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CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT HE 79-47-582

GLADNICK DENTAL CLINIC
WILMINGTON, DELAWARE

April 1979

100%

I. TOXICITY DETERMINATION

Based on the results of an environmental investigation of the Gladnick Dental Clinic, it was determined that employees of the clinic were not normally exposed to potentially toxic airborne concentrations of inorganic mercury. Such a determination is based on data collected during a NIOSH Health Hazard Evaluation (HHE) conducted at the Clinic February 27, 1979. During the HHE the Occupational Safety and Health Administration (OSHA) legal standard of 0.1 mg/M³ (ceiling concentration) for mercury exposure was exceeded only when the lid was removed from the mercury scrap storage container to deposit scrap materials (range 0.4 to 0.75 mg/M³). Although concentrations were detected in excess of the 0.05 mg/M³ NIOSH and ACGIH recommended standard, when calculated over an 8 to 10 hour workday these levels were found well within the recommended limits.

Recommendations included in this report are presented to assist in insuring the safety and health of the employees.

II. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Technical Services, 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. 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:

- a) Director, Gladnick Dental Clinic
- b) U.S. Department of Labor, Region III
- c) NIOSH, Region III

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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 National Institute for Occupational Safety and Health received such a request from the Gladnick Dental Clinic on January 25, 1979. The recognition of the potential health hazard associated with inorganic mercury was primarily responsible for the health hazard evaluation (HHE) request.

During the closing conference held on February 27, 1979 with the clinic employees, it was mentioned by Dr. Gladnick that no specific health problems were alleged as a result of the inorganic mercury exposures prior to the HHE investigation. Also during the conference it was pointed out by the investigating officer that inorganic mercury was accumulating on the waxed floors, mop heads and employee shoes; recommendations were made accordingly.

IV. HEALTH HAZARD EVALUATION

A. Description of Facilities

The Gladnick Dental Clinic occupies one side of a two tenant dwelling which has been zoned for both commercial and residential purposes. The dental clinic section of the dwelling provides for three dental offices equipped with individual amalgamators for filling preparation, an X-ray developing area, a supply storage room, an administrative office, and a reception and waiting area. Heating for the clinic is supplied by a gas furnace and is cooled and ventilated by a central air recirculation unit. Current staffing of the clinic provides for one dentist, one dental assistant, one dental hygienist, and one receptionist, all of whom work an 8-hour day, 4 1/2 days per week.

B. Process Description

The mercury handling procedures are similar to those found in many dental offices. Mercury is purchased in one pound, 10 milliliters (ml) containers, and is mixed with tablet alloys of (copper, tin, zinc and silver). During the mixing process, the mercury and alloy tablet is placed in a transator, mixed for 15 seconds by an amalgamator, placed on an amalgam squeezed cloth to remove excess mercury and then molded into a mortar. The prepared mortar is carried by an amalgam carrier to the patient's tooth. Excess amalgam is suctioned from the patient's mouth and retained in a trap which is emptied regularly. The excess and/or scrap amalgam is stored in a container located in the supply storage area until it is sold (usually within 1 to 3 years). During these procedures, the potential for mercury contamination may exist. Therefore it is necessary that precautions be adhered to during amalgam preparation to help insure that the dentists, assistants and patients are not unnecessarily exposed to inorganic mercury vapors.

C. Evaluation Design

On February 27, 1979 both breathing zone (BZ) and general area (GA) samples to detect inorganic mercury levels were collected at the Gladnick Dental Clinic.

The personal samples for mercury exposure were collected by using mercury vapor badges attached to the lapel of the worker's uniform. These badges which operate on the basis of a passive diffusion dosimeter principle require no sampling train or pump. Analysis of these samples were completed by 3M company and are based upon the reduction in the conductivity of the resulting amalgam absorbed. The charcoal tube samples for mercury vapor utilized sampling pumps calibrated at a flow rate of 50 cc/min as outlined by the NIOSH Manual of Sampling Data Sheets #20.01¹. These samples were analyzed by the atomic absorption spectroscopy method as is described in the American Industrial Hygiene Association Journal 32:614, (1971).

In addition to these samples a number of direct reading measurements were made for mercury by using a Bacharach Model MV2 Mercury Sniffer.* It should be noted that the use of the Mercury Sniffer was to point out areas of contamination rather than to provide accurate personal exposure data.

*Mention of commercial names does not constitute a NIOSH endorsement.

D. Evaluation Criteria

1. Environmental

The current U.S. Department of Labor (OSHA) legally enforceable standard for mercury exposure is 0.1 mg/M³ as a ceiling concentration which should not be exceeded.² However NIOSH³ and ACGIH⁴ are both recommending that no workers be exposed to concentrations of mercury greater than 0.05 (TWA) milligrams per cubic meter of air (mg/M³), as an 8-hour time-weighted average concentration (TWA).

2. Toxicology and Medical⁵

Inorganic mercury is a general protoplasmic poison. The primary toxic action is assumed to be due to its ability to form highly undissociable linkages with sulfhydryl groups present in most proteins and with other ligands such as amine, phosphoryl and carboxyl groups which are found in any living cell. This ability to form bonds with physiologically important chemical functional groups render mercury a potent but nonspecific inhibitor of a wide variety of enzymes. The toxic action of mercury is the result of biotransformation of elemental mercury (Hg⁰) to an oxidized mercuric ion (Hg++) which is the more physiologically active form. Elemental mercury has a significant vapor pressure, is lipid soluble and has neutral properties which favor its passage across cell membranes and its localization in tissue of relative by high lipid content such as the liver, brain and kidney. Mercury can be adsorbed by inhalation, ingestion and direct skin contact. Occupational exposures to mercury are generally chronic in form, however acute poisoning may result from massive inhalation of mercury vapors.

Classical symptoms of chronic intoxication of mercury (mercurialism) consist of excessive salivation and gingivitis, a metallic taste in the mouth, erethism, and a tremor of the upper and/or lower extremities. Erythema is a syndrome that consists of the following symptoms: nervousness, irritability, hyperexcitability and loss of temper. Mercurialism is also associated with depression, headache, fatigue, insomnia, impaired memory, anorexia, weight loss, loose teeth, bleeding gums, sore throat, black line on gums (mercury line), various gastrointestinal disturbances, dermatitis, stomatitis, tingling sensation of the tongue, "shaky" legs, tension, tremor of lips, hands or feet, loss of muscle strength in arms and legs, disturbances of gait, and nephrotic syndrome with edema, proteinuria and casts in the urinary sediment.^{6,7,8}

Presently the effects of inorganic mercury on embryological and fetal development are not clearly defined, however, studies have shown that mercury may pass the placental barrier since this barrier has a relatively high lipid content. Mercury is transported from the body via urine, feces, and to some extent from the sebaceous secretions of hair follicles and sweat.

E. Evaluation Results and Discussion

All samples collected at the Gladnick Dental Clinic have been analyzed and the results are recorded in Tables I and II. As indicated in these tables, the employees are being exposed to very low airborne concentrations of mercury throughout the dental work area. The mercury badge and charcoal tube samples (Table I) ranging from 0.006 to < 0.01 mg/M³ concentration found on the receptionist badge resulted from the opening of a scrap amalgam container. The direct reading instrument, used primarily to point out areas of contamination, also detected an increase concentration (0.4 to 0.75) when the lid from the amalgam scrap can was removed.

Other locations in the clinic where mercury was detected in significant concentrations were the operatories utensil shelves 0.01 to 0.08 mg/M³; amalgam bowls for mixing and disposing scraps 0.02 to 0.09 mg/M³; mop heads 0.01 to 0.02 mg/M³ and employee shoes 0.01 to 0.05 mg/M³.

V. RECOMMENDATIONS

Generally the majority of the mercury level detected during the industrial hygiene survey were within the present OSHA standard. However 15 percent of the direct reading samples did exceed the NIOSH and ACGIH recommended standards during peak periods. Therefore the following recommendations are offered as control measures to reduce mercury vapor levels to the lowest reasonably achievable concentrations.

1. The amalgam scrap storage container should be removed from the supply storage area to prevent supply contamination.
2. Since mercury scrap products will eventually deteriorate tin or metal it is recommended that the amalgam scraps be placed in a container made of similar material as that used when purchasing and storing pure mercury (plastic or glass).
3. Mercury contamination should be removed from the instrument trays and storage shelves. This can be achieved by cleaning the shelves and trays with a powdered soap. (HgX soaps) and rinsing thoroughly with plain water. There are commercial soaps available that will break down and remove mercury.
4. Floors should be stripped of wax scrubbed with a HgX soap, and then rewaxed on a regular basis.

5. Mop heads should be washed and/or replaced periodically.
6. The procedures for waste mercury disposal or mercury spill decontamination should be studied by all employees working in and around mercury use areas, including housekeepers.
7. Since mercury accumulates in carpets and cloth materials the carpet and couch should be removed and/or replaced in the near future.
8. A separate storage locker should be maintained for employee work shoes to prevent mercury from being carried home.
9. Recommendations set forth by the American Dental Association for reducing employee mercury exposures, should be consulted.
10. Additional information concerning Dental Office Mercury Poisoning may be obtained from: Dr. John J. Hefferren, Director, Research Institute American Dental Association, 211 East Chicago Avenue, Chicago, Illinois 60611.

VI. REFERENCES

1. NIOSH Manual of Sampling Data Sheets, 1977 Edition, DHEW (NIOSH) Publication No. 77-159.
2. Occupational Safety and Health Standard (OSHA) for General Industry, 29 CFR Part 1910, January 1, 1978, pp. 291-293.
3. Criteria for a Recommended Standard, Occupational Exposure to Inorganic Mercury, HSM 73-11024; U.S. Department of Health, Education and Welfare, Public Health Service. National Institute for Occupational Safety and Health, 1973 Edition.
4. Threshold Limit Values for Chemical Substance in Workroom Air Adopted by ACGIH, 1978, P.O. Box 1937, Cinti, Ohio 45201.
5. White, Gary L. Industrial Hygienist, Industrial Hygiene Section, HETAB, DSHEFS, NIOSH, Cinti, Ohio. Clermont County Children's Dental Services, Batavia, Ohio, HEW, TA 76-108, December 1976.
6. Encyclopedia of Occupational Health and Safety, Vol. II, pp. 860-863, 1971.
7. National Safety Council Safety Newsletter, July, 1976.
8. National Institute for Occupational Safety and Health (NIOSH), "Working with Mercury in Industry", 1973.

VII. AUTHORSHIP AND ACKNOWLEDGEMENT

Report Prepared By:

Paul L. Johnson
Industrial Hygienist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

Report Typed By:

Linda Morris
Clerk-Typist
Industrial Hygiene Section
Hazard Evaluations and
Technical Assistance Branch
Cincinnati, Ohio

TABLE I

Results of Charcoal Tube and Mercury Vapor Badge Samples
 Collected at the Gladnick Dental Clinic
 Wilmington, Delaware
 February 27, 1979

Sample #	Sample Description	Location	Time	Concentration in milligrams/meter cubed (mg/M ³)
2245	Personal Mercury Badge	Dental Ast. Op. # 2&3	0905-1645	0.003
2246	Personal Mercury Badge	Dentist Op. # 2	0845-1643	0.004
2247	Personal Mercury Badge	Dental Hyg. Op. # 3	0843-1641	0.004
2726	Personal Mercury Badge	Receptionist	0840-1636	0.006
CT-1	Charcoal GA **	Reception Area	0900-1630	<.01 *
CT-2	Charcoal GA	Hall	0905-1630	<.01 *
CT-3	Charcoal GA	Op. # 2 Window	0912-1630	<.01 *
CT-4	Charcoal BZ	** Op. # 2	0915-1630	<.01 *

* Limits of detection were determined using a 20 liter sample volume and were calculated at 0.01 mg/M³ of air.

** General Area (GA) Breathing Zone (BZ)

The NIOSH recommended standard for exposure to inorganic mercury is 0.05 mg/M³ for 8-hour time-weighted average (TWA) daily exposure.

TABLE II

Results of Mercury Sampling with the Bacharach
 Model MV2 Mercury Sniffer at the Gladnick Dental Clinic
 Wilmington, Delaware
 February 27, 1979

	Location	Concentration * (mg/m ³)
Operatory # 1	- ambient air	.01
	counter top	.01
	Over amalgam scrap bowl	.02-.09
	Utensil shelves	.04-.07
Operatory # 2	ambient air	.01
	counter top	.01
	Over amalgam scrap bowl	.04-.08
	Utensil shelves (storage)	.02-.08
Operatory # 3	ambient air	.01
	counter top	.01
	Utensil shelves (storage)	.01-.04
Supply Storage	- ambient air	.01-.02
	Mercury scrap can	.01-.02
	Removal of lid from scrap can	.4-.75
Reception	ambient air	.01
	carpet	.01
Waiting	ambient air	.01
	couch	.01-.02
Hall	ambient air	.01
	carpet	.01
Director's Office	ambient air	.01
	carpet	.01
Basement	ambient air	.01
	Mops for operatory cleaning	.01-.02
Employee Shoes:	**	
	Receptionist	.01
	Dental Hygienist	.01
	Dentist	.01-.02
	Dental Assistant	.01-.05

* Milligrams of mercury per cubic meter of air.

** Employees should consider keeping work shoes at work to avoid tracking mercury home.

The OSHA "Ceiling Concentration" standard is 0.10 mg/M³.