

**TUBERCULOSIS CONTROL IN RURAL MONTANA:
A HOSPITAL EXPOSURE CONTROL PLAN**

by

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ABSTRACT

Tuberculosis is an airborne infectious disease increasing in incidence in the last ten years in the United States. Concurrently strains of drug and multi-drug resistant tuberculosis have developed.

Recent outbreaks of tuberculosis among health care workers and patients have demonstrated a need for more stringent control of tuberculosis bacilli in health care settings. In October 1994, the Centers for Disease Control issued guidelines outlining appropriate control measures to institute in health care settings. This project involved the design and implementation of a control plan for a 196-bed hospital in rural Montana.

Components of the plan included the following: a) policies and procedures related to risk assessment and early detection methods; b) isolation room features and isolation methods; c) screening of health care workers; and d) personal protective equipment use.

The plan is designed to protect health care workers and patients from the risk of nosocomial acquired tuberculosis.

CHAPTER 1

INTRODUCTION

Background of the Problem

Tuberculosis (TB) rates in the United States have been increasing steadily throughout the past decade. A resurgence in reported numbers of cases began around 1985 and continues to the present (Dowling, 1991; Hamrick & Yeager, 1988; Hellman & Gram, 1993). Until the mid-eighties, TB incidence rates had steadily decreased since national reporting began in 1953. During the 1980's, the increasing number of cases concerned communicable disease experts because TB was thought of as becoming an extinct disease in the United States (Hamrick & Yeager, 1988). From 1953 to 1984, the annual incidence of TB decreased from 84,302 to 22,255 cases in the United States. However, in 1985, an anticipated decrease in the incidence of cases was not observed (Reider, Cauthen, Kelly, Bloch, & Snider, 1989). The expectation was that reported cases would continue to decrease, however, no change was noted. Two years later rates began to rise. Kent (1993) summarized the trend of increasing cases noting an excess of approximately 39,000 cases, had the anticipated rate of decline in new cases continued from 1985 to 1991.

Hamrick and Yeager (1988) proposed several reasons for increased TB incidence. They included the following:

1. A rise in cases of acquired immunodeficiency syndrome (AIDS).
2. An increase in cases in non-white minorities.
3. Increasing numbers of immigrants from countries with endemic TB.
4. Greater numbers of institutionalized elderly.
5. An increase in the number of homeless people in the United States.

Epidemiology of TB: National and Statewide Trends

Incidence in the United States

In 1994, 24,361 new TB cases were reported to the Centers for Disease Control (CDC) as reported in the publication Morbidity and Mortality Weekly Report (CDC, 1995c, p. 387). Annual incidence for years 1990 through 1993 numbered 24,710, 26,384, 26,673, and 25,313 respectively (CDC, 1994c, p. 67).

Incidence in Montana

The Montana Department of Public Health and Human Services, Preventive Health Bureau, TB Program Coordinator (D. D. Ingman, personal communication, October 10, 1995), reported the incidence of TB in Montana through October as 15 cases for 1995, and 25 cases in 1994. For 1993, there were 22 incidence cases reported, 16 in 1992, 22 in 1991, and 22 in 1990.

Incidence in Cascade County Montana

The Cascade City-County Public Health Department, Public Health Nurse (M. A. Ward, personal communication, October 4, 1995), reported four new cases of TB as of October 1995, with eight cases reported in 1994, one in 1993, zero in 1992, one in 1991 and three cases in 1990. These trends demonstrate that there is not a decline

in cases, and that cases have increased over a two-year period. The report from the health department provided evidence that Cascade County has a high incidence of TB, compared to the totals reported for Montana.

Development of Drug, Multi-drug Resistant TB

Concurrently, with the rise in the number of cases of TB, there was a rise in cases of drug resistant (DR-TB) and multiple drug resistant TB (MDR-TB) (Dowling, 1991; Hellman & Gram, 1993; Iseman, 1989). Such cases are most often a consequence of inappropriate treatment at the time of diagnosis. Other contributing factors to the development of MDR-TB include treatment of the disease in the general medical community (not using experts), patients who are not compliant in taking their medications, misdiagnosis, immigrants who were not treated correctly in their country of origin, and increasing numbers of people with altered immune functioning (Dooley, Jarvis, Martone, & Snider, 1992; Iseman, 1989; Iseman & Madsen, 1989; Kent, 1993).

In surveys conducted at 22 hospitals from 1961 to 1968, the rate of primary drug resistance (PDR-TB) of TB to a single drug was 3.5% and to two or more drugs was 1%. Later surveys from March 1975 to September 1982 revealed a rate of PDR-TB to a single drug was 6.9% and to two or more drugs was 2.3%. Drug-resistant cases occurred mostly in urban centers, where the rate of PDR-TB was as high as 23% of total cases of TB (Kent, 1993; Sepkowitz, 1994).

Hospital-based Outbreaks of MDR-TB

Ten clusters of MDR-TB outbreaks have been reported since 1990. All these outbreaks affected health care workers (HCWs). Kent (1993) reported that 17 HCWs have developed MDR-TB. Eight of the 17 were HIV positive, eight were HIV negative, and HIV status of the remainder of the workers was unknown. Six of the 17 have since died, four of these were HIV positive, one had cancer and one died from other causes. According to a CDC report (CDC, 1991), of four outbreaks that were studied, TB skin test conversion rates for two of the reporting hospitals were 13 (33%) of 39, and six (50%) of 12. In relation to these outbreaks, in patients that were HIV positive, TB infection progressed from active disease to death in a median time of seven weeks. This compares to a 5 to 10% chance of progression to active disease in a lifetime, for patients without impaired immunity and no other risk factors.

These hospital-based disease outbreaks have primarily been responsible for the development of guidelines to prevent HCW exposure to TB. It was found that patients with TB and MDR-TB were not diagnosed in a timely fashion. These patients were not isolated upon admission. When they were finally isolated, isolation principles for acid fast bacillus (AFB) isolation were not followed by staff. Doors were left open to isolation rooms. Negative pressure airflow was not present between hallways and isolation rooms, and in most cases positive pressure airflow was measured. HCWs did not use adequate personal protection.

Problem Statement

The problem, because of increasing incidence of TB disease in the United States and Montana, is increased risk of exposure for HCWs caring for individuals with TB disease in Montana hospitals.

Project Goal

The overall goal of this project was to respond to TB risks to clients and employees of Columbus Hospital by designing a written TB exposure control plan based on the CDC guidelines. The final guidelines were published in the Federal Register on October 28, 1994, and titled Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Facilities (CDC Guidelines, 1994b). This exposure control plan was produced for Columbus Hospital in Great Falls, Montana, for use by employees, the hospital administration, the occupational health department, and the infection control department.

Specific Aims

As part of the overall project goal, the initial objective of the project was to review the literature addressing TB. This review included literature on the history of the disease, past and recent epidemiology, diagnosis principles, screening practices, development of MDR-TB, exposure control measures and principles of treatment. The review included literature related to recommended control measures and how to implement them.

CHAPTER 2

LITERATURE REVIEW

The literature addressing TB incidence, management, transmission and control includes thousands of research and clinical articles. The literature comes from many disciplines including medicine, industrial hygiene, public health, government, and nursing. Because this project addressed the development of a TB exposure control plan for a 198-bed Montana hospital, the review of literature outlined in this chapter included the following topics: a) a brief history of the worldwide trends of the disease; b) diagnosis and screening of TB; c) development of DR-TB and MDR-TB; d) exposure control; and e) treatment of TB infection and TB disease.

Worldwide Trends

Worldwide, the agent causing TB infection and disease currently causes three million deaths each year. TB is estimated to have infected 1.7 billion people or one third of the world's population (Barnes & Barrows, 1993). The disease will probably claim more than 30 million lives in the coming decade (Nakajima, 1995). The overwhelming majority of deaths, 95%, will occur in developing countries. It is estimated that eight million more persons will become infected each year (Bloch, Rieder, Kelly, Cauthen, Hayden, & Snider, 1989).

National and Montana Trends

The United States began a national system of reporting TB in 1953. In 1953, 84,304 new cases were reported. The annual incidence rate at that time was 53.0 per

100,000 population (Reider, Cauthen, Comstock, & Snider, 1989). In 1987, 22,517 new cases were reported. This was an annual incidence rate of 9.3 per 100,000 population (Bloch et al., 1989). This decline in reported incidence represented a decrease of 6.5 per 100,000 population annually from 1975 to 1980 (Reider, Cauthen, Comstock et al., 1989). The rate stopped decreasing and in a few years (1988) began to climb, as demonstrated below in Figure 1.

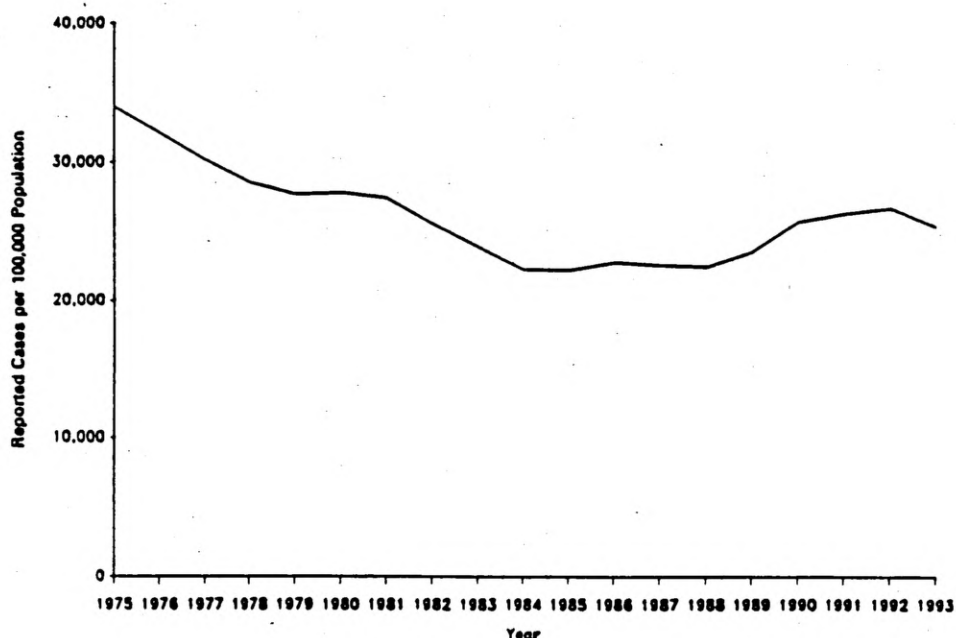


Figure 1. Incidence of Tuberculosis, by Year, United States, 1975-1993

Note. From "Summary of Notifiable Diseases," Centers for Disease Control, 1993, *Morbidity and Mortality Weekly Report*, 42(53), p.60.

In Montana, the upward trend in disease occurrences was not as pronounced as on the national level. The figure below (Figure 2), obtained from the Montana Department of Health and Environmental Science, Preventive Health Services Bureau,

Division of Surveillance, shows reported new cases in Montana from 1984 to 1994 (as of January 1995).

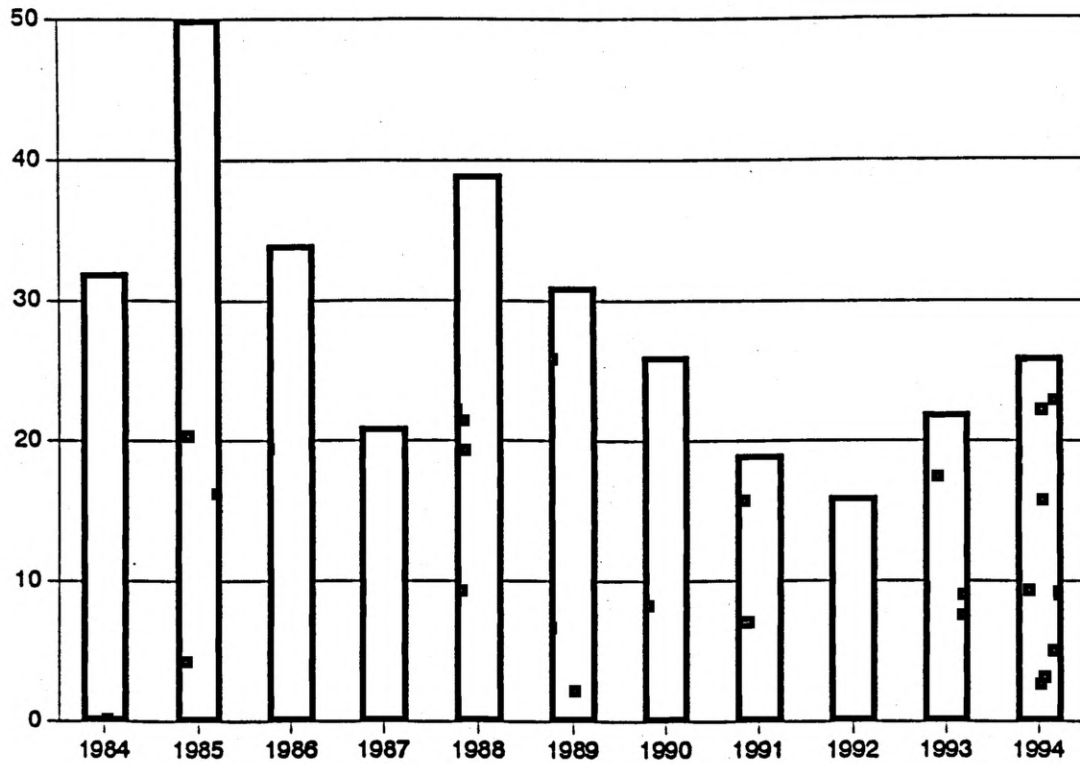


Figure 2. New Tuberculosis Cases in Montana, 1984-1994.

Montana has seen a variable rate of new cases that does not closely follow national trends year by year. The highest reported number of cases was 50 in 1985; this figure decreased to a low of 16 in 1992. New cases since 1992 rose to a reported high of 25 cases in 1994. Statistics obtained from the above for Cascade County in Montana for 1990-1994 are as follows:

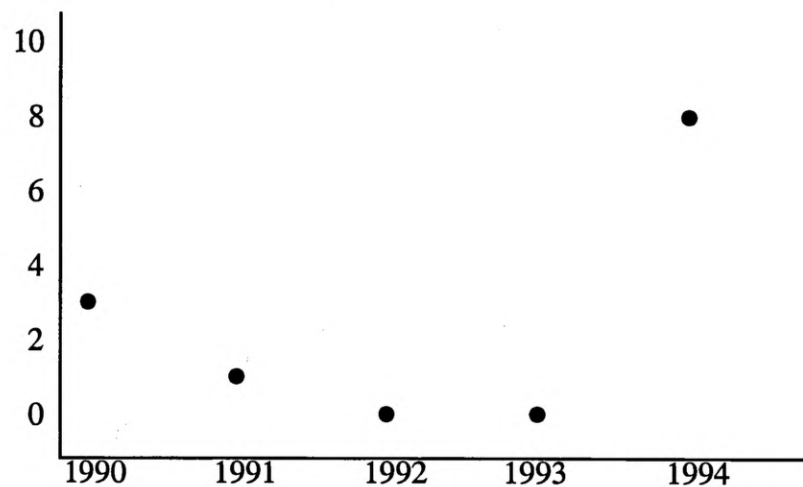


Figure 3. New Tuberculosis Cases, Cascade County, Montana, 1990-1994

Factors Impacting TB Disease Trends

Many factors have had an influence on national trends in TB incidence. Changes in risk groups are considered to be the largest factor responsible for recent changes in TB occurrence. As reported by the American Thoracic Society (ATS) (ATS, 1990), such factors include increasing numbers of persons with HIV infection as well as increasing nationwide social and economic problems associated with homelessness, low-income and minority persons, the medically underserved, immigrants and intravenous drug use. Other populations at risk include correctional facility inmates, long-term care patients, health care providers and other personnel that have exposure to any of these groups.

Probably the most important of the high-risk groups are HIV infected persons. It is estimated that since 1990, 4.3% of the 152,441 AIDS cases in the United States are co-infected with TB (ATS, 1990). These are predominately young men, with a

high proportion with black race or Hispanic ethnicity. Of this group, the major risk behavior is intravenous drug use. This risk factor is most important because, it has been reported that HIV infection co-existing with TB infection increases the probability of infection leading to TB disease to 10% within one year; this compares with 10% per lifetime for non-HIV infected hosts. Many times progression to active disease takes only weeks or months for those hosts with AIDS. Barnes and Barrows (1993) reported that as many as 37% of HIV infected hosts develop TB within five months of being exposed. The disease appeared quickly, was very virulent and was often fatal within six to eight weeks in this population.

The literature addressing TB is large and diverse, primarily because of the impact this disease has had on global health. The majority of studies were found in the medical literature. Most of these studies were descriptive with few studies or articles other than reporting of cases. This section of the literature was consistent, easy to read and very interesting for background information on the resurgence of TB disease.

Diagnosis and Screening of TB

The infectious agent of TB is *Mycobacterium tuberculosis*. According to Nardell (1993), it is carried on airborne droplet nuclei. Droplet nuclei are produced when persons with TB cough, sneeze, speak or sing. Droplet nuclei may also be produced by manipulation of extrapulmonary lesions or processing of tissue and secretions in the laboratory. The droplet nuclei, sized from one to five microns, are carried on air currents in indoor space and may remain airborne for several hours.

Air currents disperse droplet nuclei through the room. Inhaling and exhaust ventilation are ways droplet nuclei are removed from the air.

Pathogenesis

Droplet nuclei are inhaled, pass down the bronchial tree and settle in a bronchiole or alveolus. The agent multiplies initially, without resistance from the host. The organisms are engulfed by macrophages but remain viable and multiply within the cells. The tubercle bacilli may spread through the lymphatic system to regional lymph nodes and through the bloodstream (ATS, 1990; Farer & Snider, 1988). Organisms may also deposit in kidneys, bones, or brain, producing extra-pulmonary lesions. As reported by Bloch et al. (1989), in 1987, 82% of the reported cases of TB in the United States were pulmonary only; 4.6% were pleural, 5.1% lymphatic, 2.2% genitourinary, 1.7% bone/joint, 1.4% miliary and 0.9% were meningeal. Because the project focused on risks for pulmonary TB, the discussion in this chapter focused primarily on respiratory disease.

The immune response by the host to the agent is usually adequate to further limit multiplication of the bacilli after infection. The host remains asymptomatic and any lesions will heal. About 10% of persons infected with TB will develop active disease sometime during their lifetime (ATS, 1990; "CDC Core Curriculum," 1994a). Sensitivity to the components of the agent are demonstrated by a positive reaction to the tuberculin skin test, which develops two to ten weeks after the infection. This is the time needed to develop a cell-mediated immune response.

Clinical Manifestations

TB causes a diverse number of symptoms depending on its expression within the host. The first symptoms are fatigue, anorexia, weight loss, irregular menses or persistent low grade fever. Other persons may have acute febrile illness, chills and a generalized influenza-like illness. Usually in pulmonary TB there is an imperceptible onset of cough. Symptoms progress to more frequent cough and production of mucoid or purulent sputum and possible hemoptysis. There may be dull pain or tightness in the chest. Dyspnea is not common. Other physical findings include rales or signs of lung congestion (ATS, 1990; "CDC Core Curriculum," 1994a; Farer & Snider, 1988).

Chest X-ray

Diagnosis of patients with symptoms of TB includes standard posterior-anterior and lateral x-rays. Initial findings include parenchymal infiltration accompanied by ipsilateral lymph node enlargement. In adults, lesions are typically seen in the apical and posterior segments of the upper lobes or in the superior segments of the lower lobes. Lesions may occur in any lung segment. Nodular infiltrates of varying sizes are most common. Lesions may be dense and homogenous. Cavitation is common. To help differentiate between recent and old infection, exams should be done in three to four-month intervals. Exams showing no changes are indicative of old infection (ATS, 1990; "CDC Core Curriculum," 1994a).

Laboratory Tests

According to the ATS (1990), there are three levels of laboratory testing for the diagnosis and management of TB. They are as follows:

1. Level I: Collections and transportation of specimens: preparation and examination of smears for acid-fast bacilli.
2. Level II: Procedures of Level I, plus isolation and identification of *mycobacterium tuberculosis*.
3. Level III: All procedures of Level II, plus identification of mycobacteria other than *mycobacterium tuberculosis*. The determination of drug susceptibility may be performed at Level II and should be performed at Level III (p. 728).

Sputum Collection

Consistent with a focus on pulmonary TB outlined in this project, the discussion of diagnostic testing will center on analysis of sputum. According to the ATS (1990), attending personnel should direct and observe the collections of sputum specimens. Patients must be instructed on how to obtain specimens. Nasopharyngeal discharge and saliva are not proper specimens. Sputum brought up from deep in the lungs is the proper specimen. These specimens should be collected in approved sterile containers, identified with the patient name and date of collection. The container should be transported to the lab in a clear water-tight bag for the protection of personnel. A series of three single specimens on different days should be collected. The procedures to collect proper sputum specimens are considered high risk to transmit droplet nuclei to unprotected attending employees.

Acid-fast Bacilli (AFB) Smears and Cultures

Detection of acid-fast bacilli in stained smear is the first bacteriologic evidence of mycobacteria. It is the easiest and fastest method to provide a preliminary confirmation of the diagnosis of TB. The smear gives a quantitative estimate of the number of bacilli being excreted and is important in assessing the person's infectiousness (ATS, 1990). The ATS (1990) reported that 50 to 80% of patients with TB will have positive smears.

The specimen will then be inoculated into culture medium. The culture makes detection of the organisms easier. Growth of the organisms is necessary for species identification. Drug susceptibility testing should be done to identify those drugs which will be effective ("CDC Core Curriculum," 1994a).

Smears and cultures are used to check for level of infectiousness after the diagnosis is made. After treatment begins, the number of bacilli identified is used to predict infectiousness and indicate when a patient may be removed from isolation. Results of smears can be reported immediately, but cultures and susceptibility testing can take six to 12 weeks (ATS, 1990).

A relatively new test, the radiometric BACTEC method, which uses liquid media culture, is becoming available. Species identification results should be available within 10 to 14 days of specimen collection. Susceptibility results can be obtained within five days of inoculation ("CDC Core Curriculum," 1994a). This test is obviously the method of choice, if available, due to the shorter time to confirm the

diagnosis of TB. It will take time for the new technology to replace the older culture method.

Community Screening for TB

According to Levin, Gums, and Grauer (1993), the purpose of tuberculosis screening is two-fold: 1) identify infected persons at high risk for active disease who will benefit from preventive treatment, and 2) identify people with active disease needing treatment. According to Bloch et al. (1989), the most critical step in TB elimination is detection and preventive treatment of infected persons. Pugliese (1992) recommended screening for the following groups:

1. Persons with HIV infection;
2. Close contacts of persons with infectious TB cases (e.g., persons who share the same indoor environment with confirmed or suspected TB patients);
3. Persons with certain medical conditions known to increase the risk of TB disease once infected (e.g., silicosis, diabetes mellitus, chronic renal failure, history of gastrectomy, being 10% or more below ideal body weight, prolonged corticosteroid or other immunosuppressive therapy, some hematologic disorders (such as leukemia and lymphomas), and other malignancies;
4. Foreign-born persons from countries with a high prevalence of TB (e.g., those from Asia, Africa, Latin America, and some Caribbean and European countries);
5. Persons from medically underserved, low-income populations, including

high-risk racial or ethnic minorities (low-income blacks, Hispanics, Native Americans), and homeless;

6. Alcoholics and users of intravenous drugs;
7. Correctional inmates;
8. Residents of long-term care facilities (e.g., nursing homes and mental institutions);
9. Workers, including health care workers, in settings that provide service to any of the high-risk groups (p.38).

According to the ATS (1981), "the tuberculin test is based on the premise that infection with *mycobacterium tuberculosis* produces sensitivity to certain components of this organism (antigens), which are contained in culture extracts called tuberculin (p. 356). There are two types of preparation currently licensed for use in the United States.

Screening Tests for TB

Old Tuberculin (OT) (Tine Test)

OT is available in multiple puncture devices (tine test). This is a filtrate prepared from heat sterilized concentrated broth of TB cultures. According to Dickensheets (1989), it was first produced in 1890 by Robert Koch, who discovered the tubercle bacilli. This was the first test available and was soon used as a screening tool. According to the American Pharmacy Association (American Pharmacy, 1988), this test is no longer recognized as the standard for use in the United States. The OT (tine) is associated with high rates of false positives and negatives. However, it may

still be used by some providers. Providers should determine when questioning someone with a history of positive test by the tine method, if that result was ever checked by the Mantoux method.

OT is not recommended for current use by providers. The tine method (i.e. multiple puncture devices) is easy to administer and so is useful in doing large screening. Purified protein derivative (as discussed below) is also available in tine test form; this is the recommended procedure for large screenings.

Purified Protein Derivative Test (PPD)

PPD of tuberculin is a precipitate from filtrates of OT. According to the ATS (1981), Florence Siebert first made this in 1934. PPD has become the preparation used in the United States.

According to Pugliese (1992), the PPD test (Mantoux method) is administered by injecting 0.1 milliliter of PPD intradermally into the volar or dorsal surface of the forearm. This is done with a one-quarter inch, 27 gauge needle and a tuberculin syringe. The solution is injected just under the skin with the needle bevel up. An elevation of skin described as a weal, six to ten millimeters in diameter, should appear. The test is examined and read in 48 to 72 hours. Interpretation is based on the absence (negative) or presence of induration and by palpation. The induration diameter is measured transversely to the long axis of the forearm and is recorded in millimeters. This is commonly known as the Mantoux skin test method. PPD can be administered by multiple punctures, but if the result is positive it is checked by the Mantoux method, as long as vesiculation has not occurred.

Interpretation of the PPD Test

Positive reactions are measured by the presence of induration at the time the test is read. As reported by Pugliese (1992), the larger the reaction, the greater the probability that it represents infection. This reaction usually takes two to ten weeks after infection with TB.

Classifications of tuberculin reactions have been published by the CDC publication Core Curriculum on Tuberculosis (1994a) and are listed in Table 1.

Table 1. Classification of Tuberculin Reaction

Size of Induration in millimeters (mm)	Description
> 5 mm is positive in	- persons known to have or suspected have HIV infection - close contacts of a person with infectious TB - Persons who have a chest radiograph suggestive of previous TB - persons who inject drugs (if HIV status unknown)
> 10 mm is positive in	- persons with certain medical conditions, excluding HIV infection - persons who inject drugs (if HIV status unknown) - foreign-born persons from areas where TB is common - medically underserved, low-income populations, including high-risk racial and ethnic groups - residents of long-term care facilities - children younger than four years of age - locally identified high-prevalence groups (e.g., migrant farm workers or homeless persons)

(table continues)

Size of Induration in millimeters (mm)	Description
> 15 mm is positive in	- all persons with no known risk factors for TB

Note. From Core Curriculum on Tuberculosis, What the Clinician Should Know (p. 20), Centers for Disease Control and Prevention, 1994a, Atlanta, GA.

These classification guidelines should also be applied to those people with occupational exposure to TB. The determining point for a positive reaction depends on the employee's risk factors for TB and the incidence of TB in the facility.

The tuberculin skin test is not perfect. Several factors, including infection with mycobacteria other than *myobacterium tuberculosis*, immuno-suppressed persons, vaccination with bacille Calmette-Guerin (BCG), use of corticosteroids, vaccination of other live virus vaccines, and infection with other viruses may affect results. This can lead to false-positive in persons not infected. False-negative reactions can be due to anergy ("CDC Core Curriculum," 1994a); this phenomenon is described below.

Anergy

Immunosuppressed people may have delayed hypersensitivity response. Tuberculin reactions may decrease or be absent. This is referred to as anergy. According to the CDC Core Curriculum on Tuberculosis (1994a), anergy can be caused by many conditions such as "HIV infection, overwhelming miliary or pulmonary TB, severe or febrile illness, measles or other viral infections, Hodgkin's disease, sarcoidosis, live-virus vaccination, and the administration of corticosteroids or immunosuppressive drugs" (p. 21). This condition can be detected by the

simultaneous injection by the Mantoux method of other antigens, such as tetanus toxoid, mumps, or Candida. Persons with at least a greater than 3 millimeter reaction to any of the other antigens are not considered anergic.

Two-step Testing

In hosts infected with *mycobacterium tuberculosis*, delayed hypersensitivity to tuberculin may wane over time. With skin testing, these persons may have a negative reaction. This test may "boost" their reaction to tuberculin, causing future tests to be classified as positive, then misdiagnosed as a new infection. The CDC Guidelines (1994b) recommended two-step testing on HCW's upon employment. Unless they have proof of a negative result in the last 12 months, the second test is administered one to three weeks after the initial test. If the reaction is positive, the person is classified as previously infected. This is not considered conversion. If the second test is negative, the person is considered uninfected. Any future testing that is positive will be considered a new infection ("CDC Core Curriculum," 1994a).

Of utmost importance to the control of TB is early diagnosis and adequate treatment of infection and disease. As reported previously, screening methods have been available since the 1930's. The at-risk populations outlined previously need to be targeted for more intense efforts at screening to detect TB infection and disease as soon as possible. After infection, progression to disease can be prevented with chemoprophylaxis. The current culture procedures needed to confirm cases of TB take too long to prevent transmission opportunities. If the initial smear does not contain acid-fast bacilli, the diagnosis of TB disease can be delayed as long as six to

12 weeks. The newer and faster BACTEC test should be used to reduce this time period. As long as a host with TB remains undiagnosed, the greater the likelihood that the disease is spread to others.

Drug-resistant TB

Evidence of rare cases of drug resistance has been reported since the 1950's, when TB chemotherapeutic use began (Kent, 1993). Iseman and Madson (1989), and Kent (1993) have described two types of natural resistance; one type of broad resistance is caused by random chromosomal mutations, and the other type leads to resistance for individual drugs. A small proportion of drug-resistant mutants are found in the populations of drug susceptible bacilli. It is not until these mutants reach a critical threshold that the population is considered drug-resistant. Kent (1993) also reported that the likelihood of spontaneously occurring resistance to two drugs is very low.

The scientific literature addressing drug resistance generally describes two classifications of resistance (Brudnay & Dobkin, 1991; Edlin, Tokars, Grieco, Crawford, Williams, Sordillo, Ong, Kilburn, Dooley, Castro, Jarvis, & Holmberg, 1992; Iseman & Madsen, 1989; Kent, 1993; Riley, Arathoon & Loverde, 1989). Primary drug-resistance (PDR) is defined as resistance to one of the first-line drugs used in persons with TB who have not had previous treatment. Secondary or acquired drug resistance (ADR) is defined as resistance in hosts who have had previous incomplete or incorrect treatment. A third category described by Kent, (1993) is referred to as transmitted drug resistance. This happens when a host is

infected by another with a drug-resistant strain whether it be recognized as PDR or ADR. Kent (1993) defines MDR-TB as "resistance to two or more first-line anti-tuberculosis medications" (p. 1394).

Iseman and Madsen (1989) described a process common for the development of ADR-TB. In this scenario, a patient with TB is prescribed two drugs, isoniazid (INH) and rifampin. The patient decides that the rifampin produces unacceptable side effects. The patient quits taking the rifampin but does not inform their medical provider. Because most TB bacilli are susceptible to INH, the patient improves. As time passes, a few INH resistant mutants emerge in increasing numbers. A relapse occurs, usually between three and six months, during therapy. The provider tries to treat the relapse with the addition of another drug, ethambutol. At this point, the patient has large amounts of bacilli resistant to INH but there may be a few resistant to ethambutol. Essentially, the provider has added only one drug and the process repeats itself. The second relapse is due to bacilli resistant to both INH and ethambutol. This type of episode demonstrates how non-compliance and careless prescribing create bacilli with resistance to multiple drugs. According to Goble, Iseman, Madsen, Waite, Ackerson and Horsburgh (1993), initially in the 1950s, 1 to 3% of bacilli were resistant to the first-line drugs. This has increased to 8.8% of previously untreated hosts from 1982 through 1986.

As reported by the CDC (1992), nationwide trends in the first three months of 1991 revealed that 14.4% of all new cases of TB were resistant to at least one and 3.3% were resistant to two of the first-line chemotherapeutic agents. In the 1982

through 1986 era, only 0.5% of new cases were resistant to the first-line drugs INH and rifampin, by 1991 3.1% were.

MDR-TB takes longer to treat and to cure. Sensitivity results take longer than culture results. During the interval between obtaining the culture and having the sensitivity reported back, the patient may not be receiving appropriate treatment. The extension of time needed to treat MDR-TB also increases the risk for non-compliance. It was reported that some strains of TB are resistant to as many as seven drugs (Dooley et al., 1992; Kent, 1993; Mitchison & Nunn, 1986). This would include all of the drugs that are currently used to treat TB. If the strain is resistant to all seven, then there is no treatment available. The trend to see more DR and MDR-TB makes the eradication of TB more difficult (Dooley et al., 1992).

Outbreaks of MDR-TB in Hospitals

Dooley et al. (1992) reported from 1990 through 1992, six outbreaks of MDR-TB in hospitals were reported. The combined number of new cases from these outbreaks exceeded 200. Nosocomial transmission was confirmed using DNA testing demonstrating a single strain of TB in the setting. Most strains in these outbreaks were INH and rifampin resistant, but there was resistance to up to seven other drugs. Infection with multi-drug resistant strains increases the duration of chemotherapy to 18 to 24 months and the overall cure rate decreases. Mortality among the patients with these strains maybe as high as 89% and a rapid progression from diagnosis to death from four to 16 weeks was noted. Of these patients, 80% were HIV positive (p. 257). As discussed earlier, HCWs were infected in the outbreaks. Four of eight

HCWs infected, who were also HIV positive, have died.

Investigations of these outbreaks revealed factors that contributed to the transmission to both patients and employees. Most cases were not recognized, diagnosed and isolated in a timely fashion. When the diagnosis was made and patients were isolated, AFB isolation recommendations were not strictly followed. Some of the recommended air flow controls were not available. Sensitivity testing results took six to 12 weeks and appropriate chemotherapy was not initiated promptly.

These investigations point out that the early recognition and isolation of suspected TB patients, especially when there are immunocompromised patients and staff involved, were very important to prevent exposure. Even when patients were isolated the additional control methods involving ventilation were not routinely available. The author believes that the section of the CDC Guidelines (1994b) regarding ventilation in the AFB isolation rooms originated from the investigations of these deadly outbreaks.

These outbreaks and the increasing incidence of MDR-TB cases have been reported in urban areas of New York, California, Florida, and Texas. Outbreaks of MDR-TB were also reported in other settings such as prisons and homeless shelters in these areas. The risk of infection with MDR-TB is greater in these areas. The Montana Department of Public Health and Human Services, Preventive Health Bureau, TB Program Coordinator (D. D. Ingham, personal communication, October 10, 1995) noted there have been no confirmed cases of DR or MDR-TB in Montana.

Exposure Control

The scientific literature related to exposure control was vast and encompassed a variety of disciplines including medicine, public health, engineering and industrial hygiene. There was one article written by a nurse author. The literature is divided between two broad topics; public health information and acute-care related information. The public health literature discusses prevention of exposure, early diagnosis, and increased screening methods, detection and treatment. The second type of studies pertain to exposure control in institutional settings, such as acute-care hospitals. Most of the CDC Guidelines (1994b) published and enforced by the Occupational Safety and Health Administration (OSHA) fall into this second group. Because the goal of this project was to produce a written TB exposure control document for an acute-care hospital, this section primarily focused on those measures addressing hospital settings.

Hierarchy of Controls

OSHA has recommended a three-tier approach to levels of protection for employees in many different hazards encountered in the workplace. Generally, the tiers are referred to as administrative controls, engineering controls, and personal protective devices. The controls are to be instituted in the order stated above. The goal of the administrative and engineering controls is to eliminate hazards, so that personal protective equipment is not needed.

Administrative Controls

Administrative controls that are to be used in an acute-care hospital setting begin with policies and procedures. The policies and procedures indicate who is responsible for each section of the plan. The disciplinary process used for employees not following the procedures are included. The next step in the CDC Guidelines (1994b) is a risk assessment conducted by hospital employees. The results of the risk assessment determines what category the facility is in and which measures must be instituted. The CDC Guidelines (1994b) contain five categories and are labeled minimal risk; very, very low risk; low risk; medium risk; and high risk.

Next, the CDC Guidelines (1994b) mandate the institution to write policies and procedures for early recognition and isolation of suspected or confirmed TB patients. This is to be achieved by education and training of staff. The guidelines mandate that training address the following topics: TB disease, signs and symptoms, epidemiology nationwide and locally, current concepts in laboratory testing, chemotherapy, initiating and discontinuing isolation, review of the institution's controls that are in place, and the written exposure control plan.

The next section of administrative controls were related to screening of staff and patients. The CDC Guidelines (1994b) mandate two-step PPD testing where appropriate on new employees and yearly PPD testing on all other employees. The CDC Guidelines (1994b) identify procedures to be used for outbreaks and exposures to undiagnosed TB patients. The CDC Guidelines (1994b) include not only PPD

testing of exposed employees, but an investigation into why the diagnosis of TB was missed, followed by appropriate steps, including education, that should take place.

Engineering Controls

The second tier of exposure control is engineering controls. The scientific literature in this area is very technical, difficult to read and interpret, and comes from the engineering and industrial hygiene disciplines. The CDC Guidelines (1994b) include the construction and use of negative pressure isolation rooms. According to Hutton and Polder (1992), Lindberg (1993), and Marier and Nelson (1993), the isolation rooms will have negative pressure or inward airflow in relation to the main hall. The rooms will have separate air exhaust so that contaminated air will not be recirculated to any other parts of the institution. Isolation rooms will have a minimum of six total air exchanges per hour (three is standard) to help reduce the number of droplet nuclei in the air. All patients with suspected or confirmed active TB will be admitted to the isolation rooms. In areas where the features of isolation are not in place, the CDC Guidelines (1994b) suggest other control measures. These include high-efficiency particulate air (HEPA) filtration and or ultra-violet light disinfection, especially in waiting areas where undiagnosed TB patients may be. The CDC Guidelines (1994b) mandate the use of isolation booths for high hazard procedures, especially in areas without the features of negative pressure air flow and ultrafiltration.

Personal Protective Equipment (PPE)

The final level in exposure control is always personal protective equipment. This is to be implemented when the other two levels cannot control exposure to the hazard. PPE for TB exposure control refers primarily to respirator use. This last tier is necessary even in the isolation rooms because of the inability to measure the amount of droplet nuclei in the air. There is currently no technology available to do this. If there is a question as to continued exposure, respirators must be instituted. It is probable that in the next few years that this type of measurement will become available. Until that time, OSHA expects employers to use all three tiers of exposure control.

The use of PPE as part of the CDC Guidelines (1994b) has caused the most dissention and discussion among healthcare providers. According to the CDC Guidelines (1994b), the only reliable type of respirator that will be used is one with HEPA filtration abilities and can be reliably fitted. The most popular model is a particulate respirator, made out of HEPA filter material. These look like masks that are used in the hospital setting, but must be fit-tested to ensure there is a seal around the mouth and nose. The use of respirators in the hospital mandates compliance with the OSHA standard for respiratory protection, 29 CFR 1910.134. This requires more policies and procedures for training, education, fit-testing and issuing of equipment. Many persons in the health care industry would prefer to use a particulate respirator commonly called a dust/mist/fume respirator. These respirators are better than surgical masks, having the capability to filter out more particles. The problem with

dust/mist/fume respirators is they cannot be reliably fit-tested by any of the acceptable methods now in use. During the CDC Guidelines (1994b) final comment period, much of the discussion centered around which respirators would be adequate for protection. It is the author's opinion that the use of HEPA respirators is probably not necessary in regions of the country where there are few cases of TB and where MDR-TB has not been detected. The further demands on staff time for education and fit-testing are excessive in the parts of the country where there are no hospital units dedicated to HIV and TB infected patients.

Cleaning and Disinfection

Studies addressing cleaning and disinfection of TB contaminated items were few in number. Two references were found that were useful. The Association for Practitioners in Infection Control (APIC) published guidelines (described below) which were useful in outlining the general concepts of cleaning and disinfection. Chapter three in the book Disinfection, Sterilization and Preservation (1991), edited by Block, was also reviewed. This chapter was concerned with which chemical cleaning agents were most useful in inactivating *mycobacterium tuberculosis*.

APIC published guidelines for selection and use of disinfectants (Rutala, 1990). This is an excellent source for general information on cleaning and disinfection. Information was included for all types of patient equipment and pathogens, not just TB.

APIC defines sterilization as "the complete elimination or destruction of all forms of microbial life" (Rutala, 1990, p. 100). APIC defines disinfection as "a

process that eliminates many or all pathogenic microorganisms on inanimate objects with the exception of bacterial spores generally accomplished by liquid chemical or wet pasteurization" (Rutala, 1990, p. 100). APIC defines levels of disinfection as follows:

1. Sterilization, as defined above.
2. High-level disinfection: can be expected to destroy all microorganisms with the exception of high numbers of bacterial spores.
3. Intermediate-level disinfection: inactivates TB, vegetative bacteria, most viruses, most fungi, but not bacterial spores.
4. Low-level disinfection: can kill most bacteria, some viruses and fungi, but cannot be relied on to kill resistant microorganisms such as tubercle bacilli or bacterial spores (p. 100).

Cleaning is defined as the removal of material from objects accomplished with water, mechanical action, and detergents, and must precede disinfection or sterilization processes. APIC categorizes equipment used with patients by degree of risk for infection. These equipment categories are defined as critical, semi-critical and non-critical. Critical items would include anything that may enter sterile tissue or the vascular system. Some examples of critical items include surgical instruments, urinary and cardiac catheters, implants or needles. All critical items should be sterile.

Semi-critical items are those that come in contact with mucous membrane or non-intact skin. Examples of semi-critical items are respiratory and anesthesia

equipment and endoscopes. These items require high-level disinfection with the use of wet pasteurization or chemical germicides.

Non-critical items are those which may come in contact with intact skin but not mucous membrane. Examples of these are bedpans, blood pressure cuffs, crutches, bed rails, linens, and other patient furniture. These items do not have to be sterile and can be cleaned with low-level disinfection.

Following these guidelines, most of the equipment used on TB patients can be cleaned by the ordinary cleaning procedures used by the facility. All surfaces of patient furniture and bathrooms can be considered clean using this method. Handling of non-critical items by HCWs is generally not considered a transmission route for TB. Patients with TB disease do not need disposable dishes or utensils because TB is not spread by direct contact. HCWs should avoid handling items directly contaminated with respiratory secretions without gloves. Thorough hand washing, upon glove removal, is always recommended.

Any items used for TB patients, which are defined as critical items should be thoroughly cleaned and sterilized before reuse. Items in the semi-critical category should be cleaned and undergo high-level disinfection after use. TB patients may require bronchoscopy or respiratory therapy. These scopes and other reusable items should undergo high-level disinfection after use.

TB is spread by the airborne route. Engineering controls and PPE use are the best methods to prevent transmission. According to Nardell (1993), large respiratory droplets, defined as greater than 5 microns, tend to settle out of the air quickly.

These droplets do not return to an airborne state, even when they dry out. These droplets are then removed by usual room cleaning methods. Droplet nuclei, defined as 1 to 5 microns, tend to stay airborne and these particles, when inhaled deep into the respiratory system, will infect susceptible hosts.

Controls related to increased air circulation, cleaning (HEPA), a negative direction of flow, and PPE use are the most important controls used to prevent transmission and infection of TB. Daily cleaning of rooms can be done in the facility's usual manner. Terminal cleaning of isolation rooms does not need to be more rigorous than the facility's usual procedures. Any semi-critical or critical items used with patients with TB need to undergo the appropriate level of disinfection before reuse.

Chemotherapeutic Treatment of TB

There were many references addressing the treatment of TB infection and TB disease; most of this clinical and research information is found in the medical literature. The information was very congruent on the recommendations.

There are two different treatment regimens for persons with TB: 1) preventive therapy against TB infection progressing to disease, and 2) therapy in response to active disease. Infection with the agent can be detected by PPD conversion from a previous negative to positive result.

Treatment of TB Infection

Preventive therapy is indicated in those persons who are newly infected and are at high risk of developing disease. Therapy reduces the risk the TB infection will

progress to TB disease. The persons in the following groups should receive preventive therapy, regardless of their age.

1. Persons known to have or suspected of having HIV infection, including persons who inject drugs and whose HIV status is unknown (PPD > 5 mm).
2. Close contacts of a person with infectious TB (PPD > 5 mm).
3. Persons who have chest radiograph findings suggestive of previous TB and who have received inadequate or no treatment (PPD > 5 mm).
4. Persons who inject drugs and are known to be HIV negative (PPD > 10 mm).
5. Persons with certain medical conditions such as diabetes mellitus, silicosis, cancers, hematologic and reticuloendothelial diseases (PPD > 10 mm).
6. Persons whose tuberculin skin test reaction converted from negative to positive within the past two years (PPD > 10 mm increase if younger than 35 years of age, > 15 mm increase if 35 years of age or older).

All persons younger than 35, with a positive skin test in these groups:

1. Foreign-born person from areas where TB is common.
2. Medically underserved, low-income populations, including high-risk racial and ethnic groups (e.g., Asians and Pacific Islanders, blacks, Hispanics, and Native Americans).
3. Residents of long-term care facilities (e.g., correctional facilities and nursing homes).
4. Children younger than four years of age.

5. Other groups identified locally as having an increased incidence of TB e.g., migrant farm workers or homeless persons ("CDC Core Curriculum," 1994a, p. 33).

Persons who have occupational exposure to TB should be considered for preventive therapy if they have a positive reaction. INH therapy is not routinely recommended for infected persons over 35 unless they are at high-risk of developing disease. INH may produce unacceptable side effects that may be more pronounced and serious in persons over 35. All PPD conversions should be evaluated for preventive therapy (Dowling, 1991).

The regimen for preventive therapy is daily INH, with five milligrams per kilograms as a maximum dose, for six months in adults (Hanson & Reichman, 1989; Miller, 1993). If the person is exposed to hosts with known drug-resistant strains, they should have additional medications based on the identified resistance (Braush & Bass, 1993; Iseman & Goble, 1988; Lordi & Reichman, 1991).

Treatment of TB Disease

Treatment of active TB primarily includes four drugs: INH, rifampin, pyrazinamide and either ethambutol or streptomycin. This regime should be adjusted when drug susceptibility testing results are known. Treatment must be continued for a minimum of six months to a possible 24 months. Medications can be taken daily or modified to twice or three times per week, based on adherence assessment and adverse reactions ("CDC Core Curriculum," 1994a). Which drugs to continue and for what length of time will depend on the susceptibility tests and monitoring of

number of bacilli in smears and cultures. Careful monitoring of the patient should be conducted by the practitioner. Monitoring will help prevent the development of resistant strains because of incomplete therapy. Affected persons should be evaluated by a practitioner who is knowledgeable about current trends in TB therapy. TB is theoretically considered to be 100% curable. However, in clinical practice, there are many factors which contribute to poor cure rates. It is obvious from the preceding discussion that measures can be improved to control TB. With infection, chemotherapy is continued at a minimum of six months. This length of therapy increases the chance of non-compliance by infected hosts. It is difficult for a host without any clinical symptoms to continue chemotherapy for extended periods of time. New drugs are needed that have a shorter course so compliance is enhanced. Compliance is also problematic in hosts with disease. Most chemotherapy regimens are extended to one full year. After symptoms abate, the chance the person will quit taking their prescribed drugs becomes more likely.

TB incidence is higher in groups which are low income, medically underserved, homeless, IV drug users, HIV positive, and minority. These patients have fewer resources available to them, especially those needed to continue therapy for extended periods of time. The chance for non-compliance increases with each risk factor identified in the host (Etkind, 1993).

Research and development of an effective vaccine should be encouraged. According to the CDC Core Curriculum (1994a) the current vaccine, bacille Calmette-Guerin (BCG), is not recommended for use in the United States. There is

low risk of TB infection in the United States. The effectiveness of BCG varied from 0% to 76%, and so is considered unreliable for immunity. BCG immunization may cause a positive PPD skin test. This may complicate the decision to use preventive therapy with BCG vaccinated people with positive skin tests.

BCG vaccination is recommended for infants or children with negative skin test results who:

1. Cannot be given preventive therapy but will be continuously exposed to a person with infectious TB.
2. Will be continuously exposed to a person with infectious TB that is resistant to isoniazid and rifampin.
3. Belong to groups for which the rate of new infection exceeds 1% per year and for whom the usual surveillance and treatment programs have not been successful (e.g., those without access to health care) ("CDC Core Curriculum," 1994a, p. 64).

Immunity from TB, induced by a reliable vaccination, should be the ultimate goal of research and development efforts.

Conceptual Framework

This project produced a TB exposure control plan for use in an acute care setting. TB is an infectious disease of increasing incidence in the United States and Montana. An epidemiological model was selected to conceptualize the natural history of TB and opportunities for prevention. The resurgence of TB in the United States and Montana has occurred as a result of changes in host, agent, and environment.

The author used epidemiologic concepts in this framework to identify efforts at prevention (exposure control) with the greatest impact on worker health.

Valanis (1992) described three characteristics that are needed to differentiate one scientific discipline from others: the methods by which data are collected, the body of knowledge accumulated by the discipline, and the underlying theory that guides the collection of data (p.6). These characteristics, as they relate to an epidemiologic perspective on TB prevention and control, are discussed below.

Epidemiological Methods

The use of rates or quantitative measures of disease frequency provided a scientific basis for the methodologic approach to disease occurrence. These methods were applied to the investigation of disease patterns as they related to the distribution of potential causal factors. This approach forms the conceptual basis for the science of epidemiology. Investigations based on these methods have yielded valuable data about patterns of human health and disease.

Body of Epidemiological Knowledge

Early epidemiological studies focused on infectious conditions such as plague or cholera. Epidemics of these diseases were associated with high mortality. Valanis (1992) reported the focus of epidemiological study has expanded to include communicable, noncommunicable, and acute and chronic conditions that affect the health of population groups. The discipline of epidemiology includes all health-related characteristics of populations, including mental and social conditions. This change in focus has encouraged the disciplines of psychology, sociology and others to

participate in epidemiological investigations. Valanis (1992) reports the strength of epidemiology is its multidisciplinary approach to health problems.

Epidemiological Theory

Stallones (1980) proposed the following statements as a central axiom and corollaries upon which modern epidemiology is based:

1. Axiom: Disease does not distribute randomly in human populations.
2. Corollary 1: Nonrandom aggregations of human disease are manifested along axes of measurement of time, space, individual personal characteristics, and certain community characteristics.
3. Corollary 2: Variations in the frequency of human disease occur in response to variations in the intensity of exposure to etiologic agents or other more remote causes, or to variations in the susceptibility of individuals to the operation of those causes (p.80).

Valanis (1992) notes this axiom and corollaries recognize that "patterns of disease occurrence or other alterations of states of health in human communities are determined by forces that can be identified and measured and that modification of these forces is the most effective way to prevent disease" (p.7).

The author goes on to state the purposes of modern epidemiology. These include:

1. Identifying the etiology of deviations from health.
2. Providing the data necessary to prevent or control disease through public health interventions.

3. Providing data necessary to maximize the timing and effectiveness of clinical interventions (p.6).

Definition of Concepts

Epidemiology: a science concerned with health events in human populations. It is the study of how different health states are distributed in populations and what factors (environmental conditions, lifestyles) are related to absence or presence of disease (Lilienfeld & Lilienfeld, 1980; Mausner & Bahn, 1974; Valanis, 1992).

Natural history of disease: the process by which diseases occur and progress in human hosts (Mausner & Bahn, 1974; Valanis, 1992). This process involves the interaction of three factors; the causative agent, a susceptible host and the environment (Valanis, 1992, p. 19). As long as a balance between the three factors is maintained, there is a state of health. If any of the factors increase or decrease, there is a possibility of exposure and subsequent disease.

Agent: a factor whose presence causes a disease or one whose absence causes disease (Lilienfeld & Lilienfeld, 1980; Mausner & Bahn, 1974; Valanis, 1992).

Agents of disease are generally characterized as physical, chemical, nutrient, genetic, psychological or biological. The TB bacillus is characterized as a biological agent, because it is a live, infectious organism.

Host: the individual human in whom an agent produces disease (Lilienfeld & Lilienfeld, 1980; Mausner & Bahn, 1974; Valanis, 1992). The hosts for TB are those humans who come in contact with droplet nuclei contaminated with TB bacilli and are susceptible to infection after breathing in these nuclei. According to Rogers (1994),

there are many host factors that influence exposure, susceptibility or response to agents. Examples of these factors include genetic predisposition, age, sex, ethnic group, physiologic state, prior immunologic experience, intercurrent or preexisting disease and human behavior (p. 170).

Environment: refers to all external conditions and influences affecting the life of living things (Lilienfeld & Lilienfeld, 1980; Mausner & Bahn, 1974; Valanis, 1992). Rogers (1994) describes environmental factors as physical, biological or socioeconomic. The biological environment may serve as the reservoir where an agent lives or a vector as a living carrier that transports an infectious agent. Tubercle bacilli residing in the environment in soil and in the air in the form of droplet nuclei (expelled from infected persons) can infect human hosts. The agent of TB transmission is the infected human host which expels droplet nuclei into the air, through coughing, sneezing or breathing.

Relationships Among Concepts

The natural history of TB can be examined by exploring relationships among the concepts of host, agent and environment. The agent *mycobacterium tuberculosis* is expelled from an infected human host and into the physical environment (air) of a susceptible host. If droplet nuclei containing the agent are inhaled deeply into the lungs of a susceptible host, infection usually occurs. The infection may or may not progress to an active disease status. Many humans infected with the TB bacillus do not develop active disease; however, these hosts harbor the bacillus in the respiratory system for many years.

Susceptible humans usually become infected by the airborne route. To a large extent host factors determine whether TB infection progresses to active disease. Infected hosts also contribute to the reservoir of the agent. If active TB is undiagnosed, such individuals may transmit the infection to other susceptible hosts. In the natural history of TB, the agent is transmitted by the diseased hosts. No matter how persons with active disease are diagnosed and treated, further transmission can be prevented.

Changes in agent, host, and environment have resulted in increased TB disease in the United States and Montana. The major agent change noted is the development of drug resistant strains of TB. This change in microbial vulnerability has increased the length and characteristics of treatment for TB. Once a host is diagnosed with TB, cultures are done to determine susceptibility to drugs. If the agent is resistant to the commonly used drugs, treatment begins with less commonly used medications, which may require longer time frames for cure (Iseman & Madsen, 1989). If the agent is resistant to all currently used drugs, the host cannot be cured and will eventually die. However, in the interim there is the possibility of transmission to other humans with this resistant strain.

Recent host changes affecting TB incidence include an increase in the number of persons who are immunologically suppressed. Most areas, including Montana, have increasing numbers of persons infected with HIV. These persons are more susceptible to a rapid progression from infection to disease. In addition to HIV-related risks, the population in the United States is aging; older persons often

demonstrate compromised immunity to a number of infectious agents. In addition, persons with chronic diseases such as diabetes, silicosis, severe kidney disease, and certain types of cancers are more susceptible to TB infection and disease than the general population (CDC, 1995a).

Environmental changes are mostly related to extrinsic factors influencing the existence of agent, exposure or susceptibility. One environmental change affecting TB incidence is the increasing number of homeless and displaced people in the United States. Lack of available housing has affected the balance between host and environment by increasing exposure opportunities for those housed in shelters. In addition, many of these persons have incurred changes in socioeconomic factors that decrease their access to health care and continuation of therapy once diagnosed. An additional factor impacting TB incidence is the increased occurrence in immigration of people from geographic areas with endemic TB (CDC, 1995b).

A Conceptual Basis of TB Prevention

Because the project focuses primarily on exposure control, a brief discussion of TB prevention principles are outlined below. Valanis (1992) noted the natural history of disease provides the practitioner with a basis to plan interventions. The overall aim of intervention is to halt or reverse the etiologic process and prevent further damage in individuals or populations. Valanis (1992) outlined two periods in regard to the natural history of disease; prepathogenesis and pathogenesis. Prepathogenesis can also be divided into two stages, susceptibility and adaptation. In susceptibility, disease has not developed, but an imbalance among the factors of

agent, host and environment has occurred that favors disease occurrence. If there is exposure to an agent at this time, some type of response occurs. This response may be functional or dysfunctional. If these adaptation processes are successful, no disease will occur. In TB, prepathogenesis can be described as those persons who have been exposed to infected hosts, do not become infected and do not develop active disease, and those who are infected but never develop active disease. These are generally persons in good health with functional immunological systems.

Valanis (1992) divided pathogenesis into two stages, early pathogenesis or presymptomatic disease and clinical disease. In early pathogenesis, the host has no symptoms of disease but adaptation has failed and pathogenic processes have begun. Clinical disease is defined as "disease that is detectable because of symptoms experienced by the patient or signs apparent to a clinician during a physical exam" (Valanis, 1992, p. 24). By the time clinical disease has become apparent, significant pathological changes have usually occurred. In TB, the stage of early pathogenesis can be compared to those who have been infected and have not yet developed active disease. If these infected hosts can be detected and preventative chemoprophylaxis is initiated, they will not progress to active disease. Those infected hosts which have developed active disease can be treated with appropriate chemotherapy to cure the disease and prevent the spread to others.

Valanis (1992) and Mausner and Bahn (1974), described levels of prevention as primary, secondary, and tertiary. "Primary prevention measures are aimed at intervening before pathological changes have begun, during the stage of susceptibility"

(Valanis, 1992, p. 25). Nursing interventions at this point are frequently directed at preventing host and agent from interacting, therefore removing possibility of exposure. In a hospital setting, these interventions are accomplished by exposure control methods such as the early identification and isolation of infected persons, removal of droplet nuclei from the air, and preventing inhalation of droplet nuclei by HCW's.

"Secondary prevention seeks to detect disease early, treat promptly, and cure disease at the earliest stage possible. Activities are focused on the stage of presymptomatic disease or in very early clinical disease" (Valanis, 1992, p. 28). Secondary prevention activities applied in the pathogenesis stage of the natural history of TB include PPD screening to detect infected hosts and prophylactic treatment of these hosts to prevent progression to disease. Such measures also include treatment of active cases to cure and prevent the spread of TB.

"Tertiary prevention activities are aimed at limiting disability and toward the rehabilitation of those persons with residual disability" (Valanis, 1992, p. 29). Tertiary prevention activities primarily focus on the treatment of the disease to arrest its progress and pathogenic changes. In cases where there is multiple drug resistance, the activities may be limited to prevention of infection of others, until death occurs.

The epidemiological model is useful in conceptualizing TB infection and disease, its natural history and prevention of infection. The resurgence of TB in the United States and Montana has been influenced by changes in host, agent, and environment. Concepts in this framework have been used to direct nursing activities

where efforts at prevention (exposure control) result in the most favorable consequences for HCW's and the general public.

CHAPTER 3

METHODOLOGY

Project Design

Overview

The production and implementation of the TB exposure control plan required many phases and an approximate time frame of six months. A few of the requirements contained in the CDC Guidelines (1994b) are still not complied with as of October 1995, at Columbus Hospital.

The project began with the review of the CDC Guidelines (1994b), design of the plan, writing of the plan, physical construction at the hospital and selection of respirators. The next phase included general education on TB, the TB exposure control plan for all staff, and on respirator use for targeted staff.

There were barriers to implementation which included time constraints for targeted staff, construction of the negative pressure isolation rooms, correct handling of suspected TB patients and staff resistance to respirator use.

The TB Exposure Control Plan

Design of the TB Exposure Control Plan

The second draft of the proposed CDC guidelines entitled, Draft Guidelines for Preventing the Transmission of Tuberculosis in Health Care Facilities, 2nd Edition, were published in the Federal Register on October 12, 1993. There was an original comment period of six months, which was extended to January 13, 1994.

There were more than 2500 comments received. A portion of the final CDC Guidelines published October 28, 1994, reflected changes guided by the comment period. Changes from the previous version of the document were outlined in the beginning of the final document.

CDC Guidelines

The author obtained a copy of the CDC Guidelines (1994b). The major parts of the document included a condensation of comments and included an executive summary, introduction, recommendations, supplements, glossary and a bibliography. The author made an outline of the requirements from the document to guide the exposure control plan development. This was helpful because some of the requirements were already in place and some were not. Requirements not in place then became a priority for completion, since it was assumed that these would take longer to put in to place for compliance.

Facility TB Risk Assessment

The author and the hospital's infection control nurse conducted a facility risk assessment, as outlined in the CDC Guidelines (1994b). This assessment was done to determine in which of the five risk categories, delineated in the final guidelines, Columbus Hospital would be placed. The CDC Guidelines (1994b) outlined what was to be assessed and the ensuing category placement process. The assessment resulted in the facility's placement in the category "Low Risk". The CDC Guidelines (1994b) outlined which sections of the recommendations were required for each category. The category placement guided what was to be included in the final written exposure

control plan, as well as which procedures and practices needed to be changed or initiated. This activity took approximately two weeks and included employee medical record review, limited patient chart review, and the obtaining of county TB case numbers.

Plan Construction

The author purchased a copy of the Montana Chapter of APIC, Model Pulmonary Tuberculosis Exposure Control Plan, in October 1994, which is contained in Appendix A. After reviewing this document, the author decided that it met all the CDC Guidelines (1994b) recommendations and could be used to guide construction of the TB exposure control plan. The APIC document (1994) was modified specifically to the practices, personnel, and physical layout of Columbus Hospital. The final TB exposure control plan was presented to the hospital's Infectious Disease Committee (See Appendix B for committee membership) at the regular meeting in November, 1994. With minor revisions, the document was accepted as the basis for the TB control plan.

Physical Construction

After reading the draft guidelines published in 1993, the author noted that one of the recommendations was to have negative pressure rooms for the isolation of suspected or confirmed TB patients. This was discussed in a meeting of the Infectious Disease Committee. The committee requested that administration review the requirements and begin to construct two isolation rooms on the general medical floor. This proposal was approved by the hospital administration. The plant

engineering department contracted with consultants who were experts in ventilation design and remodeling plans were obtained. The plans were approved and the remodeling was begun by the consultants in November 1994. These rooms were finished in January 1995 and approved for use by state authorities on March 14, 1995.

Respiratory Protection

The hospital administration was then approached with a request for training on respirator selection and use. This request was also approved. A consultant, with a master's degree in industrial hygiene, was contracted to conduct two four hour sessions of training held for the plant engineering department and the author. A written respiratory protection plan is required by OSHA when respirators are used in any facility. The respiratory protection plan was written with the consultant's assistance. The consultant and the author reviewed the respirator requirements in the final guidelines. The consultant recommended a form of HEPA respirator be purchased to meet the requirements. The author requested information and samples of several brands of negative pressure HEPA respirators and one positive pressure model. Each type was shown to staff members who would be required to use a respirator in their work. These two types of respirators are pictured in Appendix C. Most staff felt the positive pressure respirator was less physically stressful and easier to work in. A request was made and subsequently approved by administration to purchase nine positive pressure respirators.

Implementation

Staff Education: General TB Information

The CDC Guidelines (1994b) included an outline of educational requirements found in Section I on page 54262. The author reviewed the section and designed an outline for classes to meet these requirements; the outline is contained in Appendix D. These classes were scheduled for one hour sessions and were mandatory for all hospital personnel (see memorandum on class schedule in Appendix E). The sessions were held in January 1995, with two make-up sessions held in February 1995.

Each class session had a pre-post test, an introduction, a video, a review of the written exposure control plan, and handouts from the CDC's facsimile information service related to TB. The pre-post test was reviewed at the end of each session. These tests were not collected after the sessions, but most staff commented that any responses that were missed on the pre-test, were reviewed in the presentation. Anonymous evaluations were distributed and collected at the end of each session.

Approximately 821 of a total potential 936 eligible employees (88%) attended. Employees were encouraged to attend live sessions because this teaching format is ideal for responding to questions. One session was videotaped and made available for check-out from the education department, for those employees unable to attend live sessions. The sessions were scheduled at varying times and dates, to accommodate as much of the staff as possible.

Staff Education: Respiratory Protection

The CDC Guidelines (1994b) mandate the use of HEPA respirators when working directly with suspected or confirmed TB patients. This requirement presented additional training needs for those employees required to use respirators. Employees included in this group were those identified as high risk groups outlined in the plan in section VII, Respiratory Protection. There was an additional hour of classes to learn how to use the selected respirator and to review the written respiratory protection plan (see memorandum on class schedule in Appendix F). Sessions were scheduled for March and April 1995. Fifty percent (129 of 256 employees) of targeted employees attended these training sessions.

Barriers to Plan Implementation

Staff Education Activities

The barrier to implementation most frequently encountered was the time required by employees to be away from work to attend staff education classes. This was especially true for those employees potentially involved in direct care of suspected or confirmed TB patients. These employees were required to go to an additional hour of respiratory protection training. Midway through respiratory training class sessions, a reminder was sent to department directors urging attendance of employees at the final sessions. Three make-up sessions were scheduled in May 1995. This was done following requests made by department directors with large departments, who had not sent a number of employees. An additional 49 employees attended the extended sessions.

Respirator Use

Another barrier to implementation was non-acceptance of the positive pressure HEPA respirators by some employees and by local physicians. These individuals believed that the use of positive pressure respirators went beyond the requirements of the CDC Guidelines (1994b). However, no staff were observed in non-compliance with recommended respirator procedures.

Resistance in staff was decreased by attendance at the respirator training sessions. Respirator use was reinforced by reminding staff that PPE use is a requirement of employment. Non-use could result in implementation of the hospital's disciplinary process (included as part of the written plan). Local physicians were informed about the respirators selected. The respirators were made available for physician use, but these respirators were not required by hospital administration. Physicians were allowed to use their personal negative pressure respirators, obtained at their place of employment.

Isolation Discontinuation

One barrier to implementation of the TB exposure control plan noted was the removal of suspected TB patients from isolation before three negative AFB smears were obtained. The proper procedure for dismissal from isolation rooms is three consecutive negative AFB smears and/or a physicians's order for isolation discontinuation (CDC Guidelines, 1994b). Fortunately, none of the patients removed from isolation prematurely were later diagnosed with TB disease. Plans made to rectify this situation included holding an educational seminar for physicians reviewing

the CDC Guidelines (1994b) in the fall of 1995. The seminar was conducted by the Infectious Disease Committee medical director who is an infectious disease specialist. The Infectious Disease Committee medical director was very familiar with the CDC Guidelines (1994b) and has been a consultant for the occupational health nurse and infection control nurse on many occasions.

CHAPTER 4

PROJECT OUTCOME

The Written Exposure Control Plan

The purpose of this project was to produce a written TB exposure control plan.

The text of the exposure control plan follows:

PURPOSE: The intent of the *mycobacterium tuberculosis* exposure control plan at Columbus Hospital is to provide early detection and treatment of persons with active pulmonary TB and to protect patients and health care workers in the facility from TB exposure.

POLICY: Columbus Hospital provides administrative controls, engineering controls, education, personal protective equipment, and medical follow up to employees to reduce the potential for transmission of TB.

- | | |
|---|--|
| I. Responsibility: | Position or title: |
| A. Design of TB Plan | 1. Occupational Health & Safety
2. Infection Control |
| B. Education/training | 1. Occupational Health & Safety
2. Infection Control
3. Education Department
4. Department Directors, Supervisors |
| C. Engineering controls
To include daily
monitoring of room
when in use. | 1. Director, Plant Engineering
2. 4 East Director
3. 4 East Staff |
| D. TB screening of
employees follow up
post/exposure | 1. Occupational Health & Safety
2. Infection Control |

- | | |
|--|-----------------------------------|
| E. Placement of patient in respiratory precautions | 1. Physicians, R.N.'s, R.T.'s |
| | 2. Infection Control |
| F. Discontinuing respiratory precautions | 1. Physicians, R.N.'s, R.T.'s |
| | 2. Infection Control |
| G. Oversee use of work practice controls | 1. Department Directors |
| | 2. Occupational Health and Safety |
| | 3. Infection Control |
| H. Identification/Notification of tuberculosis isolates. | 1. Lab Director |
| | 2. Lab Personnel |
| I. Committee oversees plan | 1. Infectious Disease Committee |
| | 2. Safety Committee |

All HCW's are responsible for knowing and following current guidelines for isolation precautions, detection, reporting, and follow up of TB exposure.

II. Hierarchy of Controls:

A. Assessment of Endemic Risk of TB*

1. Columbus Hospital treats fewer than six (6) active TB cases per year as inpatients.
 - a. 1992 1 patient
 - b. 1993 0 patients
 - c. 1994 2 patients
2. The seroconversion rate among employees is no higher in groups without occupational exposure to TB.
3. There have been 0 clusters of PPD test conversions.
 - a. 1992 1 Conversion
 - b. 1993 2 Conversions
 - c. 1994 1 Conversion

(A cluster is defined as two or more PPD conversions among persons in one area or in a single occupational group that works in multiple areas within a three month period.)

4. There is no evidence of patient to patient or patient to HCW transmission.

* Reference: TB risk assessment attachment #1.

5. Drug susceptibility patterns of TB seen in the facility. (If there is infectious tuberculosis identified in Columbus Hospital, attach a summary of the drug susceptibility pattern.)
6. Cases reported in Cascade County.
 - a. 1994 - 8

III. Early Detection of Patients with Symptoms of Tuberculosis:

- A. Symptom screen for each patient. (See VI. A.1 of this document)

Consider a TB diagnosis in any patient with 3 or more of the following symptoms/signs:

1. persistent cough > 2 weeks duration
2. bloody sputum observed or reported
3. night sweats
4. weight loss
5. anorexia
6. fever
7. CXR findings

B. Known high risk persons, include:

1. Non-Caucasian (Black and Native American population)
2. Recent immigrant from high TB endemic area, (Caribbean Region, South America, Southeast Asia, China)
3. History of HIV positivity
4. Homeless persons
5. Correctional facility resident
6. History of substance abuse
7. Immunosuppressed/compromised patients (i.e., elderly, dialysis, etc.)

C. High-hazard procedures, emphasis on cough producing procedures:

1. Respiratory treatments, including Pentamidine aerosols (use PAPR Breathe Easy Turbo Unit for Pentamidine administration)
2. Suctioning patients
3. Bronchoscopy exams
4. Pulmonary function testing
5. Sputum inductions
6. Endotracheal intubation
7. Autopsy
8. Handling lab specimens and cultures
9. Disposal of secretions after procedures

D. When clinical symptoms are present, the attending physician(s), Columbus Convenience Care or E.R. physician(s) should be alerted to a possibility of

TB and consulted concerning the patient need to be placed in the negative air pressure isolation room, if admitted to the hospital. If there are further questions, contact the Infection Control Nurse.

IV. Management of Patients with Probable or Confirmed Infectious TB:

The patient's physician, registered nurse, respiratory therapist, or infection control nurse may initiate isolation precautions for TB and monitor compliance. Discontinuing isolation is based on physician order.

A. Management of Out-patients:

1. Provide patient with a surgical mask, box of tissues and instructions to cover mouth when coughing, sneezing, etc.
2. Place patient in separate waiting area or TB isolation room.

B. Management of In-patients.

The following specific precautions are to be implemented for preventing tuberculosis exposure:

1. The patient is to be placed in a negative air pressure room, located on 4 East (Room 401 or Room 402).
 - a. When either room is occupied by the TB patient, the door to the vestibule, as well as both patient room doors, shall be kept closed, except when entering and leaving the room.
 - b. Staff entering the vestibule will check the lights on the wall by the sink. This indicates that the exhaust is working. If the lights are off, contact plant engineering immediately.

- c. Do not enter patient room unless absolutely necessary and only with powered air-purifying respirator (PAPR) on, (housed in the cabinet in the vestibule).
- d. Any staff entering the patient rooms must wear a PAPR. Visitors are to be limited to the immediate family/significant others. Visitors must wear a dust/mist/fume mask that fits over the nose and mouth.
- e. All staff must wash hands after taking off the PAPR respirator, before leaving the vestibule.

- 2. The patient must be instructed to completely cover their nose and mouth with tissues during coughing and sneezing. Used masks and tissues are considered general waste and disposed of as general waste.
- 3. Any employee performing a high risk procedure, aerosolized medication treatments, bronchoscopy, sputum inductions, endotracheal intubation, suctioning procedures and autopsy, need to wear PAPR.
- 4. Only essential care givers are permitted to enter the room.
- 5. If the patient must leave the room for other tests, they must wear a surgical mask that completely covers the nose and mouth.

C. Removal of TB Precautions:

- 1. Patients with TB will remain in isolation until 3 consecutive, coughed sputum smears for AFB are negative. (Obtained on 3 different days.) See attachment #2.

2. Other etiologic agent found for patient's condition.
3. Physician indicates effective treatment in progress and symptoms have abated and evidence of reducing numbers of AFB in sputum smears.
4. Outpatient status started.

V. Patient Education:

A. Patient/Family Education

The patient remains in the room with negative pressure. Patient should be instructed to cover mouth with tissue when coughing or sneezing. A surgical mask should be worn by the patient if leaving the room. Avoid having the patient wait in common waiting area by scheduling appointments. Persons entering the negative pressure isolation room should be kept at a minimum.

See attachment #3.

B. Discharge Planning

Continuation of therapy is an essential element of discharge planning.

Included should be:

1. Appointment with provider for follow-up care.
2. Sufficient medication to take until follow up appointment.
3. Placement into local health department program for anti-TB directly observed therapy, where indicated.
4. Discharge into facility with TB isolation capabilities or home

environment without persons at high risk of contracting active TB (HIV positive, immunocompromised, or children less than five years old.)

VI. Exposure Control:

A. Patient Surveillance and Management

1. Hospital waiting rooms, convenience care waiting areas, other areas of the hospital, or other work places where infectious persons may collect on an outpatient, emergency or ambulatory care basis, staff will be trained to identify TB symptoms and instructed to isolate suspected cases of active TB until a more complete diagnosis can be made. (See Section IV.A.)

B. Engineering Controls

1. All confirmed or probable infectious TB patients admitted to the hospital, will be placed in respiratory isolation rooms with negative pressure air flow. (Room 401 or Room 402).
 - a. Isolation rooms will have at least 6 total air exchanges an hour, all is outside air.
 - b. The direction of air flow is towards the patient and away from the caregiver.
 - c. Air is exhausted directly to the outside through an approved and properly monitored HEPA filter (located in the penthouse).
 - d. Lights on the wall by the sink in the vestibule is on, indicating that the exhaust system, in the patient rooms, is working. If the

lights are off, call plant engineering immediately.

2. Use of booths, hoods, tents or other devices for containing droplet nuclei at the source shall be used whenever possible.
 - a. This is mandatory during cough inducing procedures.
3. Work practice controls
 - a. Procedure specific precautions should be followed for cough inducing or aerosol generating procedures such as sputum induction, administration of aerosolized medications, bronchoscopy, endotracheal intubation or suctioning.
 - b. Warning signs should be placed outside isolation rooms. The signs should include what precautions should be taken before entering the room. Signs should also direct ventilation and other maintenance and repair mechanics to the proper hospital authority for instruction in case of an emergency call.
 - c. When a patient who may have infectious tuberculosis must be transported outside the isolation room, he or she should wear surgical mask. The transport personnel do not need respiratory protection.
4. Maintenance and review of controls
 - a. Plant engineering will be responsible for routine inspection and maintenance of engineering controls.

- b. Plant engineering will be responsible to measure air exchanges at least every 6 months.
- c. Determination of air flow will be done daily, when a probable or confirmed TB patient occupies either isolation room. 4 East personnel will do this in the following manner:
 - i. Direction of air flow is required to be from corridor into vestibule and from vestibule into both patient rooms.
 - ii. Place smoke tube near bottom of door.
 - iii. Small amount of smoke is expelled by squeezing the bulb.
 - iv. Direction of smoke travel is noted. Under negative pressure, smoke will move into the room. If not under negative pressure, smoke will be blown outward or stay stationary.
 - v. The smoke tube is to be held parallel to the door and done with the door closed.
 - vi. Smoke is to be expelled slowly so the velocity of the smoke from the tube does not overpower the air velocity.
 - vii. This test must be done on the corridor side of the door between the corridor and the vestibule and on the vestibule side of the doors between the patient rooms and the vestibule.
 - viii. The equipment for this testing is purchased by 4 East and will be housed there.

- ix. When the isolation room is occupied by a probable or confirmed TB patient, the test for air flow is done daily, is recorded and signed off on the sheets provided. (See attachment #4). These will be routed to safety department after the patient is discharged.
 - d. Air flow will be measured by plant engineering by use of an air measuring device (i.e., a velometer, flowhood). This will be done every six months, in January and June. A record of these checks and the results will be kept in plant engineering. A copy of these records will be routed to the safety department at the end of each calendar year.
5. Personal protective equipment consists of PAPR respirator use. Employees must be instructed in the use of these respirators. (See Respiratory Protection Plan p. 69 in Safety Manual).

VII. Respiratory Protection:

A. PAPR Respirators

- 1. All employees entering the isolation room or working directly with suspected or confirmed TB cases are to wear PAPR respirators. See Attachments #5. Only those employees who are in identified high risk groups and have been instructed on the use of PAPR respirator, will be allowed in negative-pressure rooms or to work directly with TB patients.

- a. These high risk groups have been identified and designated as the following involved in direct patient care:

4 East Staff	ASC/Recovery Room
Respiratory Therapy	ICU/CCU
Cardiopulmonary	Emergency Department
Endoscopy	Housekeeping on 4 East
X-Ray	Hospice
Home Health	Morgue
Laboratory (specimen collectors)	
Float Nursing Personnel	
Plant Engineers monitoring negative pressure rooms.	
Employee Physicians	
Non-Employee Physicians (optional by personal choice)	

2. PAPR respirators are located in these departments: (Power packs are numbered)
- a. 4 East - 3, packs #1, 2, & 3
 - b. Respiratory - 1, #9, (Turbo Unit)
 - c. Emergency Department - 2, #7 & 8
 - d. CP&D - 3, packs #4, 5, & 6
3. PAPR respirators do not require individual fit testing or medical clearance.

4. Hoods to PAPR respirators may be reused multiple times by the same individual. They are to be discarded as general waste when the hood becomes visibly soiled, moist, or physically damaged.
5. Individual disposable hoods to PAPR respirators which are reused, will be labeled and stored individually in a plastic bag in a clean, dry area. Hoods are to be labeled with employee's name and are not to be used by any other employee or person.
6. O.R. personnel cannot use Air-Mate HEPA 12 PAPR, during operative procedures. The Sterile View by DePuy will be used in OR.

VIII. Outbreak Management:

- A. A response plan for outbreaks includes:
 1. Identification of all potentially exposed individuals and notification of such individuals in a timely manner that they may have sustained an exposure. (See attachment 6).
 2. Training and information covering the nature of the outbreak and the risk of infection will be given to those involved.
 3. Offering all affected individuals TB screening free of charge.
 4. Compliance with the post-exposure management section of this document.
 5. Implementation of any controls that can prevent further exposure to employees.

IX. Post-exposure Management:

- A. Give Mantoux if none completed within the last month.
- B. If the Mantoux results are negative, repeat 8 weeks post-exposure.
- C. If Mantoux results are positive, refer to physician who will follow guidelines issued by CDC or department of health. (Report positives to health department.)
- D. Employees tested will receive confidential counseling, which includes:
 - 1. Risks of further complications
 - 2. Present options
 - 3. Alternate work placement

X. HCW TB Education/Training and Training Records:

- A. All HCW receive training and education appropriate to their job upon hiring and annually thereafter.
 - 1. Training and Education.
 - a. About disease:
 - 1) Signs and symptoms of TB infections
 - i. Cough, hemoptysis, weakness, weight loss, malaise, night sweats, shortness of breath, difficulty breathing, chills, fever.
 - 2) The distinction between TB disease and TB infection.
 - 3) The purpose and interpretation of TB skin testing, including the significance of a skin test conversion.

- 4) Methods for diagnosing cases of TB
 - i. PPD test
 - ii. CXR
 - iii. Sputum examination (AFB smears and cultures)
 - 5) Explanation of anergy testing for immune-compromised persons and false negative PPD readings.
 - 6) Procedures to prevent transmission of TB.
 - 7) The purpose of preventive therapy, the current drugs used for treating TB infection and disease, and the side-effects of these drugs.
 - 8) The causes of drug resistance and the importance of completing treatment.
 - 9) The link between immunocompromised status, including HIV infection, and TB, and the facility's policy on providing alternative work assignments to those who may be at increased risk of acquiring TB.
-
2. Explanation of the exposure control plan and how to obtain a copy.
 3. Department specific protocols, including the reporting mechanism of the signs and symptoms.
 4. Information on how to recognize tasks or areas that might increase the risk of occupational exposure.

5. Engineering controls in use in the person's work area.
 6. Procedures for proper marking, labeling and packaging of cultures sent through the mail to testing facilities.
 7. The use and limitations of personal protective equipment (PAPR respirators).
- B. Education and training is provided by infection control nurse, occupational health and safety nurse or education for sections X:A.1, a. 1 - 9, A - 2, A - 4, A - 7. Education provided by department directors or supervisors - A - 3, A - 5, A - 6.
- C. Training records are kept by human resources for a period of three years.
- XI. Counseling and Screening/Medical Recordkeeping:
- A. Screening
1. Montana Administrative rules direct all health care facilities monitor their employees for tuberculosis.
 2. Tuberculosis screening is to be performed on all employees at the time of hire and annually thereafter. Persons who have not had a previously positive TB skin test should have testing performed using the Mantoux test method. Any person who has had a previous positive TB skin test reaction should not receive skin testing. Yearly Mantoux testing is done on all employees and volunteers in birthday month. (See Annual TB Screening Policy: this Manual).
 3. Tuberculosis screening is performed at no cost to the employee.

4. Procedures for those not complying with Mantoux requirements.
 - a. See Columbus Hospital Employee Personnel Handbook, page 14,
Section B. Disciplinary Methods:
 - 1) Oral Warning
 - 2) Written Warning
 - 3) Suspension
 - 4) Termination

B. PPD Test Conversion

1. The HCW is evaluated by their private physician, for active TB.
 - a. History, physical examination, CXR. Sputum examination may be indicated based initial evaluation.
2. The HCW is placed on preventive therapy, as determined by their private physician, based on current guidelines.
3. History of possible exposure is obtained, if MDR-TB, treatment may vary.
4. Problem evaluation of source will be conducted, if possible, and record kept in employees health file. (See attachment #6).
5. HCWs suspicious for active TB are not returned to work until TB is excluded or the HCW is on adequate therapy and is documented non-infectious.
6. The local health department is notified by lab, infection control nurse,

physicians, or occupational health and safety nurse as required by state law.

C. Counseling

- a. Infection control nurse or occupational health and safety nurse counsels all healthcare workers regarding TB and TB infection.

D. HCW's Medical Records

1. All results of skin testing, medical evaluation and treatments are in employee medical files in the occupational health department.
2. All TB infections and disease of employees will go in OSHA 200 log.
3. Records of employees exposed to patients with DR or MDR-TB will be kept, with the strain the employee was exposed to.
4. These cases will be reviewed initially and at least annually by Infectious Disease Committee, occupational health, and Safety Committee to determine effectiveness of the hospital's TB program.
5. These records are kept for employment plus 30 years.

XII. Medical Removal:

- A. Employees who are immunocompromised are at increased risk of acquiring active tuberculosis if infected. Therefore, upon physician recommendation, the employee should be able to elect to be excused from direct care of TB patients, removed or transferred to a low-risk job.
- B. Employee confidentiality should not be breached. The employer must maintain the earnings, seniority and other employment rights and benefits of

an employee as though the employee had not been removed from potential exposure to TB.

C. Anti-discrimination:

1. Employees must be protected from being forced to work under conditions which their training has taught them may put them at risk of acquiring TB infection. (See Appendix G for TB exposure control plan attachments)

Summary

The written exposure plan was finalized and distributed in January 1995. The majority of recommendations in the CDC Guidelines (1994b) were already in place at Columbus Hospital or put into place with the exposure control plan. The hospital remodeled two private rooms on the medical floor into negative pressure isolation rooms in February 1995. The isolation rooms were the largest and most costly project the hospital had to complete for compliance. The hospital began two-step PPD testing of all new employees and volunteers in January 1995. The hospital installed portable HEPA air filtration units in the outpatient admission/emergency room waiting area and the radiology department waiting area. The use of positive pressure HEPA respirators for personnel working directly with suspected or confirmed TB patients began in March 1995. The administration was supportive of any request for change made by the author and the appropriate committees, to be in compliance with the recommendations.

There have been no documented employee PPD conversions in 1995 as of October 1995. The hospital admitted two patients who ultimately were diagnosed as active TB cases. In each instance, some degree of unprotected exposure of employees to these patients occurred prior to isolation. In the following exposure investigation, there were no PPD conversions by exposed employees. Hopefully, these incidents will provide supporting evidence that the measures instituted by the hospital have resulted in increased protection for employees. The exposure control plan has become a formal guide and source of information and direction for the hospital's administration and personnel.

Implications and Recommendations

The written exposure control plan, TB education, and resulting changes in practice have heightened the hospital staff's awareness to the problems in the United States and Montana with increasing incidence of TB. The staff have begun to question the possibility of TB in patients with similar presenting symptoms and have initiated actions to protect themselves and other patients until TB is ruled out. The staff has been supportive overall of the changes, realizing that the goal is protection for them against TB infection.

The hospital plans to remodel one suite in the endoscopy unit into a negative pressure room. The hospital planned on constructing two negative/positive pressure rooms in the intensive care/cardiac care unit, when this unit was scheduled for remodeling. This project is on hold pending the outcome of merger negotiations

between Columbus Hospital and Montana Deaconess Medical Center, another acute-care facility in Great Falls.

The exposure control plan will be reviewed annually and changed to reflect any changes in practice or further recommendations by the CDC.

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APPENDICES

APPENDIX A

MODEL PULMONARY TUBERCULOSIS
EXPOSURE CONTROL PLAN

Terri Peterschick
MSU Graduate Student
3631 7th Avenue South
Great Falls, MT 59405

Montana Chapter of APIC
President and Members

September 20, 1995

Dear Julie Bushmaker:

I am a graduate student at MSU-Bozeman. My professional project paper has been to write a TB exposure control plan. The plan written was patterned after your chapters document "Model Pulmonary Tuberculosis Exposure Control Plan". I am asking for written permission to have your document reproduced in the final project paper.

Thank-you for your consideration.

Sincerely,

Terri Peterschick, BSN RN

September 25, 1995

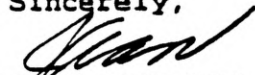
Ms. Terri Peterschick
MSU Graduate Student
3631 7th Avenue South
Great Falls, MT 59405

Dear Terri:

The Montana APIC Chapter has voted to allow you permission to reproduce the "Model TB Control Plan", in your final project paper for MSU.

We wish you success with your education and your TB Exposure Control Plan.

Sincerely,



JEAN FASTENAU
Risk Management Consultant
Montana APIC Chapter Secretary

MONTANA APIC CHAPTER
MODEL
PULMONARY TUBERCULOSIS EXPOSURE CONTROL PLAN

PURPOSE: The intent of the Mycobacterium Tuberculosis Exposure Control Plan at _____ (facility name) _____ is to provide early detection and treatment of persons with active pulmonary TB and to protect the health care workers in the facility.

POLICY: _____ (facility name) _____ provides administrative controls, engineering controls, education, personal protective equipment, and medical follow-up to employees to reduce the potential for transmission of airborne pathogens.

I. RESPONSIBILITY	NAME\POSITION\TITLE
- Design of TB Plan	_____
- Education\training coordinator	_____
- Engineering controls to include daily monitoring of room when in use	_____
- TB screening of employees follow-up post\exposure	_____
- Placement of patients in respiratory precautions	_____
- Discontinuing respiratory precautions	_____
- Oversee use of work practice controls	_____
- Identification/Notification of tuberculosis isolates	_____

All healthcare workers are responsible for knowing and following current guidelines for isolation precautions, detection, reporting, and follow-up of TB exposure.

II. HIERARCHY OF CONTROLS

A. Assessment of Endemic Risk of TB*

1. _____ (facility name) _____ treats (circle one) fewer than/more than six (6) active TB cases per year as inpatients: having _____ (#) _____ in 19(yr) and _____ (#) _____ in 19(yr).
2. The seroconversion rate among employees is (circle one) no higher/higher than in groups without occupational exposure to TB.
3. There have been _____ (#) _____ clusters of PPD test conversions.

- a. 19(yr) (#) conversions
 b. 19(yr) (#) conversions

(A cluster is defined as two or more PPD conversions among persons in one area or in a single occupational group that works in multiple areas within a three month period.)

4. There is (circle one) no evidence/evidence of patient to patient or patient to Healthcare Worker (HCW) transmission.

* Reference: TB Risk Assessment

5. Drug susceptibility patterns of TB seen in the facility. (If there is infectious tuberculosis identified in your facility, attach a summary of the drug susceptibility pattern.)

III. Early Detection of Patients with Symptoms of Tuberculosis

A. Symptom screen for each patient

Consider a TB diagnosis in any patient with:

- persistent cough > 2 weeks duration
- bloody sputum observed or reported
- night sweats
- weight loss
- anorexia
- fever

B. Known high risk persons, include:

- Native Americans
- S. E. Asians
- recent immigrant
- history of HIV positivity
- homeless persons
- correctional facility resident
- history of substance abuse

- C. When clinical symptoms are present, the attending physicians should be alerted to a possibility of TB and consulted concerning the patient need to be placed in the negative pressure room. If there are further questions, contact the _____ (designate title responsible) _____.

IV. Management of Patients with Possible Infectious TB

The (designate title responsible) may initiate isolation precautions for TB, monitor compliance, and discontinue isolation, based on current guidelines of practice.

A. Management of Out-Patients:

1. Provide patient with a surgical mask, box of tissues and instructions to cover mouth when coughing, sneezing, etc.
2. Place patient in separate waiting area or TB isolation room.
3. Promptly initiate TB precautions if symptoms suspicious of TB.

B. Management of In-Patients:

The following specific precautions are to be implemented for preventing tuberculosis exposure:

1. The patient is to be placed in a private room with negative air pressure. The door is to be kept closed except for entering and leaving the room.
2. Anyone entering the room must wear an approved particulate respirator. Visitors are to be limited to the immediate family/significant others. If a particulate respirator is not tolerated, visitors must wear a dust/mist/fume/ mask that fits snugly over the nose and mouth.
3. The patient must be instructed to completely cover their nose and mouth with tissues during coughing and sneezing. Used masks and tissues are considered general waste and disposed of as general waste.
4. Any employee performing a high risk procedure (aerosolized medication treatments, bronchoscopy, sputum inductions, endotracheal intubation, suctioning procedures and autopsy) need to wear approved particulate respirators.
5. Staff entering room are limited to essential care givers. Whenever possible, cross training is implemented.

6. If the patient must leave the room for other tests, they must wear a valveless approved particulate respirator if tolerated or a dust/mist/fume mask that completely covers the nose and mouth.

C. Removal of TB Precautions:

1. Patients with TB will remain in isolation until 3 consecutive, induced, sputum smears for AFB are negative.
2. Three negative culture results.
3. Other etiologic agent found for patient's condition.
4. Physician indicates effective treatment in progress and symptoms have abated.
5. Outpatient status started.

V. Patient Education

A. Patient/Family Education

The patient remains in a private room with negative pressure. Patient should be instructed to cover mouth with tissue when coughing or sneezing. A mask should be worn by the patient if leaving the room. Avoid having the patient wait in common waiting area by scheduling appointments. Persons entering the negative pressure isolation room should be kept at a minimum.

B. Discharge Planning

Continuation of therapy is an essential element of discharge planning. Included should be:

1. Appointment with provider for follow-up care.
2. Sufficient medication to take until follow-up appointment.
3. Placement into local health department program for TB.
4. Discharge into facility with TB isolation or home environment without

persons at high risk of active TB (HIV positive, immunocompromised, or children less than 5 years old.)

VI. Respiratory Protection

A. Particulate Respiratory Masks

1. All persons entering the room are to wear approved particulate respirators, i.e. Hepa mask.
2. Particulate masks are located (where) .
3. Particulate respirators require individual fit testing and medical clearance by (responsible doctors title).
4. Disposable particulate respirators may be reused multiple times by the same individual. They are to be discarded as general waste when the mask becomes visibly soiled, moist, physically damaged or difficult to breath through.
5. Individual, disposable masks which are reused are to be labeled and stored individually in a paper bag in a clean, dry area.

VII. Counseling and Screening/Medical Recordkeeping

A. Screening

1. Montana Administrative rules direct all health care facilities monitor their employees for tuberculosis.
2. Tuberculosis screening is to be performed on all employees at the time of hire and annually thereafter. Persons who have not had a previously positive TB skin test should have testing performed using the Mantoux test method. Any person who has had a previous positive TB skin test reaction should not receive skin testing.
3. Tuberculosis screening is performed at no cost to the employee.

B. PPD Test Conversion

1. The HCW us evluated promptly for active TB
 - a. History, physical examination, CXR. Sputum examination may be

indicated based on initial evaluation.

2. The HCW is placed on preventative therapy based on current guidelines.
3. History of possible exposure is obtained, if MDR-TB treatment may vary.
4. Problem evaluation of source will be conducted if possible.
5. HCW's suspicious for active TB are not returned to work until TB is excluded or the HCW is on adequate therapy and is documented non-infectious.
6. The local health department is notified by (responsible title) as required by state law.

C. Counseling

1. (title) counsels all healthcare workers regarding TB and TB infection.

D. HCW's Medical Records

1. Medical Records will be kept (responsible title/dept) for the duration of employment plus thirty years.

E. HCW TB Education/Training and Training Records

1. All HCW receive training and education appropriate to their job upon hiring and annually thereafter.
2. Education includes:
 - epidemiology of tuberculosis
 - signs and symptoms of tuberculosis
 - purpose and proper use of control measures
 - respiratory protection training effective for TB prevention
 - medical surveillance and therapy
3. Education and training is provided by (responsible title).
4. Training records are kept by (responsible title/dept) for a period for three years.

APPENDIX B
INFECTIOUS DISEASE COMMITTEE MEMBERSHIP

INFECTIOUS DISEASE COMMITTEE MEMBERS 1994

- | | |
|---|--|
| 1. R.A. Geyer, D.O., Chairman | 9. Rick Mink, Vice President of Support Services |
| 2. C.M. Reichert, M.D.
Department of Pathology | 10. Robin Martn, Medical Staff Secretary |
| 3. D.E. Swift, M.D. | 11. Lynn Williamson, Laboratory |
| 4. T.B. Addison, M.D. | 12. Kathy Lehman, RN Nursing Service |
| 5. L.K. Scott, M.D.
Emergency Department | 13. Karin Bushaw, Pharmacy |
| 6. Pam Webb, RN Infection Control | 14. Barney Ellis, Plant Engineering |
| 7. Terri Peterschick, RN
Occupational Health | 15. Ruth Eldridge, RN Central Processing |
| 8. Mary Jo Mattocks, Vice President of Nursing | 16. Jim O'Brien, Respiratory Therapy |

APPENDIX C
RESPIRATORS



NEGATIVE
PRESSURE
HEPA
RESPIRATOR

POSITIVE PRESSURE →
HEPA RESPIRATOR



APPENDIX D
GENERAL TB CLASS OUTLINE

TB Training outline, Jan. 1995, 9 sessions

First Hour: All Staff

PRE-TEST

Introduction: Self

- why all attend
- new standard
- who will need to stay
- what about all the hand-outs

- A) Movie: Tuberculosis: Prevention and Practices for Healthcare Workers, by Medcom, 22 minutes
1. Basic Concepts
 - a. what is TB
 - b. signs and symptoms of TB
 - c. PPD testing how done, reading
 - d. transmission
 - e. infection vs active TB
 2. HIV infected persons
 3. MDR-TB
 - a. briefly-medications for MDR-TB
 4. Preventing transmission
 5. Rapid diagnosis
 6. Anergy, very briefly
 7. Isolation rooms
 8. Health care workers screening
 - a. outbreak investigation

QUESTIONS

- B) Written TB Exposure Control Plan (Overheads of Plan)
1. Written policies
 2. PPD testing policy
 - participation and consequences of not
 3. Medical evaluation
 4. Notifying hosp if dx with TB, employees
 5. Work reassignment

QUESTIONS

- C) Hand-outs from CDC, pp. 1-15
- | | |
|---|----------|
| 1. TB general information | Page 1&2 |
| 2. Screening for TB | 3&4 |
| 3. Infection vs TB disease | 5 |
| 4. Diagnosis of infection vs active disease | 6, 7&8 |
| 5. Treatment of TB infection, Preventive therapy, prophylaxis | 9&10 |
| 6. Treatment of TB disease | 11-14 |
| 7. BCG vaccine | 15 |
- Need to cover #'s 5, 6, & 7. Use overheads of pages 9, 10, 11, 12, 13, 14 and 15.

QUESTIONS

REVIEW THE TEST

(overhead of test)

HAND IN EVALUATIONS

APPENDIX E
GENERAL TB CLASS SCHEDULE



Columbus Hospital

Established in 1892 by Sisters of Providence

500 15TH AVENUE SOUTH · P.O. BOX 5013
GREAT FALLS, MONTANA 59403 (406) 727-3333

Memo

To: All Department Directors
All Staff
Administration

From: Terri Peterschick, Safety Officer

Date: December 27, 1994

Re: Mandatory Tuberculosis (TB) Training

=====

To comply with recently published Centers for Disease Control (CDC) guidelines on prevention of TB transmission to healthcare workers, the following classes are mandatory. There are many sessions and times to allow all employees to attend. The following are times and dates:

<u>DATE</u>	<u>TIME</u>	<u>PLACE</u>
Monday Jan. 1	07:30 to 09:30	Lewis and Clark
	14:00 to 16:00	Lewis and Clark
Monday Jan. 9	07:30 to 09:30	Lewis and Clark
Wednesday Jan. 11	09:00 to 11:00	Lewis and Clark
	14:00 to 16:00	Lewis and Clark
Friday Jan. 13	09:00 to 11:00	Lewis and Clark
Monday Jan. 16	07:30 to 09:30	Lewis and Clark
	13:00 to 15:00	Lewis and Clark
Thursday Jan. 19	16:00 to 18:00	Clark
Friday Jan. 20	09:00 to 11:00	Lewis and Clark
Monday Jan. 30	16:00 to 18:00	Clark

APPENDIX F

RESPIRATORY PROTECTION CLASS SCHEDULE



**Columbus
Hospital**

Established in 1892 by Sisters of Providence

500 15TH AVENUE SOUTH · P.O. BOX 5013
GREAT FALLS, MONTANA 59403 (406) 727-3333

Memo

**To: Appropriate Department Directors
Staff Working Directly With Known or Suspected TB Patients**

From: Terri Peterschick, Safety Officer

Date: March 15, 1995

**Re: Respirator Training for Staff Working With Known or Suspected
TB Patients**

=====

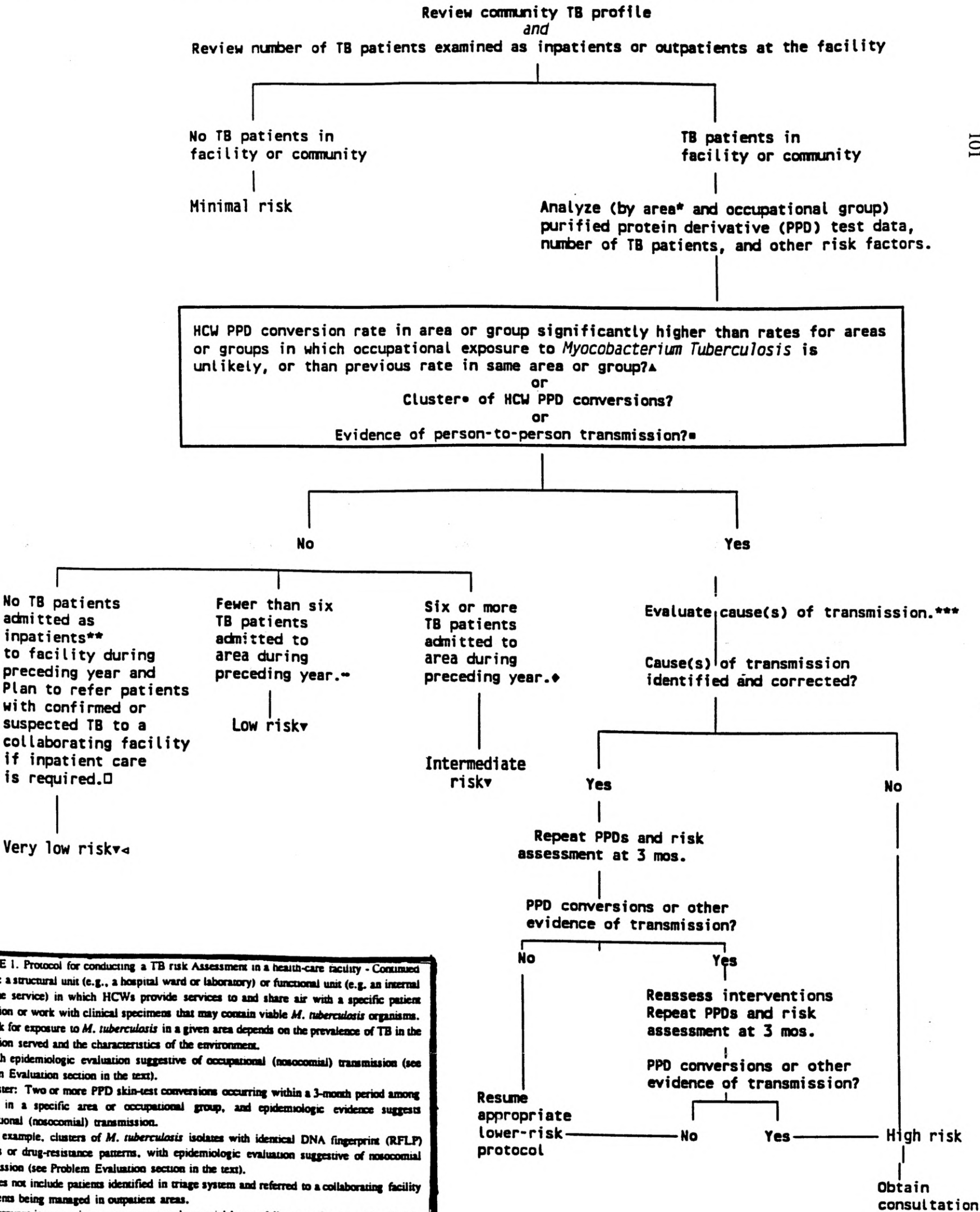
This training is for all those employees that will work directly with known or suspected TB patients and will be expected to wear the Powered Air Purifying Respirators (PAPR's). The class is scheduled for 1 hour sessions. The training includes review of the written Respiratory Protection Program, use and maintenance of the PAPR's, checking for appropriate hood size, and time for hands on. The groups of employees needing training are those designated high risk outlined on Page 7 and 8 in the TB Exposure Control Plan located in the Infection Control Manual. These sessions are being held in the Lewis Room and it can hold 36 people maximum. We will keep each session to this size and go by first come first in. There are 10 sessions planned at different times for convenience. No employee whom has not attended these training sessions will be allowed to use these respirators. Please call ext. 5612 for questions on who should attend or other topics.

LEWIS ROOM	<u>DATE</u>	<u>TIMES</u>
	Wednesday March 29	09:00 to 10:00 10:00 to 11:00 14:00 to 15:00 15:00 to 16:00
	Thursday April 20	07:30 to 08:30 09:00 to 10:00
	Monday April 24	07:30 to 08:30 09:00 to 10:00 14:00 to 15:00

APPENDIX G

ATTACHMENTS TO WRITTEN TB EXPOSURE CONTROL PLAN

ATTACHMENT 1: FIGURE 1: Protocol for conducting a tuberculosis (TB) risk assessment in a health-care facility.



ATTACHMENT #2**HOW TO COLLECT A SPUTUM SAMPLE**

Your doctor has ordered tests to be done on your sputum. The tests can help find out if there is any bacteria present, and if needed, help your doctor choose the right medication. Follow these guidelines to help you collect a sputum sample.

1. It is best to get a sputum sample when you wake up. Try to be away from other people when coughing and getting sample.
2. Open container lid.
3. Rinse your mouth with water.
4. Take three (3) deep breaths.
5. After your third deep breath, cough hard. Try to bring up sputum from deep in your lungs. **Do not hold sputum in mouth.**
6. Spit directly into the sterile cup. At least one (1) one teaspoon of sputum is needed. Try not to touch the inside of cup or inside of lid with your hands.
7. Place lid on cup. If a patient is in the hospital, let the nurse know as soon as you have a sample. If at home, keep sample refrigerated until you bring the sample to Columbus Hospital as soon as you can.

Talk with your nurse if you have any questions or need help with your sputum sample.

ATTACHMENT #3

RESPIRATORY ISOLATION GUIDE

Your doctor has ordered that you be placed in a special private room. You may have an illness that can be given to others by small droplets that come from your lungs when you talk, laugh, or especially when you sneeze or cough. You will stay in isolation until your doctor says it is no longer needed. You can help with your care by following isolation guidelines:

1. The door is kept closed at all times.
2. Stay in your room except when you need to leave for tests.
3. When you leave your room for tests, the nurse will give you a mask to wear. Wear the mask at all times.
4. When doctors, nurses, and your family and friends come into your room, they will wear a special mask. You do not need to wear a mask in your room.
5. Cover your mouth and nose with tissue when you sneeze or cough. Throw away used tissue into a waste bag or can.
6. To protect your family and friends, visit by phone until your doctor(s) tell you it is safe.

For any questions, talk with your doctor, nurse, or ask to talk with the Infection Control Nurse.

[illegible]

ROUTE TO SAFETY DEPARTMENT WHEN PATIENT IS DISCHARGED

ATTACHMENT #5

POWERED AIR-PURIFYING RESPIRATORS (PAPR)

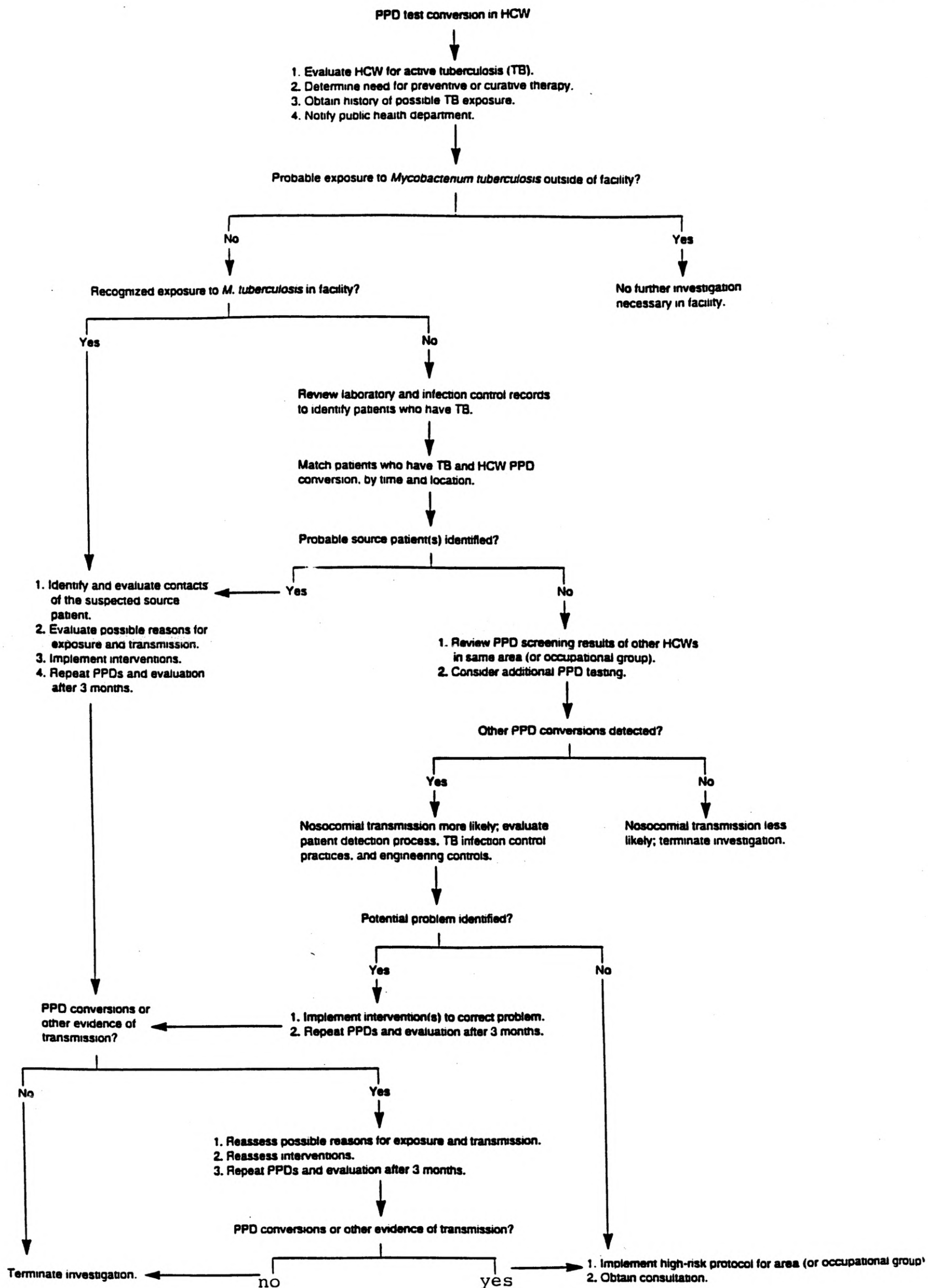
1. Obtain all needed parts of systems:
 - a. hood
 - b. breathing tube
 - c. HEPA air filter/power pack
 - d. belt
2. Connect hose to power pack and personal hood (large-blue or regular-white).
3. Put power pack around waist with belt. Power pack should be on back.
4. Put on hood, adjust so that internal head piece is at the middle of the forehead.
5. Turn on to make sure power pack is working. Will feel constant stream of air from top of head to release holes in hood below chin.

IMPORTANT:

- **LEAVE CONTAMINATED AREA IMMEDIATELY IF DIZZINESS OR OTHER DISTRESS OCCURS!**
- **IF AIR STREAM IN HOOD EVER STOPS, HOLD BREATH AND LEAVE THE AREA (AROUND THE PATIENT) IMMEDIATELY.**

Protocol for Investigating PPD Skin-test Conversions

Attachment 6



Centers for Disease Control and Prevention, Atlanta.

INFECTION CONTROL MANUAL

DEPARTMENT: INFECTION CONTROL/EMPLOYEE HEALTH	POLICY #
SUBJECT: ANNUAL TB SCREENING	PAGE 1 OF 2
APPROVED BY: Infectious Disease Committee	EFFECTIVE: June, 1994
	SUPERSEDES: July, 1991
REFERENCE: CDC Guidelines for Preventing Transmission of TB in Healthcare Facilities Fed. Reg., Vol 59, pg. 208	REVIEW: <u>Oct, 1994</u>

I. POLICY:

To comply with state regulations, each employee is required to show documentation of freedom from communicable tuberculosis prior to employment and yearly within two months of their birthday. Failure to complete the annual TB screening may be cause for discharge.

II. PROCEDURE:

A. Initial Hire:

1. On the day of hire, the Human Resource Department notified the employee to report to the Infection Control/Employee Health Department for Mantoux testing or chest x-ray evaluation. The employee may report to the Emergency Room for testing if the Infection Control/Employee Health Nurse is not available.

Mantoux Testing:

1. An employee who has never had a positive skin reaction or who has never been tested, receives 0.1 ml of tuberculin purified protein derivative (Mantoux) intradermally.
2. The employee must return to the Infection Control/Employee Health Department (or in applicable cases, to the Emergency Room) within 48-72 hours to have the Mantoux test read.
3. If the new employee had not had a negative PPD result within the last 12 months, repeat Mantoux PPD test in 1 - 3 weeks.
4. If the initial Mantoux test is positive, the employee must:
 - a. Complete the TB risk questionnaire and return it to the Employee Health/Infection Control Department.
 - b. Have a chest x-ray immediately (no cost to employee).
 - c. See his/her physician for evaluation (employee responsible for cost).

BEFORE THE EMPLOYEE CAN REPORT FOR WORK, HE/SHE MUST BE EVALUATED BY HIS/HER PHYSICIAN AND SHOW DOCUMENTATION THAT HE/SHE IS FREE FROM COMMUNICABLE TUBERCULOSIS AND HAS BEGUN CHEMOTHERAPY IF WARRANTED.

Infection Control Policy - Annual TB Screening

Page 2

Chest X-ray:

1. An employee who has a history of positive skin reaction (i.e., positive Mantoux):
 - a. Complete the TB risk questionnaire and return it to the Employee Health/Infection Control Department.
 - b. Have a chest x-ray (no cost to employee).
2. For an abnormal chest x-ray, the employee must be evaluated and show documentation that he/she is free from communicable tuberculosis by his/her physician before he/she can report for work. Compare with previous chest x-ray if available.

B. Annual Evaluation:

1. Prior to annual mandatory inservices ("Birthday Review") each month the Education Department will send each department director a list of employees who need to complete their annual TB screening.
2. Employees requiring Mantoux testing will report to the immunization clinic at the Infection Control/Employee Health office. Immunization clinic is usually scheduled for the Monday prior to "Birthday Review." For off-shift employees, Mantoux testing may be done in the Emergency Room.
 - a. Mantoux results are read on the day of "Birthday Review." If results are positive, the employee must:
 - 1) Complete the TB risk questionnaire
 - 2) Have a chest x-ray immediately (no cost to employee)
 - 3) See his/her physician for evaluation
 - 4) Send documentation to Infection Control/Employee Health Department from evaluating physician stating he/she is free from communicable tuberculosis and has begun chemotherapy if warranted
 - 5) Complete an employee incident report and send to the Employee Health Department.
3. The Human Resources Department will send a TB risk questionnaire to employees who have had a positive skin test (Mantoux). The employee will fill out the TB risk questionnaire and return it to the Employee Health/Infection Control office for evaluation. The Employee Health or Infection Control Nurse may order a CXR but annual x-rays are not recommended unless the employee is symptomatic.

Consultation:

The Employee Health Nurse or the Infection Control Nurse will consult with the Infectious Disease Committee chairman or other physician members of the ID Committee, the ER physician, or the Public Health Department for recommendations if needed.

**EMPLOYEE ANNUAL T.B. RISK QUESTIONNAIRE
PROCEDURE FOR POSITIVE SKIN TEST REACTORS**

NAME: _____ SS #: _____ AGE: _____

A. NEW EMPLOYEES:

Report to the Infection Control/Employee Health Office with the following questions answered:

- 1) Date of positive skin test: _____
- 2) Date of last chest X-ray: _____
Result: _____
- 3) Chemoprophylaxis: Yes ___ No ___
Dates from _____ to _____

B. ALL EMPLOYEES:

- | | | |
|--|--------------------------|--------------------------|
| 1) Do any of the following exist: | YES | NO |
| a) X-ray indicative of tuberculosis infection | ☐ | ☐ |
| b) History of exposure to a communicable case of tuberculosis within the previous 2 years. | ☐ | ☐ |
| c) Negative skin test within the last 2 years. | ☐ | ☐ |
| d) Severe or poorly controlled diabetes. | ☐ | ☐ |
| e) Immunologic deficiencies. | ☐ | ☐ |
| f) Immunosuppressive therapy. | ☐ | ☐ |
| g) Chronic obstructive pulmonary disease. | ☐ | ☐ |
| h) Gastrectomy. | ☐ | ☐ |
| i) Renal transplantation. | ☐ | ☐ |
| j) Ileal bypass surgery for obesity. | ☐ | ☐ |
| 2) Have you experienced any of the following in the past 12 months? | YES | NO |
| a) Fever, chills, night sweats. | ☐ | ☐ |
| b) Chronic cough. | ☐ | ☐ |
| c) Unexplained fatigue. | ☐ | ☐ |
| d) Unexplained rapid weight loss. | ☐ | ☐ |

REPORT ANY OF THESE SYMPTOMS TO OCCUPATIONAL HEALTH/INFECTION CONTROL IF EXPERIENCED DURING THE NEXT YEAR.

Employee Signature/Date
(Bring or route to Employee Health)

FOLLOW UP ACTION: _____

COMMENTS: _____

I have reviewed this employee's health history and find him/her free of signs of active tuberculosis.

ICN/OHN Signature/Date