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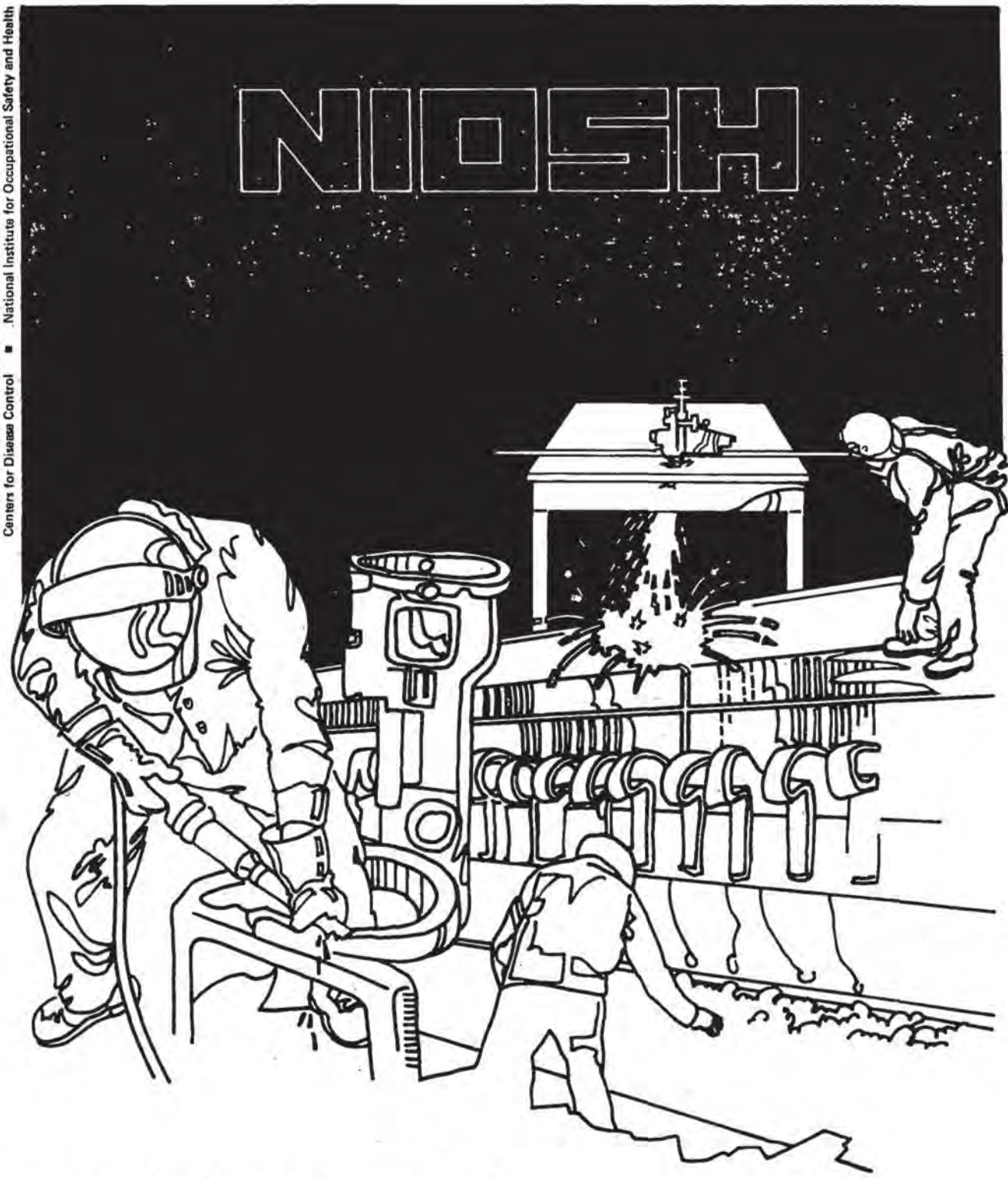

Health Hazard Evaluation Report

HHE 80-158-902
LINCOLN MEDICAL AND
MENTAL HEALTH CENTER
BRONX, NEW YORK

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.

HHE 80-158-902
June 1981
Lincoln Medical and
Mental Health Center
Bronx, New York

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I. SUMMARY

In May, 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of employees of the Lincoln Medical and Mental Health Center to evaluate the exposure of operating room personnel to waste anesthetic gases. Concern was expressed in the request about acute symptoms and the number of miscarriages observed among the personnel.

On August 6-8, 1980, NIOSH conducted an initial environmental-medical evaluation at the hospital. General area and personal breathing zone samples were collected for nitrous oxide, halothane and ethrane. Operating room personnel were also asked to complete self-administered questionnaires directed at acute and chronic health effects. A follow-up survey was conducted on February 9-12, 1981 to collect additional samples for nitrous oxide, halothane and ethrane.

The results of the samples collected for nitrous oxide showed that the anesthetists' exposures ranged from 39 ppm to 850 ppm (averaged over the length of the procedure). All concentrations exceeded the NIOSH recommended level of 25 ppm for nitrous oxide. The circulating nurses' exposures were lower, ranging from 16 ppm to 58 ppm for nitrous oxide. Eleven of the 15 samples collected on the nurses exceeded the 25 ppm recommended level. General area recovery room samples indicated nitrous oxide levels around 3 ppm. Concentrations of halothane were found to range from non-detectable (N.D.) to 14.4 ppm and ethrane concentrations were found to range from N.D. to 2.4 ppm. Sixteen of the 19 samples collected on the circulating nurses and anesthetists exceeded the NIOSH recommended limit of 0.5 ppm for halogenated anesthetics when used in combination with nitrous oxide.

Questionnaires were completed by 2 anesthetists, 23 of 34 operating room personnel and 9 of 9 recovery room personnel. Fifteen (65%) of the operating room respondents reported one or more acute symptoms versus 8 (88%) recovery room respondents. Reported symptoms included headache, lightheadedness, dizziness, fatigue, nausea, heart palpitation and skin and throat irritation. Recovery room respondents had a statistically significant excess of acute symptoms over operating room staff. No workers reported a history of kidney or liver disease. Of 10 reported pregnancies in the operating room staff, there was one miscarriage versus 6 pregnancies and three miscarriages in the recovery room staff. Analysis for job specific rate for chronic disease or reproductive effects was not possible because the numbers were too small for statistical analysis or comparison to expected rates.

Data collected during the time of this evaluation indicate that operating room personnel are being exposed to concentrations of nitrous oxide, halothane and ethrane in excess of the NIOSH recommended levels. Recovery room personnel reported a higher proportion of acute symptoms than operating room personnel. The small number of employees surveyed preclude a definite conclusion about waste anesthetic gas associated chronic health effects. However, based on environmental levels measured, steps should be taken to reduce exposures. Recommendations for reducing waste anesthetic gas levels are included in Section VIII of this report.

KEYWORDS: SIC 8062, Hospitals, nitrous oxide, halothane, ethrane.

II. INTRODUCTION

On May 27, 1980, NIOSH received a health hazard evaluation request from the American Federation of State, County and Municipal Employees, District Council 37 regarding exposure of personnel to waste anesthetic gases in the operating rooms and recovery rooms at the Lincoln Medical and Mental Health Center, Bronx, New York. Concern was expressed for acute symptoms such as fatigue and lightheadedness and miscarriages among operating room personnel.

III. BACKGROUND

The surgical suite of Lincoln Hospital is located on the second floor of the hospital and consists of 7 operating rooms and one large recovery room. Five to six of the operating rooms are typically in use each day. The number of operations per day varies, but the average number of patients in surgery based on 1979-80 consensus was approximately 300-350/month (range 299-356).

The anesthetics used at the hospital are nitrous oxide, and either halothane or ethrane. A central gas supply system delivers nitrous oxide and oxygen to a ceiling column in each room. Gas tanks are present to serve as emergency back ups. Scavenging systems are present on all anesthesia machines and are vented into the vacuum line. Each room is supplied with 100% fresh air from a central air conditioning unit. There are two exhaust grilles and one large supply air grille per room.

Staffing consists of 34 persons for the operating rooms and 9 for the recovery room. Employees work a five day week. Anesthesiologists and surgeons are from numerous different practicing groups and departments.

IV. ENVIRONMENTAL DESIGN AND METHODS

On August 6-8, 1980, NIOSH conducted an initial environmental and medical evaluation at Lincoln Hospital. General area and personal breathing zone samples were collected for nitrous oxide, halothane and ethrane. Operating and recovery room personnel were also asked to complete self-administered questionnaires directed at acute and chronic health effects related to waste anesthetic gases.

On February 9-12, 1981, NIOSH performed a follow-up survey in the operating rooms. Personal breathing zone and general area samples were again collected for nitrous oxide, halothane and ethrane. The anesthesia equipment in several of the operating rooms was leak tested using a Wilks 103 portable infrared gas analyzer. This instrument was also used to evaluate changes in nitrous oxide concentrations during the course of two surgical procedures. Ventilation measurements were made in six of the operating rooms.

Samples for nitrous oxide were collected in 25-liter bags via a 3-foot length of Tygon tubing attached to a sampling pump adapted for bag filling. Air was drawn from the breathing zone via the Tygon tubing. When the bags were filled

or the procedure was complete, the bag was removed and capped and a new bag was attached. Analysis for nitrous oxide followed almost immediately using a Wilks Miran I Infrared Analyzer. Analyses were performed at a wavelength of 4.48 micrometers and a pathlength of 5.25 meters.

Personal breathing zone and area samples for halothane and ethrane were collected on charcoal tubes using personal sampling pumps at a flow rate of 200 cc per minute. (Charcoal tubes were not changed for each procedure.) Analysis of charcoal tube samples was by gas chromatography.

V. EVALUATION CRITERIA

In a criteria document for a recommended standard for occupational exposure to anesthetic gases (1), NIOSH states: "Current scientific evidence obtained from human and animal studies suggests that chronic exposure to anesthetic gases increases the risk of both spontaneous abortion among female workers and congenital abnormalities in the offspring of female workers and the wives of male workers. Risks of hepatic and renal diseases are also increased among exposed personnel. In addition, physiological function may be impaired. A few studies have suggested increased risk of cancer. Effects on the central nervous system due to acute exposures of anesthetic gases have been associated with headaches, nausea, fatigue, irritability, etc." Control procedures and work practices presented in that document, however, should prevent the effects caused by acute exposure and significantly reduce the risk associated with long term, low level exposure. A dose response relationship for halogenated anesthetic toxicity has not been defined.

That same NIOSH publication recommends maximum exposures of 25 ppm nitrous oxide (8-hour time weighted average); and 2 ppm halogenated anesthetic when used alone, or 0.5 ppm when used with nitrous oxide. These recommendations are based upon available technology in reducing waste anesthetic gas levels.

Reports by Vaisman and Askrog and Harvald were among the first to identify increased incidence of spontaneous abortion in women exposed to anesthetic gases and in wives of men exposed to anesthetic gases. Results of a more recent and comprehensive nationwide survey of occupational disease among operating personnel were published in 1974 by American Society of Anesthesiologists (ASA). The results of this study indicate "that female members of the operating room-exposed group were subject to increased risks of spontaneous abortion, congenital abnormalities in their children, cancer and hepatic and renal disease. This increased risk of congenital abnormalities was also present among the unexposed wives of male operating room personnel. No increase in cancer was found among the exposed males, but an increased incidence of hepatic disease similar to that in the female was found."

While several investigators have reported increased rates of resorption in animals, particularly rats, most of these studies involved concentrations of anesthetic gases well above the levels found in occupational exposure. One investigator, however, showed increased fetal death rates in two groups of rats following exposure of 1,000 and 100 ppm of nitrous oxide. Doenicke, et al concluded from their study of anesthetized pregnant rats that halothane demonstrates an abortive effect directly proportional to the concentration inhaled, again referring to anesthetic concentrations, but nitrous oxide does not produce an abortive effect. Bruce reports no significant difference, including implantations and resorptions per pregnancy, in his exposure of rats to 16 ppm halothane.

Several epidemiological studies that indicate increased spontaneous abortions also indicate an increased rate of congenital abnormalities. The ASA study, as well as surveys by Knill-Jones, et al and Corbett, et al indicated an increased rate of congenital abnormalities in children of women with occupational exposures to anesthetic gases, and to wives of men with similar exposures. While most animal exposures studies have been conducted at anesthetic levels, one study indicated liver, kidney, and brain tissues changes in pups born to rats exposed to sub-anesthetic concentrations of halothane during pregnancy.

The same epidemiological and toxicological studies that indicated an increase in spontaneous abortion and congenital abnormalities also indicated an increase in liver and kidney abnormalities. This increase, however, was less pronounced in both rate and severity.

In a study published by NIOSH, "nitrous oxide and halothane in respective concentrations as low as 50 parts per million (ppm) and 1.0 ppm, caused measurable decrements in performance on some psychological tests taken by healthy male graduate students. Nitrous oxide alone caused similar effects. The functions apparently most sensitive to these low concentrations of anesthetics were visual perception, immediate memory, and a combination of perception, cognition and motor responses required in a task of divided attention to simultaneous visual and auditory stimuli." Headache, fatigue, irritability, and disturbance of sleep have also been reported; and damage to cerebral cortical neurons has been seen in rats after sub-anesthetic exposure to halothane. Quimby, et al reported permanent learning deficits in rats exposed to anesthetic concentrations of halothane during early development (from conception).

Mortality and epidemiological studies have raised the questions of possible carcinogenicity of anesthetic gases, but sufficient data are lacking to list nitrous oxide, halothane or enflurane as suspected carcinogens.

Literature reviews regarding halothane indicate the most widely accepted mechanism of bio-transformation is the production of trifluoroacetic acid with resulting urinary excretion of trifluoroacetic acid and bromide. The

literature regarding enflurane does not indicate any one accepted mechanism, but increased serum and urinary fluoride levels were found in patients receiving enflurane anesthesia. While epidemiological and toxicological studies have indicated several symptoms apparently related to sub-anesthetic exposure to anesthetic gases, no cause and effect relationship has yet been shown.

VI. RESULTS AND DISCUSSION

A. Environmental

Results of the environmental samples collected for nitrous oxide, halothane and ethrane during the initial survey are presented in Tables I and II. A review of the results indicate that two circulating nurses were exposed to 37 ppm and 24 ppm of nitrous oxide (averaged over the length of the surgical procedures). Two general area air samples collected about 1-2 feet from the anesthetists' breathing zone showed levels of 151 ppm and 38 ppm. General area recovery room samples indicated levels averaging approximately 3 ppm. A personal breathing zone concentration for halothane on a circulating nurse was found to be 0.71 ppm. General area samples taken near the anesthetists' breathing zone showed 0.71 ppm ethrane and 4.5 ppm halothane.

The results of the personal breathing zone nitrous oxide samples collected during the follow-up survey appear in Table III. The anesthetists' exposures ranged from 39 ppm to 850 ppm nitrous oxide (averaged over the length of the procedures). All concentrations exceeded the NIOSH recommended level of 25 ppm for nitrous oxide. The circulating nurses' exposures were lower, ranging from 16 ppm to 58 ppm. Ten of the 13 samples collected for this group exceeded the 25 ppm recommended level.

The personal breathing zone sample results for halothane and ethrane are shown in Table IV. Halothane concentrations on the circulating nurses ranged from N.D. (non-detectable) to 14.4 ppm and ethrane concentrations ranged from N.D. to 0.53 ppm. Halothane and ethrane concentrations on the anesthetists ranged from N.D. to 6.4 ppm and N.D. to 2.4 ppm, respectively. Fifteen of the 19 samples collected on the circulating nurses and anesthetists exceeded the NIOSH recommended limit of 0.5 ppm for halogenated anesthetics when used in combination with nitrous oxide.

During 2 surgical procedures, a portable direct reading nitrous oxide analyzer was placed in the room near the anesthesia equipment. Continuous records of the concentrations of nitrous oxide were made during the procedures (1 and 2.5 hours in Rooms 315 and 317, respectively). Results showed that during the 7 minutes prior to administering anesthesia in Room 315, the nitrous oxide level increased from N.D. to 5 ppm. At the start of administration, the level of nitrous oxide fluctuated from 5 to 100 ppm. During the majority of the time of the procedure (about 25 minutes) the concentration ranged from 50 ppm to above 250 ppm. The nitrous oxide levels then decreased from 175 ppm to 5 ppm

following the procedure. In Room 307, the nitrous oxide level was stable at 10 ppm. After the onset of anesthesia the concentrations fluctuated from 50 ppm to 200 ppm (20 minutes). During the remainder of the procedure, the nitrous oxide levels gradually increased from 50 ppm to 125 ppm, with an average of approximately 75 ppm.

The anesthesia equipment in 4 of the operating rooms (305, 312, 314, and 315) was tested for nitrous oxide leaks using the portable analyzer. In each of the rooms checked, leaks were detected in various parts of the equipment including mask inlets and outlets, breathing bag connections, rotometers, canister connections, carbon dioxide absorber connections and bacteria filters. In one operating room (315) visible damage to the tubing was observed.

Ventilation measurements were made at the exhaust grilles in 6 of the operating rooms (305, 307, 310, 312, 314, and 315). The purpose of the measurements was to determine the effectiveness of the existing ventilation system. The results appear in Table V. The calculated air exchange rate ranged from 2 to 19 room air changes per hour. The recommended rate is 25 air changes per hour.

B. Medical

Questionnaires were completed by 2 anesthetists, 23 of 34 (67.7%) of the operating room staff (13 R.N., 10 non-R.N.) and 9 of 9 (100%) of the recovery room staff (5 R.N., 4 non-R.N.). Table VI contains the surveyed population's characteristics.

Fifteen (65%) of the operating room respondents reported one or more acute symptoms (headache, lightheadedness, dizziness, nausea, fatigue, heart palpitation and skin and throat irritation) versus eight (89%) recovery room respondents. Recovery room respondents had an apparent excess prevalence of acute symptoms over operating room staff which was statistically significant ($P < .05$, Fisher's exact). See Tables VII and VIII for breakdowns. Those with acute symptoms did not differ significantly from those without acute symptoms with respect to smoking status and job duration. Three (15.8%) of the operating room females reported menstrual or related irregularities versus 2 (22.2%) of recovery room females. No workers reported a history of kidney or liver disease. Of 10 reported pregnancies in the operating room staff, there was one miscarriage versus 6 pregnancies and three miscarriages in the recovery room staff.

Analysis for job specific rates for chronic disease or reproductive effects was not possible because the numbers were too small for accurate statistical evaluation, or comparison to the expected rates for miscarriages in operating room workers reported by Cohen, et al[3].

The findings in this cross sectional study did not establish any association of acute symptom occurrence and any index of operating room anesthetic gas exposure (i.e., operating room shift duration, operating room job duration).

Prevalence of acute symptoms was higher in recovery room personnel than operating room personnel. This difference was found to be statistically significant, i.e., the difference in percentage of symptoms between the two groups seen would not be expected if only chance were operating. The occurrence of symptoms (i.e., fatigue, headache) might be explained by the general occurrence of some of these symptoms or by the demands of the jobs of these persons, e.g., standing on feet for long periods of time. Although extensive environmental data were not obtained in the recovery room, it is possible that continuous exposures that could be experienced by a recovery room nurse from constant anesthetized patient exhalation nitrous oxide exposure versus intermittent nitrous oxide exposures as seen in operating room personnel might explain the difference in symptoms prevalence in these personnel.

It should be noted that the numbers in this survey are very small and would not be sensitive to small differences in these groups. This limited study could not detect any excess of excess chronic disease or adverse fertility effects in this worker population; however, because the numbers in this survey are small such effects would not be expected on a statistical basis to be seen here. The menstrual disorders reported are difficult to interpret since irregularities are not uncommon, subject to variable influences and a usual prevalence is not known. Two patients of the five reporting heart palpitations were taking medications which might explain these symptoms; the cause of palpitations in the other three are not known. Heart palpitations are not known to be acute or chronic effects of nitrous oxide. Skin irritation was mentioned by nine respondents. If this is associated with "scrubbing" and/or using the surgical scrub Betadine, hypersensitivity reactions to iodine may occur in susceptible individuals.

VII. CONCLUSIONS

Operating room personnel are being exposed to concentrations of nitrous oxide, halothane and ethrane in excess of the NIOSH recommended levels. There appears, however, to be no major health hazard based on acute symptoms in this group of operating room department personnel. Recovery room personnel reported a higher proportion of acute symptoms than operating room personnel although no excess chronic health effects were detected. The small number of employees surveyed preclude a definite conclusion about waste anesthetic gas associated chronic health hazards at this hospital.

Based on the environmental levels measured, steps should be taken to reduce exposures. Recommendations for reducing waste anesthetic gas levels follow.

VIII. RECOMMENDATIONS

Several actions, including improved work practices and engineering controls, should be undertaken to reduce worker exposure to waste anesthetic gases. Work practices should be reviewed and revised to assure minimum waste of anesthetic gases. Other revisions in work practices, which would reduce the

exposure to waste anesthetic gases include:

1. Reducing the flow of oxygen and anesthetic gases to the patient may be a viable option since the patient's metabolic rate requires only a fraction of the oxygen provided by the techniques currently used.

2. Prior to anesthetizing the patient, all waste gas disposal systems should be connected, and checked to ensure proper functioning.

3. The face mask should provide an effective seal to prevent leakage from occurring.

4. All vaporizers should be filled with the aid of a funnel. When not in use, the vaporizers should be turned off.

5. Anesthetic gas flow should not be started until the induction of anesthesia.

6. When the breathing circuit is disconnected from the patient, either the rotometers should be turned off or the Y-piece sealed.

7. The breathing bag should be emptied into the scavenging system before it is disconnected from the anesthetic delivery system.

8. Anesthetic equipment should be inspected and maintained on a regular basis. Both high and low pressure components should be leak tested. Face masks, tubing, breathing bags, and endotracheal tubes should be visually inspected for cracks and other leak sources. For further information refer to References 1 and 2.

9. The present air conditioning/exhaust system fails to meet the minimum specifications listed in Reference 2. It is strongly recommended that this system be inspected and modified (if necessary) to ensure proper functioning.

IX. REFERENCES

1. Criteria for a Recommended Standard...Occupational Exposure to Waste Anesthetic Gases and Vapors, U.S. Department of Health, Education and Welfare (NIOSH), 1977.

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4. Corbett, T.H., et al: "Birth Defects Among Children of Nurse-Anesthetists." Anesthesiology 41: 341-344, 1974.

5. Corbett, T.H., et al: "Incidence of Cancer Among Michigan Nurse-Anesthetists." Anesthesiology 38: 260-263, 1973.

6. Knill-Jones, R.P., et al: "Anesthetic Practice and Pregnancy." Lancet 2: 807-809, 1975.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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 22161.

Copies of this report have been sent to:

1. Lincoln Medical and Mental Health Center
2. AFSCME, District Council 37
3. NIOSH, Region II
4. OSHA, Region II

For the purpose of informing the affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees, for a period of 30 calender days.

TABLE I

Nitrous Oxide Concentrations

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

August 7, 1980

Room No.	Sample Location	Sampling Period	Nitrous Oxide Concentration (TWA over length of procedure)
314	Circulating Nurse	9:15-10:25	37 ppm
317	Circulating Nurse	11:30-14:00	24 ppm
317	General Area	11:49-15:21	151 ppm
315	General Area	13:56-15:25	38 ppm
Recovery Room	General Area	12:10-15:19	3 ppm

TABLE II

Halothane and Ethrane Concentrations

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

August 8, 1980

Room No.	Sample Location	Sampling Period	Concentrations in ppm Halothane	Ethrane
307	Circulating Nurse	9:39-11:45	N.D.	N.D.
307	General Area	9:41-10:45	N.D.	0.71
314	Circulating Nurse	10:35-11:20	0.71	N.D.
314	General Area	9:40-11:30	4.5	N.D.

TABLE III

Nitrous Oxide Exposure of Operating Room Personnel

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

February 10-11, 1981

Room No.	Job	Procedure Number	Date	Total Sampling Time (minutes)	ppm N_2O (TWA over length of procedure
305	Anesthetist	1	2/10	137	63
305	Circulating Nurse	1	2/10	173	18
305	Anesthetist	2	2/10	35	93
310	Anesthetist	1	2/10	153	165
310	Circulating Nurse	1	2/10	168	53
310	Anesthetist	2	2/10	160	39
315	Circulating Nurse	1	2/10	60	30
312	Anesthetist	1	2/10	100	850
312	Circulating Nurse	1	2/10	75	58
312	Anesthetist	2	2/10	57	90
312	Circulating Nurse	2	2/10	56	35
312	Anesthetist	3	2/10	13	115
307	Anesthetist	1	2/10	198	85
307	Circulating Nurse	1	2/10	243	48
307	Anesthetist	1	2/11	98	320
307	Circulating Nurse	1	2/11	123	50
307	Anesthetist	2	2/11	75	190
307	Circulating Nurse	2	2/11	28	23
305	Anesthetist	1	2/11	182	280
305	Circulating Nurse	1	2/11	193	16
312	Anesthetist	1	2/11	100	135
312	Circulating Nurse	1	2/11	107	23
312	Anesthetist	2	2/11	78	155
312	Circulating Nurse	2	2/11	69	35
315	Anesthetist	1	2/11	71	315
315	Circulating Nurse	1	2/11	72	45
315	Circulating Nurse	2	2/11	30	40
315	Circulating Nurse	3	2/11	60	38
NIOSH Recommended Exposure Limit (Averaged over the procedure's length)					25

TABLE IV

Halothane and Ethrane Concentrations

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

February 1981

Room No.	Job	Date	Sampling Period	Concentrations in ppm Halothane	Ethrane
309	Circulating Nurse	2/10	8:37-11:30	0.16	0.13
	Anesthetist	2/10	9:12-11:31	N.D.	1.1
310	Circulating Nurse	2/10	8:24-11:40	0.24	0.08
	Anesthetist	2/10	8:49-11:40	1.4	0.08
315	Circulating Nurse	2/10	8:25-9:30	N.D.	0.22
	Anesthetist	2/10	8:30-9:30	N.D.	2.4
312	Circulating Nurse	2/10	8:27-11:43	0.58	0.04
	Anesthetist	2/10	8:20-11:45	6.4	0.04
307	Circulating Nurse	2/10	8:15-11:40	0.30	0.4
	Anesthetist	2/10	8:53-11:40	N.D.	1.3
312	Circulating Nurse	2/10	14:15-15:15	N.D.	0.39
	Anesthetist	2/10	14:12-14:25	N.D.	2.3
305	Circulating Nurse	2/11	9:25-12:40	0.1	N.D.
	Anesthetist	2/11	9:25-13:02	1.1	N.D.
307	Circulating Nurse	2/11	9:25-12:30	0.82	N.D.
312	Circulating Nurse	2/11	9:12-14:10	14.4	N.D.
	Anesthetist	2/11	9:10-14:10	0.63	3.3
315	Circulating Nurse	2/11	9:25-13:20	0.67	0.53
	Anesthetist	2/11	9:17-10:40	2.9	N.D.

TABLE V

Ventilation Measurements and Air Exchange Rates

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

February 11-12, 1981

Operating Room Number	Average Velocity (FPM)*	Average Flowrate (CFM)**	Dimension (cu. ft.)	Approximate # of Air Exchanges per hour***
305	640	760	3213	14
307	480	570	3213	11
310	1000	1200	3762	19
312	130	180	4356	3
314	90	130	4752	2
315	1000	1200	3366	21

*Average velocity for the two exhaust ducts (feet per minute).
**Product of duct surface area (in square feet) and velocity result in cubic feet per minute.
***Determined by dividing the room's dimension into the product of the average flowrate and 60 minutes.

TABLE VI

Responding Population Characteristics

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

Group/Job	Number	Male	Female	Age (Years) Mean	Job Duration (Years) Range
Operating Room					
R.N.	13	2	11	43.6	9.3
Non-R.N.		2	8	41.6	12.5
Techs.	5				
Aids	2				
L.P.N.	2				
All O.R.	23	4	17		
Recovery Room	19				
R.N.	6	0	6	45	9.0
Non-R.N.	3	0	2	47.5	11.25
All R.R.	9	0	8		

TABLE VII

Reports of Symptom History by Department & Personnel

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

	Acute Symptoms	Chronic Disease Liver	Chronic Disease Kidney	Fertility PG/LB/SB/MC/ABO*
Operating Room				
R.N.	9	0	0	9/8/0/1/0
Non-R.N.	6	0	0	1/1/0/0/0
Total	15 (65.2%)**	0	0	10/9/0/1/0
Recovery Room				
R.N.	5	0	0	4/3/0/1/0
Non-R.N.	3	0	0	2/0/0/2/0
Total	8 (88.9%)**	0	0	6/3/0/3/0

*KEY: PG = Pregnancy
LB = Live Birth
SB = Still Birth
MC = Miscarriage
ABO = Therapeutic Abortion

**Difference is statistically significant, P<.05, Fisher's exact.

TABLE VIII

Types of Reported Symptoms

Lincoln Medical and Mental Health Center
Bronx, New York
HETA 81-158

	CNS*	Fatigue	GI**	Skin Irrit.	Throat Irrit.	Heart Palp.
Operating Room						
R.N. (13)	7	9	3	3	4	3
Non-R.N. (10)	7	6	2	3	3	0
Recovery Room						
R.N. (5)	4	5	4	2	2	1
Non-R.N. (4)	3	1	1	1	0	1
Totals (32)	21	21	10	9	9	5

*CNS: Includes headache, lightheadedness, dizziness, sleepiness

**GI: Includes nausea, decreased appetite

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