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# Health Hazard Evaluations: **Tuberculosis** **1990 to 1999**

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



**Health Hazard Evaluations:**  
*Tuberculosis*  
*1990 to 1999*

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES**  
**Public Health Service**  
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**National Institute for Occupational Safety and Health**

January 2001



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## Foreword

The Health Hazard Evaluations and Technical Assistance (HETA) Program responds to requests from employers, employees, employee representatives, other Federal agencies, and State and local agencies. Through a staff of industrial hygienists, engineers, occupational physicians, epidemiologists, other health professionals, and support personnel, the Hazard Evaluations and Technical Assistance Branch (HETAB) collaborates with appropriate personnel in other divisions of the National Institute for Occupational Safety and Health (NIOSH) to respond to approximately 400 requests for assistance each year. The typical HETA response to a request for assistance results in (1) an evaluation of whether chemical, physical, biological, or other agents are hazardous as used or found in the workplace and (2) the development of recommendations for control procedures, improved work practices, and medical programs to reduce exposure levels and prevent adverse health effects. The results of individual evaluations may trigger wider studies of similar exposures in other settings or may stimulate recommendations for implementation or modification of health standards. More than 10,000 evaluations have been completed since the inception of the HETA Program in 1972. Requests received by the HETA Program tend to reflect emerging occupational problems, such as tuberculosis (TB) in the workplace and other National Occupational Research Agenda (NORA) priority areas.

The TB-related Health Hazard Evaluation (HHE) Project administers HHEs of occupational exposure to TB. Site visits are conducted if warranted, and interim and final reports are developed and distributed to the employer, employees, and relevant State and Federal agencies. Seventy-seven TB-related HHEs were requested from 1990 to 1999. The HHE requests came from a variety of workplaces, including hospitals, neighborhood health centers, TB clinics, homeless shelters, drug treatment centers, correctional facilities, social service facilities, laboratories, medial waste treatment facilities, and an inspection station for imported non-human primates.

This document presents titles and summaries of HHEs related to TB, organized by type of facility. In most cases TB exposure was just one of several exposures that NIOSH researchers investigated at a work site. In many cases, corrective measures were made in response to the evaluation and recommendations made by NIOSH investigators.

A handwritten signature in black ink, appearing to read "Lawrence J. Fine".

Lawrence J. Fine, M.D., Dr..P.H.  
Acting Director  
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## Health Care Facilities

**HETA 90-0122-2073**  
**October 1990**

**Purpose:** To investigate potential occupational hazards related to germicidal lamps used to disinfect the air in tuberculosis (TB) and aerosolized pentamidine (AP) clinics.

**Keywords:** SIC\* 8011 (Offices and Clinics of Doctors of Medicine) and 8071 (Medical Laboratories), TB, skin testing, ventilation.

**Abstract:** Because of concerns regarding the ultraviolet (UV) exposure in this hospital and medical center, an evaluation was undertaken of possible hazardous working conditions at that site. Concern existed about exposures to hazards while operating the germicidal lamps at this facility. Germicidal lamps were used to disinfect the air in TB and AP clinics. All rooms used a 30-watt germicidal lamp. Lower wattage bulbs in the smaller rooms would have reduced occupational UV exposure. Reflectance levels of UV radiation were quite high and varied. Worker exposure to germicidal lamp UV levels was dependent on many factors, some of the most important ones being the position of the bulb in the room, age of the bulb, obstruction of the UV radiation by objects near the bulb, and the height of the worker. While no consensus guidelines are available on ventilation systems designed for areas where germicidal lamps are used, the provision of good room air distribution and mixing is recommended to prevent stagnant air conditions or short circuiting of supply air within the room. Bulb changers need to be aware of the need for protective clothing and gloves for protection from both the UV radiation levels as well as possible glass breakage.

Copies are available from HETAB.†

\*Standard Industrial Classification

†Hazard Evaluations and Technical Assistance Branch

**HETA 90-0330-2479**  
**December 1994**

**Purpose:** To evaluate occupational exposure to aerosolized pentamidine (AP) and purified protein derivative (PPD) skin test conversion among employees administering AP treatments.

**Keywords:** SIC 8069 (Specialty Hospitals, Except Psychiatric), pentamidine, pentamidine isethionate, AP, tuberculosis (TB), health care worker, human immunodeficiency virus (HIV), *Pneumocystis carinii* pneumonia.

**Abstract:** NIOSH representatives conducted health hazard evaluations at four hospitals to evaluate exposures to AP and to determine whether workers administering AP were at increased risk of occupational TB transmission. The NIOSH evaluations included air sampling for pentamidine during AP administration and a review of employee health records to assess the rate of TB PPD skin test conversion. The exposed respondents indicated that they gave an average of 11 pentamidine treatments per week (range 0 to 20). None of the employees who were PPD skin test negative before administering AP had converted to PPD positive on their most recent test. However, the most recently reported tests for three employees had been administered more than 1 year previously (ranging from 12 to 18 months). Personal breathing zone concentrations of pentamidine ranged from non-detectable to 46 µg/m<sup>3</sup>. Local exhaust ventilation was effective in minimizing environmental contamination and worker exposures to pentamidine and would also serve to reduce exposures to *Mycobacterium tuberculosis* (*M. tuberculosis*) if present in the environment. Recommendations to further reduce workers' exposures to AP and to *M. tuberculosis* while caring for HIV-infected patients and to improve medical surveillance programs for PPD skin test conversion are contained in the full report.

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‡National Technical Information Service



**HETA 90-0350**  
**January 1991**

**Purpose:** To evaluate the ventilation systems, work practices, and administrative procedures at this hospital in conjunction with a separate investigation of possible nosocomial transmission of tuberculosis (TB).

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, aerosolized pentamidine (AP), ventilation system, health care workers.

**Abstract:** The NIOSH evaluation focused on an inpatient Acquired Immunodeficiency Syndrome (AIDS) unit and a special immunology clinic that performed AP administration and sputum induction. A ventilation system evaluation was performed that included measurement of the volume rate of air flow, the direction of airflow, and quantitative determinations of air pressure differential between inside the patient rooms and the corridors. Air change rates were calculated from the air flow rate data and were compared with existing guidelines. On the AIDS unit, approximately one-fourth of the patient rooms allowed air to flow out into the corridor (i.e., they were under positive pressure), and more than half of the rooms had an insufficient supply of outside air. The special immunology clinic, the pentamidine administration rooms, main treatment room, and several examination rooms were under positive pressure and had an insufficient supply of outside air. Air recirculation also existed in the main treatment room and several examination rooms which allowed the introduction of infectious aerosols escaping from the pentamidine room into these areas. Based on the history of work practices and administrative controls and on the results of the NIOSH evaluation, there was potential for employee exposure to infectious microorganisms in the evaluated areas. Recommendations were made to correct the ventilation deficiencies and other procedural problems identified in the NIOSH evaluation.

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**HETA 91-0148-2236**  
**July 1992**

**Purpose:** To investigate exposure to ultraviolet (UV) radiation emitted by germicidal lamps at a tuberculosis (TB) clinic.

**Keywords:** SIC 8099 (Health and Allied Services, Not Elsewhere Classified), germicidal ultraviolet (GUV) radiation, TB clinic, ventilation.

**Abstract:** NIOSH representatives provided assistance in documenting occupational exposure to UV radiation emitted by germicidal lamps at this TB clinic. NIOSH personnel made GUV radiation measurements on all lamps at the TB clinic. The results of this evaluation showed that the levels of occupational exposure to GUV radiation produced in most of the work areas were below the NIOSH recommended exposure limit (REL) of 0.1 effective  $\mu\text{W}/\text{cm}^2$ . The only exceptions found were GUV levels at very close distances to lamps. Other findings noted were the presence of old lamps, inappropriate labeling and posting of signs, and ventilation deficiencies in the TB clinic area. Based on GUV radiation measurements, it was determined that a health hazard could exist from exposure to the germicidal lamps at a distance of 10.2 cm or closer if workers did not wear protective eyewear. Except for one situation, exposure to GUV at distances greater than 10.2 cm did not represent a health hazard on the day of measurement. Recommendations for minimizing the UV exposures as well as improving certain ventilation parameters were provided.

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**HETA 91-0187-2544**  
**November 1995**

**Purpose:** To investigate nosocomial transmission of tuberculosis (TB) in health care workers.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, aerosolized pentamidine (AP) isethionate, aerosolized pharmaceuticals, respirators, ventilation system, aerosol containment system, health care workers, ultraviolet (UV) radiation, germicidal lamps.

**Abstract:** A health hazard evaluation was conducted by NIOSH researchers at this hospital to assess nosocomial transmission of TB in health care workers. NIOSH investigators evaluated the risk of tuberculin skin test (TST) conversion in employees exposed to patients with infectious TB, the adequacy of ventilation in areas of the hospital where patients with infectious TB are treated, the potential for exposure to AP and to *Mycobacterium tuberculosis* in workers who administered AP, and the potential for overexposure to ultraviolet germicidal irradiation (UVGI) from UV lamps. The risk of TST conversion was evaluated through a 4-year retrospective cohort study among exposed (n=249) and unexposed (n=355) employees. Employees who worked in areas where patients with active TB were cared for, including workers who did not provide direct patient care, had a higher rate of TST conversion than employees who did not work in these areas. A decline in this elevated risk was seen over time. Reasons for the decline include outbreak termination, fewer admissions of TB patients, implementation of effective infection control measures, and possible resistance to infection in some members of the study population. Some hospital areas where patients with infectious TB are cared for had inadequate ventilation. Workers who administered AP treatments to patients had no increase in symptoms or risk of TB

infection over workers who did not administer these treatments. The potential for overexposure to UV radiation existed for those who worked around functioning UVGI lamps. Recommendations addressing each of these issues are provided in the full report.

Copies are available from NTIS, individually or on CD-ROM. The study was published in the *American Journal of Industrial Medicine*. (Boudreau AY, Baron SL, Steenland NK, VanGilder TJ, Decker JA, Galson SK, and Seitz T. [1997] Occupational Risk of *Mycobacterium tuberculosis* Infection in Hospital Workers. *Am J Ind Med* 32: 528-534.)

**HETA 92-0215-2268**  
**November 1992**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission at this TB hospital.

**Keywords:** SIC 8069 (Specialty Hospitals, Except Psychiatric), TB, state hospital, ventilation, infection control.

**Abstract:** NIOSH investigators performed a health hazard evaluation (HHE) that included industrial hygiene and medical components at a state TB hospital. The industrial hygiene component focused on assessing the effectiveness of the ventilation systems in use at the hospital. A visual inspection of the ventilation systems and a review of the original specifications of the air-handling units were completed by the investigators. Additionally, measurements were made of the airflow from supply and exhaust diffusers in patient rooms, along with temperature and relative humidity measurements. The direction of airflow between patient rooms and hallways and between hospital wards was also determined in several locations in the hospital complex. The medical component consisted of a qualitative review of current employee infection control practices. Some deficiencies were noted in the ventila-





tion systems that could potentially contribute to the transmission of TB from infectious patients to other patients and hospital staff. Recommendations to modify the ventilation systems to meet isolation evaluation criteria are contained in the full report along with recommendations to strengthen the hospital's employee skin testing and infection control programs.

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**HETA 92-0232-2767**  
**November 1999**

**Purpose:** To evaluate the risk of transmission of *Mycobacterium tuberculosis* (*M. tuberculosis*) to hospital workers.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), tuberculosis (TB), hospital workers, occupational exposure, nosocomial transmission, tuberculin skin test.

**Abstract:** NIOSH investigators conducted an epidemiologic study of the risk of *M. tuberculosis* transmission (as defined by tuberculin skin test [TST] conversion) among hospital workers with "patient contact" compared to workers with "no patient contact." Hospital workers employed at the hospital from January 1, 1990, through September 30, 1992 were included in the retrospective cohort study. Personal, community, and occupational risk factors for TST conversion were evaluated in 2,362 workers with potential tuberculosis exposure and 886 workers with little or no potential for exposure. Among workers with potential exposure, statistically significantly elevated risks for TST conversion were found for nurses, phlebotomists, emergency room workers, housekeepers, clerks, and emergency responders. Among nurses, the risk was related to a proxy measure of occupational TB

exposure (i.e., the number of positive *M. tuberculosis* cultures from their work location).

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**HETA 92-0296-2243**  
**August 1992**

**Purpose:** To determine if ventilation requirements for the isolation of tuberculosis (TB) patients were being met at this medical center.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this medical center to evaluate the ventilation systems in an infectious disease ward. NIOSH investigators made ventilation measurements to determine the status of the ventilation systems serving the area. Smoke tube traces were used to determine room-to-corridor pressure relationships and the pressure relationship of the infectious disease ward to the core areas of the hospital. There was a general flow of air out of the infectious disease ward and into the core area. In fact, the air flowed through the core area and into an adjacent wing of the hospital. This condition could cause the circulation of infectious agents to other wards and floors of the hospital because of shared heating, ventilating, and air conditioning (HVAC) systems. On the basis of the measurements made during the evaluation, there was no apparent isolation of infectious patients in the infectious diseases ward. It was recommended that a separate isolation facility be constructed in the hospital to house infectious TB patients. Interim corrective measures for the systems in place were also recommended.

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**HETA 92-0298-2325**  
**June 1993**

**Purpose:** To investigate the ventilation systems serving the isolation rooms for tuberculosis (TB) patients in six hospitals.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, ventilation, infection control.

**Abstract:** NIOSH investigators conducted a health hazard evaluation to evaluate the ventilation systems serving the isolation rooms for TB patients in six hospitals. A visual inspection of the ventilation systems, as well as a review of the original specifications of the air-handling units, was completed for each facility. Where the ventilation systems were operating, airflow measurements from supply and exhaust diffusers were made. Smoke tube traces were used to determine room-to-corridor pressure relationships. General information was gathered on employee tuberculin skin testing programs. Some deficiencies were noted in the ventilation systems of these facilities that could potentially contribute to the transmission of TB from infectious patients to other patients, hospital staff, and visitors. Recommendations to modify the ventilation systems so that isolation evaluation criteria are met were offered in the full report, along with recommendations to strengthen the infection control programs at the facilities.

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**HETA 93-0046**  
**March 1995**

**Purpose:** To investigate the collection of environmental air samples for *Mycobacterium tuberculosis* (*M. tuberculosis*).

**Keywords:** SIC 8069 (Specialty Hospitals, Except Psychiatric), tuberculosis (TB), state hospital, ventilation, infection control.

**Abstract:** This research was conducted to test an experimental methodology for collecting environmental air samples for *M. tuberculosis*. This hospital was selected for this experimental study design based on the number of active TB patients resident at any given time. Eighty culturable air samples were collected in various locations throughout the hospital including three patient rooms and two control locations. Subsequent analysis of sample plates revealed no acid-fast bacilli. Numerous theories exist about the inability to culture *M. tuberculosis* from the air including the appropriateness of the sampling method and the fastidiousness of the organism. However, the infectious nature of the patients was not suspected as a limiting factor considering that at least one of the patients was identified as sputum smear positive one day prior to the sampling efforts.

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**HETA 93-0652**  
**November 1997**

**Purpose:** To investigate occupational exposures to *Mycobacterium tuberculosis* (*M. tuberculosis*) at a medical center.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals) tuberculosis (TB), medical centers, ventilation, ultraviolet lamp.

**Abstract:** NIOSH investigators conducted an environmental assessment regarding occupational exposures to *M. tuberculosis* at a department of this medical center. The assessment was conducted as a result of an epidemiologic investigation of suspected nosocomial transmission of multidrug-resistant *M. tuberculosis* at the facility in 1992. NIOSH personnel conducted an evaluation of the medical center, examined the ventilation systems serving the isolation and treatment rooms, and evaluated germicidal ultraviolet lamps that were used as environmental controls. The ventilation system evaluation included discussions with persons responsible for operation and maintenance of the system and performance of airflow measurements. Some of the isolation rooms operated under positive pressure at all times with respect to surrounding areas. Specific recommendations regarding the ventilation system and ultraviolet lamps evaluated during the survey were offered in the closeout letter.

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**HETA 93-0746 and 93-0747**  
**August 1995**

**Purpose:** To investigate the potential for occupational exposure to *Mycobacterium tuberculosis* among employees in county health care facilities.

**Keywords:** SIC 8093 (Specialty Outpatient Facilities, Not Elsewhere Classified), tuberculosis (TB), ventilation, tuberculin skin testing.

**Abstract:** NIOSH investigators examined the airflow between rooms and hallways, and the status of the germicidal ultraviolet lamp contained in the facility nebulizer room. Inspection of the air handling systems revealed no general maintenance problems. Investigators found that the close proximity between the outdoor air intake and system exhaust could lead to reintrainment of exhausted air back into the system and subsequently, the occupied spaces. The ultraviolet bulb was dust-covered, potentially rendering it less effective as an air disinfectant. Employees in the health clinics serve patients with suspected or active TB at the clinics or at the homes of the patients. Results from the environmental investigation indicate that the ventilation systems in both buildings were recirculating with a common return air plenum that could increase the potential risk of TB transmission into other areas of the buildings. Recommendations were offered to help the clinics improve their work environments and potentially reduce the risk of TB transmission.

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**HETA 93-0770**  
**February 1996**

**Purpose:** To evaluate the effectiveness of the ventilation systems for preventing tuberculosis (TB) transmission at this outpatient TB clinic.

**Keywords:** SIC 8099 (Health and Allied Services, Not Elsewhere Classified), tuberculosis, sputum induction, ventilation system, outpatient clinic, health care workers, purified protein derivative skin test, respirator.

**Abstract:** NIOSH investigators conducted an evaluation at this outpatient TB clinic to assist the facility in determining the best location for a future TB isolation room and to determine the operational status of the ventilation systems serving the areas of concern. Visual inspections were made of the general ventilation system and the local exhaust ventilation (booth) used for sputum inductions. The direction of air flow between rooms and adjacent areas was determined using smoke tubes. Deficiencies identified during the environmental evaluation that may increase the risk of TB transmission included the lack of an isolation room, recirculation of air throughout the facility, insufficient use of respiratory protection, and problems with operation of the sputum collection booth. Recommendations were made to correct the noted deficiencies and improve the overall TB prevention program at this facility.

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**HETA 93-0772**  
**July 1995**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission in a neighborhood health center.

**Keywords:** SIC 8011 (Offices and Clinics of Doctors of Medicine) and 8071 (Medical Laboratories), TB, skin testing, ventilation.

**Abstract:** Because of concerns regarding the potential for TB transmission in the facility, NIOSH was asked to evaluate a neighborhood health center and make recommendations regarding TB infection-control procedures. NIOSH representatives conducted a site visit to review the tuberculin skin testing program, determine the operational status of the ventilation system, and review ventilation plans and specifications for the new addition to the building which was under construction at the time of the survey. On the basis of a review of the blueprints of the facility and a walk-through inspection, several rooms in the new addition were chosen as future isolation rooms because of their location within the facility and the ability to optimize the ventilation rates of the rooms. NIOSH investigators found that although the facility had implemented a comprehensive screening program for employees, engineering control deficiencies and the lack of appropriate respiratory protection may increase the risk of *Mycobacterium tuberculosis* (*M. tuberculosis*) transmission in the facility. Since most of the areas of the existing building recirculate all room air, a potential to spread *M. tuberculosis* throughout the facility existed whenever a client with active TB entered the clinic. Additionally, the inappropriate use of a chemical fume hood for the preparation of TB specimens may pose additional risks to employees. Recommendations based on current Centers for Disease Control and Prevention guidelines are offered in the report.

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**HETA 93-0780**  
**March 1996**

**Purpose:** To investigate the tuberculosis (TB) prevention program, work practices, and engineering controls at this hospital.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, ventilation, skin test, Centers for Disease Control and Prevention.

**Abstract:** NIOSH investigators conducted a health hazard evaluation to review the TB prevention program, work practices, and engineering controls within this hospital. The investigation was prompted by concerns about several purified protein derivative (PPD) skin test conversions among personnel in the Intensive Care Unit (ICU). The TB infection-control program and administrative procedures and policies were reviewed with hospital representatives. Also, a limited ventilation evaluation was conducted in several regular patient rooms, treatment rooms, and rooms designated for TB isolation. The ventilation evaluation revealed a need to increase the air changes per hour (ACH) in the ICU. Also, a need for improved respiratory protection devices and a complete respirator program were needed. On the basis of updated Centers for Disease Control and Prevention guidelines, NIOSH investigators made specific recommendations about the employee purified protein derivative (PPD) skin testing program, procedures for handling infectious patients, use of respiratory protection, engineering controls, and the bacteriology laboratory's procedures for processing sputum samples.

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**HETA 93-0950**  
**May 1997**

**Purpose:** To investigate the effectiveness of the tuberculosis (TB) control program at this medical center.

**Keywords:** SIC 8062 (General Medical and Surgical Hospitals), TB, health care, hospital, infection control.

**Abstract:** NIOSH personnel conducted a health hazard evaluation of the TB control program at this medical center. Environmental evaluations were conducted at two hospitals. The evaluations focused on areas where exposure to *Mycobacterium tuberculosis* would most likely occur. Discussions were held with representatives from Infection Control, Plant Services, Respiratory Services, and the Laboratory. A limited ventilation evaluation was conducted in selected areas, including measurements of exhaust airflow and an assessment of airflow direction. A 1997 site visit included a walk-through survey of the hospitals. Observations of smoke tube traces were made to evaluate the direction of airflow in certain locations. Discussions were held with the infection control specialist and a unit nurse. A copy of the revised TB Control Policy and Procedures Manual was obtained for review. Since the initial NIOSH visit in 1994, several improvements occurred in the TB Control Program. These changes and NIOSH recommendations for other improvements to the tuberculin skin test screening program and ventilation systems are presented in the closeout letter.

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**HETA 93-0845-2367, 93-0846-2386,  
93-0751-2408, 93-0847-2384, and  
93-0848-2399**

**November 1993 to March 1994**

**Purpose:** To investigate the effectiveness of ventilation systems in reducing tuberculosis (TB) transmission in health care center facilities.

**Keywords:** SIC 8011 (Offices and Clinics of Doctors of Medicine), TB, ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation to assess the ventilation systems at several health care centers, especially in regard to the suitability of these systems for minimizing TB transmission. A visual inspection of the ventilation systems, as well as a review of the original specifications of the air-handling units, was completed for the centers. Smoke tubes were used to determine pressure relationships between examination rooms and corridors. A number of problems were observed with respect to the operation and maintenance of the ventilation systems that could potentially increase the risk of TB transmission in areas where TB patients might be present. Heating, ventilating, and air-conditioning units were operated in an automatic mode that resulted in no air being supplied to examination rooms and laboratories when temperature set-points were satisfied. The clinics had established a tuberculin skin test screening program for clients but had no program for employees. Recommendations to correct deficiencies in the ventilation system and TB control program are offered in the full report.

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**HETA 96-0192  
August 1996**

**Purpose:** To investigate engineering controls planned for two county tuberculosis (TB) clinics.

**Keywords:** SIC 8093 (Specialty Outpatient Facilities, Not Elsewhere Classified), TB, clinic, respirator.

**Abstract:** NIOSH representatives conducted a health hazard evaluation to provide assistance in evaluating engineering controls planned for two county TB clinics. To prevent TB transmission from patients with unknown or unrecognized active TB, the county had committed to renovating two existing medical facilities where TB clinics are held. NIOSH visited the two facilities to determine if the proposed control measures were necessary and adequate for preventing TB transmission. NIOSH representatives met with personnel from the county's environmental health, nursing, and engineering departments to discuss ventilation requirements, use of germicidal ultraviolet radiation lamps, tuberculin skin testing, and use of respirators and portable high efficiency particulate air (HEPA) filtration units. Following this meeting, NIOSH representatives toured the areas where the current TB clinics were held as well as the area that was being renovated for future use at the facility. At both facilities, routine TB skin testing of clients was provided along with TB skin testing of suspect TB cases and close contacts of persons known to have active TB. The medical staff also provided X-rays and medical exams, and sputum samples were sometimes collected from persons suspected of having active TB. Surgical masks were provided to patients who may be infectious, and staff wore NIOSH-approved disposable HEPA respirators when treating or examining



potentially infectious TB patients. On the basis of a facility tour and discussions with county health department personnel, the NIOSH investigators supported their efforts to consolidate TB-related activities and to improve engineering controls at both facilities. NIOSH recommendations are included in the full report.

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## Drug Treatment Facilities

**HETA 93-0365-2421**  
**May 1994**

**Purpose:** To investigate the administrative and engineering control measures that are used to reduce potential exposures to tuberculosis (TB) in an outpatient methadone maintenance and detoxification center.

**Keywords:** SIC 8093 (Specialty Outpatient Facilities, Not Elsewhere Classified), drug treatment center, methadone, TB, tuberculin skin test (TST), ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this outpatient facility to investigate potential TB transmission due to contact with a client population at high risk for TB. NIOSH investigators reviewed the facility's written TST program and testing results and conducted informal interviews with employees. A visual assessment of the ventilation and airflow patterns was performed, and random measurements of the supply airflows were made. The investigators found that of the 55 employees, three persons converted to a positive skin test during their employment. As information about the duration of employment was not fully available, NIOSH investigators were unable to calculate the incidence of positive skin tests among all

employees. Investigators found that the ventilation system within the center recirculated 100% of the air and is therefore not an effective engineering control for reducing exposure to TB. It was determined that a potential hazard existed for health care workers at this facility who were exposed to clients with active TB. Recommendations were made in the report to improve the ventilation systems, use appropriate personal protective equipment, and improve the TST program.

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## Social Services

**HETA 92-0271-2349**  
**September 1993**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission at a parole office building.

**Keywords:** SIC 8322 (Individual and Family Social Services), parole office, TB.

**Abstract:** NIOSH investigators conducted an evaluation of the ventilation system in this parole office to assess air distribution, outside air intake and dilution. NIOSH researchers measured outside airflow and carbon dioxide (CO<sub>2</sub>) concentrations, a surrogate indicator of outside airflow into a building, and administered questionnaires to employees. Outside air intake on the first floor (and possibly the third floor) did not meet the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) ventilation recommendations for office space. Parole board employees may have had an added risk of TB infection because (1) parolees are at increased risk for developing active TB (all have been incarcerated, some are medically underserved,



and some are homeless) and (2) the ventilation system recirculated most of the air in the facility, thereby permitting any infectious droplet nuclei in the air to spread throughout the facility. Recommendations for an employee TB screening program and improvements to the ventilation system were provided in the full report.

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**HETA 92-0345-2457**  
**September 1994**

**Purpose:** To investigate the potential for occupational exposure to *Mycobacterium tuberculosis* (*M. tuberculosis*) among social services employees.

**Keywords:** SIC 8093 (Specialty Outpatient Facilities, Not Elsewhere Classified), tuberculosis (TB), tuberculin skin test (TST).

**Abstract:** NIOSH investigators conducted a health hazard evaluation to assess the potential for occupational exposure to *M. tuberculosis* among county social services employees. NIOSH conducted a TST program among these county employees. One hundred forty-eight employees participated in the initial TST. In the follow-up TST program, one person converted to a positive skin test out of a total of 78 who completed the study. The low participation rates for the study prevented drawing any definitive conclusions regarding the risk of occupational transmission of TB among employees. A recommendation was made to continue the skin testing program for those workers who are potentially occupationally exposed to TB.

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**HETA 93-0891-2430**  
**June 1994**

**Purpose:** To investigate the potential risk of tuberculosis (TB) transmission to social service employees at three sites.

**Keywords:** SIC 9441 (Administration of Social, Human Resource and Income Maintenance Programs), TB, social service, welfare, indoor air quality, indoor environmental quality.

**Abstract:** NIOSH representatives conducted a health hazard evaluation of several social service offices to determine (1) whether employees can reasonably anticipate risk of exposure to TB, and (2) what engineering and administrative controls should be recommended for social service settings. NIOSH investigators assessed the ventilation system of the food stamp office and conducted a medical evaluation of employees at all three sites. The environmental evaluation indicated that the air handling units were not supplying sufficient outdoor air (for dilution ventilation) on the day of measurement. The medical evaluation included confidential interviews with 18 workers and a review of the methods and results of a voluntary TB screening. Because of sample size, the results of this screening effort may not represent the actual prevalence of tuberculous infection. Recommendations for an employee TB education and screening program for Division of Welfare employees and for improvements to the ventilation system in the food stamp office were provided in the full report.

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**HETA 96-0233**  
**September 26, 1996**

**Purpose:** To investigate potential transmission of tuberculosis (TB) from high-risk clients to employees working in housing program administrative offices.

**Keywords:** SIC 9531 (Administration of Housing Programs), TB, engineering controls.

**Abstract:** NIOSH investigators met with staff and management of this city housing program to discuss potential transmission of TB from high-risk clients to employees. NIOSH was asked to provide advice about procedures and engineering controls to prevent occupational transmission of TB. NIOSH representatives did not collect specific data about the risk of TB infection incurred from relatively brief visits to the offices by applicants seeking housing. However, many of the applicants appear to fall within high-risk categories for active TB disease. Therefore, it is reasonable to take measures to reduce the chances of TB transmission. Recommendations for reducing exposure risk through employee education and early identification of persons with symptoms of active disease were provided in the closeout report.

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## Coroner's Office

**HETA 92-0171-2255**  
**September 1992**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission resulting from autopsies of persons with TB at time of death.

**Keywords:** SIC 9199 (General Government Not Elsewhere Classified), autopsy, morgue, TB, germicidal ultraviolet (UV) radiation, ventilation.

**Abstract:** NIOSH investigators conducted an evaluation at this medical examiner's office regarding the potential for TB transmission resulting from autopsies conducted on persons who had active multidrug-resistant TB at the time of their death. Investigators evaluated the ventilation systems serving the morgue and office areas and observed work practices and use of personal protective equipment during an autopsy. A fog-generating device and ventilation smoke tubes used to visually assess airflow patterns demonstrated the potential for air movement out of the morgue and into surrounding areas. Thus, researchers concluded that a potential hazard existed for workers exposed to aerosols containing *Mycobacterium tuberculosis* generated during autopsy. The use of high-speed tools and other aerosol generating procedures that encounter collections of TB-infected material presents a potentially high-risk exposure situation. Recommendations were made in the report to correct existing ventilation deficiencies, including isolation of the morgue ventilation system, use of personal protective equipment, safe use of germicidal UV lamps, and the provision of separate clean and dirty change areas for morgue personnel.

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**HETA 96-0019-2666**  
**December 1997**

**Purpose:** To investigate airborne particulates generated by a pneumatic reciprocating saw equipped with local exhaust ventilation (LEV).

**Keywords:** SIC 9221 (Police Protection), tuberculosis, human immunodeficiency virus, coroner, bloodborne pathogen, noise, cranial saws.

**Abstract:** NIOSH investigators conducted a health hazard evaluation in this coroner's office to evaluate a pneumatic reciprocating saw equipped with LEV used for making cranial openings during forensic autopsies and examinations. The objective of the NIOSH evaluation was to determine if the alternative reciprocating saw generated less tissue and bone fragment aerosol that could potentially enter the breathing zone of the operating forensic technician. Differences in peak concentrations of airborne particulates measured during autopsies with and without the aid of LEV, indicate that LEV significantly reduced the aerosols produced by the reciprocating saws. No short-term, high concentrations of particulates were observed during autopsies utilizing the LEV system. LEV applied at the cutting surface of reciprocating surgical saws can be an effective tool to reduce the risk of occupational exposure to blood, bone, and tissue aerosol fragments during autopsies. However, the vacuum system should be mechanically integrated with the activation of the reciprocating saw, eliminating the possibility of operator error.

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## Correctional Facilities

**HETA 92-282-2297**  
**March 1993**

**Purpose:** To investigate medical department staff exposure to *Mycobacterium tuberculosis* (*M. tuberculosis*) at a correctional facility.

**Keywords:** SIC 9223 (Correctional Institutions), prisons, tuberculosis (TB).

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this correctional institution to determine whether staff in the Medical Department were potentially exposed to *M. tuberculosis* from an inmate diagnosed with active TB. NIOSH investigators met with representatives of labor and management to collect information regarding the patient's illness, isolation, and treatment, and the TB screening programs provided by the correctional institution. The heating, ventilating, and air-conditioning system in the Medical Department was evaluated to identify possible deficiencies that could contribute to the transmission of *M. tuberculosis*. The majority of air in the building was recirculated. Because of this, there was a potential for *M. tuberculosis* from the Medical Department to be transmitted throughout that department as well as the administrative offices. Other ventilation deficiencies that may increase the potential for *M. tuberculosis* transmission included insufficient total and outside air supply, and incorrect pressure relationships between rooms and adjacent corridors. Recommendations to reduce the potential for *M. tuberculosis* transmission, including medical screening and improved ventilation, were provided in the report.

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**HETA 93-0364**  
**May 1993**

**Purpose:** To evaluate the tuberculosis (TB) control policy at this youth detention center.

**Keywords:** SIC (9223 Correctional Institutions), TB, correctional facility, detention, youth, tuberculin skin test.

**Abstract:** NIOSH investigators reviewed the TB control policy at this youth detention center. The detention center's policy required TB skin testing for all employees at time of employment and annually thereafter. Review of the medical department TB records revealed that the records were incomplete. Test results and follow-up procedures were recorded on a number of different forms located in different areas. In addition, many of the negative skin tests were recorded in the records as "negative," rather than as the number of millimeters of induration. The only skin test conversion documented in the records occurred in 1982. There had been no known active TB cases among residents or staff at the detention center. Recommendations were made in the report to develop a written TB control program in accordance with the Centers for Disease Control and Prevention guidelines, improve record keeping, and enhance TB educational efforts.

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**HETA 93-0748**  
**January 1996**

**Purpose:** To evaluate the ventilation systems serving this county jail.

**Keywords:** SIC (9223 Correctional Institutions), tuberculosis (TB), correctional facility, jail, ventilation.

**Abstract:** NIOSH investigators conducted a ventilation system evaluation to assess the potential for dissemination of airborne *Mycobacterium tuberculosis* (*M. tuberculosis*) at this county jail. The ventilation system evaluation consisted of a review of mechanical plans, discussions with persons responsible for maintenance of the heating, ventilation, and air-conditioning (HVAC) systems, and a visual assessment of air flow patterns (using chemical smoke) in the cell block areas. HVACs of various designs were observed throughout the jail. Many of the systems or components were inoperable. In some areas, natural ventilation (open windows) and ceiling fans were used to enhance the mechanical ventilation. In the cell block area used to isolate suspected TB infected inmates, the exhaust and supply duct work to the individual cells and associated corridors were disconnected from the central HVAC system to minimize the recirculation of contaminated air. However, this also resulted in no outdoor air being delivered to the occupied spaces. A floor fan was positioned to blow air across the face of the isolation cells, and another was positioned perpendicular to the first, exhausting entrained air out of an open door. Based on the location of the guard's desk, air from the cells that was not exhausted was directed at the guard. Recommendations were made to correct the ventilation deficiencies and improve directional air flow, dilution, and removal of contaminated air. Additional recommendations were made to improve the overall TB control program (screening of employees, education and training, use of respiratory protection, etc.).

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**HETA 94-0238-2484**  
**February 1995**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission among law enforcement personnel who have contact with prisoners.

**Keywords:** SIC 9221 (Police Protection), TB, tuberculin skin test (TST), correctional facility, indoor environmental quality, ventilation.

**Abstract:** NIOSH representatives conducted an environmental and medical evaluation at this correctional facility. Confidential medical interviews were conducted with five of the seven employees who were reported to have newly reactive TSTs. The on-site occupational health nurse was interviewed, and medical records and the employee TST program were reviewed. The heating, ventilating, and air-conditioning (HVAC) units that served the offices and cellblocks were evaluated to determine their effectiveness in reducing the airborne transmission of infectious agents. The medical evaluation found that six (9%) of the employees who had received a TST had a positive response. The available TST data were not sufficient to assess the prevalence of TB infection or the extent of work-related risk of TB among employees. The physical evaluation of the ventilation system indicated that it was potentially inadequate, and some of the HVAC units serving the office areas had signs of deficient general maintenance. NIOSH investigators determined that the employees may have had an increased risk of occupationally acquired TB infection because they are in contact with prisoners, a group considered to be at high risk for developing active TB. Recommendations for an employee TB education and surveillance program, and for improving the work environment, especially the ventilation systems, were presented in the full report.

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**HETA 95-0024-2518**  
**August 1995**

**Purpose:** To investigate the potential for tuberculosis (TB) transmission among law enforcement personnel who have contact with prisoners.

**Keywords:** SIC 9221 (Police Protection), TB, tuberculin skin test (TST), correctional facility, prisoners, indoor environmental quality ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this correctional facility to evaluate the potential for TB transmission among personnel who have contact with prisoners. Confidential medical interviews were conducted with employees who were reported to have newly reactive TSTs, and medical records and the employee TST program were reviewed. A walk-through inspection of the facility was conducted, and ventilation measurements were made to evaluate the potential for dissemination of droplet nuclei. The environmental evaluation revealed deficiencies in the amount of outdoor air supplied to the cell block area and in the delivery of supply air to the cell block and office areas. These deficiencies minimize the contribution of ventilation and directional airflow in diluting or removing contaminated air. The available TST data were not sufficient to assess the prevalence of TB infection or the occupational risk of TB transmission among employees. However, employees have contact with prisoners, a group considered to be at high risk for developing active TB. Recommendations for improving the TST surveillance program and environmental controls were provided in the report.

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## Laboratory

**HETA 92-0377-2625**  
**January 1997**

**Purpose:** To investigate the transmission of TB among employees working in laboratories where clinical specimens are processed.

**Keywords:** SIC 8071 (Medical Laboratories), TB, laboratory-acquired infections, skin testing, ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this medical laboratory regarding the transmission of tuberculosis among employees working in laboratories where clinical specimens were processed. Workers handling viable *Mycobacterium tuberculosis* (*M. tuberculosis*) specimens may be at increased risk of becoming infected while performing their jobs. According to employee recall, 23% of persons employed in the labs converted to a positive tuberculin skin test over an 8-year period. However, limitations of the study made it difficult to draw any definitive conclusions regarding the risk of occupational transmission of *M. tuberculosis* among the employees at these laboratories. It is imperative that the laboratory follows current Centers for Disease Control and Prevention guidelines for handling *M. tuberculosis* samples. Recommendations were offered in the full report to reduce the risk of occupational transmission of TB and to improve the working environment for the employees.

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**HETA 93-0282-2303**  
**April 1993**

**Purpose:** To investigate possible exposures to ultraviolet (UV) radiation in a hospital microbiology laboratory.

**Keywords:** SIC 8071 (Medical Laboratories), tuberculosis (TB), UV radiation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation to evaluate possible exposures to ultraviolet radiation in a hospital microbiology laboratory. Exposure to UV radiation was from germicidal UV lamps present in a Class II Type A biological safety cabinet (BSC). Ultraviolet radiation levels varied widely, depending on the location of measurement. At eye level directly in front of the BSC, irradiance was approximately 4.0 microwatts per square centimeter ( $\mu\text{W}/\text{cm}^2$ ); this equates to a NIOSH/ACGIH permissible exposure time of 25 minutes for unprotected workers. The UV irradiance at an adjacent computer terminal (eye level) was 0.8  $\mu\text{W}/\text{cm}^2$  (permissible exposure time of 120 minutes). Exposure to UV radiation was determined to present a potential health hazard for employees working near the BSC. Recommendations to minimize employee exposures to UV are included in the report.

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**HETA 93-0769-2489**  
**February 1995**

**Purpose:** To investigate the potential for *Mycobacterium tuberculosis* (*M. tuberculosis*) transmission in this mycobacteriology laboratory.

**Keywords:** SIC 8071 (Medical Laboratories), tuberculosis (TB), laboratory-acquired infections, skin testing, ventilation.

**Abstract:** NIOSH investigators conducted an evaluation to assess the control measures used to prevent *M. tuberculosis* transmission in this mycobacteriology laboratory. A walk-through survey of the laboratory and a visual assessment of its heating, ventilating, and air conditioning system was conducted at the time of the site visit. Additionally, the employee tuberculin skin testing (TST) program was reviewed, and a microbiologist was observed during the processing of samples to evaluate work practices and procedures. The visual assessment of the ventilation system and evaluation of the design of the laboratory revealed that the potential exists for dissemination of *M. tuberculosis* to other parts of the laboratory. The facility did not have a written TST surveillance program and, at the time of the evaluation, no central file was used for tracking TST results. A respiratory protection program meeting Occupational Safety and Health Administration requirements had not been implemented for the laboratory. A potential health hazard existed for workers who may be exposed to aerosols generated in the laboratory, due to deficiencies in the design of the laboratory and operation of the ventilation system and the lack of appropriate respiratory protection. Since the TB laboratory is not properly sealed, the possibility existed that *M. tuberculosis* bacilli could be disseminated to other areas of the laboratory. Recommendations were presented in this report to

correct deficiencies identified during the evaluation and to meet the minimum guidelines recommended by Centers for Disease Control and Prevention and National Institutes of Health.

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**HETA 98-0296**  
**November 1998**

**Purpose:** To investigate the tuberculosis (TB) transmission controls in place in a mycobacteriology laboratory.

**Keywords:** SIC 8071 (Medical Laboratories), TB, laboratory-acquired infections, ventilation.

**Abstract:** An evaluation of this mycobacteriology laboratory was conducted to assess the TB controls in place at the facility. Measurements were taken for airflow, air static pressure, and particle counts to quantify containment parameters. Measurements were also made of the energy produced by ultraviolet germicidal irradiation (UVGI) lamps located in the bacteriology laboratory, the biology safety cabinet, and the Biosafety Level 3 containment laboratory. NIOSH investigators found that the use of physical barriers alone could not prevent the migration of contaminants from one area to another. NIOSH recommended the use of general ventilation to create pressure differentials between activity zones to minimize opportunities for contaminant escape when doors are opened. Additional recommendations concerning the use of UVGI and respiratory protection are made in the report, along with recommendations for preventative maintenance of the ventilation system and laboratory hoods.

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## Homeless Shelters

**HETA 92-0320-2357**  
**October 1993**

**Purpose:** To investigate control measures used to prevent tuberculosis (TB) transmission at a social service facility and homeless center.

**Keywords:** SIC 8399 (Social Services, Not Elsewhere Classified), TB, germicidal ultraviolet (GUV) radiation, skin testing, ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at a social services facility that provides counseling, medical care, and housing assistance for homeless clients. NIOSH was asked to investigate the operational status of a ventilation system and GUV lamps in preventing TB transmission, along with assessing the potential for *Mycobacterium tuberculosis* (*M. tuberculosis*) exposures from the homeless center located in the same building. At this facility, investigators reviewed the written tuberculin screening program and results of the client and employee tuberculin skin tests (TST). A visual assessment of the ventilation system and airflow patterns was made, and measurements of the supply and exhaust airflows were obtained and compared to the design specifications. The majority of the air in the facility is recirculated and therefore, there is potential for airborne *M. tuberculosis* to be transmitted throughout the facility. Other deficiencies identified that may increase the potential for TB transmission included insufficient outside air supply and inconsistent client screening techniques. At the homeless center, a visual assessment of the ventilation system was performed and results of the employee tuberculin screening were reviewed. The only mechanical ventilation systems are the exhaust

fans, in the bathrooms, gymnasium, and kitchen and the cool-air recirculating system in the cafeteria. Since the center relies on exhaust fans and natural ventilation for dilution and removal of air contaminants, a potential for TB exposures exists whenever a client with active TB attends the center. A potential health hazard existed for workers exposed to clients who have active TB in both the social services facility and the homeless center. The report, contained recommendations to reduce the potential for TB transmission, including improved TST screening and ventilation at each facility.

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**HETA 93-0771-2437**  
**July 1994**

**Purpose:** To investigate the potential for *Mycobacterium tuberculosis* (*M. tuberculosis*) transmission in a residential care facility.

**Keywords:** SIC 8361 (Social Services, Residential Care), tuberculosis (TB), human immunodeficiency virus (HIV)-infection, skin testing, ventilation.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this residential care facility to evaluate the potential for *M. tuberculosis* transmission in the residential facility duplexes that were to provide housing for homeless HIV- infected persons. On the basis of a review of the plans of the facility and a walk-through inspection, a room was selected that could be used to house individuals with suspected infectious TB. The room was recommended on the basis of its remote location within the complex and the ability to optimize ventilation rates. Further evaluation was recommended to ensure that short-circuiting of the supply and exhaust airflows would



not occur. Investigators found that a potential health hazard existed due to deficiencies in the ventilation system and the lack of appropriate respiratory protection. At the time of the investigation, no guidelines addressing *M. tuberculosis* exposures existed in residential facilities for HIV-infected individuals; however, many of the guidelines pertaining to health care facilities are applicable for this type of setting. The report contained recommendations regarding administrative and engineering controls and the use of appropriate respiratory protection to prevent *M. tuberculosis* transmission in the facility, as well as during the transport of potentially infectious individuals.

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## Other Facilities

**HETA 93-0859**  
**August 1995**

**Purpose:** To investigate the potential for exposure to tuberculosis (TB) during inspection of nonhuman primates.

**Keywords:** SIC 9512 (Land, Mineral, Wildlife, and Forest Conservation), TB, nonhuman primates, zoonotic pathogens.

**Abstract:** NIOSH and the Centers for Disease Control and Prevention investigators made a site visit to an airport to observe procedures used during inspection of two shipments of imported nonhuman primates. NIOSH investigators observed and conducted an interview with an animal inspector. The investigators observed that the inspector's actual contact with the animals was very brief during a routine inspection. "Contact" was defined as being within 5 feet of an animal. The inspec-

tions were done on the airport tarmac. Based on observations from this evaluation, inspectors have the potential for exposures to zoonotic pathogens including *Mycobacterium tuberculosis* during inspection of nonhuman primate shipments. This risk is minimized in that inspectors are not required to handle the animals or cages during routine inspection. Considering that inspectors do not have direct physical contact with the animals or cages during routine inspection, the most probable route of exposure for zoonotic pathogens during inspection would be respiratory exposure. On the basis of the brief nature of the work task and the variable nature of the work locations and environments, engineering controls such as exhaust ventilation would be difficult to use as a control for respiratory exposures. Personal protective equipment was noted to be a more suitable control alternative.

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**HETA 95-0031-2601**  
**October 1996**

**Purpose:** To investigate the effectiveness of a supplemental high efficiency particulate air (HEPA) filtration system in reducing potential tuberculosis (TB) transmission.

**Keywords:** SIC 4119 (Local Passenger Transportation, Not Elsewhere Classified), TB, ambulance, emergency medical services, Emergency medical service (EMS), health care, HEPA filtration.

**Abstract:** NIOSH investigators conducted a health hazard evaluation at this medical center to evaluate a supplemental HEPA filtration system installed in a new ambulance. NIOSH investigators conducted a field evaluation of particle clearance in an ambulance equipped with a supplemental HEPA filtration system. A similar ambulance without the HEPA

filtration system was also evaluated for comparison. The results indicated that the ambulance with the supplemental HEPA filtration system cleared particles faster than the ambulance without the supplemental system, when tested under similar conditions. This evaluation also showed that particle clearance could be improved by the use of the rear vent fan (when positioned on the “high” setting) in conjunction with the provision of outside air through the vehicle’s main heating, ventilating, and air-conditioning systems. For vehicles that do not have supplemental HEPA filtration systems, using the vent fan and providing outside air through the vehicle’s main HVAC system improves aerosol clearance and thus reduces the potential risk of TB transmission. Recommendations concerning the use of respiratory protection by workers during transport of known or suspected infectious TB patients, and for the performance of regular preventive maintenance and leak testing of the HEPA unit were included in the report.

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**HETA 95–0328–2630**  
**March 1997**

**Purpose:** To investigate the ventilation system at this textile sewing plant.

**Keywords:** SIC 2361 (Girls’, Children’s, and Infants’ Dresses, Blouses, and Shirts), tuberculosis (TB), sewing, ventilation, tracer gas, sulfur hexafluoride.

**Abstract:** NIOSH researchers conducted an evaluation of this sewing plant to evaluate the ventilation system after one employee was diagnosed with TB and a large number of others tested positive on tuberculin skin tests. NIOSH investigators performed an initial evaluation to measure airflow rates and assess air movement within the plant. An in-depth ventilation assessment was later made to document conditions that likely occurred during the period that the employee with TB was infectious. This involved a tracer gas evaluation to quantify the extent and speed of contaminant dispersion and contaminant removal rate. When the tracer gas was released in the middle of the plant, it was detected at the furthest points in the production area (approximately 100 feet away) within 11 minutes. The tracer gas was also detected in the engineering and main office areas, the cafeteria, and the conference room. The NIOSH evaluation determined that ventilation conditions were favorable for TB transmission based on a low air change rate and excellent air mixing within the plant. Thus, TB bacteria would have spread quickly and uniformly throughout the plant and remain suspended for hours before being removed from the air. Other factors that may have influenced TB transmission include prolonged infectiousness of the individual, virulence of the organism, and TB exposure outside the workplace. Recommendations for improving general ventilation were made in the report.

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**HETA 98-0027-2709**  
**March 1998**

**Purpose:** To investigate potential occupational exposures to *Mycobacterium tuberculosis* (*M. tuberculosis*) at a biomedical waste disposal facility.

**Keywords:** SIC 4953 (Refuse Systems), tuberculosis (TB), biomedical waste.

**Abstract:** NIOSH investigators conducted a health hazard evaluation to evaluate potential occupational exposures to *M. tuberculosis* at this medical waste treatment facility. The request concerned exposures to *M. tuberculosis* from the processing of infectious waste due to a recent outbreak of TB among employees at the facility. NIOSH investigators conducted a site visit to (1) observe work practices, (2) collect information about the operation and maintenance of the process equipment, and (3) discuss company policies regarding the use of personal protective equipment, training programs, and accident/injury and spill response. NIOSH identified several factors in the facility that could contribute to employee exposures to pathogens potentially present in the medical waste. These included the use of a process that creates the potential for aerosolization of the products contained in the waste prior to deactivation; deficiencies in the design of the facility; the policies in place at the facility; the design and operation of the equipment used at the facility (including personal protective equipment); and misunderstandings among employees about operations, personal protective equipment, medical issues, and policies and procedures. Recommendations to help prevent exposures to *M. tuberculosis* and bloodborne pathogens are provided in the report.

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