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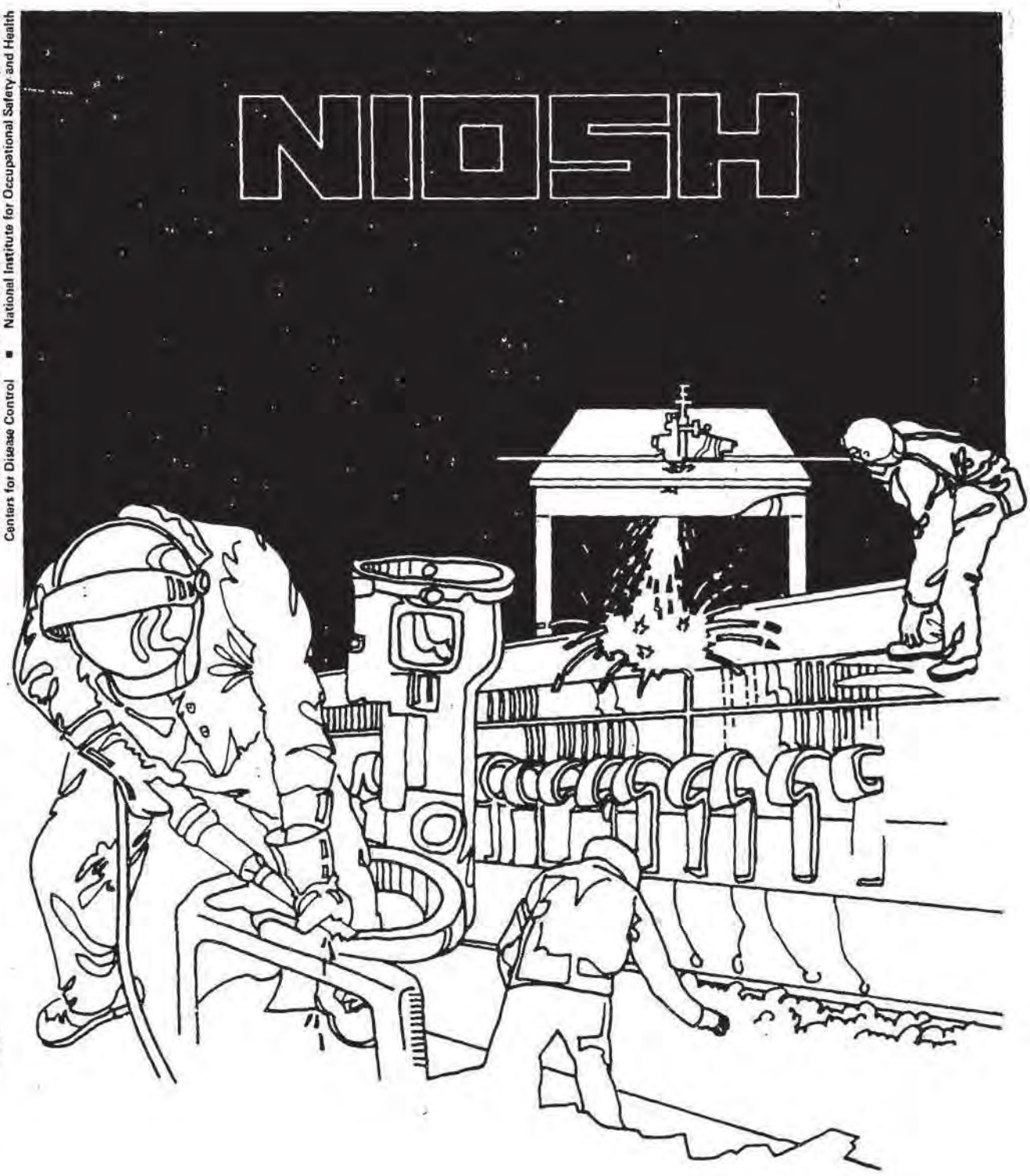

Health Hazard Evaluation Report

HETA 84-090-1533
J. BUTLER, D.D.S.
WELLSTON, OHIO

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 84-090-1533
NOVEMBER 1984
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I. SUMMARY

In December 1983 the National Institute for Occupational Safety and Health (NIOSH) was requested by the Jackson County Health Department to assess the potential health hazard of occupational mercury exposure at a dental office in Wellston, Ohio, particularly the hazard posed to a pregnant dental assistant.

NIOSH investigators visited the dental office on January 9-10, 1984 and conducted an environmental and medical evaluation. The environmental investigation included airborne monitoring for mercury vapors and an assessment of surface mercury contamination. In addition, work practices were evaluated.

The medical evaluation included observation of office procedures, informal discussions with dental office personnel, review of previously-determined 24-hour urine mercury levels, and discussions with a local obstetrician.

Personal exposure to airborne mercury ranged from 4 to 18 ug/m^3 on eight passive dosimeters and from 3.8 to 11.5 ug/m^3 on four sorbent tubes. These concentrations were all well below the current full-shift exposure limit of 50 ug/m^3 for NIOSH and ACGIH. Concentrations of mercury in instantaneous area air samples were all below 20 ug/m^3 except for two samples. All values were below the OSHA standard of 100 ug/m^3 (as a ceiling value not to be exceeded). Surface readings for mercury contamination were higher in the immediate vicinity of high mercury use areas. The highest contamination readings were obtained on a powered vacuum cleaner used to clean the office carpeting.

Results of the medical investigation revealed that employees were not experiencing any symptoms suggestive of mercury toxicity. Urine mercury levels were also below toxic ranges.

Based on these results NIOSH investigators determined that a current health hazard did not exist for nonpregnant dental office personnel. No safe level of mercury exposure has been established for pregnant individuals, and therefore the decision to remove the employee from exposure was prudent.

Recommendations are made in this report (Section VIII) to improve mercury-hygienic-techniques and procedures for taking X-rays.

KEYWORDS: SIC 8021 (Offices of Dentists), mercury, mercury-hygienic-techniques, X-ray.

II. INTRODUCTION

In December 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at a dental office located in Wellston, Ohio. The request was submitted by the Jackson County Health Department on behalf of the dental office, and concerned potential airborne mercury exposure to a pregnant dental hygienist.

NIOSH visited the dental office on January 9-10, 1984 to conduct an environmental and medical evaluation. An interim report, distributed in June 1984, presented environmental and medical findings and recommendations for improving working conditions at the Wellston facility.

III. BACKGROUND

The Wellston dental office constitutes one half of a small medical facility built in 1951. The dental office consists of seven rooms, excluding closets, bathrooms, etc. The office has four patient rooms, and has a staff of two dentists and two to three dental assistants. The entire floor area is carpeted and was scheduled to be recarpeted in 1984 (the carpeting was 12 years old at the time of the NIOSH survey).

A typical day begins at 8:00 a.m. and ends between 4:30 and 6:00 p.m. The office staff estimated that mercury usage averages about 1 pound per year, which is in the range of usages reported in the published literature.[1,2]

Mercury is used for making amalgams. The staff estimates that anywhere from 8 to 20 amalgams are used per day, depending on the type of dental work performed. The office does not use any anesthetic gases. When an amalgam is needed, a dental assistant places an amalgam tablet into a small capsule and adds a premeasured drop of mercury. The capsule is then capped and vibrated in a small machine called an amalgamator for five seconds. The amalgam is then removed and excess mercury squeezed out using a cloth tissue. Depending on who prepares the amalgam, it may be placed in the naked palm for final processing. The amalgam is then given to the dentist, who uses it to fill a recently drilled cavity. The process appears similar to that described in other publications.[3,4]

In addition to daily staff clean-up activities, a cleaning service cleans the office once a week, for approximately four hours.

IV. MATERIALS AND METHODS

On January 9-10, 1984, a three-member NIOSH team conducted an environmental/medical evaluation at the dental office. The environmental investigation consisted of airborne monitoring for mercury, evaluation of general mercury contamination, and evaluating employee work practices. Airborne mercury samples were collected using 3M Diffusional Mercury Monitors, hopcalite sorbent tubes, and a Bacharach Instrument Company Mercury Sniffer® - Model MV2. The 3M Mercury Monitor operates on the principal of passive diffusion of mercury vapors across a quiescent air space to a piece of gold foil on which mercury vapors are adsorbed. After collection, these monitors were returned to the manufacturer and analyzed by measuring the change in resistance across the gold foil.[5,6]

The sorbent tubes were attached via flexible tubing to battery-operated pumps calibrated at approximately 0.05 liters of air per minute. As air passes through the tube, hopcalite collection media absorbs mercury vapor. The tubes were analyzed using flameless absorption spectroscopy.

The Mercury Sniffer is a direct-reading instrument that operates on the principal of atomic absorption at a wavelength (253.7 nanometers) specific for mercury.[7]

The 3M monitors and sorbent tubes were used to collect full shift samples to estimate personal exposures to airborne mercury. The Mercury Sniffer was used to evaluate instantaneous airborne mercury concentrations and to obtain surface level readings to evaluate mercury contamination in the office.

Medical evaluation of dental office workers included observation of office procedures, informal discussion with employees (including one pregnant employee off work), review of previously determined 24-hour urine mercury levels, and discussions with a local obstetrician.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Inorganic Mercury

Mercury can enter the body through the lungs by inhalation, through the skin by direct contact, or through the digestive system.[8]

Acute or short-term exposure to high concentrations of mercury causes tightness and pain in the chest, difficulty in breathing, coughing, inflammation of the mouth and gums, headaches, and fever.[8,9] Acute mercury poisoning is, however, relatively rare in industry today.

Chronic or long-term exposure to lower concentrations of mercury is more common. Chronic mercury poisoning is known to cause kidney damage (nephrosis), tremors and shaking (usually of the hands), inflammation of the mouth and gums, metallic taste, increase in saliva, weakness, fatigue, insomnia, allergic skin rash, loss of appetite and weight, and impaired memory. These symptoms generally occur gradually and may be associated with personality changes such as irritability, temper outbursts, excitability, shyness, and indecision.[8,9]

The reproductive effects of elemental mercury have not been well studied in humans. It has been demonstrated that elemental mercury does pass the placental barrier and appears in the fetal blood. Fetal plasma levels at birth average 30% higher than maternal plasma levels.[10] In animals, exposure to elemental mercury vapor has been associated with litter resorption, growth retardation, subcutaneous edema (swelling), etc. Animal birth defects included cleft lip and palate, rib fusions, and syndactylia (fused digits).[11] No studies to our knowledge have demonstrated these or other defects in the children of mothers exposed to mercury vapor. The lowest level recommended for pregnant women in the literature we reviewed is 10 micrograms per cubic meter, based on a Russian study alleging symptoms in adults at exposure levels from 10 to 30 micrograms per cubic meter.[12,13] This recommendation is not based on a study of reproductive effects. In summary, no data have demonstrated a risk to pregnant women at exposure levels below the NIOSH recommended standard. However, comprehensive studies have not been done, and it is prudent to minimize exposure.

NIOSH currently recommends that exposure to inorganic mercury be limited to 50 micrograms per cubic meter (ug/m^3) as an 8-hour time-weighted average (TWA).[14] The American Conference of Governmental Industrial Hygienists (ACGIH) also recommends that inorganic mercury exposure be limited to 50 ug/m^3 as an 8-hour TWA.[15] The current Occupational Safety and Health Administration (OSHA) standard for inorganic mercury is a ceiling level of 100 ug/m^3.[16]

VI. RESULTS

A. Environmental

1. Mercury Monitoring

Table I presents the results of sampling for airborne mercury using passive dosimeters and hopcalite tubes. Airborne concentrations on passive dosimeters ranged from 4 to 18 ug/m^3 for eight personal samples. Concentrations on hopcalite tubes ranged from 3.8 to 11.5 ug/m^3 for four personal samples and from 5.4 to 7.2 ug/m^3 for three area

samples. All 15 values were below the current full-shift criteria of 50 ug/m^3 for NIOSH and ACGIH. All samples were less than 40% and 13 of the samples were less than 20% of the criteria.

Table II presents the results of area sampling for mercury vapor concentrations, collected using the Mercury Sniffer. Concentrations ranged from 0 to 60 ug/m^3 for approximately 47 readings. All readings were well below the OSHA PEL of 100 ug/m^3 (ceiling value not to be exceeded), and eighty-five percent of the readings were below 15 ug/m^3. All reading except for two (50 and 60 ug/m^3), were consistent with full-shift values listed in Table I. One of the high readings was taken after a clean-up attempt of a mercury-contaminated area. The clean-up activities resulted in an increased mercury concentration.

Table III presents the results of surface measurements, taken to evaluate mercury contamination. Four surface areas were found to have the highest values. The floor below the mixing area had the highest value (148 ug/m^3), the crack at the side lip on the mixing counter had the next highest (140 ug/m, after cleaning), room 3 had a high reading of 80 ug/m^3 and the X-ray room (room 4) had a high reading of 50 ug/m^3. Other surface readings were relatively low (0-20 ug/m^3).

The only other high readings were obtained next to the power vacuum cleaner motor. A reading of 250 ug/m^3 was measured before the sweeper was operated and 350 ug/m^3 was measured after it ran for a few minutes.

Figure 1 depicts the approximate locations of floor surface readings.

2. General Observations

The office appeared to be relatively free of gross mercury/amalgam contamination except in those areas where cleaning was difficult. These areas include the crack at the mixing area and the sink lip at the same location; the base of some dental chairs; and the power vacuum cleaner. It is interesting that after a few minutes of operation the area next to the vacuum cleaner motor had an airborne concentration of 350 ug/m^3 as compared to 250 ug/m^3 previously (Table III). This increase may have been due to previous accumulation of mercury on the motor which subsequently vaporized as the motor heated up.

The office staff, particularly the dental assistants, seemed conscientious about housekeeping during the NIOSH survey. This may be one reason why most of the airborne mercury concentrations were well below current occupational exposure limits. While it is difficult to directly compare mercury values from one study to another, the mercury measurements obtained in this study fall into the lower range of published data from studies using similar sampling (short term and/or full shift) techniques.[1,3,4,17-19] Average airborne concentrations are not much higher than the limit of detection for the hopcalite tubes (average concentration = 6.2 ug/m^3, limit of detection = 3 ug) and the passive dosimeters (average concentration = 8 ug/m^3, limit of detection = 5 ug).

Subsequent discussions with personnel from both the dental office and the Jackson County Health Department indicated that most of the recommendations presented at the closing conference and in the interim report were utilized at the Wellston facility. The main recommendation that was not used was replacement of the old carpeting with seamless floor covering, especially in the high mercury use areas. At the closing conference on January 10, 1984, the issue of carpeting was discussed indepth. The office personnel listed the advantages of carpeting as safety, aesthetics, and comfort. These and other advantages have been discussed in some articles. One of the reported advantages is that carpeting limits the area of contamination from a mercury spill.[19] The principal problem with carpeting is that once it is contaminated with mercury, decontamination is virtually impossible. For carpeted offices, two of the best recommendations are to replace the carpeting (especially in high use areas) often and to use vacuum cleaners specifically designed for mercury clean up. Regardless of the type of flooring present, the most important recommendation for working with mercury is to use good mercury hygiene. Good hygienic practices will limit mercury contamination of the floor and other surface areas.

At the time of the NIOSH survey the dental office was using some recommended techniques for working with mercury. First, the amalgator was equipped with a cover for the mixing compartment. Additionally, metal trays were used at the dental chairs as a working surface and counter tops in the dental operatories were continuous, seamless, and lipped at the wall interface.

The NIOSH investigators observed dental personnel taking an X-ray of a patient. While taking the X-ray, the operator stood next to the patient, and neither individual wore a protective apron. Use of leaded aprons for the patient and maintaining an adequate distance (at least 6 feet) between the operator and the X-ray beam, are necessary precautions for using X-ray machines.

B. Medical

Interviews with employees asked for any health symptoms and reviewed the effects of chronic mercury toxicity: hair loss, loss of appetite, abdominal pain, sleep disturbances, tremor, and difficulty walking. None of the employees interviewed knew of these potential toxic effects, and none were experiencing symptoms suggestive of mercury toxicity.

Previously determined urine mercury concentrations were available for four of the five workers. All samples represented a 24 hour collection, and reported the number of micrograms per sample. The four samples contained 4.3, 10.1, 45, and 54.9 micrograms of mercury. Urine creatinine was not measured, therefore correction for urine concentration was impossible. The World Health Organization recommends that urine mercury levels in exposed workers not exceed 50 micrograms per gram of creatinine, which corresponds roughly to 50 micrograms per 24 hours[20].

Much concern was expressed about the pregnant dental assistant. She has been off work since the time that her mildly elevated urine mercury levels were detected during her pregnancy. The reproductive hazard posed by mercury depends on its chemical form. It should be noted that the mercury present in the dental office is in the inorganic elemental form and not bound to carbon groups to form an organomercurial (for example, methyl mercury). Although little information is available on the reproductive effects of inorganic mercury exposure during pregancy, it is probably less toxic than the more well-known organomercurial compounds.[12] In this situation, the finding of a mildly elevated urine mercury level in a pregnant dental assistant triggered this investigation to evaluate mercury exposures. It was prudent to isolate the worker until exposure information was available. Whether the low levels of mercury vapor found in the office presented a hazard, and whether any risk would persist throughout all the stages of a pregnancy is open to debate. Unfortunately, insufficient information is available to make a judgement.

Discussion of other potential hazards in the dental office environment revealed two additional areas of concern: hepatitis B and radiation. It is well documented that the handling of blood or saliva-contaminated needles and instruments constitutes a risk of transmission of hepatitis B virus from patients to health care personnel. Hepatitis B is a serious illness that can result in a chronic hepatitis, which may be fatal. The recent availability of hepatitis B vaccine allows for prevention of this disease.

Hepatitis B vaccine should only be given to those workers not already immune to hepatitis B.[20] Determination of immune status requires a blood test (prior to vaccination).

Radiation as emitted by X-ray equipment is a known health hazard. X-ray exposure has been associated with leukemia, cataract formation, and sterility. Cancers caused by radiation may not appear for 20 or more years after exposure. Prudent policy is to minimize exposure to radiation to the maximum extent possible. This would entail multiple precautionary work practices to minimize exposure. In addition, to detect lapses in technique or equipment malfunctions, film badges should be worn to measure cumulative exposure.

VII. DISCUSSION AND CONCLUSIONS

The results of this investigation indicate that personal exposures to airborne mercury concentrations were well below the current occupational exposure limits. Mercury/amalgam surface contamination was highest in the immediate vicinity of high mercury use areas (i.e. mixing area and adjacent hallway).

The results of surface measurements and measurement taken on the vacuum cleaner suggest that its use may have reduced the overall carpet contamination. The results of this investigation are not sufficient to definitively answer this question. Some publications have discussed the effectiveness of vacuum cleaners in mercury clean-up.[14,21] One article, however discussed a situation involving spillage of a large quantity of mercury (20 pounds). The article reported that airborne mercury levels increased, when a vacuum cleaner was used to clean the spill.[22] This situation is unusual and differs from the one encountered at the Wellston dental office. Twenty pounds of mercury would represent approximately a 20 years supply for this office. The normal spillage rate is difficult to estimate, but one would expect it to be much less than the one pound per year used at this facility.

In addition to the previously referenced articles, the American Dental Association provides literature on safety and hygiene for dental facilities. This literature includes specific guidelines for working with various materials, including mercury and X-rays.[23]

VIII. RECOMMENDATIONS

The following recommendations are made per conditions encountered during the NIOSH survey.

1. It was prudent to isolate the pregnant dental assistant until mercury exposure levels were known. The risk posed by the low exposure levels (below the lowest recommended exposure level for pregnant women found in the literature) cannot be quantified due to lack of data.

2. Carpeting should be removed, particularly in the high mercury use areas (i.e. mixing), or the mixing area should be moved to a location with no carpeting. If vacuum cleaners are used they should be designed for mercury clean up such that mercury vapor is not discharged into the workroom air.[14,21]

3. Liquid mercury and amalgam should not be touched by bare skin.

4. The mixing area counter top should be replaced with a top that has no seams, to reduce contamination from mercury and/or amalgam.

5. Spilled mercury droplets should be cleaned up using a vacuum system with a water trap.

6. Pre-enclosed amalgam capsules should be considered for future use, as this would eliminate one mercury-handling step.

7. All amalgam scrap should be stored under water.

8. A cleaning material such as Hg-X should be used when cleaning mercury contamination.

9. Hepatitis B vaccine should be offered to all non-immune employees.

10. When taking an X-ray the patient should wear a leaded apron and collar, and the operator should be at least six feet from the X-ray machine. If assistance is needed for a small child or elderly person, the operator should also wear a leaded apron and collar. Film badges should be worn by the X-ray machine operators to assess cumulative exposure.

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X. 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. Jackson County Health Department
2. Wellston Dental Office
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing the affected employees, this report should be posted for a period of 30 calendar days in a prominent place in the Dental Office.

Table I

Airborne Mercury Concentrations
Personal Samples

Dental Office
Wellston, Ohio
HETA 84-090
January 1984

Job/Location	Volume	Date	Sampling Time	Type of Sample	Concentration (ug/m^3)
Dentist A	55.8	1/9	0811-1738	H-Tube	3.8
Dentist A	-	1/9	0811-1738	P-Monitor	8
Dentist A	-	1/10	0800-1654	P-Monitor	8
Dentist B	-	1/9	0818-1732	P-Monitor	6
Dentist B	-	1/10	0757-1700	P-Monitor	18
Dentist B	54.4	1/10	0757-1700	H-Tube	11.5
Assistant A	50	1/9	0815-1728	H-Tube	4.8
Assistant A	-	1/9	0815-1728	P-Monitor	4
Assistant A	-	1/10	0759-1622	P-Monitor	6
Assistant B	-	1/9	0817-1718	P-Monitor	7
Assistant B	-	1/10	0822-1654	P-Monitor	7
Assistant B	47	1/10	0822-1654	H-Tube	5.5
Area Sample At Amalgam Mix Area	53.7	1/9	0820-1723	H-Tube	5.4
Area Sample At Amalgam Mix Area	52	1/10	0802-1645	H-Tube	5.4
Area sample, Room 4, On Dental Chair Support, 5' Above Floor	53	1/10	0806-1650	H-Tube	7.2

H-Tube = Hopcalite Tube
P-Monitor = Passive Monitor
Environmental Criteria (ug/m^3): NIOSH = 50
ACGIH = 50

Table II

Area Airborne Mercury Concentrations Obtained With A Mercury Sniffer

Dental Office
Wellston, Ohio
HETA 84-090
January 1984

Location	Date	Time	Concentration (ug/m^3)
Room No. 1, Sniffer Setting On Counter, Probe Pointing Toward Middle Of Room	1/9	1246	1-50
Room No. 3, Sniffer On Counter, Probe Pointing Toward Middle Of Room	1/9	1255	7
Utility Room, Sniffer Setting On Counter	1/9	1237	1-10
	1/10	0844	2
	1/10	1029	10
	1/10	1050	8
	1/10	1054	8
	1/10	1337	8
On Top Of Counter At Mixing Area	1/9	1241	10
	1/9	1251	10
	1/9	1527	15
	1/10	0846	2
Ambient Reading In Hallway	1/9	1300	5
Mixing Area, At Area Sample	1/9	1305	10
	1/9	1529	19
	1/10	0846	3
	1/10	1025	6
	1/10	1105	9
	1/10	1158	0
	1/10	1159	60*
	1/10	1236	15
	1/10	1309	10
	1/10	1428	8
	1/10	1444	10
Room 2, Sniffer On Counter, Probe Pointed Toward Middle Of Room	1/9	1445	10

(Continued)

Table II (Continued)

Location	Date	Time	Concentration (ug/m^3)
Room 4, Sniffer On Counter Pointing Toward Middle Of Room	1/9	1501	9
	1/10	0858	5
Reception Room, Sniffer On Desk	1/9	1514	10
Utility Room, Sniffer Held 5' Above Floor	1/9	1533	10
In Room 3, At Area Sample	1/10	0921	12
	1/10	1027	8
	1/10	1052	8
	1/10	1105	7
	1/10	1157	10
	1/10	1234	8
	1/10	1334	7
	1/10	1507	5
	1/10	1534	7
Ambient In Coat Closet	1/10	1011	7
Ambient In Entrance Way (Common For Both Eye Doctor and Dental Office)	1/10	1340	2
	1/10	1344	2
	1/10	1337	2
Ambient In Dentist's Office (Not An Operative Room)	1/10	0941	5
	1/10	0950	3
Same As Above Except Samples Taken After Vacuum Cleaner Ran For 3 Minutes To See If Ambient Levels Increased	1/10	1003	6
Eye Doctor's Office, Waiting Area	1/10	1353	1-2
Eye Doctor's Office, In Exam Room	1/10	1357	1-2
Air Inlet In Eye Doctor's Exam Room	1/10	1405	2
Ambient Reading Outside On Front Porch	1/10	1342	0
	1/10	1539	0

*Sample taken immediately after clean up attempt of contamination in crack at mixing counter.

Environmental Criterion (ug/m3): 100 (OSHA, as a ceiling concentration not to be exceeded)

Table III

Surface Readings Obtained With A Mercury Sniffer

Dental Office
Wellston, Ohio
HETA 84-090
January 1984

Location	Date	Time	Surface Reading (ug/m^3)
At Crack Under Side Lip of Mixing Counter	1/9 1/10	1237 0848	highest = 60-80 highest = 40-50
Room 3, Carpet At Base Of Chair	1/9 1/10 1/10	1258 0921 0921	20 14-17 13-17
Room 3, At Base Of Heating Duct	1/9	1258	10
Room 3, At Wall Floor Joint 50" From Door (On Wall Opposite Pictures)	1/9	1258	80
Room 3, Under Trash Can	1/10	0921	16-22
Dispenser Opening On Amalgamator	1/9	1304	10
Room 2, Base Of Chair	1/9	1445	10-20
Room 2, Base Of Counter, Long Side	1/9	1445	10
Room 2, Under Instrument Tray	1/9	1445	10
Room 2, Bottom Of Tray, Under Paper	1/9	1445	10
Room 2A, Base Of Counter, Long Side	1/9	1425	10
Room 4 (New X-Ray Room) Probe At Vent On Floor	1/9	1305	5
Room 4 (New X-Ray Room) Base Of Chair, Side Opposite Door	1/9	1305	50
Room 4 (New X-Ray Room) Base Of Chair, Side Toward Door	1/9	1305	8-10
Carpeting Under Receptionist Desk	1/9	1514	8
Area Behind Receptionist Desk At Base Of Wall, Midpoint Between Door To Patient Rooms And Closet	1/9	1514	8
Reading At Carpet Level In Middle Of Door Leading To Patient Rooms	1/9	1518	13

(Continued)

Table III (Continued)

Location	Date	Time	Surface Reading (ug/m^3)
Readings Taken Down Hallway (3' From Reception Area) At Each Wall And In Center	1/9	1500	12-17
Readings Six Feet Down Hallway, On Each Wall And In Center	1/9	1522	18-63
Readings Nine Feet Down Hallway, On Each Wall And In Center (Highest Reading At Base Of Sink)	1/9	1523	19-148
Readings 12 Feet Down Hallway, On Each Wall And In Center	1/9	1524	7-17
Readings 15 Feet Down Hallway, On Each Wall And In Center	1/9	1526	5-26
In Center of Doorway From Reception Area To Waiting Room	1/10	0858	3
Three, Six, and Nine Feet From Above Doorway)	1/10	0900	1-2
Series Of Readings Near Door Leading From Entrance To Waiting Room	1/10	0902	0-3
Hand Operated Sweeper:			
- On Brush	1/10	0941	7
- Inside Dust Compartment	1/10	0941	5

(Continued)

Table III (Continued)

Location	Date	Time	Surface Reading (ug/m^3)
Readings On Power Vacuum Cleaner (Standard Vacuum Cleaner - Not Special Purpose)			
- Beater Brush	1/10	0930-1000	26
- Top Of Bag	1/10	0930-1000	32
- Middle Of Bag	1/10	0930-1000	90
- Base Of Bag	1/10	0930-1000	120
- Checked Near Motor (Motor Cover On)	1/10	0930-1000	8
- Inside Motor Cover	1/10	0930-1000	250
- Inside Motor Cover (After Running Vacuum Cleaner For 3 Minutes)	1/10	1011	350
Carpet Level In Closet Where Vacuum Cleaners Are Stored	1/10	1015	8-10
At Crack On Mixing Counter After It Was Cleaned Out	1/10	1542	highest = 115
Rezeroed Sniffer, Checked Battery, Then took Reading At Crack Again			
- 2 1/2" From Front	1/10	1555	40
- 4 3/4" From Front	1/10	1555	60
- 7 3/4" From Front	1/10	1555	100
- 9 1/2" From Front	1/10	1555	140

Surface readings were taken within 1" of the surface being measured.

Figure 1
Approximate Locations of Floor Surface Mercury Readings (ug/m^3)
(Map Not To Scale)
HETA 84-090
Wellston, Ohio
1/9-10/84

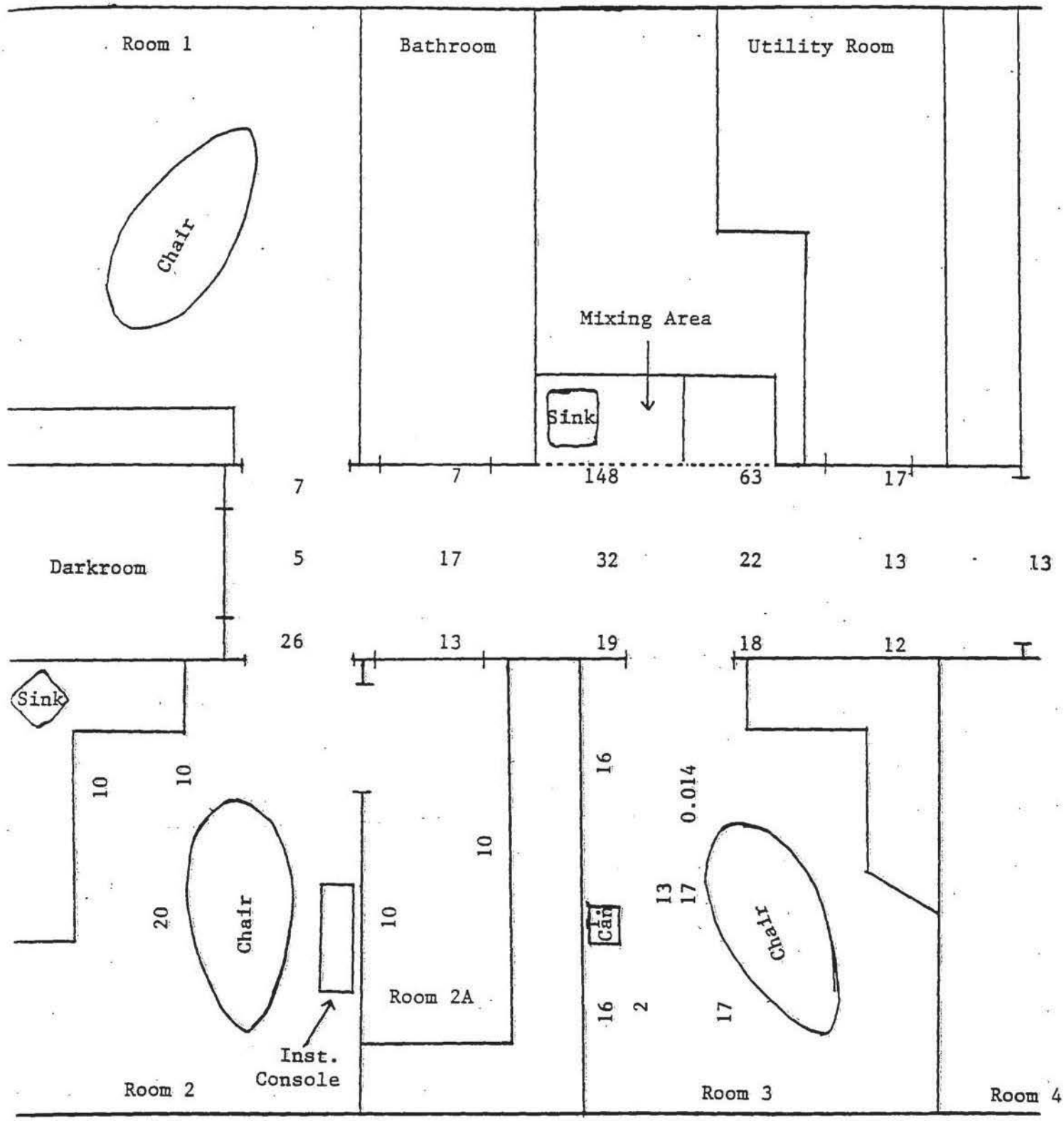
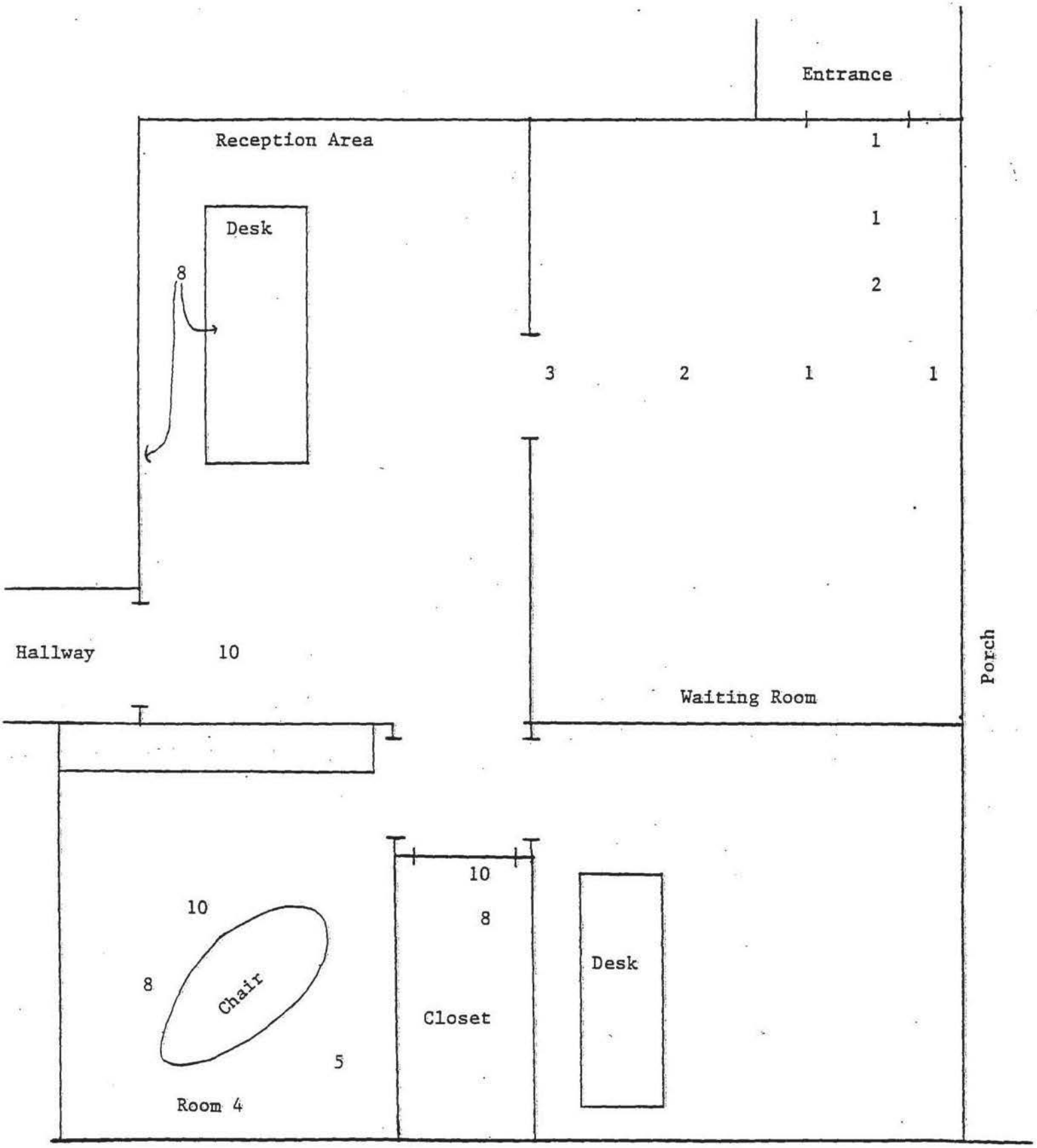


Figure 1

(Continued)



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