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OLNEYVILLE HEALTH CARE CENTER
PROVIDENCE, RHODE ISLAND

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I. SUMMARY

In March 1993, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the Providence Ambulatory Health Care Foundation in Providence, Rhode Island. Since the clinics serve foreign-born populations who are considered by the Centers for Disease Control and Prevention (CDC) to have a high prevalence of tuberculosis (TB), management requested NIOSH to evaluate the ventilation systems serving the five Providence Ambulatory Health Care Foundation Community Health Care Centers, especially in regard to the suitability of these systems for preventing TB transmission.

On June 15, 1993, NIOSH investigators conducted an environmental evaluation at the Olneyville Health Care Center. 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 facility. Airflow measurements from supply and exhaust diffusers were made and compared to available design specifications. Smoke tubes were used to determine pressure relationships between examination rooms and corridors.
The investigation found that the heating, ventilating, and air-conditioning (HVAC) units were operated in an automatic mode which resulted in no supply air being delivered to the examination rooms and the laboratory when temperature setpoints were satisfied. One of the thermostats that controlled the HVAC units was not working properly.

The clinic had established a tuberculin screening program for clients but had no program for employees. New patients are screened for tuberculosis using a tuberculin skin test on their first visit. If the test result is positive, the patient is referred to a central TB clinic for additional follow-up.

Deficiencies were observed in the ventilation systems of this facility which could potentially increase the risk of TB transmission in areas where TB patients may be present. These deficiencies could also contribute to other indoor environment problems. Recommendations to correct these deficiencies are offered in Section IX of this report along with recommendations to strengthen the clinic's tuberculosis control program.

KEYWORDS: SIC 8011 (Offices and Clinics of Doctors of Medicine), tuberculosis, TB, ventilation.

II. INTRODUCTION

In March 1993, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the Providence Ambulatory Health Care Foundation in Providence, Rhode Island. The management request asked NIOSH to evaluate the suitability of the current ventilation systems for preventing tuberculosis (TB) transmission at the Olneyville Health Care Center and four other health care centers. In response to this request, NIOSH investigators conducted an environmental evaluation of the Olneyville facility on June 15, 1993. The results of the other four clinic evaluations will be issued in separate reports.

III. BACKGROUND

The Olneyville Health Care Clinic was built in the 1970's. The facility employs 27 full-time staff and up to 10 additional part-time physicians, dentists, and laboratory workers. The building is built of metal and wood with a single-ply tarred rubber roof. The examination rooms, offices and patient waiting areas have suspended ceilings. The floors are carpeted or tiled. The windows cannot be opened. The clinic has enclosed offices around the perimeter. Figure 1 is a sketch of the clinic (not to scale).

The clinic is served by four single-zone, heating, ventilating, and air-conditioning (HVAC) package units located on the roof as well as an additional air-conditioning unit for the perimeter offices, laboratory, and conference room. Each of the package units serves a separate quadrant of the clinic and is controlled by its own thermostat in tamper-proof boxes. At the time of the site visit, when the interior temperature reached the thermostat setting, the unit turned off. When the HVAC fan is operating, a fixed amount of outside air enters each of these units (approximately 10% of the total maximum supply air flow) through dampers on the side of each HVAC unit. In each air handler, outside air mixes with the return air from the ceiling plenum and passes through a bank of fiberglass panel filters. The fiberglass filters have a rated efficiency of 25%. Filtered, mixed air passes through the refrigerant cooling coils, the fan, supply air ductwork, and is delivered to the occupied space through ceiling diffusers. There are also separate thermostats in some of the examination rooms to help provide optimal thermal comfort to those rooms. Air is exhausted from the building through seven exhaust fans on the roof and part is recirculated through the HVAC units. The exhaust fans for the conference room and laboratory are controlled manually. The other exhaust fans operate when the air handling units are activated. Natural gas is used as fuel to heat the supply air in the winter months. A separate furnace serves the perimeter rooms.

Since the clinics serve foreign-born populations who are considered by the Centers for Disease Control and Prevention (CDC) to have a high prevalence of TB[1], all new patients are screened for TB using a tuberculin skin test on their first visit. If the test result is positive, the patient is referred to the Provident TB clinic for additional follow-up and treatment. Diagnostic and treatment procedures, which may induce coughing such as bronchoscopy, sputum induction, and aerosol treatment, are not done at this facility. According to management, the Provident TB clinic would like to institute a policy to refer patients with latent TB infection back to the community health centers for appropriate preventive drug therapy instead of providing the therapy at the main clinic. Individuals with latent TB infection usually have a positive skin test, have no symptoms, and are non-infectious. Providing drug therapy at the local clinic would hopefully result in

better compliance and completion of the drug therapy. According to management, if patients come to the clinic and are coughing and show other symptoms which suggest active TB, they are placed in the laboratory instead of the general waiting area until seen by a health care provider.

To protect employees from exposure to persons suspected of having active TB, the health center is in the process of setting up a respiratory protection program with assistance from outside consultants. Surgical masks were used for respiratory protection. There was no employee tuberculin screening program in place at the time of the site visit.

IV. TUBERCULOSIS

Tuberculosis is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*. *M. tuberculosis* is carried in airborne particles, known as droplet nuclei, that can be generated when persons with pulmonary or laryngeal TB sneeze, cough, or speak. The droplet nuclei are so small (1-5 microns) that normal air currents keep them airborne and can spread them throughout a room or building. Infection occurs when a person inhales aerosolized* *M. tuberculosis* and bacilli become established in the alveoli of the lungs and spread throughout the body.[1] In 1992, there were 26,673 reported TB cases (rate of 10.5 cases per 100,000 people) in the United States, an increase of 1.5% over the previous year. In 1992, Rhode Island reported 54 TB cases (rate of 5.4 cases per 100,000 people).[2]

The most common site of TB infection is the lung, where the organisms come to rest after being inhaled. In a small proportion of newly infected persons (usually <1%), the initial infection develops into active TB disease. The predominant symptom associated with TB disease is a chronic cough, usually with the production of sputum; fever, weight loss, and fatigue are also common. In the United States, 90 to 95% of those infected with *M. tuberculosis*, who are otherwise healthy, may never develop active disease because their immune system limits the infection; symptoms don't develop and a chest x-ray may only show a small area of calcification in the lung or in a nearby lymph node. For the remaining five to 10% of those infected with *M. tuberculosis*, illness develops after an interval of months, years, or decades, when the bacteria begin to replicate and produce disease.[1]

Populations in the United States known to have a high incidence of TB include blacks; persons born in Asia, Africa, the Caribbean, and Latin America; American Indians; Alaskan Natives; current or past prison inmates; alcoholics; intravenous (IV) drug abusers; the elderly; and immunocompromised individuals such as those with human immunodeficiency virus (HIV) infection. The risk of progression to active disease is markedly increased and infection outside the lungs is more common for persons with HIV infection.[3,4,5]

Tuberculosis transmission is recognized as an occupational health risk for health-care workers. The magnitude of the risk varies by type of health-care setting, patient population served, job category, and the area of the facility in which a person works. The risk may be higher for personnel routinely in close contact

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* "Aerosolized" refers to the dispersion of aerosols. The aerosols of interest in this report are droplet nuclei that may contain *M. tuberculosis.*

with infectious patients, in areas where patients with TB are provided care before diagnosis, such as clinic waiting areas and emergency rooms, or during diagnostic or treatment procedures that cause the aerosolization of *M. tuberculosis*. These procedures include bronchoscopy, endotracheal intubation and suctioning with mechanical ventilation, open abscess irrigation, and autopsy. Sputum induction and aerosol treatments that induce cough may also increase the potential for TB transmission.[1]

Because infection requires the inhalation of aerosolized *M. tuberculosis*, the probability that a person will become infected depends upon the concentration of infectious droplet nuclei in the air. Environmental factors that enhance transmission include: the sharing of a relatively small, enclosed space by uninfected persons and an infectious person who is coughing; inadequate ventilation that results in insufficient dilution or removal of infectious droplet nuclei; and recirculation of air containing infectious droplet nuclei.[1]

V. EVALUATION CRITERIA AND GUIDELINES

The control of TB requires a hierarchy of different measures. Administrative measures should be used as the first approach to reduce the risk of exposure to persons with infectious TB. These include the early identification and treatment of infected patients, and the use of effective work practices. Engineering and environmental controls can be used to prevent the spread and reduce the concentration of infectious droplet nuclei. These controls include the use of local exhaust ventilation to control droplet nuclei at their source, general ventilation to dilute and remove contaminated air, air flow direction to prevent the contamination of adjacent areas, and air cleaning mechanisms (filtration or ultraviolet germicidal irradiation [UVGI]). Personal protective equipment should be used as a final control in high-risk areas such as treatment rooms where cough-inducing procedures are performed and TB isolation rooms. These control measures are explained in further detail below.

In October 1993, the Occupational Safety and Health Administration (OSHA) issued an enforcement policy for inspections, based on CDC guidelines, concerning occupational exposure to TB in health care settings, correctional institutions, homeless shelters, and long-term care facilities for the elderly.[6] OSHA is requiring: 1) a protocol for the early identification of individuals with active TB, 2) medical surveillance for employees using skin tests, 3) evaluation and management of workers with positive skin tests, skin test conversions, or symptoms of TB, 4) placement of individuals with confirmed or suspected TB in acid fast bacilli (AFB) isolation rooms and performing high risk procedures in areas with negative pressure and appropriate exhausts, and 5) training and information for employees concerning issues such as TB transmission, signs and symptoms of the disease, medical surveillance and follow-up therapy, and proper use of controls. OSHA is citing facilities under Section 5(a)(1) - General Duty Clause of the Occupational Safety and Health Act of 1970.

In October 1993, CDC published a draft document entitled, *Guidelines for Preventing the Transmission of Tuberculosis in Health Care Facilities, Second Edition*, for public comment.[1] This document was developed to replace the previously published CDC guidelines for the prevention of TB in health-care facilities, and discusses, in detail, the importance of administrative and engineering controls, personal protective equipment, early identification and screening, risk assessment and a written TB control plan, skin testing programs, and worker education.

A. Early Identification and Screening

To minimize the transmission of *M. tuberculosis*, early identification and treatment of infected persons, both with and without active disease, is necessary. The identification of individuals with tuberculous infection is commonly accomplished using the tuberculin skin test. A protocol is required by OSHA. For the tuberculin skin test, a small amount of purified protein from *M. tuberculosis* is injected into the upper layers of the skin. If the test subject has previously been infected with *M. tuberculosis*, his or her immune system usually reacts against this protein; the reaction causes a reddish swelling at the site of the injection (a positive result). If the subject has not been infected previously, there will be little or no reaction (a negative result). There are standardized guidelines for interpreting the test.[7] The injection does not contain live *M. tuberculosis* bacteria and cannot cause infection; furthermore, repeated skin testing will not cause a positive test in a person who has not been infected with TB.

Interpreting skin tests for tuberculous infection can be complicated by the fact that, over a period of years, some infected people test negative because they have lost their sensitivity to the test. The test however, "reminds" the person's immune system to react (if the person is in a periodic screening program), which will cause positive results from a subsequent test. It might then be incorrectly believed that the person had been infected in the time between the two tests. To avoid this problem, a "two-step" test procedure is recommended by CDC for the first skin test administered to a person being enrolled in a TB surveillance system. If the first test is negative, a second skin test is given a week later. If the second test is also negative, the person is considered to be free of tuberculous infection and can then be enrolled in the periodic screening program. (They need only receive a single skin test at each subsequent periodic screening.)[3]

Routine screening of health care workers at least annually is recommended by CDC and required by OSHA; workers who routinely perform procedures with a high risk of exposure to *M. tuberculosis* (e.g., bronchoscopy, sputum induction, or aerosol treatments given to patients who may have TB) should be retested at least every six months.[1,6] If a person with a previously negative skin test converts to positive, the test should be followed by a chest x-ray to determine whether active TB disease has developed. The x-ray of an infected person without active disease may show no abnormalities, or show little more than a small spot on the lung where the infection has occurred, possibly with deposits in a nearby lymph node.[8] A series of prophylactic (preventive) drug therapies are generally prescribed upon diagnosis to prevent the infection from advancing to TB disease. The two drugs most commonly used for this purpose are isoniazid (INH) and rifampin.

In addition to identifying individuals for whom prophylactic treatment is appropriate, routine screening can also serve as a surveillance tool to identify areas or occupations for which there may be an increased risk of TB transmission. It should be noted that even if the drug treatment successfully kills the TB bacteria and prevents the development of active disease, the patient will continue to test positive on later TB skin testing because his or her immune system will "remember" the TB protein and react to the skin test.

When a patient develops active pulmonary TB, the infection in the lung destroys lung tissue as it grows, thus forming a cavity. When the cavity erodes into an airway, infectious material (which includes live *M. tuberculosis*) in the airway causes the patient to cough, which can aerosolize *M. tuberculosis*. A diagnosis of TB should be considered for any patient with persistent cough or other symptoms compatible with TB, such as weight loss, anorexia, or fever. Because diagnosis of TB disease is generally based on recognizing symptoms, there is a time period before diagnosis that the patient is infectious but has not been isolated. For this reason, early diagnosis of TB is critical for minimizing transmission. Upon diagnosis, drug therapy should be promptly initiated and the patient isolated until the drug therapy has killed enough bacteria to leave the patient non-infectious.[1]

The selection of drugs for treating a patient (either to prevent the development of active TB after identification of infection, or to treat active TB disease) depends on a number of factors including the health status of the patient and the strain of *M. tuberculosis* causing the infection. Some strains of *M. tuberculosis* are resistant to the most commonly used drugs requiring the use of other pharmaceuticals; drug therapy should be selected appropriately.[9]

B. Engineering and Environmental Controls

1. Ventilation

There are two general categories of ventilation which may be of used to reduce *M. tuberculosis* exposures: local exhaust ventilation (LEV) and general ventilation. LEV is used to capture emissions near or at the source of generation before they contaminate the general room air. The use of scavenging booths or hoods for sputum induction is an example of LEV which can be used to control *M. tuberculosis* exposures.[1] General guidelines for LEV are provided in, "Industrial Ventilation, a Manual of Recommended Practice."[10]

General ventilation reduces the concentration of contaminants through dilution and removal of contaminated air. There are two basic designs for general ventilation systems. The first, a "single pass" system exhausts all the room air to the outside. The second design recirculates most of the air, with a small portion being exhausted and replaced with outside air. The primary advantage of the single-pass design is that contaminated air is exhausted directly to the outside and not recirculated within the building; the principal disadvantage is the greater cost of heating or cooling the necessary additional outside air. Heat recovery systems can be used with recirculating systems.

Ventilation rates for health care facilities are expressed in terms of air changes per hour (ACH). An ACH is defined as the ratio of the ventilation rate (volume of air entering the room per hour) to the room volume. This terminology, however, can be misleading because the total volume of room air may not actually be "changed" the theoretical number of times per hour due to air flow patterns in the room. The units of ACH are used to provide a convenient way of relating the volume flow rate of air to the size of the room.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American Institute of Architects (AIA) have recommended at least six ACH for health care facility isolation and treatment rooms based on comfort and odor control.[11,12] However, there are no laboratory or clinical data that can validate any significant control of worker exposure to droplet nuclei containing *M. tuberculosis* bacteria at these recommended air flow rates. Hospital-ventilation studies published in the 1960's provide evidence to indicate that general ventilation rates substantially higher than six ACH in hospital rooms do improve dilution and removal of airborne bacteria.[13,14,15]

It is important to recognize that the available studies do not permit quantitative estimation of the risk of infection at any given level of general ventilation. Similarly, the available studies do not permit quantitative estimation of decreases in risk that would result from specific increases in general ventilation levels from six ACH to substantially higher values. However, the data indicate the need to have general ventilation rates at the highest possible levels to reduce exposure to droplet nuclei. Therefore, CDC has recommended in their draft guidelines that health-care settings be designed to achieve the best general ventilation air flows (striving for substantially greater than six ACH) in those areas where

confirmed or potential TB patients are present (e.g., isolation and treatment rooms).[1]

In addition to supplying the specified airflow, ventilation systems should also provide satisfactory directional airflow patterns both from area to area and within each room. Airflow should be from "clean" to "less clean" areas, such as from hallways to treatment rooms. This can be accomplished by creating negative pressure in the area into which flow is desired relative to adjacent areas by exhausting more air from the area than is being supplied, preferably directly exhausting the air to the outside. Rooms where *M. tuberculosis* is likely to be present, such as isolation and examination rooms, should be under negative pressure with respect to adjacent corridors. Pressure differentials are more easily maintained in closed rooms;[13] therefore, it is important that doors close tightly and are kept closed as much as possible.

2. <u>High Efficiency Particle Air (HEPA) Filtration and Ultraviolet (UV) Radiation</u>

The use of HEPA filtration and UVGI have been proposed as measures to control *M. tuberculosis* transmission. UVGI can be used as a method of air cleaning that can be used in conjunction with other TB control measures. Two systems of UVGI can be used: duct irradiation and upper room air irradiation. Concerns that arise from the use of UV radiation for infection control include the potential health hazards from overexposure to UV radiation itself, which include keratoconjunctivitis (inflammation of the cornea and conjunctiva) and erythema (reddening) of the skin, and proper maintenance of the UV lamps and fixtures. Broad spectrum ultraviolet radiation has been associated with increased risk of skin carcinomas.[1] UV-C radiation has been classified as "probably carcinogenic to humans" by the International Agency for Research on Cancer (IARC) based on animal studies that suggest UV-C radiation can cause skin cancers and damage genetic material.[1,16] Recent studies have demonstrated, in the laboratory, that UV radiation can activate human immunodeficiency gene promoters in human tissue cultures, but the implications of this for humans is unknown at this time.[1,16] UVGI should not be used as a substitute for HEPA filters if it is necessary to recirculate air from TB isolation rooms, as a substitute for local exhaust ventilation to the outside, or as a substitute for negative pressure or general ventilation rates of at least six ACH.

HEPA filtration should be effective at reducing air concentrations of *M. tuberculosis*. Research has shown it to be effective at reducing air concentrations of *Aspergillus* spores which are of a similar size range to aerosolized *M. tuberculosis* particles.[17,18,19] HEPA filters can be used to clean air before it is recirculated into other parts of a facility or back into the same area, or exhausted to the outside. HEPA filtration systems require proper installation, periodic leak testing, and meticulous maintenance.

C. Respiratory Protection

In addition to engineering controls, NIOSH recommends that personal respiratory protection be used to reduce the risk of infection for health care workers. NIOSH considers this to be necessary because of the lack of

available data to fully assess the efficacy and reliability of the engineering controls discussed above. Recommendations for respiratory protection for workers exposed to *M. tuberculosis* are provided in the NIOSH document, NIOSH Recommended Guidelines for Personal Respiratory Protection of Workers in Health Care Facilities Potentially Exposed to Tuberculosis.[20] In this document, NIOSH specifies the type of respirator that should be used for various locations and procedures. For areas or procedures which NIOSH considers to have a medium potential for exposure to aerosolized *M. tuberculosis*, such as isolation rooms, NIOSH recommends a half-face powered air-purifying respirator with a HEPA-filter as a minimum level of respiratory protection. For areas or procedures which NIOSH considers to have a high potential for exposure, such as sputum induction, NIOSH recommends that half-face positive-pressure air-line respirators be used as a minimum level of respiratory protection. OSHA has recommended, at a minimum, the use of NIOSH-approved HEPA particulate respirators for entering isolation rooms, when performing medical procedures such as bronchoscopy and sputum induction, and while transporting patients in closed vehicles.[6] CDC, in their 1990 guidelines, recommended the use disposable dust/mist respirators and, in their 1993 proposed guidelines, recommended specific criteria for respirators which HEPA respirators (including disposables) meet at the present time.[1,21]

If respirators are used, a complete respirator program must be implemented that meets the requirements of OSHA respiratory protection standard (29 Code of Federal Regulations [CFR] 1910.134).[22] Guidelines for implementing a personal respiratory protection program are included in the NIOSH document, *NIOSH Guide to Industrial Respiratory Protection.* [23] The minimum requirements for a respiratory protection program include a written standard operating procedure for the selection and use of respirators; training and instructions on respirator usage; the cleaning, repair, and housing of respirators; the continued surveillance of work area conditions for worker exposure and stress, and for the evaluation of the effectiveness of the respirator program; and the medical evaluation of employees to determine that they are physically able to wear the respirator selected for use.

In addition to the use of respirators by health care professionals, the wearing of respirators by infectious patients may also reduce *M. tuberculosis* exposures; it is important that respirators used for this purpose do not have an exhalation valve.

VI. METHODS

A walk-through tour of the clinic was conducted to visually inspect the ventilation systems, including the mechanical units, outside air dampers, filters, and examination room systems. The mechanical diagrams of the ventilation systems were reviewed. Smoke tubes were used to qualitatively determine the pressure relationship between the examination rooms and patient waiting areas.

When the ventilation systems were supplying air, airflow measurements were made using a Shortridge Instruments, Inc. Flowhood® Model CFM 88. Using this instrument, airflow through a supply diffuser or exhaust grille can be read directly in cubic feet per minute (cfm). The measured airflows were compared to the design specifications on the mechanical plans.

VII. RESULTS

Inspection of the HVAC air handling systems revealed few maintenance problems. The fan belts, condenser pans, and cooling coils were clean with no evidence of visible microbial contamination. The condensate pans were draining freely. A private contractor performs routine maintenance on the units in the spring and fall and responds to any ventilation problems that develop. The four roof-top HVAC units were controlled by individual thermostats. When the thermostats were satisfied, the units turned off. As a result, there are times when no airflow is provided by the HVAC systems. One thermostat (for HVAC 4) had its tamper proof cover removed and showed evidence of tampering. As a result, that system did not turn on during the site visit.

Since the units were cycling on and off throughout the site visit and the thermostats were locked and there was no access to the key, air change rates could not be determined. The actual and design air flow measurements for the supply diffusers are presented in Table 1. The measured flow rates were similar to design specifications with the exception of the nurse's office served by the HVAC 1 unit. It was not possible to measure the other supply diffusers for that unit since they were located over filing cabinets that went almost to the ceiling. The room-to-corridor pressure relationships were variable, depending on whether air was being supplied or not, and no pattern could be determined. The exhaust fans in the conference room and laboratory were operated by switches which were turned on when employees were in the rooms. The exhaust fans in the waiting areas were also operational and turned on when the HVAC units were activated. There were no design specifications for exhaust fans available for the perimeter offices. The clinic used the laboratory as a waiting area for patients with potentially infectious conditions.

VIII. DISCUSSION/CONCLUSIONS

The use of appropriate administrative controls, engineering controls, and personal protective equipment will reduce the potential for TB transmission in health care settings. This investigation found some problems with the ventilation systems which could lead to indoor environmental problems and increase risk of exposure to airborne infectious agents, including *M. tuberculosis*. These problems included HVAC units that cycled on and off throughout the day leaving waiting areas and examination rooms without continuous general ventilation, and a control thermostat that was not working. The use of the laboratory as a separate waiting area for potentially infectious patients was not appropriate since the laboratory was serviced by the recirculating ventilation system. The exhaust systems were operational. The clinic has a patient tuberculin skin testing program but there was none for employees. Correcting the ventilation deficiencies, as well as creating and enforcing certain administrative policies, will help minimize workers risk of exposure to *M. tuberculosis*.

IX. RECOMMENDATIONS

The following recommendations are offered to help the clinic correct some deficiencies in the ventilation systems and in other areas which were identified during this site visit.

1) The clinic should establish a formal employee tuberculin skin test screening and follow-up program in accordance with CDC guidelines and OSHA requirements.[1,6,21]

2) The HVAC systems should be balanced and set up to continuously supply a minimum amount of airflow at all times when the building is occupied to prevent a build-up of air contaminants.[11] The thermostat for the HVAC 4 unit should be repaired and covered with a tamper-proof cover. To reduce the potential for infectious disease transmission, airflow rates in the examination rooms should be designed to achieve the best ventilation airflow possible, striving for substantially greater than six ACH for each room.

3) The laboratory, as currently ventilated, is not a suitable isolation area for TB patients. An isolation room should be created that has substantially greater than six ACH, is under negative pressure with respect to the surrounding areas and exhausts all of the room air directly to the outside. As an interim measure to establish an isolation room for the clinic instead of using the laboratory, an additional exhaust fan to the roof for the designated isolation room could be installed to create negative air flow with respect to the hallway and patient waiting areas. The outside air intakes for the building should be taken into consideration during installation. The return grilles in this room should be sealed off to prevent air from returning to the main air handler. If potentially contaminated air is recirculated, a HEPA filter should be installed as a precautionary measure to minimize possible re-entrainment of contaminants into the recirculating ventilation system. If used, HEPA filters must be inspected and leak-tested on a regular basis.[1]

4) The clinic should establish a policy for health-care workers regarding the use of respiratory protection against potential inhalation hazards when working with known or suspected TB infected patients. Respirators should meet the requirements specified by NIOSH in 30 CFR 11. Respiratory protective devices should be worn and a respiratory protection program which meets the OSHA requirements (29 CFR 1910.134) should be in place at the facility.[22] For exposure to aerosols containing TB organisms, NIOSH recommends that the respirator offering the highest level of protection should be selected that is consistent and feasible with the tasks to be performed by the workers. OSHA has recommended, at a minimum, the use of NIOSH-approved HEPA particulate respirators for entering isolation rooms, when performing medical procedures such as bronchoscopy and sputum induction, and while transporting patients in enclosed vehicles.[6] Surgical masks do not meet these guidelines and do not provide adequate protection to the wearer due to poor face fit characteristics and potential leakage of small particles through filter media.

5) In accordance with draft CDC guidelines and OSHA requirements, an employee training program covering issues such as TB transmission, signs and symptoms of the disease, medical surveillance and follow-up therapy for employees, and proper use of controls, should be implemented.[1,6,21]

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Industrial Hygiene Section

XII. DISTRIBUTION AND AVAILABILITY OF REPORT

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3. R.I. Committee on Occupational Safety and Health
4. OSHA, Region I

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.

TABLE 1

Ventilation Measurements

Olneyville Health Care Center
Providence, Rhode Island
HETA 93-0848
June 15, 1993

Location of Diffuser	Field Measurement (cfm)*	Design Measurement (cfm)
HVAC1/Nurse's Office	+327	+500
HVAC2/Waiting Area	+730	+700
HVAC2/Pediatrics	+548	+550
HVAC3/Waiting Area	+805	+700
HVAC3/Waiting Area	+755	+700
HVAC3/Waiting Area	+692	+700
HVAC3/Examination Room	+261	+200

* - cfm (cubic feet per minute)