NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2003-0205-3032
Interfaith Medical Center
Brooklyn, New York

March 2007

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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 employers 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.

HETAB also provides, upon request, technical and consultative assistance 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 NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Chandran Achutan and Vincent Mortimer of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Ron Sollberger. Desktop publishing was performed by Robin Smith. Editorial review was performed by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Interfaith Medical Center and the OSHA Regional Office. The report may be viewed and printed from the following internet address: http://www.cdc.gov/niosh/hhe. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

For the purpose of informing 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 calendar days.

Highlights of the NIOSH Health Hazard Evaluation

The National Institute for Occupational Safety and Health (NIOSH) received a request from the New York State Nurses Association (NYSNA) for a health hazard evaluation (HHE) at Interfaith Medical Center (IMC) in Brooklyn, NY. The NYSNA submitted the HHE request because of indoor environmental quality concerns at the main IMC facility and at a methadone clinic. NIOSH investigators conducted an evaluation from July 30-August 1, 2003.

What NIOSH Did

- We took air samples for glutaraldehyde in the endoscopy department.
- We measured air flow at the ventilation diffusers.
- We measured temperature, relative humidity, and carbon dioxide levels.
- We reviewed OSHA logs of illness and injury.
- We talked to employees about health and safety issues.

What NIOSH Found

- Glutaraldehyde levels in air were very low.
- Parts of the main IMC facility did not have enough ventilation.
- There was no ventilation system present at the methadone clinic.
- The methadone clinic did not have enough outdoor air.
- Employees were being hurt by violent psychiatric patients.
- Most employees did not have health concerns related to the work environment.

What IMC Managers Can Do

- Restore ventilation to rooms at the main IMC facility.
- Install appropriate ventilation at the methadone clinic.
- Improve communication within management and between employees and management.
- Exhaust air from airborne-infection isolation rooms to the outside.
- Implement a violence prevention program.
- Develop policy and procedures for working with psychiatric patients.

What IMC Employees Can Do

- Report to management any illnesses and injuries.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2003-0205-3032

Health Hazard Evaluation Report 2003-0205-3032
Interfaith Medical Center
Brooklyn, New York
March 2007

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SUMMARY

On March 24, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the New York State Nurses Association (NYSNA) to conduct a health hazard evaluation (HHE) at Interfaith Medical Center (IMC) in Brooklyn, New York. The survey was conducted July 30 - August 1, 2003.

Air monitoring was conducted in the endoscopy unit for glutaraldehyde and indoor environmental quality (IEQ), and ventilation measurements were taken in the operating room, intensive care unit (ICU), and emergency department at the main facility. IEQ measurements were also taken at the methadone clinic, which is at a separate location. Confidential interviews were conducted with twelve employees in the ICU at the main IMC facility, and an informal interview was conducted with three employees at the methadone clinic. OSHA logs were reviewed as well.

Glutaraldehyde levels in air were well below applicable occupational exposure limits. However, approximately half the rooms at the main IMC facility lacked adequate ventilation and there was no mechanical ventilation system in place at the methadone clinic. Some employees were concerned about inadequate ventilation in their workplace. Another mentioned that there was a delay in learning whether a patient had a communicable disease. Employees also expressed satisfaction with management's timely response to their complaints. OSHA logs showed that there were 80 cases of workplace violence over a 2-year period.

The NIOSH evaluation identified areas in the main IMC facility with inadequate ventilation. Ventilation at the methadone clinic was nonexistent, leading to complaints of heat exhaustion among employees. NIOSH investigators recommend consultation with ventilation engineers who are familiar with hospital facilities to improve ventilation. NIOSH investigators recommend addressing workplace violence, improving communication between management at the main IMC facility and management at the methadone clinic, as well as between employees and management at the methadone clinic.

Keywords: NAICS 622110 (General medical and surgical hospitals), glutaraldehyde, cancer, indoor environmental quality, IEQ, ventilation, methadone clinic, workplace violence, heat strain

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INTRODUCTION

On March 24, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the New York State Nurses Association (NYSNA) to conduct a health hazard evaluation (HHE) at Interfaith Medical Center (IMC) in Brooklyn, New York. The request stated that employees were concerned about the lack of ventilation and about indoor environmental quality (IEQ) at two IMC locations: the main facility on Atlantic Avenue and an outpatient methadone clinic on Prospect Place. The request also noted a concern about glutaraldehyde exposure in the endoscopy unit, located in the operating room (OR) at the main facility. During a telephone conversation with the NIOSH investigator, the requestor also mentioned that three nurses working in the intensive care unit (ICU) had died of cancer, and said employees were concerned that these deaths may be related to exposures at the hospital. Based on the HHE request and conversations with the requestor, the survey at the main IMC facility was confined to the fifth floor surgery wing which included labor and delivery (L&D), ICU, OR, the neonatal intensive care unit (NICU), and the emergency department (ED).

On July 30, 2003, an opening conference was held with NIOSH representatives, management officials, and NYSNA representatives. From July 30-August 1, 2003, NIOSH investigators conducted an evaluation at IMC, including the offsite methadone clinic. Confidential interviews were also conducted with employees in the ICU at the main IMC facility, and an informal interview was conducted with a group of employees at the methadone clinic.

BACKGROUND

Interfaith Medical Center

The IMC was formed in 1982 following a merger between Brooklyn Jewish Medical Center and St. John's Episcopal Hospital. IMC offers a wide array of medical, surgical, obstetric, gynecological, dental, psychiatric, pediatric, and other services. The hospital operates and staffs more than 400 beds. This HHE included the main IMC facility located on Atlantic Avenue and the substance abuse facility on Prospect Place, which treats substance abuse patients with methadone and offers group counseling sessions.

Overview of the IMC Ventilation System

The ventilation system for the IMC consists of several air handlers with ducted return and/or exhaust. The surgery wing on the fifth floor is ventilated by air handler AC-5 along with its return fan, RF-5, exhaust fans GX-11 and EF-2, and a separate exhaust fan for the toilet in OR-4. Air handler AC-5 and return fan RF-5 also ventilate rooms on the three floors below surgery, and GX-11 also exhausts rooms on the third floor. The ED, housed in a first floor wing on the northeast corner of the facility, is ventilated by AC-8, RF-8, GE-4 and a separate bathroom exhaust fan, TE-4. AC-8 and TE-4 ventilate other areas and rooms on the first floor. GE-4 also exhausts areas of the basement under the ED. In this facility, rooms/areas either have exhaust air returned through a return fan to the supply air handler or exhausted by an exhaust fan, but not both.

METHODS

Glutaraldehyde

Glutaraldehyde samples were collected at the endoscopy unit in the OR. One full-shift personal air sample (sample collected in the breathing zone of an employee), and four full-shift area air samples (samples collected in fixed locations) were collected. The personal sample was collected on an employee who placed soiled medical instruments in the sterilizing equipment, and placed sterilized instruments in the patient examination room prior to medical procedures. Two of the area samples were collected in the patient examination room, and two samples were collected in an adjacent room that housed the sterilization unit. Of the two samples in this

latter room, one sample was collected above the sterilization unit, and the other by the sink where surgical equipment was sometimes soaked. Glutaraldehyde samples were collected at a flow rate of 200 milliliters per minute (mL/min) on silica gel cartridges coated with 2,4-Dinitrolphenyhydrazine (Supelco, Bellefonte, Pennsylvania), and analyzed per NIOSH Manual of Analytical Methods (NMAM) Method 2532.[1]

IEQ Measurements

Measurements for temperature, relative humidity (RH), and carbon dioxide (CO_2) were taken using a direct reading instrument (QTRAK™, TSI Inc., Shoreview, Minnesota). Measurements were collected in the morning and afternoon in the OR, ICU, L&D, and ED at the main IMC facility, and group counseling rooms, methadone dispensing area, and patient waiting rooms at the methadone clinic. Temperature and RH are parameters often used to evaluate occupant comfort, while CO_2 concentrations are used to indicate if adequate outdoor air is being introduced into indoor spaces.

Ventilation

Prior to starting the ventilation assessment, ventilation blueprints that showed the layout of the facility, placement of supply and exhaust fans, and design specifications were reviewed. Where possible, the air flow through ventilation inlets and outlets was measured using a flow-hood (ACCUBALANCE PLUS® Air Capture Hood Model 8372, TSI, Inc., Shoreview, Minnesota) with a 2-ft x 2-ft hood. To measure flow through the 2-ft x 4-ft ceiling diffusers, the diffuser was treated as two diffusers, and each half was measured separately and the two values were added to estimate the total flow through the diffuser. A similar technique was used for the wall return grilles, which were longer than 2 ft.

For two rooms in the surgery wing where the flow hood could not be properly positioned over the exhaust grille, the net flow into the room was estimated by measuring the air velocity through the opening between the floor and the bottom of the door using a hot-wire anemometer (VELOCICALC® Air Velocity Meter, TSI, Inc., Shoreview, Minnesota). Eight velocities were recorded for each opening, and the average velocity was multiplied by the area of the opening to estimate the flow rate.

In both these situations, the supply diffuser was measured with the flow hood and the estimated value of the exhaust air was determined by adding the estimated room net flow rate to the measured supply flow rate.

The pressure relationship to adjacent areas was evaluated by observing the flow of air through the small opening between the bottom of the closed door and the floor using a ventilation smoke tube kit (Mine Safety Appliances Company, Pittsburgh, Pennsylvania). The "smoke" was released at the bottom of the door and observed to note whether it flowed into the room (indicating that the room was under negative pressure relative to the hallway relative to the hallway) or out (indicating that the room was under positive pressure).

Employee Interviews and Review of OSHA logs

Every fourth employee from the ICU and the NICU employee rosters at the main IMC facility was selected and asked to participate in a confidential interview. Employees were chosen from departments where there were concerns about the IEQ or about cancer clusters. Of the 55 employees in NICU and ICU, 38 employees (first and second shifts) were available for interviews during the NIOSH visit. Five employees each from NICU and ICU volunteered to be interviewed. In addition, an employee from ED and another from the telemetry department requested to speak with NIOSH investigators. An informal interview was carried out between three employees at the methadone dispensing area at the outpatient clinic and NIOSH investigators. The Illness and Injury reports (OSHA 200/300 logs) for the years 2000, 2001, and 2002 were reviewed.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though 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 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 increases 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 Recommended Exposure Limits (RELs),[2] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[3] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever is the more protective criterion.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

Glutaraldehyde

Glutaraldehyde is a colorless liquid with a pungent odor.[5] It is used at IMC as a 2% aqueous solution for cold sterilization of endoscopic equipment. Glutaraldehyde is a mucous membrane, skin, and eye irritant that can also cause skin sensitization (allergic contact dermatitis) and respiratory sensitization.[6,7,8]

There is no OSHA PEL for glutaraldehyde. The NIOSH REL for glutaraldehyde is a ceiling limit of 0.2 parts per million (ppm); the ACGIH TLV for glutaraldehyde is a ceiling limit of.05 ppm.

IEQ Measurements

Carbon Dioxide

CO_2 is a normal constituent of exhaled breath and is not considered a building air pollutant. It is an indicator of whether sufficient quantities of outdoor air are being introduced into an occupied space. However, CO_2 is not an effective indicator of ventilation adequacy if the ventilated area is not occupied at its usual level at the time the CO_2 is measured. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends that the indoor CO_2 concentration be within 700 ppm of the outdoor concentration for comfort (odor) reasons.[9] Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased. If CO_2 concentrations are elevated, the amount of outdoor air introduced into the ventilated space needs to be increased.

Temperature and Relative Humidity

Temperature and RH measurements are often collected as part of an IEQ investigation because these parameters affect the perception of comfort in an indoor environment. The perception of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperature.[10] Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The American National Standards Institute (ANSI)/ASHRAE Standard 55-2004: Thermal Environmental Conditions for Human Occupancy, specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable.[11] Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68.5°F to 76°F in the winter, and from 75°F to 80.5°F in the summer. The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained at or below 65%. Excessive humidity can promote the excessive growth of microorganisms and dust mites. Specific recommendations for temperature and relative humidity in selected areas of health care facilities are available.[12,13]

Ventilation

Suggested ventilation criteria for hospitals and healthcare facilities have been published by several groups including the American Institute of Architects (AIA) in its *Guidelines for Design and Construction of Hospital and Health Care Facilities*[12] and ASHRAE in its handbook[13] and ventilation design manual for hospitals and clinics.[14] Table 1 includes information on recommended pressure relationships (direction of air movement between the room and adjacent areas), minimum outdoor air, total air changes per hour, and exhaust air considerations for areas included in the NIOSH evaluation.

RESULTS

Glutaraldehyde

The concentrations of glutaraldehyde in personal and area air samples were well below applicable occupational exposure limits. The personal sample and two area samples in the patient examination room did not contain detectable concentrations of glutaraldehyde. The minimum detectable concentration was 0.02 ppm for a sample volume of 82 liters. Two other area samples, collected in the room that housed the sterilization unit, showed concentrations of 0.017 ppm and 0.018 ppm.

IEQ Measurements

The IEQ measurements obtained at the main IMC facility (summarized in Table 2) were mostly within limits recommended for indoor environments. According to ASHRAE, the concentration of CO_2 in the indoor environment should be within 700 ppm of the outdoor CO_2 concentration. The outdoor CO_2 concentration was approximately 350 ppm. Of the 31 indoor measurements taken, only one measurement, taken in the waiting room at the L&D area, exceeded 1050 ppm. The indoor temperatures ranged from 69.8ºF to 78.8ºF, and the RH ranged from 41% to 62%. These values are within the acceptable range for indoor environments. The CO_2 concentrations at the methadone clinic (Table 3) ranged from 859 to 1300 ppm, indicating that insufficient outdoor air was being introduced into some areas. The maximum temperature was 80ºF; RH was 45%.

Ventilation

The ventilation assessment was complicated by vents being inaccessible because of obstructions and rooms being unavailable because medical procedures were in progress when the flow rates were measured. For the rooms for which sufficient data were collected, approximately half (14 of 27 on the fifth floor surgery wing and 11 of 21 in the ED) did not meet at least one of the criteria for directional air flow or amount of air delivered to the space. The results are

summarized in Tables 4 (surgery wing) and 5 (ED) and are discussed further below.

The room in the endoscopy unit that housed the sterilizing equipment was adequately ventilated. It had 10 total air changes per hour (ACH), which exceeded the ASHRAE recommendation of 6 ACH for a soiled workroom/ decontamination room in the sterilizing and supply area, and met the 10 total ACH recommended for a soiled workroom in the diagnostic and treatment area. A similar room designed for cleaning and disinfection of surgical instruments in OR-5 had an even greater total ACH (27), but air flowed out into OR-5 instead of in from the adjacent room because there was no measurable exhaust. At the time of the evaluation, this second disinfection room was not being used for glutaraldehyde disinfection and OR-5 was being used as a staging/storage area for equipment. OR-5 (inactive) and two other (active) operating rooms, OR-2 and OR-3, met the AIA recommendation of 15 ACH. Additionally, air flowed into these operating rooms from the corridor, contrary to the recommendations of these guidelines. Active ORs should be under positive pressure. The remaining two (active) operating rooms, OR-1 and OR-4, essentially met all criteria with 34 total ACH (OR-1) and 24 total ACH (OR-4), and air flowed from both rooms into the adjacent areas. In addition to the deficient exhaust flow in the inactive OR-5 cleaning/disinfection room, there was no measured airflow at the exhaust grills at the scrub stations for OR-4 and OR-5, in the women's locker room, and in the toilet in the men's locker room. Additionally, no exhaust was found in the anesthesia storage room or in the toilet in the women's locker room.

In the ED, the toilet exhaust was not functioning on the day of the evaluation, resulting in a failure to meet all criteria for total air flow and pressurization (directional flow) for all six toilet rooms. Five other rooms could not be evaluated completely because the flow rate for one or more vents could not be measured due to ED activity or the presence of some object or structure that could not be reasonably moved, preventing the proper placement of the flow-hood.

All other rooms/areas were adequately ventilated with three exceptions: the soiled holding room, the trauma room, and the triangular-shaped exam room. The soiled holding room had supply and return flow rates less than 60% of the design values, which resulted in 6 total ACH, significantly less than the recommended 10 ACH. The total flow rate of air supplied to the trauma room was lower than the return flow, causing air to be drawn into the room. The supply and return flow rates for the exam room across the corridor from the trauma room were even lower relative to its design values, such that both the total and the outdoor ACH were lower than the recommended minimum values.

Employee Interviews

Of the twelve employees who were interviewed, two mentioned that they had work-related asthma. One of these was diagnosed by a physician as having work-related asthma; the other was not sure if a physician diagnosed occupational asthma, but the employee felt that the asthma was work related.

Eight of the twelve employees expressed concern about poor ventilation in their workplace; one employee specified the fourth floor locker room as having inadequate ventilation. One of the employees said that there was a delay learning of a patient's designation as a contact isolation case. In this event, adequate or appropriate air filters to filter the air in the patient's room before returning it to the air-handling unit may not be on hand. The air filters are brought over from central supply. Five employees did express satisfaction with management's timely response to their complaints on environmental problems.

Six of the twelve employees interviewed were aware of the cancer deaths that occurred at ICU and NICU. None expressed a concern regarding the cancer deaths and their potential relationship to the workplace environment.

The informal interview with employees at the methadone clinic revealed employee concerns over their health and safety. Employees complained of excessive heat in the medication dispensing area. A cooling unit was provided to them to alleviate the problem, but the noise from the unit hampered communication between employees and patients. Employees mentioned that a few months preceding the NIOSH site visit, an employee was reportedly hospitalized for heat exhaustion acquired at work. It is the NIOSH investigators' understanding that this episode was not reported to IMC management. The employee who suffered the heat exhaustion was not available for an interview during the NIOSH site visit.

A review of the OSHA logs from 2000 to 2002 revealed approximately 80 cases of workplace violence. OSHA logs for 2003 were not available. Most of the cases involved patients physically abusing physicians and nursing staff, leading to scratches in forehead, arms, and shoulders; punches to head, eye and mouth; and kicks in the chest.

DISCUSSION

On the fifth floor surgery wing, 14 of the 27 rooms tested did not meet at least one of the ventilation evaluation criteria, including nine that did not have a proper pressure relationship with an adjacent space, four that did not receive enough outdoor air, and three that were deficient in total ACH. Separating out the fifth floor/ surgery portion of the ventilation provided by AC-5, the measured total supply ventilation flow rate was 25% less than the value specified in the design, and the measured return air flow rate was 17% greater than the design value. The total exhaust flow rate for GX-11 for the surgery wing was 45% less than the design specification, and there seemed to be no exhaust for either of the two rooms served by EF-2. The differences in design airflow and the total ventilation supplied to and returned from all floors by AC-5 could not be measured.

In the surgery wing, although the three operating rooms (OR-2, OR-3 and OR-5), two storage rooms (the sterile storage between OR-2 and OR-3 and the clean utility/equipment storage along side OR-4), and the post anesthesia care unit had the prescribed ventilation flow rates, excess return air created a net negative pressure, causing air to flow into these rooms from adjacent areas. According to the recommended guidelines, the operating rooms and the storage rooms should have a net positive pressure (air flowing out), and the recovery room's average static pressure should be equal to the adjacent areas.

Three rooms on the surgery wing need more exhaust so that air flows in from the adjacent areas. These rooms - the soiled workroom across from the supply closet where sutures are stored, the sub-sterile room in OR-5, and the anesthesia storage room across from OR-1 - have the potential to contain contaminants in the air that should be retained in the room until exhausted to the outdoors. The soiled workroom exhaust was measured to be less than 30% of its design value. The exhaust in the sub-sterile room did not seem to be functioning. The anesthesia storage room had no working exhaust vent.

Two other rooms also have exhaust problems. The men's locker room had no measurable exhaust in the toilet room, and the women's locker room had a reduced exhaust flow in its toilet room, as well as one supply diffuser (just inside the main door) with no measurable air flow and another supply diffuser (above a bank of lockers) with a measured air flow approximately 75% less than the design value. These findings are consistent with what was said during the confidential interviews.

Testing, adjusting, and balancing the system by a certified technician could yield much improvement in ventilation. If the ventilation system were restored to the design flow rate values, only one room would not meet or exceed the evaluation criteria. That room, used for sterile storage between OR-2 and OR-3, should have air flowing out under all closed doors.

In the ED, eleven rooms/areas did not meet at least one of the ventilation evaluation criteria;

eight did not have a proper pressure relationship with an adjacent space, nine did not receive enough outdoor air, and ten were deficient in total ACH. Six of the rooms in each group were the same six toilet rooms with zero exhaust causing insufficient air flow (total and outdoor air) and improper pressurization. The other two rooms with improper pressurization, the trauma room and the x-ray processing and control room, had insufficient air flow. However, three of the four other rooms with inadequate total air changes also had insufficient outdoor air changes.

Currently, there is no ventilation system in place at the methadone clinic, which explains the elevated CO_2 measurements. Fans are provided to employees. NIOSH investigators were told that the methadone clinic would be relocated in the near future, and because of that, the management at IMC was hesitant to put in a ventilation system. The distress experienced by employees and the potential for heat exhaustion necessitates that adequate ventilation be provided to employees as soon as possible.

NIOSH investigators also noted a lack of communication between the management at the main IMC facility and the management at the methadone clinic. Employee concerns at the methadone clinic were not being conveyed to the main IMC facility. There was also a lack of communication between employees and management at the methadone clinic.

The OSHA logs from 2000-2002 showed 80 instances of workplace violence, primarily psychiatric patients attacking the nursing staff. Violence in the workplace has been shown to demoralize employees and cause a reduction in productivity. Research on issues related to violence in psychiatry are available on the internet.[15,16] OSHA logs for 2003 were not available because the room where the logs were maintained was destroyed in a fire shortly before the NIOSH site visit.

No association can be made between the cancer deaths that occurred at the main IMC facility in 2002 and the hospital environment. Information on the types of cancers that resulted in these deaths was not available to the NIOSH investigators. An employee expressed concern that it is not known if a patient is designated as a contact isolation case, and there may not be adequate filters to filter the air in such a patient's room before it is returned to the air handling unit. Exposure to contact isolation patients can result in communicable diseases such as tuberculosis. To the extent possible, air from the rooms of contact isolation patients must be exhausted to the outside. If this is not possible, air may be returned through high efficiency particulate air (HEPA) filters to the air handling unit dedicated to the isolation room.

CONCLUSIONS

Approximately half the rooms evaluated at the main IMC facility did not meet one or more of the ventilation evaluation criteria. Many of these may be remedied by repairing the exhaust fans or adjusting exhaust system dampers to meet design criteria. The surgery wing (and possibly the other areas served by AC-5) needs a complete testing, adjusting, and balancing by a certified technician. Other small adjustments to supply, return, and exhaust flows to correct ventilation flow problems would be most effective and less disruptive when coupled to the adjusting and balancing. The glutaraldehyde concentrations were very low, and should not pose a health hazard to the employees. Workplace violence, specifically violent psychiatric patients attacking nursing staff appeared to be an issue.

There was no ventilation system in place at the methadone clinic. Counseling rooms had high levels of CO_2. The lack of ventilation attributed to some employees developing heat stress. Employee interviews indicated a lack of communication between management at the methadone clinic and the main IMC facility.

RECOMMENDATIONS

Based on the findings of this evaluation, NIOSH investigators offer the following recommendations:

1. Correct ventilation deficiencies noted above. Test, adjust, and balance the ventilation system at the main IMC facility. The work should be performed by a company employing certified technicians. Guidance on testing and balancing, as well as a list of certified technicians may be obtained from the National Environmental Balancing Bureau.[17]

2. Exhaust air from contact isolation rooms to the outside; however, if this is not practical, the air may be returned through HEPA filters to the air-handling unit dedicated to the isolation room.

3. Provide necessary ventilation to employees and patients in the methadone clinic. Hire a consultant familiar with ventilation requirements in health care facilities to develop and implement the ventilation requirements.

4. Develop a program to prevent violence in the workplace. The program should be developed by management with input from affected employees. Guidelines to help prevent violence in hospitals is available on the NIOSH and OSHA websites.[18,19]

5. Improve communication between management at the main IMC facility and the methadone clinic. Ensure that employee concerns are effectively conveyed to the management at the main IMC facility. In addition, open the lines of communication between employees and management at the methadone clinic. A safety committee composed of management and employee representatives who meet regularly to discuss concerns may be an option.

REFERENCES

1. NIOSH [2007]. NIOSH manual of analytical methods (NMAM®). 4th ed. Schlecht PC, O'Connor PF, eds. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 94-113 (August, 1994); 1st Supplement Publication 96-135, 2nd Supplement Publication 98-119; 3rd Supplement 2003-154. [http://www.cdc.gov/niosh/nmam/]

2. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

3. ACGIH® [2006]. 2006 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

4. CFR [1997]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

5. NIOSH [2001]. Glutaraldehyde: Occupational hazards in hospitals. Cincinnati OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2001-115.

6. Jordan WP, Dahl MV, Albert HL [1972]. Contact dermatitis from glutaraldehyde. Arch Dermatol 105:94-95.

7. Hansen KS [1983]. Glutaraldehyde occupational dermatitis. Contact Dermatitis 9: 81-82.

8. EPA [2002]. Replacing ethylene oxide and gluteraldehyde. [http://www.ciwmb.ca.gov/wpie/Healthcare/EPAEtOGlut.pdf.] Date accessed: March 1, 2007.

9. ANSI/ASHRAE [2004]. Ventilation for acceptable indoor air quality. American National Standards Institute/ASHRAE standard 62.1-2004. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

10. NIOSH [1986]. Criteria for a recommended standard: occupational exposure to hot environments, revised criteria. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 86-13.

11. ANSI/ASHRAE [2004]. Thermal environmental conditions for human occupancy. American National Standards Institute/ASHRAE standard 55-2004. Atlanta, GA: American Society for Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

12. AIA [2001]. Guidelines for design and construction of hospital and health hare facilities. American Institute of Architects, Washington, DC.

13. ASHRAE [2003]. Health Care Facilities. In: ASHRAE handbook: HVAC applications. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

14. ASHRAE [2003]. HVAC design manual for hospital and clinics. ASHRAE Special Project SP-91. ASHRAE, Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

15. EViPRG - The European Violence in Psychiatry Research Group [http://www.staff.city.ac.uk/~ra917/eviprg/]. Date accessed: March 1, 2007.

16. Almvik R, Nöttestad JA. Violence in psychiatry research in Norway. [http://www.fnrh.freeserve.co.uk/roger2.html]. Date accessed: March 1, 2007.

17. National Environmental Balancing Bureau. [http://www.nebb.org]. Date accessed: March 1, 2007.

18. NIOSH [2002]. Violence: occupational hazards in hospitals. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-101. [http://www.cdc.gov/niosh/2002-101.html]. Date accessed: March 1, 2007.

19. OSHA [2006]. Workplace violence. [http://www.osha.gov/SLTC/workplaceviolence/index.html]. Date accessed: March 1, 2007.

TABLES

Table 1
Ventilation Recommendations for Selected Areas in New or Renovated Health-Care Settings

Area	Minimum Total ACH[1]	Minimum Outdoor ACH[2]	Pressure Relationship Relative to Adjacent Areas	All Air Exhausted Directly Outdoors
Operating room:				
All outdoor air system[3]	15	15	Positive	Yes
Recirculating air system[4]	15	3	Positive	—
Recovery room [3,4]	6	2	—	—
Emergency department and radiology waiting rooms[3,4]	12	2	Negative	Yes
Labor/Delivery/Recovery/Postpartum[3,4]	6	2	—	—
X-ray[4]	15	3	Positive	—
Trauma room[4]	12	5	Positive	—
Soiled holding room[4]	10	2	Negative	Yes
Examination room[4]	6	2	—	—
Sterilizing and Supply				
Sterilizer equipment room[3,4]	10	—	Negative	Yes
Soiled or decontamination room[3,4]	6	2	Negative	Yes

[1] ACH = Air Changes per Hour.
[2] ANSI/ASHRAE Standard 62.1-2004, *Ventilation for Acceptable Indoor Air Quality*, should be consulted for outside air recommendations in areas that are not specified here. (reference # 10)
[3] Recommendation of AIA. (reference # 13)
[4] Recommendation of ASHRAE. (reference # 14)
— Not specified

Table 2
IEQ Measurements at the Interfaith Medical Center

Date	Time	Department	Location	Temp (ºF)	Relative Humidity (%)	Carbon Dioxide (ppm)
July 31, 2003	AM	OR	Patient room 1	72.5	44.6	750
		OR	Patient room 3	70.2	49.3	564
		OR	Patient room 5	69.8	51.1	644
			Elevator R	71.7	59.3	756
			2nd floor elevator	73.8	53.0	705
		ICU	N208-15	76.1	45.7	782
		ICU	N208-14	77.1	44.8	818
		ICU	N208-10	77.6	43.8	908
		ICU	N208-8	76.7	41.5	747
		ICU	N208-2	74.8	40.8	644
August 1, 2003	PM	OR	Patient Room 5	71.6	48.3	597
		OR	Male locker	72.9	51.0	600
			Elevator Q	75.4	63.4	771
			W 402 (triage)	76.4	67.3	621
		L&D	Waiting room	77.1	57.6	1076†
		L&D	Corridor between labor rooms N410-9 and N410-12	76.9	49.4	826
		L&D	Nurses' station	77.2	56.2	780
		ICU	N208-13	78.4	46.2	910
		ICU	N208-11	78.3	45.4	730
		ICU	N208-10	78.8	45.9	870
		ICU	N208-8	78.0	44.5	840
		ICU	N208-7	77.1	44.8	775
		ICU	N208-6	76.9	43.6	770
		ICU	N208-5	77.0	44.5	770
		ICU	N208-2	76.2	44.0	720
		ICU	Elevator R	76.9	61.9	830
		ED	Patient room 5	76.0	53.1	645
		ED	Patient room 2	75.6	52.7	677
		ED	Nurses' station	75.5	55.2	653
		ED	Patient room 9	75.5	56.3	650
		ED	Patient room 7	75.6	58.1	740

IEQ: Indoor Environmental Quality
OR: Operating Room
ICU: Intensive Care Unit
L&D: Labor and Delivery
ED: Emergency Department
†: Exceeded ASHRAE recommendation

Table 3
IEQ Measurements at the Methadone Clinic
July 31, 2003

Location	Temperature (ºF)	Relative Humidity (%)	Carbon Dioxide (ppm)
Group room 1	77.2	42.5	1052*
Group room 2	80.1	45.2	859
Group room 3	79.5	29.5	1631*
Patient waiting room	78.5	44.8	1105*
Methadone dispensing area	76.2	40.1	1300*

IEQ: Indoor Environmental Quality
*Measurements exceed the ASHRAE recommendation

Table 4
Ventilation Assessment of the Surgery Department at the Interfaith Medical Center
July 30-August 1, 2003.

	Net Flow IN (-) or OUT (+) in Cubic Feet/Minute			Outdoor Air ACH		Total ACH	
Room	Design	Measured	Directional Airflow	Design	Actual	Design	Actual
OR-1	200	587	OUT	9	11	28	35
Sterilizer room	-50	-25	IN	4	4	13	13
Darkroom	-35	-45	IN	4	3	14	8.8
Anesthesia storage	-30	151	OUT*	3	3	9	9
Supply closet	-20	-68	IN	11	4	34	14
Women's locker room	-55	65	OUT	NK	NK	NK	NK
Women's locker toilet	NK	0	N**	NK	NK	12	0
Men's locker room	-40	60	OUT	NK	NK	NK	NK
Men's locker toilet	-150	0	N**	NK	NK	14	0
Surgery lounge	20	-74	IN	NK	NK	9	6
OR-2	200	-338	IN*	8	6	25	19
Sterile storage	-70	-94	IN*	6	1.9	19	6
OR-3	200	-420	IN*	8	5	25	18
Nurse supervisor office	0	-41	IN	NK	NK	12	18
Nurse office	0	-130	IN	NK	NK	10	9
Post anesthesia care unit	0	-125	IN	2.3	2.1	7	7
West corridor	20	-1377	IN	2	0.8	6	3
Supply closet	-20	-68	IN	11	4	34	14
Clean utili/equip storage	20	-83	IN*	4	3	13	9
OR-4	240	271	OUT	10	7	32	24
Toilet	-100	-80	IN	NK	NK	34	28
Cidex room	-50	-91	IN	9	3	29	9.6
Soiled workroom	-60	34	OUT*	13	7	42	21
OR-5	380	-201	IN	10	6	32	19
Sterilizer room	-50	129	OUT*	10	9	32	27
East corridor	510	171	OUT	2	1.5	5	5
Foyer	470	-357	IN	15	5	48	16

ACH: Air Changes per Hour
OR: Operating Room
NK: Not Known
*Observed direction differs from standard (If observed is IN, standard is OUT, and vice-versa)
**Observed direction differs from standard (Observed is N [neutral], standard is IN)

Table 5
Ventilation Assessment of the Emergency Department at Interfaith Medical Center
July 30-August 1, 2003.

Room	Net Flow IN (-) or OUT (+) in Cubic Feet/Minute			Outdoor Air ACH		Total ACH	
	Design	Measured	Directional Airflow	Design	Actual	Design	Actual
Pantry	-100	-82	IN	NK	NK	15	12
Clean work room	40	221	OUT	4	5	12	14
GYN exam	0	75	OUT	3	3	8	9
GYN patient toilet	-100	0	N**	NK	NK	25	0
North treatment area	0	-279	IN	3	1.6	8	4
Soiled holding room	-30	-10	IN	4	2.3	11	6
Staff toilet	-100	0	N**	NK	NK	19	0
Office	0	0	N	NK	NK	NK	NK
South treatment area	0	-1428	IN	3	1.6	8	4
Exam room	-40	-109	IN	4	1.9	11	5
Triage	40	0	N**	4	NV	12	NK
Holding room	-10	-928	IN	5	6	11	16
Holding room toilet	-100	0	N**	NK	NK	0	0
Trauma	100	-140	IN*	7	5	18	12
Patient toilet	-100	0	N**	NK	NK	13	0
Lounge/locker	-200	-20	IN	NK	NK	NK	NK
Lounge toilet	-100	0	N**	NK	NK	17	0
Locker toilet	-100	0	N**	NK	NK	17	0
Processing/control room	-30	88	OUT*	15	14	41	39

ACH: Air Changes per Hour
NK: Not Known
*Observed direction differs from standard (If observed is IN, standard is OUT, and vice-versa)
**Observed direction differs from standard (Observed is N [neutral], standard is IN)

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