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MEDICAL SECTION OF THE AMERICAN LUNG ASSOCIATION

CONTROL OF TUBERCULOSIS IN THE UNITED STATES[1]

Contents

THIS OFFICIAL ATS STATEMENT WAS ADOPTED BY THE ATS BOARD OF DIRECTORS, MARCH 1992. THIS IS A JOINT STATEMENT OF THE ATS, THE AMERICAN ACADEMY OF PEDIATRICS, THE CENTERS FOR DISEASE CONTROL, AND THE INFECTIOUS DISEASE SOCIETY OF AMERICA.

Introduction

Historically the American Thoracic Society (ATS) and the Centers for Disease Control (CDC) have provided guidance on the diagnosis, treatment, prevention, and control of tuberculosis (TB) in the United States and Canada. The ATS-CDC recommendations on TB are contained, for the most part, in three official joint statements: "Diagnostic Standards and Classification of Tuberculosis," "Treatment of Tuberculosis and Tuberculosis Infection in Adults and Children," and "Control of Tuberculosis." In contrast to the "Diagnostic Standards" and "Treatment" statements, which emphasize individual patient management, this "Control Statement" emphasizes the public health aspects of TB control. Because the epidemiology of TB in the United States is changing and the technology applicable to the diagnosis, treatment, and control of TB continues to evolve, it is necessary to periodically revise these statements.

The Infectious Diseases Society of America and the American Academy of Pediatrics have joined ATS and CDC in the development of this statement.

This revision has been made in recognition of the fact that new populations at risk for developing TB, such as persons with human immunodeficiency virus (HIV) infection, have been identified, necessitating new strategies for control. In the past several years, a number of outbreaks of multidrug-resistant TB (MDR TB) have been reported in a variety of settings, including hospitals where HIV-infected persons receive treatment and correctional facilities, highlighting the need for a more aggressive approach to TB control in such settings. In addition, the secretary of Health and Human Services has endorsed a national plan for the elimination of TB from the United States which calls for a rate of one case per million of the population by the year 2010. The first phase of this plan calls for an intensification of current prevention and control strategies.

It is the aim of this document to provide guidance for establishing TB prevention, control, and elimination activities. This guidance is intended for persons working in state, city, and county TB control programs; other health department or hospital outpatient programs, such as refugee programs, sexually transmitted disease clinics, HIV clinics; acute-care and extended-health care facilities; correctional facilities; substance abuse treatment programs; shelters for the homeless; day-care centers; and other institutions. It should also benefit individual health care providers caring for persons with or at high risk for TB.

Detailed recommendations for TB control in specific populations, such as correctional institutions, have been developed by the Advisory Council for Elimination of Tuberculosis (ACET), a national advisory committee to the secretary of Health and Human Services, and the Division of Tuberculosis Elimination, CDC. These guidelines are published in *Morbidity and Mortality Weekly Reports* (see Appendix for a complete list of guidelines). In addition, a listing of documents or articles containing more detailed information on topics covered in this statement may be found in the SUGGESTED READINGS section.

Current Epidemiology of Tuberculosis in the United States

In 1991, the number of reported cases of TB in the United States was 26,283—an increase of 2% compared with the previous year. Although there had been an annual decline of approximately 5% in the number of TB cases since the 1950s and a 6 to 7% annual decline in cases during the years 1981 to 1984, in 1985 to 1991 the number of cases increased by 18%. Using the trend for 1981 to 1984 to estimate the expected number of cases for 1985 to 1991, it can be calculated that more than 39,000 excess cases of TB occurred between 1985 and 1991 (figure 1). The occurrence of TB among persons with HIV infection is a major factor contributing to this change in the decades-long pattern of decline of TB.

Through 1990, matching of TB and the acquired immunodeficiency syndrome (AIDS) registries for 152,441 AIDS cases reported in the United States revealed that 4.3% were infected with TB. Patients with TB and AIDS have been predominantly young men, and a

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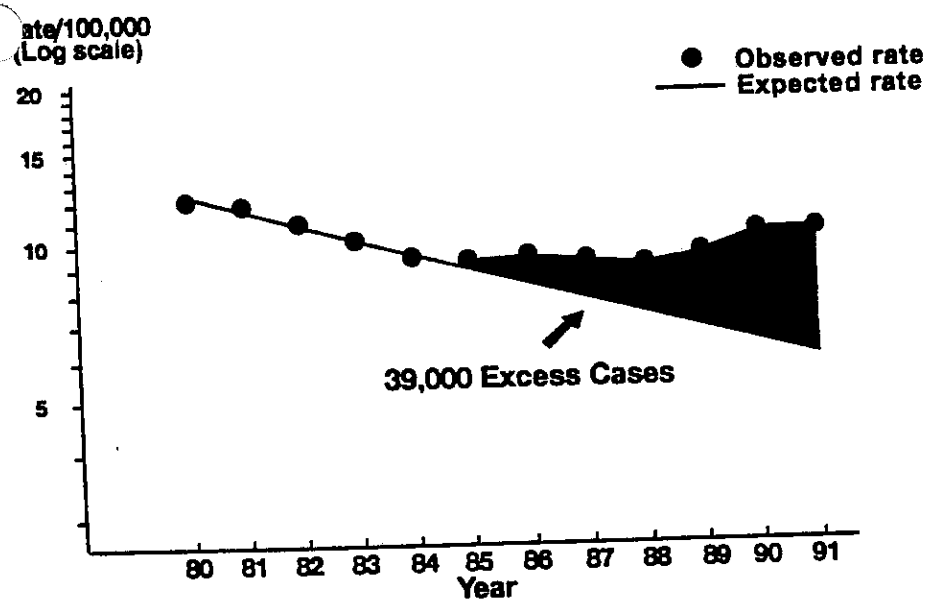

Fig. 1. Expected and observed tuberculosis cases in the United States from 1980 through 1991.

high proportion have been black or Hispanic. The major risk behavior for acquisition of HIV infection in patients with TB and HIV infection has been injecting drug use, but TB has occurred in persons from all HIV transmission categories. HIV seroprevalence surveys in selected metropolitan TB clinics have revealed that among U.S.-born TB patients the median clinic HIV seropositivity rate was 11%, with some TB clinics reporting seroprevalence rates as high as 57% among U.S.-born patients.

Studies of untreated TB patients have shown 4- to 5-yr case fatality rates of approximately 50%. Chemotherapy has helped reduce the mortality rate by 94% since 1953. In 1989, the most recent year for which final mortality data are available, the death rate was 0.8 per 100,000, with 1,970 deaths recorded. The death rate from TB has remained stable since 1984. Case fatality rates increase with increasing age, and are higher in blacks than in whites, and in persons with underlying medical conditions, such as cancer and HIV infection. In addition, death rates are higher among patients with TB caused by drug-resistant organisms.

More than two-thirds of reported TB cases now occur among nonwhite racial and ethnic groups. Compared with non-Hispanic whites, the overall risk of TB is five times higher among Hispanics, five times higher among Native Americans and Alaskan Natives, eight times higher among blacks, and 10 times higher among Asians and Pacific Islanders. Nearly one-quarter of all cases in the United States occur in foreign-born persons. Others at high risk for TB include persons with HIV infection, substance abusers, low-income populations, residents of correctional facilities and nursing homes, and persons with certain medical risk factors. It is noteworthy that nearly one-third of the cases of TB in the United States occur in persons in the middle- and upper-income groups, contradicting the popular notion that TB is a problem only of the poor.

When we examine the trend from 1985 through 1991 by age, the largest increase in TB cases in any age group occurred in the 25- to 44-yr-old cohort. Cases in this group increased by 52%, and occurred largely among non-Hispanic blacks and Hispanics. There was also a 19% increase in cases among 0- to 4-yr-olds and a 40% increase among children aged 5 to 14 yr.

A majority of the cases reported annually in the United States arises from the pool of persons who have been infected in the remote past. In the United States, the number of such persons with latent infection is estimated to be between 10 and 15 million. Within the infected population there are groups at varying risk for disease. To achieve significant progress toward reducing the number of future cases and deaths of TB, it will be necessary to identify high-risk groups, screen them for the presence of tuberculous infection and tuberculosis, and provide appropriate therapy to those with infection and disease.

Identifying Persons with Clinically Active Tuberculosis

Diagnostic Methods

The key to making the diagnosis of TB in a timely manner is (*1*) to suspect the disease in any person with signs or symptoms compatible with the disease, and (*2*) to obtain appropriate specimens for bacteriologic and histologic examination. Among the clinical findings that suggest TB are cough, hemoptysis, weight loss, fatigue, night sweats, and fever. Depending upon the location of the disease, specimens from a variety of sites may be appropriate to examine, including sputum, bronchial washings, lung tissue, lymph node tissue, bone marrow, liver, blood, urine, stool, and cerebrospinal fluid.

Although tuberculin skin testing should be routinely performed in all individuals suspected of having clinically active TB, its usefulness is limited by false-negative reactions, especially in immunosuppressed individuals such as those with HIV infection. The intracutaneous administration of 5 U of purified protein derivative (PPD) tuberculin (Mantoux test) is the preferred method.

Persons with symptoms suggestive of pulmonary TB (eg, cough, hemoptysis) should receive a chest radiograph regardless of the skin test results. If abnormalities are noted or if the person has symptoms suggestive of extrapulmonary TB, additional diagnostic studies should be undertaken. These may include histologic staining and mycobacterial culture of sputum, other respiratory secretions, and a variety of biopsy specimens and body fluids. Drug susceptibility studies should be performed routinely on all positive cultures.

Although tuberculin testing is the standard method for screening asymptomatic populations for TB and tuberculous infection, chest radiography or sputum smear examinations are the initial screening method of choice when the objective is to rapidly identify persons with clinically active disease. These include situations in which the tuberculin skin test results may be unreliable, when application and reading of the test may be impractical, and/or when the consequences of an undiagnosed case may be severe. For example, because elderly persons living in long-term care facilities are at particularly high risk of developing TB and may be anergic, all patients admitted to such facilities should have a recent chest radiograph. Sputum smear examinations and culture for mycobacteria should be performed on those with signs and/or symptoms such as chronic cough, "bronchitis," weight loss, or unexplained fever, regardless of chest radiograph findings. Similar considerations may be applied in screening persons with HIV infection who may be anergic (particularly those in institutional settings). Chest radiography may be the screening method of choice in jails or shelters for the homeless, where the time required to apply and read the tuberculin skin test on large numbers of transient persons makes this method impractical.

Case Finding

Evaluation of contacts to cases of infectious TB is one of the most productive methods of finding persons with disease (and infection). Among medically evaluated contacts in 78 areas of the United States during 1990, the rate of clinically active TB was 700 per 100,000 persons. Contact investigations are usually performed by the staff of health department TB control programs, although hospital infection control officers and staff of correctional institutions and long-term care facilities may also conduct such investi-

gations. A detailed description of how to perform a contact investigation is described subsequently.

In situations when the prevalence of TB is extremely high, such as in some homeless populations or certain immigrant or refugee populations from areas with a high prevalence of TB, or when the consequences of an undiagnosed case of TB are severe, such as residential facilities for HIV-infected persons, correctional facilities, and nursing homes, routine screening to identify persons with disease is justifiable.

Most persons with TB are identified because they seek medical care for symptoms caused by the disease. In addition, persons already receiving health care for another condition may be found to have concurrent TB. Thus, patients themselves and providers of primary health care are among the most important finders of TB. Because the manifestations of TB are protean and nonspecific, health-care providers must maintain a high index of suspicion for TB, especially in those populations that are at greatest risk. A review of current literature reveals that excess morbidity and mortality from TB is occurring because the diagnosis of the disease is frequently not considered or is considered too late.

Performing a Contact Investigation

Contacts of persons with infectious TB are at high risk of infection and disease. The risk to contacts is related to factors pertaining to the infectiousness of the source case, the characteristics of the contact, and the environment they share. Many factors interact to influence the transmission of infectious particles (droplet nuclei) from the source patient to the contact.

As soon as the diagnosis of TB in the source case is strongly suspected on laboratory and/or clinical bases, investigation of contacts should begin. This requires close coordination between the health department and hospitals or other institutions so that as soon as there is a positive smear or other strong evidence that a patient has TB, the contact interview can take place. Health-care personnel should not wait for positive cultures if the history and other clinical findings are suggestive of TB.

Although prompt contact investigation has always been desirable, under the circumstances that prevail currently, speed in evaluation of contacts is essential. In HIV-infected contacts who acquire a new tuberculous infection, clinically active disease can occur very rapidly; intervals as short as 20 days have been described. Moreover, in many areas, the highest risk groups may have impermanent residences. Such groups include the homeless who move from shelter to shelter, injecting drug users, and migrant workers. For these reasons, rapid notification of health department personnel, and prompt and thorough contact identification and evaluation are the keys to successful contact investigation.

Contact investigations should involve as few steps as possible and should be designed to identify persons with disease as well as those with tuberculous infection. Evaluations should be conducted at the convenience of the contact with, for example, tuberculin testing or sputum collection being performed in the field, and patients being transported for radiographic or other examinations.

Because of the differences in the behavior of tuberculous infection in contacts with HIV infection, knowledge of the contact's HIV status would alter the approach both to investigation and to the use of preventive therapy. For this reason, appropriate counseling and HIV testing of contacts if their status is not known is advisable.

Development of Transmission Probability Data

When a source case has been identified, the appropriate procedure in a contact investigation entails the development of a data base and an evaluation of each of the factors noted subsequently. These data are usually gathered by interviewing the source patient and by reviewing relevant medical and laboratory records. A visit to the source patient's home, place of employment, or both will usually be necessary to assemble a satisfactory initial data base.

Source patient characteristics influencing transmission. Any person who is generating aerosolized particles containing tubercle bacilli is a transmitter of *Mycobacterium tuberculosis.* The presence of acid-fast bacilli in the sputum smear is the main indicator of a potential for transmission. Other source patient characteristics that increase the probability of transmission are as follows: positive sputum culture for *M. tuberculosis*; presence of cavitation in the chest radiograph; presence of TB laryngitis; presence of cough (cough-inducing procedures such as bronchoscopy, endotracheal suctioning, and aerosolized pentamidine treatment may contribute to transmission); unwillingness or inability of the source case to cover his or her cough; high volume and watery respiratory secretions; forceful exhalation (eg, singing or shouting); prolonged duration of respiratory symptoms; inadequate anti-TB chemotherapy.

While most of these characteristics pertain to source patients with pulmonary or laryngeal TB, droplet nuclei containing tubercle bacilli may rarely be generated from procedures that produce aerosols from infected soft tissues.

Environmental characteristics influencing transmission. Air is the vehicle by which the droplet nucleus containing tubercle bacilli is transported from the source patient to susceptible persons. The greater the concentration of these droplet nuclei in air shared by the source patient and his or her associates, the greater the risk to these contacts. The following factors alter the concentration of infectious particles in the air: (*1*) The volume of air common to the source patient and contact. If low, the concentration of infectious particles is increased (eg, as in sharing a small room). (*2*) The degree of ventilation with outside air. Fresh air dilutes the concentration of potentially infectious droplets. (*3*) The degree of air recirculation. A high degree of air recirculation (as may occur in hospitals and other structures with closed-circuit heating and cooling systems) may result in the accumulation of high concentrations of infectious particles because droplet nuclei remain suspended in the air. (*4*) The presence of ultraviolet (UV) light fixtures. Irradiation of the upper air within the shared space may reduce the spread of infection by killing the tubercle bacilli contained in the droplet nuclei. (*5*) The presence of high efficiency particulate air (HEPA) filters. These filters placed within air ducts are capable of removing airborne particulates the size of droplet nuclei. The benefits of HEPA are limited by cost considerations and the amount of air that can be moved past the filters without unacceptable noise or drafts.

Contact characteristics influencing transmission. Persons who have recently shared air with the source patient should be considered potentially infected contacts. The following factors influence the risk of infection for these persons: (*1*) increased time in association with the source patient, which increases the probability of infection; (*2*) physical closeness between the source patient and the contact may increase the likelihood of infection; (*3*) preventive therapy for TB taken by the contact at the time of exposure reduces the infection risk (an example of primary prevention); (*4*) prior infection with *M. tuberculosis*, as indicated by a significant tuberculin skin-test reaction before exposure to the identified source case, reduces risk; (*5*) host factors, such as the contact's age, race, and immunologic status, can affect the likelihood of becoming infected.

Structuring a Contact Investigation

Establishment of priorities. The estimated probability of transmission, based on the information described previously and a determination of the consequences of infection should it occur, should influence the priority and rapidity with which a contact investigation is conducted.

Classification of contacts. For each source patient, the contact investigation should proceed in an orderly manner, starting with persons who are most likely to have been infected. Members of the immediate family or others who have recently shared the same indoor environment with the source patient for prolonged periods are commonly called close contacts. Contacts with less exposure are designated other than close contacts.

Establishing Limits for Contact Investigations

The infectiousness of the source patient can be determined by initially evaluating the close contacts for evidence of tuberculous infection and/or disease. The following are guide-

lines for limiting the extent of a contact investigation: (*1*) Initiate the investigation with close contacts. If there is no evidence of recent transmission of infection in this group, extending the investigation is usually not appropriate. However, priorities of the investigation should also be based on the consequences of infection in the contact. For example, infection in a newborn or in an HIV-infected person could lead to rapid development of disseminated disease. Therefore, such individuals merit evaluation, regardless of their degree of exposure. (*2*) If data indicate recent infection in the close contacts, extend the limits of investigation to progressively lower-risk contacts until the levels of infection detected approximate the levels of infection in the local community. (*3*) At each stage of the investigation, establish the number and identity of contacts to be examined. Establishing such a denominator helps to assure that no contact who should be examined is missed.

Once contacts have been identified, a diagnostic evaluation including medical history, tuberculin skin test, and, if indicated, chest radiograph and sputum examination should be performed. Contacts with evidence of clinical disease should be placed on an appropriate multidrug treatment regimen.

Contacts with a tuberculin reaction ≥ 5 mm should receive a chest radiograph; those without evidence of clinical disease should be evaluated for preventive therapy. Persons with an initial tuberculin reaction < 5 mm should receive a chest radiograph and be considered for preventive therapy if (*1*) circumstances suggest a high probability of infection, (*2*) evaluation of other contacts with a similar degree of exposure demonstrates a high prevalence of infection, or (*3*) the contact is a child, adolescent, or is immunosuppressed (eg, infected with HIV). Contacts who are initially skin-test negative should receive a repeat tuberculin skin test 10 to 12 wk after the initial test. If the repeat skin test remains negative and contact with the source case has been broken, preventive therapy may be stopped. If the repeat tuberculin test is positive, a chest radiograph should be obtained to exclude disease. If there is no evidence of disease, a full course of preventive therapy should be given. If the repeat tuberculin test is negative, no further evaluation is indicated for persons with normal immunity. Contacts with HIV infection should be considered for preventive therapy, regardless of tuberculin skin test results.

Controlling Transmission of Tuberculosis

Treatment of Persons with Clinically Active Tuberculosis

The preferred regimen for treatment of active TB includes an initial course of daily isoniazid (INH), rifampin (RIF), and pyrazinamide (PZA) for 2 months (induction phase), followed by a continuation phase of INH and RIF for 4 months, for a total duration of 6 months in most cases. Ethambutol (EMB) or streptomycin (SM) should be included in the initial regimen until drug susceptibility studies are available, unless there is little possibility of primary resistance to isoniazid. Patients with disease due to drug-resistant organisms, coexisting HIV infection, or inability to take one or more of the previously listed drugs will require a longer duration of therapy and may require additional drugs. All patients with TB should be offered appropriate counseling and HIV-antibody testing.

With adequate chemotherapy, almost all patients with organisms susceptible to the primary antituberculous drugs (INH, RIF, PZA, EMB, and SM) will become bacteriologically negative, recover, and remain well. More than 90% of patients taking the 6-month regimen will have bacteriologically negative sputum within 3 months. Among those completing anti-TB treatment regimens prescribed, > 95% of immunocompetent patients treated for the first time will be treated successfully, provided that they are fully compliant with the prescribed regimen. For most patients who have successfully completed treatment, routine follow-up examinations for TB are unnecessary.

Treatment for disease due to drug-resistant organisms is more difficult, more toxic, more expensive, and not as successful. Surgery is rarely indicated, but may play a role, particularly in treating well-localized disease due to drug-resistant organisms.

Whether a patient should have his or her normal activities restricted, and the duration of those restrictions, depends upon the estimated degree of infectiousness, the response to treatment, the nature of the activities, and who will be exposed to him or her in the course of those activities. Some patients are never infectious and have no need for restrictions. Many patients who are infectious can remain at home with those in the household who have already been exposed, as it has been shown that the risk of additional transmission of infection in this setting is extremely low. These patients may also be able to continue normal activities (eg, work) if the environment in which those activities takes place is not conducive to transmission and there is little risk of exposure of new and/or highly susceptible contacts. For example, a patient who works predominantly outdoors would require little or no work restriction compared with a health-care provider who works in a closed indoor environment with susceptible persons.

When a patient with infectious TB is hospitalized, appropriate infection control precautions, including acid-fast bacillus (AFB) isolation, should be followed to protect employees and other patients from infection. These must be maintained until the patient is judged to be noninfectious. Although the exact point at which a patient becomes noninfectious is difficult to define, most patients with disease due to drug-susceptible organisms become noninfectious very rapidly after chemotherapy is started—within several days to a few weeks. Evidence such as decreased cough, a sputum smear with fewer AFB (for patients with pulmonary TB), and improvement in other signs and symptoms, such as absence of fever and improved appetite, indicate that the patient has become much less infectious. AFB isolation precautions can be discontinued for such patients, and they can either be discharged or transferred to a private room. Three properly performed negative sputum smear examinations on properly collected specimens on separate days in a patient on anti-TB therapy indicate an extremely low potential for transmission of infection, and a negative culture virtually assures there is no potential for transmission. Patients with infectious TB should at a minimum have a negative sputum smear for AFB before being placed in indoor environments conducive to transmission, such as shelters for the homeless, or in settings where highly susceptible persons, such as those with HIV infection, will be exposed.

When a patient fails to respond to treatment as expected, or if the response is not sustained, the cause of this treatment failure should be thoroughly investigated and the need for restriction of activities, including AFB isolation, should be reevaluated. Continuing transmission of infection can occur if restrictions, including AFB isolation, are prematurely discontinued or not reinstituted for patients who fail to respond to therapy. Common reasons for a failure to respond to therapy are patient noncompliance with therapy and ineffective therapy for drug-resistant disease. Recently, several nosocomial and community outbreaks of MDR TB have occurred; these outbreaks were due in part to the failure to institute, or the premature discontinuation of, isolation precautions for MDR TB patients who were being treated with drugs to which their organisms were resistant.

Diagnostic and treatment services for TB should be available to all persons in need of such care without consideration of the patient's ability to pay. Generation of third-party support for TB services is desirable, but the administrative process of billing third parties should not become a barrier to patient care. TB care can be provided by a variety of sources in the community, both private and public, including individual practitioners, health department clinics, community health clinics and migrant health centers, correctional facilities, hospitals, hospices, long-term care facilities, and shelters. Regardless of who provides medical care, health department TB control programs play an important role in providing free medication and laboratory services, documenting the patient's response to therapy, and providing supervision of therapy whenever necessary.

It is important for all health-care workers caring for patients with TB, regardless of the clinical setting, to be knowledgeable about how TB is transmitted and to implement

measures to minimize the risk of transmission within the health-care facility.

Environmental Aspects of Infection Control for Tuberculosis

The Concentration of Droplet Nuclei and the Risk of Infection

As described previously, the probability of TB transmission is a function of the concentration of infectious droplet nuclei in room air and the duration of exposure. Droplet nuclei remain suspended in air for prolonged periods and are rapidly distributed within the available space by room air currents and the building's ventilation system. Therefore, droplet nuclei containing virulent tubercle bacilli remain a potential source of infection within indoor environments until they are removed, diluted, or otherwise inactivated.

There is great variation in the concentrations of droplet nuclei generated by various patients, estimated to range from as low as one per 11,000 ft^3 to as high as one per 70 ft^3 of air for a highly infectious patient. Because humans inhale about 18 ft^3/hour, the probability of a person becoming infected during a 1-h exposure can thus be estimated to range between one in four and one in 600. Therefore, although months of exposure are usually required for infection to occur, under extraordinary circumstances, when the concentration of droplet nuclei has been much higher, extensive transmission has been observed during exposures as brief as 2 h.

Air disinfection entails removing or inactivating infectious droplet nuclei, or diluting the concentration with outside air. When the concentration of droplet nuclei is already low, removing just one infectious droplet nucleus by ventilation may require exhausting as much as 11,000 ft^3 of room air. Even to substantially dilute the concentration of droplet nuclei, large volumes of outside air may be needed. Furthermore, as the concentration of droplet nuclei is reduced by ventilation, ever larger volumes of outside air are required to further reduce their concentration. However, the volume of ventilation that can be achieved is limited in practice by noise, discomfort, cost, and design factors. Therefore, although adequate room ventilation can reduce the chance of TB transmission, it cannot eliminate the risk entirely.

Source Control

Because it is difficult to remove droplet nuclei, or dilute their concentration in room air, it is far better to prevent their introduction into air at the source. Case finding and effective TB treatment is the ultimate form of source control. Patients can further assist in source control by covering the nose and mouth when coughing or sneezing. Larger respiratory droplets that might become droplet nuclei are thus stopped at their source. Patients unable to cooperate in covering coughs and sneezes can wear ordinary surgical masks for short periods, for example, while being transported within institutions. For longer periods, masks on patients are stigmatizing, uncomfortable, and probably ineffective. Because masks on patients serve more as a physical barrier than as a filter, stopping large droplets like a hand or a tissue, their fit and filtration properties may be less critical than for masks used as personal protection.

In addition, persons with symptoms consistent with clinically active infectious TB should be placed in an AFB isolation room before the diagnosis is certain, until there is objective evidence that they are unlikely to be contagious. Air from adjacent rooms and corridors must flow into, not out of, AFB isolation rooms ("negative pressure"), and exhaust air must not be recirculated to other rooms or vented outside to sites near air intakes. Six room air changes per hour, at least two of which are outside air, have been recommended for AFB isolation rooms.

Cough-producing procedures such as pentamidine aerosol treatments and diagnostic sputum inductions have been associated with TB transmission. Because clinically active TB cannot be reliably excluded before each procedure, it is recommended that these procedures be performed in booths or isolation rooms occupied by the patient alone. Several complete and partial enclosures marketed for this purpose use HEPA filters to obviate the need to exhaust large volumes of air to the outside. A small, well-ventilated room can be used for these procedures, but personnel may be exposed when they enter such a room to attend to patients. Bronchoscopy is another cough-producing procedure that may contribute to TB transmission. If TB is a diagnostic possibility and bronchoscopy is required, it should be performed in a room designed to meet AFB isolation specifications. It should not be performed in an operating room that is designed with positive air pressure relative to adjacent areas—that is, where air moves from the room into the corridor. All personnel in bronchoscopy rooms and in rooms where other cough-inducing procedures are taking place should wear specialized face masks known as disposable particulate respirators (PR) (see following).

Ventilation

The concentration of infectious droplet nuclei within a building depends on the rate at which they are introduced by the source case, their volume of distribution within the building, and the rate at which they are removed, inactivated, or diluted by the introduction of outside air. A highly variable amount of outside air enters most free-standing homes and older buildings in the United States by infiltration through leaks and open windows. In newer buildings, which depend upon mechanical ventilation systems, most of the air is recirculated. In such buildings, only a small, variable volume of mixed air is exhausted to the outside and is replaced with an equal volume of outside air.

National ventilation standards require enough outside air to assure the comfort of most occupants and to keep the concentration of several common indoor pollutants at acceptably low levels. Unfortunately, a ventilation system may appear to be functioning well, effectively distributing a comfortable volume of cool, dehumidified air throughout a building, and still be recirculating high concentrations of infectious droplet nuclei. A critical element in assessing the risk of airborne infection, therefore, is the amount of outdoor air ventilation.

Supplemental Approaches

Health-care providers and visitors may be exposed to infectious droplet nuclei when they enter the isolation rooms of a patient with infectious TB. Therefore, all health-care providers and visitors entering such rooms should wear a well-fitting mask with filtration properties effective for droplet nuclei, ie, a disposable PR. Disposable PR look like the cup-shaped surgical masks that are widely used in hospitals. When worn correctly, disposable PR have a tighter face seal than surgical masks and less tendency for leakage of air around the sides. Disposable PR can provide increased protection against inhalation of particles as small as droplet nuclei. Ordinary surgical masks offer little or no such protection.

In institutions where TB is prevalent, other supplemental approaches may be considered. Two such approaches are germicidal UV irradiation and HEPA filtration. HEPA filters within air ducts are capable of almost completely removing airborne particulates the size of droplet nuclei. However, the benefits of HEPA filtration are limited by cost considerations and the amount of air that can be moved past the filters without unacceptable noise or drafts.

Germicidal UV radiation (254 nm wavelength) has been shown to inactivate virulent tubercle bacilli under experimental conditions, but its efficacy in reducing transmission in actual practice is unknown. Nevertheless, UV lamps have long been used in hospitals and laboratories. UV lamps can sometimes be fitted into return air ducts, thereby disinfecting air before it is recirculated. Like outside air and HEPA-filtered air, however, the ability of duct-irradiated air to reduce the concentration of droplet nuclei in a room has practical limitations. A greater effect is theoretically possible when upper room air is irradiated by overhead UV fixtures. However, because the effectiveness of overhead UV radiation is related to the volume of air between the fixtures and the ceiling, and because safety concerns dictate that the fixtures be placed no lower than 7 feet from the floor (to prevent people from bumping their heads), overhead UV air disinfection is often limited by the low ceiling height of many contemporary buildings. Proper installation and maintenance of UV fixtures is necessary to optimize effectiveness and minimize the risk of keratoconjunctivitis and er-

ythema of the skin due to direct exposure to fixtures mounted too low or from reflected UV from fixtures mounted too close to the ceiling.

UV air disinfection should not be used as a substitute for standard TB control practices, including source control, or ventilation with outside air. It is a supplemental intervention that may be appropriate for rooms where high-risk procedures are performed, isolation rooms, intensive care areas, emergency rooms, and waiting areas in institutions serving populations at high risk for TB.

Decontamination

With the exception of bronchoscopes and respiratory and anesthesia equipment, surface contamination with tubercle bacilli is not considered an important health risk for patients or health-care personnel. Equipment that could possibly introduce tubercle bacilli directly into the airways is generally sterilized or cleaned with a high-level disinfectant, whereas other environmental surfaces need only be cleaned with low-level disinfectants. The same routine daily cleaning procedures used in other hospital or facility rooms should be used to clean rooms of patients who are on AFB isolation precautions for TB.

Evaluation of Infection Control Practices in Institutions

Institutions in which persons at high risk for TB work, live, or receive care should periodically review their TB policies and procedures, and determine the actions necessary to minimize the risk of TB transmission in their particular settings. Specific actions to reduce the risk of TB transmission should include: screening patients or residents for active TB and tuberculous infection; providing rapid diagnostic services; prescribing appropriate curative and preventive therapy; providing AFB isolation rooms for persons with, or suspected of having, clinically active infectious TB; screening personnel for tuberculous infection and TB; promptly investigating and controlling outbreaks.

Periodic evaluations of the environmental aspects of TB control in institutions should be conducted. Health departments can assist in identifying technical experts for this purpose.

Data on the occurrence of TB and skin-test conversions among patients or residents and personnel in institutions should be collected and periodically analyzed to estimate the risk of TB transmission in the facility and to evaluate the effectiveness of infection-control practices. On the basis of this analysis, infection control practices may need to be modified and the frequency of skin-testing staff and residents may have to be altered.

Identifying Persons with Tuberculous Infection

Tuberculin Skin-Testing of High-Risk Groups

Identifying persons with tuberculous infection and providing preventive therapy when appropriate are critical to the control and elimination of TB. Certain groups have a higher incidence of TB than the general population because (*1*) the group has a higher prevalence of infection (eg, persons born in countries with a high prevalence of TB) or (*2*) the group has a higher risk of disease for any given prevalence of infection (eg, persons coinfected with tubercle bacilli and HIV). Table 1 lists the populations considered at high risk for TB in whom tuberculin testing is indicated.

Each health department should assess the prevalence, incidence, and sociodemographic characteristics of cases and infected persons in their community. On the basis of these data, tuberculin screening programs should be targeted to each community's high-risk groups. It is extremely important that these screening programs undergo regular evaluation of their usefulness. Moreover, screening should not be given preference over higher priority activities such as treatment and contact identification.

Screening in most groups noted previously is carried out by staff of health departments or other facilities, such as drug treatment programs, long-term care facilities, and correctional institutions. However, all health-care providers should be aware of the patients in their communities and practices who are in one of these high-risk categories, and should skin-test these individuals as part of their routine evaluation. Members of high-risk groups should be apprised of the problem of TB in their community and should be involved in the implementation of screening and prevention programs.

A negative tuberculin skin-test reaction in an HIV-infected or otherwise immunosuppressed person may represent a true negative or false negative due to anergy. Anergy testing may be helpful in distinguishing those who are truly tuberculin negative from those who are unable to respond to the skin test.

Frequency of Tuberculin Skin-testing

Individuals at high risk for TB should have a tuberculin skin test at least once to assess their need for preventive therapy and to alert the health-care providers of those with positive skin tests of this medical problem. In institutional settings, baseline information on the tuberculin status of staff and residents is a means of identifying candidates for preventive therapy as well as determining whether transmission of TB is occurring in the facility. For this reason, tuberculin skin-testing upon employment or upon entry should be mandatory for staff and residents of all facilities for long-term care.

The frequency of skin-testing for individuals in high-risk groups should be determined by the likelihood of exposure to infectious TB. For example, follow-up skin-testing should be conducted on at least an annual basis among the staffs of TB clinics, health-care facilities caring for patients with HIV infection, mycobacteriology laboratories, shelters for the homeless, nursing homes, substance-abuse treatment centers, dialysis units, and correctional institutions. Annual testing is recommended for children in high-risk populations, such as those born abroad and those in medically underserved low-income groups. Local health officials should make decisions on the frequency of tuberculin-testing by using locally generated data. All individuals should be retested if exposure to an infectious case occurs.

For adults who will be screened periodically (eg, staff of TB clinics) use of the two-step procedure for initial skin-testing should be considered. This involves applying an initial skin test and then retesting within 1 to 3 wk for those initially negative. This second test is to identify those who demonstrate "boosting" after the second test, and to avoid the possibility that such individuals would be considered "recent converters" on subsequent testing. Decisions concerning the use of the two-step procedure should be made on the basis of data on the frequency of boosting in a particular institution.

Persons found to be tuberculin-positive should have a chest radiograph to rule out clinically active TB or to detect the presence of fibrotic lesions suggestive of old, healed TB or silicosis; persons with these conditions should receive multidrug therapy. Once these conditions are ruled out, however, follow-up skin tests and chest radiographs for persons

TABLE 1

PERSONS IN WHOM TUBERCULIN SKIN-TESTING IS INDICATED

1. Persons with signs, symptoms (cough, hemoptysis, weight loss, etc.), and/or laboratory abnormalities (eg, radiographic abnormality) suggestive of clinically active TB.
2. Recent contacts of persons known to have or suspected of having clinically active TB.
3. Persons with HIV infection.
4. Persons with abnormal chest roentgenograms compatible with past TB.
5. Persons with other medical conditions that increase the risk of TB (silicosis, injecting drug use, diabetes mellitus, prolonged corticosteroid therapy, immunosuppressive therapy, some hematologic and reticuloendothelial diseases, end-stage renal disease, and clinical situations associated with rapid weight loss).
6. Groups at high risk of recent infection with *M. tuberculosis*, such as immigrants from Asia, Africa, Latin America, and Oceania; medically underserved populations; personnel and long-term residents in some hospitals, nursing homes, mental institutions, and correctional facilities.

with a positive tuberculin skin test are unnecessary. Such persons should be offered preventive therapy, when appropriate, and should be instructed to seek medical attention should they experience symptoms suggestive of TB.

Prevention

Isoniazid Preventive Therapy

The appropriate use of preventive therapy for TB is critical to the control and elimination of TB in the United States. The main purpose of preventive therapy is to keep latent infection from progressing to clinically active TB (secondary prevention). Therefore, persons with positive tuberculin skin tests who do not have clinically active disease should be evaluated for preventive therapy. Preventive therapy may also be used to prevent initial infection (primary prevention).

When taken as prescribed, preventive therapy with INH is highly effective. In controlled trials conducted by the U.S. Public Health Service in ordinary clinical and public health settings, 12 months of INH preventive therapy reduced the incidence of disease by 54–88%. The main reason for the variation in efficacy appears to have been the amount of medication actually taken during the year in which INH was prescribed. In a trial conducted in eastern Europe among infected adults with abnormal chest radiographs, a 12-month course of INH preventive therapy was 75% effective among all persons assigned to the regimen and 93% effective among those who were compliant with therapy; a 6-month course of INH was 69% effective among those compliant with therapy. INH preventive therapy has been shown to be effective for long periods and to be relatively cost-effective when compared with preventive interventions for other diseases.

Despite its proven efficacy, preventive therapy is less widely applied in the United States than it should be. Reports submitted to the CDC by TB control programs in states and large cities indicate that < 60% of infected contacts of persons with newly diagnosed TB are being started on preventive therapy. In a study to determine why TB is not prevented, investigators found that although three-fourths of the TB patients surveyed had contact with a health-care provider within the 5 yr before diagnosis of TB, less than one-third of them had been tuberculin skin-tested, even though many had risk factors for TB. Of the persons who had positive skin tests and other factors placing them at increased risk of disease, only 5% had been offered preventive therapy.

Certain groups within the infected population are at greater risk than others and should receive high priority for preventive therapy (table 2). Persons infected with HIV or who are otherwise immunosuppressed, who have negative tuberculin skin-test reactions (ie, < 5 mm), may also need to be considered for INH preventive therapy based on the likelihood of infection with *M. tuberculosis*. Public health officials and other health-care providers should be alert for other persons in their communities who are high-priority candidates for preventive therapy. For example, tuberculin-positive staff of facilities in which an individual with clinically active TB would pose a risk to large numbers of susceptible persons, eg, day-care centers, should also be considered high-priority candidates for preventive therapy.

If otherwise indicated, preventive therapy should be offered to tuberculin-positive individuals, regardless of history of vaccination with bacille Calmette-Guerin (BCG).

The usual preventive therapy regimen is INH (10 mg/kg daily for children, up to a maximum adult dose of 300 mg daily). The recommended duration of INH preventive treatment varies from 6 to 12 months of continuous therapy. Twelve months is recommended for persons with HIV infection and other forms of immunosuppression. Other infected persons should receive a minimum of 6 continuous months of therapy. It is recommended that children receive 9 months of therapy. For persons at especially high risk of TB whose compliance is questionable, supervised preventive therapy may be indicated. When resources do not permit supervised daily therapy, INH may be given twice weekly at the dose of 15 mg/kg.

There are occasional situations in which alternative forms of preventive therapy might be desirable. Although other drugs might also be effective for preventive therapy, there are currently no data available documenting the clinical efficacy of any drug other than INH.

Patients should be thoroughly educated about signs and symptoms of toxicity to INH and should be monitored monthly by appropriately trained personnel. No more than a 1-month supply of medicine should be dispensed at any visit. If signs or symptoms of toxicity appear, INH should be stopped immediately and the patient should be reevaluated. INH preventive therapy should not be prescribed if monthly monitoring cannot be done.

Use of BCG Vaccination

Vaccination with BCG is not recommended for widespread use in the United States because of the low risk of infection in the general population, and because BCG vaccine has varied in effectiveness in eight major trials from zero to 76%. However, BCG vaccination is recommended for long-term protection of infants and children with negative tuberculin skin tests who are at high risk of continuing exposure to persons with infectious TB and who cannot be placed on long-term preventive therapy, or who are continuously exposed to persons with INH- and RIF-resistant disease. BCG vaccination should also be considered for tuberculin-negative infants and children in groups in which the rate of new infections exceeds 1%/yr and for whom the usual treatment and control programs are not effective. These groups include persons without regular access to health care, those for whom health care is culturally or socially unacceptable, and groups who have demonstrated an inability to use existing health care.

Compliance

Noncompliance with therapy is a major problem in TB control. To prevent relapses TB must be treated for many months—longer than many other infectious diseases. On the other hand, symptoms often disappear after

TABLE 2

HIGH PRIORITY CANDIDATES FOR TUBERCULOSIS PREVENTIVE THERAPY

Preventive therapy should be recommended for the following persons with a positive tuberculin test, regardless of age*:

- Persons with known or suspected HIV infection†
- Close contacts of persons with infectious clinically active TB†
- Recent tuberculin skin test converters (≥ 10 mm increase within a 2-yr period for those < 35 yr old; ≥ 15 mm increase for those ≥ 35 yr old). All children < 2 yr old with a > 10 mm skin test are included in this category.
- Persons with medical conditions that have been reported to increase the risk of TB (eg, diabetes mellitus, prolonged corticosteroid therapy, immunosuppressive therapy, some hematologic and reticuloendothelial diseases, injecting drug use, end-stage renal disease, and clinical situations associated with rapid weight loss).

Preventive therapy should be recommended for the following persons in high-incidence groups with a positive tuberculin test who are < 35 yr old and do not have additional risk factors‡:

- Non–U.S.-born persons from high-prevalence countries (eg, countries in Latin America, Asia, and Africa)
- Medically underserved low-income populations, including high-risk racial or ethnic populations, especially black, Hispanic, and Native American groups.
- Residents of facilities for long-term care (eg, correctional institutions, nursing homes, and mental institutions)

* Persons with fibrotic infiltrates on chest radiograph thought to represent old, healed TB and those with silicosis, who were formerly considered candidates for preventive therapy, should receive 4-month multidrug chemotherapy (See ATS/CDC Treatment Statement).

† Persons in these categories may be given preventive therapy in the absence of a positive tuberculin test in some circumstances.

‡ Staff of facilities in which an individual with current TB would pose a risk to large numbers of susceptible persons (eg, correctional institutions, nursing homes, mental institutions, other health-care facilities, schools, and child-care facilities, may also be considered for preventive therapy.

a few weeks of therapy and patients often discontinue therapy at that time. Compliance with preventive therapy is even more difficult to ensure as persons taking the medication do not have symptoms related to their infection. Furthermore, the concept of taking preventive medication may be unfamiliar or initially unacceptable to many individuals who are infected with TB.

Noncompliance can lead to treatment failure, drug resistance, continuing transmission of infection, increasing disability, and death. To prevent these outcomes, health-care providers must learn how to recognize, prevent, and manage noncompliant behavior.

Recognizing Noncompliant Behavior

Traditionally, health-care providers have attempted to predict compliance based on subjective judgments of behaviors or personality traits. This approach is not reliable. In assessing compliance, the response to therapy is helpful, and may be inferred by evaluating whether the patient's sputum has converted to negative and chest radiograph has improved (for patients with pulmonary TB) and if the signs and symptoms have disappeared. Patients who fail to keep their appointments and/or refill their prescriptions are, by definition, noncompliant. Conducting a pill count on home visits or clinic visits is an additional aid in assessing compliance. Asking about compliance in a nonthreatening manner may also be useful. All of these indirect measures have limitations and none should be used as the sole method of assessing compliance.

More direct measures can tell the health-care provider whether medications have actually been taken by a patient. These measures include the measurement of drugs or their metabolites in a sample of the patient's urine. Several simple methods for testing urine for the presence of major anti-TB drugs or their metabolites have been published. A quick glance at a patient's urine can detect compliance with taking RIF, as in most patients RIF turns urine an orange-red color. However, factors such as the time that RIF was taken before urination and the patient's rate of metabolizing the drug can affect the usefulness of this "observational" test.

Promoting Compliant Behavior

Consideration should be given to treating all patients with directly-observed therapy (DOT), which can be given on an intermittent schedule. DOT means observation of the patient by a health-care provider or other responsible person as the patient ingests anti-TB medications. DOT can be achieved with daily, twice-weekly, or thrice-weekly administration of medication. It may be administered to patients in the office or clinic setting, but is frequently given by a health department worker in the "field", ie, the patient's home, place of employment, school, or other mutually agreed-upon place. In some cases, staff of correctional facilities or drug treatment programs, home health-care workers, maternal and child health staff, or responsible community or family members may administer DOT.

There are many factors that can help promote compliance. The interval between the time of referral and the time of appointment should be kept to a minimum. Waiting time in an office or clinic should be minimized. The hours of office or clinic operation should be convenient for the patients, and the clinic or office should be easily accessible by public transportation or transportation services should be available to patients. Costs of clinic services should not be a barrier to receiving care. Clinic staff characteristics should be carefully assessed because patients may be more inclined to cooperate with staff they perceive as being similar to themselves, ie, of the same racial or ethnic group, the same socioeconomic status, etc.

The shortest possible treatment regimen should be used. To minimize the number of pills or capsules that must be taken, combined fixed-dose capsules (INH-RIF) should be used. Features of the patient's life-style, social support system, and health beliefs should be elicited in order to help design a treatment strategy that is tailored to the patient's needs.

Patient education is vital. The health-care provider must take the time to explain in simple language when and how much medication should be taken and assure that the explanation has been understood. Written instructions should also be provided. Pictures may be useful for illiterate patients. An interpreter may be required to communicate with those patients whose native language is not the same as that of the health-care provider.

An approach that may be useful is to assign a specific health department employee the responsibility for the education of the patient about TB and its treatment, thereby controlling the continuity of therapy and ensuring that contacts are examined. The health-care worker should visit the patient within 3 days of diagnosis to identify contacts and possible problems related to compliance with therapy.

Strategies to Manage Noncompliant Behavior

Patients who fail to keep an appointment should be contacted immediately, and the reason for this failure should be elicited. Measures to prevent further absences should be discussed.

Use of incentives and enablers may help restore compliance. Health departments have successfully used incentives, such as food and clothes to help previously noncompliant patients complete therapy. Enablers such as bus tokens and baby-sitting services may ensure that the patient can get to the clinic.

A small but increasing number of patients remain noncompliant despite the use of all the compliance-enhancing methods listed previously. Consideration should be given to confining these patients to a hospital or other institution for treatment. The exercise of this option depends on the existence of appropriate laws, cooperative court and law enforcement officials, and the availability of institutional care.

Data Collection and Analysis

In order to establish priorities for TB control activities, evaluation of the extent of the problem and of current activities should be conducted on a frequent basis by all institutions providing care to patients with or at risk of clinically active TB or tuberculous infection. To accomplish this, institutions should have ongoing surveillance systems, identifying and maintaining records on persons with TB and tuberculous infection, the demographic characteristics of these individuals, and the trends in disease and infection rates. Whatever the size or nature of the activity, each program should assess the efficacy of its activities and modify or abandon activities that are no longer productive.

Although data collected at all levels of the health-care system should be analyzed so that appropriate program adjustments can be made, the bulk of evaluation and assessment takes place at the health department. Reporting of all cases of clinically active TB is required by law in every state. Reporting makes the resources of the health department available to health-care providers and institutions to assist them in proper management of the case and in evaluation of contacts to the case. All new TB cases and suspect cases should be reported promptly to the health department by physicians or other health-care providers and by infection control practitioners in the hospital. Laboratories should promptly report all sputum smears positive for AFB, positive cultures, and instances of drug resistance. Pharmacy reporting of persons who receive a supply of anti-TB drugs may be useful. State and local health departments have different procedures for reporting TB and other infectious diseases. Health-care providers should familiarize themselves with these procedures. Health department staff should conduct periodic reviews of selected record systems (eg, laboratory reports, pharmacy reports, AIDS registries, and death certificates) to validate the surveillance system and to detect any failure to report cases.

Health department TB control programs should maintain a record system (case register) with up-to-date clinical and therapeutic information on all current clinically active and suspected TB cases in the community. Health-care providers attending to TB patients outside of the health department must provide the health department with current information on the clinical status of the patient, including the names of the patient's medications and the patient's bacteriologic status (eg, sputum smear and/or culture positive or negative). This information is important for the management of the patient and crucial for the control of transmission of disease in the community. Health department TB control programs should also maintain records on the

examination and treatment status of contacts to infectious cases of TB and other high-risk groups of infected persons, such as persons coinfected with TB and HIV.

Health department TB control programs as well as other programs such as hospital employee health units, correctional facilities, schools, and places of employment, should periodically review screening activities that are performed. Such programs should be evaluated in terms of productivity in identifying infected persons and in assuring that such persons are completing courses of preventive therapy when appropriate.

Another method of assessing TB control involves reviewing each new TB case and each death due to TB in order to determine whether the case or death could have been prevented. Based on such a review, new policies should be developed and implemented to reduce the number of preventable cases and deaths.

At least annually, health department TB control program staff should assess progress toward achievement of program objectives, and assemble and analyze morbidity and program management data. Based on these assessments health departments should prepare annual reports in collaboration with interested constituencies such as lung associations, community-based organizations, and professional societies. These reports should document the extent and nature of the TB problem in the area, assess the adequacy of prevention and control measures, and make recommendations for program improvements.

Other Functions of Tuberculosis Control Programs

Staff of TB control programs should monitor the level of knowledge about TB among health-care workers in their communities and identify training and educational needs. Health departments should work with local lung associations, local medical societies, and professional associations in meeting these training needs.

High-risk groups in the community should be educated about the signs and symptoms of TB and the methods of diagnosis, treatment, and prevention. This may be accomplished through coalitions between the health department, lung associations, and community groups.

Patients with clinically active TB and tuberculous infection may be cared for by health-care providers in a variety of settings. Ultimately, it is the responsibility of the state and local health department TB control program, however, to assure that the TB control program in the community is carried out. This supervisory function should encompass all TB control activities, including case finding and treatment, data collection and analysis, and training.

Summary

TB continues to be a major public health problem in many areas of the United States. Elimination of this disease will require coordinated efforts of public health agencies, voluntary health associations, health-care providers, and community groups.

TB control is comprised of a variety of activities. Identification and treatment of patients with clinically active disease should be the highest priority for all TB control programs. Identification and preventive treatment of infected contacts and persons with tuberculous infection at greatest risk for developing disease (eg, HIV-infected, young children) should also receive high priority. Attention should then be given to identifying other high-risk groups and administering preventive therapy to those infected.

While TB control occurs in many different settings, the health department TB control program plays a pivotal role in providing clinical services, and performing contact investigations, tuberculin-testing and prevention activities, surveillance, and evaluation of the community's overall progress in TB elimination. Health departments should receive strong and continuing support from medical care providers, voluntary health organizations, and community groups if TB elimination is to be achieved.

Glossary

Acid-fast bacilli (AFB) — Organisms that retain certain stains, even after being washed with acid alcohol. Most acid-fast organisms are mycobacteria. When seen on a stained smear of sputum or other clinical specimen, a diagnosis of tuberculosis should be considered.

Acid-fast bacilli (AFB) isolation precautions — Infection control procedures which should be applied when persons with known or suspected infectious tuberculosis are hospitalized or residing in other inpatient facilities. These precautions include the use of a private room with negative pressure in relation to surrounding areas and exhaust of air from the room directly to the outside. Not the same as "respiratory isolation," which calls for a private room, but does not require negative pressure and exhaust of room air to the outside.

Anergy — Inability to mount a delayed-type hypersensitivity response to one or several skin-test antigens as a result of immunosuppression due to disease (e.g., HIV infection) or immunosuppressive drugs.

Clinically active TB — Clinical and/or radiographic evidence of current tuberculosis. Established most definitively by isolation of *M. tuberculosis* on culture.

Compliance — Refers to the completion by patients of all aspects of the treatment regimen as prescribed by the medical provider.

Contact — An individual who has shared the same air space with a person with infectious tuberculosis for a sufficient period of time to make transmission of infection likely.

Containment — Stopping the spread of tuberculous infection. The primary methods of containment of tuberculosis are treatment of persons with disease, preventive treatment of persons with infection, and effective application of infection control measures.

Directly Observed Therapy — A compliance-enhancing strategy in which each dose of medication is given under the supervision of a health care worker or other responsible person.

Disposable Particulate Respirator (PR) — A face mask that is designed to fit snugly and to filter out particles in the droplet nuclei size range (1–5 microns in diameter).

Droplet nuclei — Microscopic particles (1–5 microns) produced by expiratory maneuvers, such as coughing and sneezing, which carry tubercle bacilli and remain airborne by normal air currents in a room.

HEPA (High Efficiency Particulate Air) Filter — Specialized filter, which is capable of removing nearly all particles > 0.3 microns in diameter. May be of assistance in environmental control of tuberculosis transmission. Requires expertise in installation and maintenance.

***Mycobacterium tuberculosis* complex** — The complex of mycobacterial species which causes tuberculosis. Includes *M. tuberculosis*, *M. bovis*, and *M. africanum*.

Preventive therapy — Chemotherapy of tuberculous infection, primarily used to prevent progression of infection to clinically active disease.

Primary prevention of tuberculosis — Use of preventive therapy in persons heavily exposed, but not yet infected with tubercle bacilli.

Secondary prevention of tuberculosis — Use of preventive therapy in persons infected with tubercle bacilli who do not have clinically active disease.

Source case — An individual with infectious tuberculosis who is capable of or responsible for infecting others.

Source control — Preventing infectious droplet nuclei from being disseminated.

Sputum smear-positive — AFB are visible after staining when viewed under a microscope. Individuals with sputum smear-positive for AFB are considered more infectious than those with smear-negative sputum.

Surveillance — Activities related to finding cases, guiding them into the health care system, and maintaining records on such cases for such purposes as identifying high-risk groups and trends in morbidity and related mortality. Includes activities related to identifying and maintaining records on persons with tuberculous infection as well, in order to identify candidates for preventive therapy and, in institutional settings, to identify the quality of infection control practices.

Tubercle bacilli — Term often used to refer to *Mycobacterium tuberculosis* complex.

Tuberculin skin-test—A method for demonstrating infection with *Mycobacterium tuberculosis* in which an antigenic protein from *M. tuberculosis* cultures is introduced into the skin, either intradermally or percutaneously.

Tuberculosis case—An individual with clinically active tuberculosis.

Tuberculosis suspect—An individual likely to have clinically active tuberculosis. Should be started on multiple drug therapy. Contact investigation should be started as soon as patient is a suspect and not delayed until diagnosis is confirmed.

Tuberculous infection—Condition in which living tubercle bacilli are present in an individual, without producing clinically active disease. Infected individual usually has a positive tuberculin skin-test, but does not have symptoms related to the infection, and is not infectious.

Ultraviolet (UV) lamps—Germicidal lamps which emit radiation predominantly in the 254 nanometers range (intermediate between visible light and X-rays). Can be used in ceiling or wall fixtures or within air ducts of recirculating ventilation systems. Effective in killing many bacteria, including tubercle bacilli.

Further information about tuberculosis control may be obtained from your State and/or local Tuberculosis Control Program; local affiliates of the American Lung Association; the Division of Tuberculous Elimination, National Center for Prevention Services, Centers for Disease Control, Atlanta, GA 30333 (404-639-2508); or from the American Thoracic Society, 1740 Broadway, New York, NY 10019-4374 (212-315-8700).

Appendix

This statement is one of a series of three statements on diagnosis, treatment, and control of TB. For information on diagnostic methods refer to "Diagnostic Standards and Classification of Tuberculosis" (Am Rev Respir Dis 1990; 142:725–35). For information on the treatment of TB and TB infection, refer to "Treatment of Tuberculosis and Tuberculosis Infection in Adults and Children" (Am Rev Respir Dis 1986; 134:355–63). Information on diagnosis and treatment of disease caused by nontuberculous mycobacteria can be found in "Diagnosis and Treatment of Disease caused by Nontuberculous Mycobacteria" (Am Rev Respir Dis 1990; 142:940–53).

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