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AN OPERATIONAL HYGIENE SURVEY FOR INORGANIC MERCURY AT CFB OTTA--ETC(U)
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An Operational Hygiene Survey for
Inorganic Mercury at CFB Ottawa (N)
Dental Clinic - B128

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B.J./Gill
B.L./Blyth

Defence and Civil Institute of Environmental Medicine
1133 Sheppard Avenue West, P.O. Box 2000
Downsview, Ontario M3M 3B9

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ABSTRACT

An occupational hygiene evaluation of the Dental Clinic - CFB Ottawa (N) was carried out to assess the existence or potential of a toxic hazard due to inorganic mercury.

Atmospheric inorganic mercury levels were measured and recommendations are included regarding safe operating procedures.

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INTRODUCTION

Routes of Entry and Symptoms

Mercury and inorganic compounds of mercury may be absorbed through the skin, gastrointestinal tract and the lungs. The principal source of occupational mercury poisoning is mercury vapour with exposure to mercury compounds occurring less frequently.

Acute exposure to high levels of mercury vapor affects the respiratory system and is manifested by pneumonitis, bronchitis, chest pains, dyspnea and coughing. Chronic exposure to low levels of mercury, the type most likely to occur in a dental clinic, may go unnoticed by the individual or attributed to other causes except for the tremor. This is particularly true with erethism which is characterized by irritability, outbursts of temper, excitability, headache, fatigue and indecision. A deterioration of legibility of handwriting may be an early sign of mercury absorption (1).

Dental Hazards

The mercury hazard to dental personnel is considered significant. Elevated atmospheric mercury concentrations may occur under the following conditions:

- a. spilled mercury lying undetected in dental suites;
- b. storage or disposal of amalgam;
- c. direct contact with elemental mercury during amalgam preparation;
- d. inhalation of amalgam particles during removal of an old restoration (2).

A Mercury Standard - Threshold Limit Value (TLV)

Because of the prevalence in the general population of non-specific signs and symptoms which can be associated with mercury, it is difficult, if not impossible, to establish a level at which no effects are observed. The problem is further complicated because of the validity of sampling and analytical methods on which the air levels are based cannot be determined conclusively; thus effects cannot be correlated with a high degree of confidence.

However, many workers have demonstrated a significant occurrence of signs of toxicity at a level below 0.1 mg/m^3 (0.005 - 0.06) indicating the need for an environmental standard for protecting the health of the employee at 0.05 mg/m^3 (3).

METHODS

General

At the time of the survey, five (5) personnel were employed in the Dental Clinic (B-128) consisting of two dental officers, two dental technicians and one clerk-receptionist.

Figure 1 indicates the location of dental chair areas and approximate dimensions of these areas. Sampling point (SP) areas are also identified in Figure 1.

Instrumentation

Atmospheric air concentrations of inorganic mercury vapor were determined using a Bacharach mercury vapor monitor. The principle of operation is based on a sample of air being drawn through an absorption chamber. The chamber with a photoresistive element on one end and a ultra violet source on the other measures the intensity of radiation passing through the space. Increasing or decreasing concentrations of mercury vapors are detected and displayed on a meter connected to a wheatstone bridge.

Calibration is done by introducing a sample of air containing a known concentration of mercury vapor. This was carried out prior to each series of readings at the selected sampling points. Readings were taken at the four (4) sampling points (SP) identified in Figure 1 on an hourly basis; commencing at 0800 hours and terminating at 1600 hrs.

Mercury Vapor Monitors

At the start of the workday - 0800 hr Mercury vapor monitors, Number 3600 manufactured by the Minnesota Mining and Manufacturing Company (3M) St. Paul Minnesota, were attached to the work dress of each member of the dental clinic. These were located as close to the breathing zone as possible. At 1600 hr the monitors were removed, sealed and forwarded to the 3M company analysis. The principle of operation is as follows:

A gold collection surface in the monitor quantitatively absorbs mercury vapor in relation to the environmental concentration. As the mercury exposure levels rise and fall, the monitors accurately integrate exposure levels using a binary diffusion system. After exposure, the mercury is retained for a comprehensive analysis which is based upon reductions in the conductivity of the resulting amalgam (4).

RESULTS

On-Site

None of the mercury vapor readings obtained during the systematic surveying of the four (4) sampling points on an hourly basis showed readings in excess of 0.005 mg/m³.

Table 1 shows random spot check readings taken from various areas throughout the dental clinic.

3M Company - Mercury Vapor Monitors

Results of personal monitoring using the 3M Mercury Vapor Monitor are as follows:

<u>Monitor Code</u>	<u>Wearer</u>	<u>TWA - mg Hg/m³</u>
Ad 3171	Receptionist	.007
Ad 3172	Sgt (technician)	.010
Ad 3173	Cpl (technician)	.011
Ad 3174	Maj (Dentist)	.007
Ad 3175	Capt (Dentist)	.010

DISCUSSION AND RECOMMENDATIONS

From the results obtained by both the direct read out instrument and the 3M Mercury monitor badge, it was evident that no toxicological hazard from inorganic mercury existed at the time of the survey.

Several spot samples gave readings greater than the Threshold Limit Value, however these do not indicate a true time weighted average based on an 8 hour workday as represented by the 3M Monitor.

Although the TLV was not exceeded in this clinic, wherever mercury is used, a potential hazard exists. Guidelines for the safe handling of mercury as recommended by the Council on Dental Materials and Devices are to be found in Appendix A (5)

A possible source of mercury contamination is from the vacuum cleaner currently in use in this clinic. Small droplets of mercury were observed in the cleaner collection system.

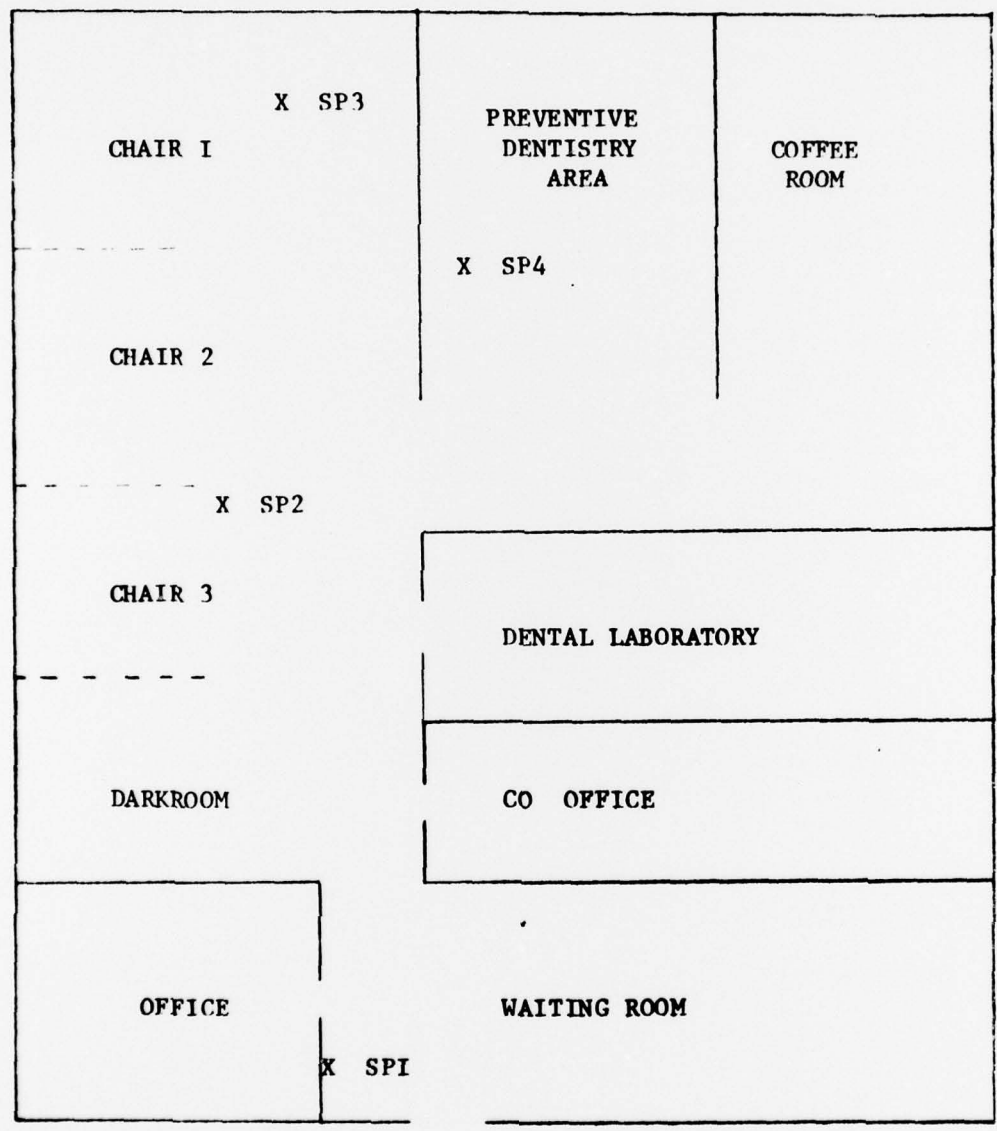
It is recommended that a commercially available mercury clean-up spill kit be procured and utilized to remove excess elemental mercury prior to usage of the vacuum cleaner.

REFERENCES

1. Occupational Health Branch, Data Sheet No. 9, Ontario Ministry of Labour. April, 1977.
2. Hefferren, J.J., Mercury surveys of the dental office: equipment, methodology and philosophy. Reports of Councils and Bureaus 89: 902-904, 1974. Pub. Council on Dental Material and Devices, Chicago.
3. Criteria for a recommended standard... Occupational Exposure to inorganic mercury - US HEW - HSM 73 - 11024.
4. 3M Technical Product Information Sheet - Mercury Vapor Monitor 3600 Minnesota Mining and Manufacturing Company, St. Paul, MN.
5. Recommendations in Dental Mercury Hygiene 96: 487-88, 1978 JADA. 96

TABLE 1

<u>Location</u>	<u>Time</u>	<u>Concentration (mg/m³)</u>
Vacuum Cleaner	0900 hrs.	0.08
Amalgamator	1000 hrs.	0.02
Amalgamator	1100 hrs.	0.60
Cpl (Technician) Finger-nail area	1100 hrs.	0.08
Vicinity Chair 1	1115 hrs.	0.015
Personal Footwear	1000-1100	
Maj (Dentist)	1000-1100	0.04
Cpl (technician)	1000-1100	0.12
Civilian (receptionist)	1000-1100	0.03



SP- SAMPLING POINT

APPROXIMATE DIMENSIONS - 130 m²

FIGURE I
DENTAL CLINIC - CFB OTTAWA (NORTH) B-128

ANNEX A

RECOMMENDATIONS IN DENTAL MERCURY HYGIENE - MARCH 1978

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1. Alert all personnel involved in handling of mercury, especially during training or indoctrination periods, of the potential hazard of mercury vapor and the necessity for observing good mercury-hygiene practices.

2. Work in well-ventilated spaces. Ventilation should include fresh air exchange and outside exhaust. Any filters placed in line, such as air conditioning filters, may act as mercury reservoirs and should be periodically replaced.

3. Since the prime source of mercury exposure to the dental team is atmospheric mercury, monitoring of the dental office area is the first step in mercury surveys.

Monitoring of the person is preferable to monitoring of the area, although the physical characteristics of most dental offices and work assignments may not require the former.

Positive air-flow absorber system or dosimeter systems designed to minimize the effect of air currents with a sensitivity of 15 $\mu\text{m}/\text{cu m}$ are recommended. (Sources of such equipment are being gathered and will be available on request to the Council office.)

Positive flow systems should use a flow rate of 1 liter a minute for one or more hours. The mercury-exposure data should be reported as a time-weighted average for an eight-hour period. Contact your state health department concerning planned surveys of dental offices in your area.

4. Perform yearly mercury determinations on all personnel regularly employed in dental offices. Urinalysis for mercury is recommended. An aliquot of the first urine voided in the morning is recommended when 24 hour specimens are not available. The maximum allowable level is 0.15 mg Hg/liter. Generally, the normal level is 0.015 mg Hg/liter.

5. Do not carpet dental operatories. Continuous seamless-sheet flooring carried up the walls for at least 10 cm is preferred.

6. Store mercury in unbreakable, tightly sealed containers away from any source of heat.

7. Confine the use of mercury to areas that have impervious and suitably lipped surfaces so as to confine and facilitate recovery of spilled mercury or excess amalgam.

8. Use tightly closed capsules during amalgamation. The tightness of new or used capsules can be checked by wrapping adhesive tape around the capsule. The adhesive will tend to hold the top of screw cap capsules in place. Therefore, attach the adhesive to the capsule so that it flares out across the capsule junction and around the cap.

A leak will show up as little drops of mercury on the adhesive tape after vibration in a mechanical amalgamator. One technique of decreasing leakage from screw-top capsules is the addition of a rubber "O" ring between the two sections to act as a gasket.

9. Use a no-touch technique for handling the amalgam. To alleviate the necessity of squeezing the amalgam mass to express excess mercury, use a low mercury-alloy ratio, preferably 1:1. If the amalgam or mercury, or both, must be handled, nonporous gloves should be worn. Also, exposed skin should be cleansed frequently. Any disposable materials contaminated with mercury or amalgam should be placed in a polyethylene bag and sealed before disposal.
10. Clean up any spilled mercury immediately. Droplets may be picked up with narrow-bore tubing connected (via a wash-bottle trap) to the low-volume aspirator of the dental unit. Strips of adhesive tape also may be useful to clean up small spills. Droplets that cannot be reached can be dusted with sulfur powder. Remember that this is only a film coating of the mercury and will be effective only while the mercury droplets remain undisturbed.
11. Avoid heating mercury or amalgam.
12. Although all types of condensation give off some mercury vapor, studies have shown that mercury vapor and droplet formation are greatest with ultrasonic amalgam condensers. Therefore, the use of ultrasonic condensers should be avoided.
13. Use water spray and high-volume evacuation when removing old or finishing new dental amalgam restorations. The exhaust for such systems should be outside the office. Use a face mask to avoid breathing amalgam dust.
14. Salvage all amalgam scrap and store in a tightly closed container.
15. Eliminate the use of mercury-containing solutions.
16. Use an amalgamator with completely enclosed arms and amalgam capsule during amalgamation.
17. Handle the mercury dispenser with care and periodically check for leakage. Some dispensers leak mercury spontaneously.
18. Examine the mercury-dispenser orifice after use for residual mercury. Any mercury droplets remaining should be disposed of as described in no. 10.



1133 Sheppard Ave West,
PO Box 2000,
Downsview, Ont., Canada
Telephone (416) 633-4240