cancer in two test animals as reported by the Chemical Industry Institute of Toxicology. Formaldehyde has also been shown to be a mutagen in several test systems.

Based on these finds, NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen. and that work practices be employed to control occupational exposures to the lowest feasible limit.

C. MATERIAL AND METHODS

Personnel and area air sampling for formaldehyde was collected from the kidney wash area, isolation room and the treatment room. The air samples were collected using an MDA (R) vacuum pump and a specially impregnated charcoal tube through which a known volume of air was drawn. The charcoal tubes were analyzed via ion chromatography using NIOSH physical chemical and analytical method 318 with minor variations in the preparation and analysis of samples (1).

Non-directive medical questionnaires were administered to nine of the ten dialysis staff.

V. RESULTS AND DISCUSSION

Ten personal breathing zone and general area air samples were collected from the kidney wash area, the isolation room and the treatment room on March 16 and 20, 1981 (TABLE I). Based on the quantity of formalin used and the work procedures, it was decided to collect high volume low flow air samples (17-45 liters). Formaldehyde concentrations ranged from below the limit of detection (less than 8 micrograms) to 0.90 ppm. These concentrations were below Federal OSHA standard cited in Table A.

A nondirective medical questionnaire was administered to nine of ten employees. Workers symptoms included eye, nose and throat irritation, cough, and headache; however, the most frequent complaints were of periodic eye and nose irritation during kidney rinsing. Workers irritant symptoms were reported to disappear once they left the wash area.

A follow-up environmental survey was conducted July 13, 1981 to determine when peak formaldehyde air concentrations occur. Seven personal air samples were collected during purging of the central system and while flushing the artificial kidneys before and after patient dialysis. It was learned that the kidney rinse procedure had changed subsequent to NIOSH's

initial survey. The procedure required that water be continually run while flushing the kidney with formalin. No formaldehyde vapors were detected during the day shift. The change in kidney rinse procedures appears to have eliminated formaldehyde exposures previously detected.

A general room exhaust fan was recently installed in the kidney wash area and connected to a light switch to assure it would be operating whenever anyone is in the room. The fan was installed to control formaldehyde vapors released during kidney rinsing. This type of exhaust ventilation system is inadequate for preventing occupational exposures to formaldehyde vapors based on air measurements conducted during the initial survey (Table I). Local exhaust ventilation is the only engineering control designed to control source exposures. Based on the follow-up environmental air sampling results, the new rinsing procedures appear to be effective in controlling formaldehyde vapors.

VI. CONCLUSION

Workers at the dialysis department reported periodic symptoms (eye, nose and throat irritation, cough and headache) which are consistent with formaldehyde exposures during kidney rinsing. Based on the new kidney rinsing procedure initiated subsequent to the initial survey, no formaldehyde air concentrations were detected on the follow-up survey. It is believed that the workers previously reported irritant symptoms should not recur.

VII. RECOMMENDATIONS

1. Nurses who occasionally flush the artificial kidneys should be aware of new kidney flushing procedures.

2. Employees should wear proper protective equipment whenever handling carboys of formalin or when preparing dilute formalin solutions. Protective equipment should include: rubber gloves, protective apron, and eye and face protection to prevent skin contact.

3. The portable dialysis units should be sterilized at the end of the day when the central supply system is being sterilized.

4. The lines connecting the portable and console units to the drain line should be air tight to prevent formaldehyde vapors from escaping into the treatment room.

5. The main drain trap located in the isolation room should be connected to prevent formaldehyde vapors from escaping during central system purging.

6. Periodic monitoring should be conducted for formaldehyde vapors to assure the new procedures are working properly.

VIII. REFERENCES

1. NIOSH Manual of Analytical Methods, HEW Publication No. (NIOSH) 80-125.

2. Criteria for a Recommended Standard: Occupational Exposure to Formaldehyde, DHEW (NIOSH) Publication No. 77-126, Cincinnati, U. S. Dept. of HEW, PHS, NIOSH, 1977.

3. Formaldehyde: Evidence of Carcinogenicity, NIOSH Current Intelligence Bulletin 34, April 15, 1981. DHHS (NIOSH) Publication No. 81-111.

4. NIOSH Manual of Sampling Data Sheets, Supplement to 1977 Edition, DHEW (NIOSH) Publication No. 78-189.

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22216.

Copies of this report have been sent to:

1. U.S. Public Health Service Hospital, San Francisco, California
2. U.S. Department of Labor/OSHA - Region IX
3. NIOSH Region IX

For the purpose of informing the 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 I

Personal and Area Air Samples
Collected for Formaldehyde
U.S.P.H.S. Hospital
San Francisco, CA
March 16 and 20, 1981
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JOB DESCRIPTION or LOCATION	Type Sample	Sampling PERIOD	VOLUME(LITERS)	Concentrations(ppm)[1]
Chief Dialysis Tech.	P[2]	0855-1355	35.9	0.42
Central System Machine	A[3]	0855-1455	18.5	0.90
Kidney Wash Area	A	0900-1450	17.1	N.D.[4]
Hallway outside Rm. 6309	A	0915-1450	37.1	0.29
Nurses Station - (Dialysis Rm.)	A	1205-1455	20.2	0.58
Kidney Wash Area	A	0655-1330	20.2	0.62
Isolation Rm.	A	0700-1300	39.1	0.45
Dialysis Technician	P	0700-1335	18.6	0.63
Nurses Station- (Dialysis Rm.)	A	0700-1330	45.7	0.29
Dialysis Nurse	P	0700-1330	46.6	0.27

(1) ppm - parts of a vapor or gas per million parts of air.

(2) P - Personal sample

(3) A - Area Sample

(4) ND - None detected.