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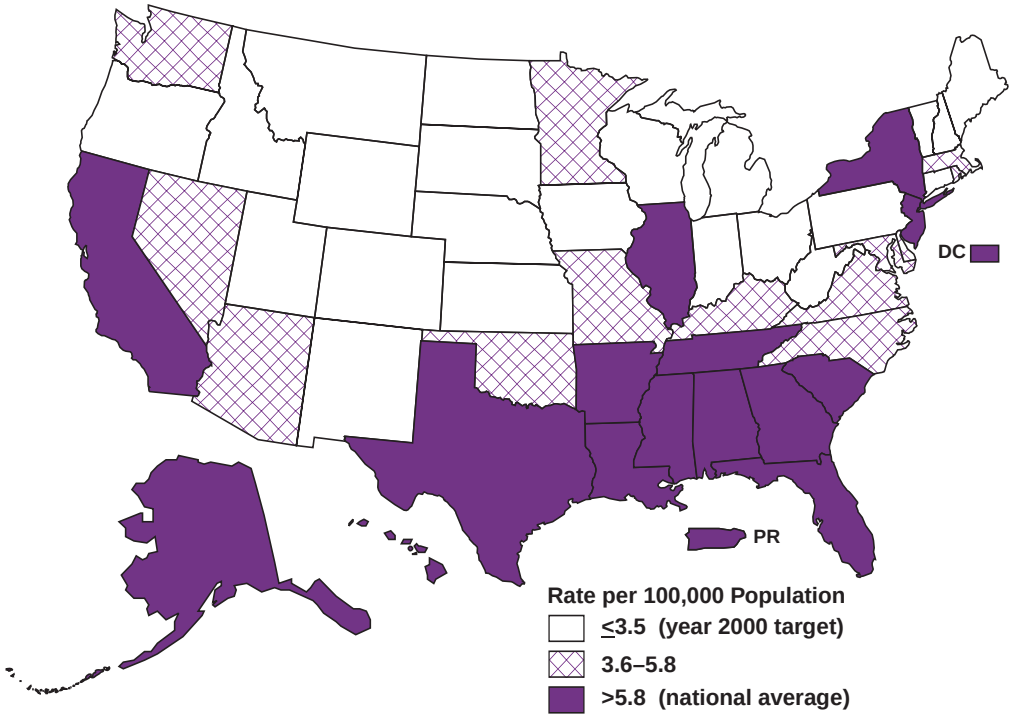
Progressing Toward Tuberculosis Elimination in Low-Incidence Areas of the United States

Recommendations of the Advisory Council for the Elimination of Tuberculosis

Reported Tuberculosis in the United States, 2000



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Progressing Toward Tuberculosis Elimination in Low-Incidence Areas of the United States

Recommendations of the Advisory Council for the Elimination of Tuberculosis

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Summary

In 2000, 22 states had tuberculosis (TB) incidence rates less than or equal to the Advisory Council for the Elimination of Tuberculosis (ACET) year-2000 interim objective of 3.5 cases/100,000 population, which is defined as low incidence. These states reported 1,949 TB cases, 11.9% of the national total of 16,377 cases in 2000. Health departments in low-incidence states, and in low-incidence regions within states with higher rates, need distinctive strategies, based on their specific epidemiologic characteristics, for maintaining skills and resources for finding increasingly rare TB cases, containing outbreaks, and ending transmission. Capacity for all the essential components of a TB prevention and control program must be retained at local, state, and national levels; failure to do so increases the risk of a new TB resurgence. In low-incidence areas, especially important are an adequate public health infrastructure and creative integration of resources, some of which until now have not played a role in TB control. Operational research is needed for determining the most efficient control measures. Eventually, with continued success in eliminating TB, low incidence will be attainable in all states, and the nation will profit from the lessons learned in the current low-incidence states.

Introduction

Following a period of resurgence of tuberculosis (TB) that began in the mid-1980s and peaked in 1992, the United States reestablished control over the disease. Before that epidemic, the public health infrastructure* and resources for TB control had declined below the level needed to respond to an emergent threat (*1*). Once the epidemic and its causes were recognized, infrastructure and resources were restored in the early 1990s by a large infusion of resources at local, state, and national levels (*2*). From 1992 through 2000, the incidence of TB decreased by 45%, reflecting the impact of renewed capability to implement the essential elements of TB control. In 2000, the eighth consecutive year of decline, the TB incidence rate was 5.8 cases/100,000 population, the lowest ever recorded in this country.

The success in reversing the recent epidemic has refocused attention on eliminating TB in the United States. In 1999, the Advisory Council for Elimination of Tuberculosis (ACET) called for a renewed commitment to its strategic plan (*3*), which was published originally in 1989 (*4*). In 2000, the Institute of Medicine (IOM), in an independent review (*5*), proposed a comprehensive action plan for TB elimination in the United States.

The recent epidemiologic trend noted above indicates that TB control is now entering a new phase in the United States, a transition from low incidence to elimination.† For example, in 2000, 22 (44%) states reported incidence rates ≤3.5/100,000, which was the year-2000 interim objective set by ACET in the 1989 strategic plan (*4*). These states are regarded as areas with a low TB incidence rate, on target in the drive toward elimination. Furthermore, the fraction of U.S. counties reporting no TB cases has increased steadily during the past several decades. In 2000, 1,606 (51%) counties reported no cases. Yet 712 (44%) of these counties had reported one or more cases in the preceding 5 years, which underscores another public health challenge in these settings, i.e., how to maintain sufficient resources to stay prepared for sporadic cases

* Public health infrastructure is the "underlying foundation that supports the planning, delivery, and evaluation of public health activities and practices. Its three basic components are workforce capacity and competency, information and data systems, and organizational capacity." (Source: CDC. Public health's infrastructure: a status report. Atlanta: CDC, 2001).

† Elimination was defined by ACET in 1989 as a TB incidence rate <1 case per year per million population.

The material in this report was prepared by the National Center for HIV, STD, and TB Prevention, Harold W. Jaffe, M.D., Acting Director; Kenneth G. Castro, M.D., Director, Division of Tuberculosis Elimination.

when TB becomes rare. Even after elimination is achieved, a plan will be required for finding and treating sporadic cases, investigating transmission to contacts, and preventing TB in those who are infected.

Distinctive challenges to TB control have arisen in regions where cases occur infrequently. Among documented obstacles is the diversion of public health resources to other purposes, which predicts a "cycle of neglect"(*5*,*6*). Tuberculosis outbreaks have occurred in such areas and have produced severe and long-term effects (see Outbreaks). Low-incidence states or local jurisdictions with minimal TB control programs sometimes are unprepared to detect and contain these outbreaks. Likewise, shifting migration patterns are rapidly altering the TB epidemiology in communities and states that previously had not had large immigrant populations who are at risk for TB (Box 1). In this scenario, existing TB control programs that are equipped only for infrequent cases are confronted with an abrupt increase of cases and unfamiliar cultural issues. In addition, because of the rarity of TB, some health-care providers in these settings lack either proficiency in TB diagnosis or familiarity with the latest treatment guidelines.

BOX 1. Minnesota: Impact of changing immigration patterns

The annual TB incidence rate for Minnesota consistently has been less than the national average. The rate was less than 3.5 cases per 100,000 population from 1993 through 1998, which would have put Minnesota in the low-incidence category. However, the case count began increasing in 1994 at an average of 9% per year, and by 1999 the incidence rate had increased to 4.2/100,000.

The most remarkable feature of the recent upsurge in Minnesota is the large and growing fraction of cases among foreign-born persons. From 1995 to 1999, cases occurring in persons born outside the United States increased from 50% to 78% of the total cases, and in 2000 these cases accounted for 82%. Although the number of cases reported for U.S.-born persons decreased by 42% from 1995 to 1999, the number reported for foreign-born persons doubled in this same period.

These epidemiologic trends are connected to changes in immigration patterns. For the federal fiscal year 2000, the U.S. Congress established a ceiling of 85,000 new refugees to be admitted to the United States, which includes 17,000 persons from Africa. This is more than twice the number of African refugees admitted annually since 1995. Approximately 3.5% of refugees admitted to the United States initially arrive in Minnesota. During 1995–1999, Minnesota was the initial destination for 11,955 refugees. More than 3,900 of these arrived in 1999, which was more than double the 1998 arrivals. In 1999, 75% of the primary refugees coming to Minnesota were from sub-Saharan Africa, in contrast to earlier in the decade, when most refugees were from Southeast Asia. Most of the recent African refugees are coming from Somalia, and they are being followed by other Somalis who initially arrived elsewhere in the United States. Approximately 40,000 Somali persons now reside in Minnesota, making up the largest Somali population anywhere outside Somalia.

Foreign-born TB patients in Minnesota during 1995–1999 originated from 52 countries. Of 156 foreign-born patients in 1999, 52% originated from sub-Saharan Africa. The number of Somalian TB patients increased from 2 (4%) of 53 foreign-born patients in 1993 to 56 (36%) of 156 in 1999. Demographic trends indicate that the Somalian population in Minnesota will grow in upcoming years, and further increases in TB are anticipated.

Providing services to foreign-born TB patients presents substantial challenges. Some patients have complicating factors such as drug-resistant or extrapulmonary disease. Many patients face economic hardships and cultural or linguistic barriers that interfere with obtaining medical care, adhering to prescribed therapy, and participating in contact investigations. The state TB control program is meeting these challenges by building culturally specific outreach capacity consisting of providers for directly observed therapy, language interpreters, incentives, enablers, translated educational materials, and convenient referral mechanisms.

Tuberculosis control in Minnesota involves the collaboration of private health-care providers, the state health department, and a decentralized system of more than 80 local public health agencies that provide direct services such as contact investigations. Local resources and expertise vary widely, and culturally sensitive health-care services are not readily accessible in rural areas. The state TB control program works directly with local public health agencies and also provides clinical consultation for hospitals, clinics, long-term care facilities, and correctional facilities statewide.

The consultation, coordination and surveillance services offered by the Minnesota TB control program are critical to maintaining adequate capacity statewide. This program is seeking additional resources for expanding prevention activities, particularly culturally specific targeted testing for latent TB infection among foreign-born persons.

During the era of resurgent TB, national attention and resources had to be focused on bringing the disease under control in areas with the highest incidence rates, but states and communities in which TB incidence remained low did not receive such large increases in resources. Further, few of the recommendations developed during the past decade to guide the national effort to control TB have addressed the perspective of low-incidence settings.

ACET believes that continued progress toward TB elimination requires a strategy for TB control in low-incidence settings. Although the 22 states that have achieved low-incidence status need a strategy now, all areas eventually will enter a phase of low incidence if their programs have continued success. This ACET statement examines the challenges to TB control in current low-incidence areas and offers recommendations for meeting those challenges. The purpose of this statement is to inform federal, state, and local public health officials, health-policy makers, and the general health-care community about the unique challenges of TB control and about the roles each can play to ensure progress toward elimination in those areas where the disease is becoming increasingly uncommon. In these places, where TB has become a "rare" disease, the opportunity exists to take decisive steps to eliminate it and to make pioneering contributions to TB elimination nationwide by inventing and testing novel strategies.

Tuberculosis Profiles of Low-Incidence States

Epidemiologic Profiles

Strategies for state and local TB control must take their direction from detailed epidemiologic analysis. The results are distinct for each of the low-incidence states. Although the low-incidence states all had an incidence rate of ≤3.5 cases per 100,000 population in 2000, they reported a wide range in numbers of cases, from 4 (Vermont and Wyoming) to 383 (Pennsylvania), because their denominator populations vary widely. For making general comparisons with the rest of the United States, in this report the 22 low-incidence states are grouped into two categories by the numbers of TB cases reported in 2000: low caseload (≤50 cases) and intermediate caseload (>50 cases) (Table 1). Expenditures for some routine TB-control items or activities, such as chest radiographs, medicines, and outreach services, are based on per-case costs and are therefore dependent on caseloads.

In 2000, the 22 low-incidence states, encompassing 27.2% of the U.S. population, reported 1,949 TB cases, 11.9% of the national total of 16,377 cases. The 13 low-incidence states with low caseloads reported from 4 to 49 cases each and a total of 304 cases. The nine low-incidence states with intermediate caseloads reported from 77 to 383 cases each and a total of 1,645 cases.

TABLE 1. Tuberculosis case counts and incidence rates for low-incidence states, 2000

State	Cases	Rate*
Low-caseload states		
Vermont	4	0.7
Wyoming	4	0.8
North Dakota	5	0.8
Idaho	16	1.2
South Dakota	16	2.1
Montana	21	2.3
New Hampshire	22	1.8
Maine	24	1.9
Nebraska	24	1.4
West Virginia	33	1.8
Iowa	40	1.4
New Mexico	46	2.5
Utah	49	2.2
Overall	**304**	**1.7**
Intermediate-caseload states		
Kansas	77	2.9
Wisconsin	92	1.7
Colorado	97	2.3
Connecticut	105	3.1
Oregon	119	3.5
Indiana	145	2.4
Michigan	287	2.9
Ohio	340	3.0
Pennsylvania	383	3.1
Overall	**1645**	**2.7**

Source: National surveillance data, CDC.
*Per 100,000 population.

The relative incidence-rate trends, 1993 through 2000, were estimated by aggregating the states into the two low-incidence categories described above and comparing them with the remainder of the United States. The aggregated incidence rate declined most quickly for higher-incidence states, at an average of 7.4% annually, and more slowly in the two groups of low-incidence states, at an average of 5.8% annually in the intermediate-caseload states and at an average of 4.6% annually in the low-caseload states. Within each category, the trends varied by state, and the TB incidence rate fluctuated considerably in states with the lowest counts.

A descriptive comparison of TB cases among the two groups of low-incidence states and the remainder of the United States can supplement the basic incidence data (Table 2). For example, TB patients in both groups of low-incidence states were more often >65 years of age and more likely to be non-Hispanic white. The low-caseload, low-incidence states had the highest percentage of American Indian/Alaska Native patients. The intermediate-caseload states had the lowest percentage of cases among foreign-born persons. A smaller percentage of patients in the low-caseload states were incarcerated at the time of diagnosis.

TABLE 2. Selected characteristics of tuberculosis patients in low-incidence and other states — United States, 1993–2000

Characteristic	Low-incidence states (n = 22)				All other states	
	Low caseload (n = 13)		Intermediate caseload (n = 9)			
	Cases	%	Cases	%	Cases	%
Total	**3,043**	—	**16,060**	—	**146,089**	—
Age group (yrs.)						
0–4	73	2.4	564	3.5	5,568	3.8
5–14	57	1.9	372	2.3	3,921	2.7
15–24	197	6.5	1,145	7.1	12,010	8.2
25–44	847	27.8	4,988	31.1	53,431	36.6
45–64	835	27.4	3,999	24.9	38,777	26.5
≥65	1,033	34.0	4,985	31.0	32,349	22.1
Unknown	1	<0.1	7	<0.1	33	<0.1
Race/ethnicity						
White, non-Hispanic	1,399	46.0	6,394	39.8	34,299	23.5
Black, non-Hispanic	232	7.6	5,490	34.2	49,345	33.8
Hispanic	563	18.5	1,654	10.3	33,245	22.8
Alaska Native or American Indian	462	15.2	129	0.8	1,611	1.1
Asian or Pacific Islander	385	12.7	2,338	14.6	27,161	18.6
Unknown	2	< 0.1	55	0.3	428	0.3
Country of origin						
United States	2,127	69.9	11,772	73.3	88,732	60.7
Other countries	909	29.9	4,204	26.2	56,191	38.5
Unknown	7	0.2	84	0.5	1,166	0.8
HIV (25–44 yrs.)*						
Positive	84	9.9	798	16.1	11,539	27.6
Negative	353	41.8	1,972	39.7	15,863	37.9
Testing refused	57	6.8	274	5.5	1,644	3.9
Testing not offered	147	17.4	563	11.3	3,511	8.4
Unknown†	204	24.1	1,356	27.3	20,834	22.2
Correctional facility						
Yes	60	2.0	399	2.5	5,897	4.0
No	2,973	97.7	15,478	96.4	137,971	94.4
Unknown	10	0.3	183	1.1	2,221	1.5

* Excludes California cases and records with indeterminate HIV test results. California does not report HIV results to the national TB surveillance system.
† Includes testing done, results unknown.

Reported results of human immunodeficiency virus (HIV) testing for TB patients provide a minimum estimate of the degree of overlap between TB and HIV infection and of the implementation of HIV counseling and testing, which is recommended for all TB patients. The fraction of TB patients aged 25 to 44 years (i.e., the age group accounting for the majority of acquired immunodeficiency syndrome [AIDS] cases) with HIV coinfection was lowest in the low-caseload states, at 9.9%. However, these states had a higher frequency of "test refusal" and "test not offered," which occurred in 24.2% of cases in the 25- to 44-year age group, possibly indicating difficulties in implementing HIV counseling and testing. Examples of such difficulties are insufficient HIV awareness among health-care providers and patients or a need for increased HIV counseling and testing services readily available to those patients who receive TB care outside of health departments.

Outbreaks

In recent years, several TB outbreaks have been reported from low-incidence states. Outbreaks pose immediate threats to the health of communities, and in the long term, they expand the reservoir of latent TB infection. To control TB outbreaks, health departments must redirect resources that are already scarce, especially when TB programs are operating at full capacity. The results of the following investigations in four areas with low TB incidence illustrate various outbreak situations and the impact that each has caused:

Maine

During 1989-1992, a total of 21 cases in a small Maine community and its local shipyard were traced back to a source case of pulmonary TB that was diagnosed after an 8-month delay (*7*). During the entire previous decade, this community had documented fewer than 10 cases. The contagious source-patient infected nearly 700 local residents and coworkers. However, fewer than 350 of the infected contacts completed

treatment for latent TB infection. Prompt discovery and management of the index case could have limited transmission, and the number of secondary cases could have been reduced if more contacts had received complete courses of treatment for latent TB infection.

North Dakota

During 1998, in a contact investigation of a 9-year-old child with cavitary pulmonary TB, approximately 50 children in a small North Dakota town were found to be infected (*8*). The first clue to discovering the source case was the diagnosis of extrapulmonary TB in the child's adult guardian. In the previous 6 years, only one TB case in a patient <15 years had been reported from all of North Dakota. The child had immigrated to North Dakota from the Republic of the Marshall Islands in 1996, and although latent TB infection was detected then, it was not treated.

Indiana

From 1996 to 1998, a town in Indiana experienced a fivefold increase in TB cases (*9*). DNA fingerprinting (by restriction fragment length polymorphism analysis) and a novel social-networking approach for investigating the outbreak linked together 23 outbreak-related cases. The connection between the cases probably would not have been discovered by routine interviews because the patients knew each other only through drug use and other illicit activities, and transmission probably was occurring during secretive gatherings outside their homes. At least 15 of the cases might have been prevented by comprehensive contact investigations followed by complete treatment of the infected contacts.

Kansas

From 1994 to 2000, epidemiology plus DNA fingerprinting linked 18 TB cases in Wichita, Kansas (*10*). The common social thread connecting the patients was occupation as dancers in adult-entertainment clubs (i.e., "exotic dancers") or association with exotic dancers. No single site for TB transmission was found, but illicit-drug–using activities and incarceration were possible risk factors. Of the 344 contacts who could be reached during the investigations, 302 were evaluated at least in part for TB, and of these, 76 (25%) had latent TB infection. These were in addition to the 18 patients who had active TB. Social barriers related to drug use and incarceration interfered with the contact investigations and probably contributed to the long duration of the outbreak. Only three fourths of contacts who should have been treated actually started therapy, and the rate of completing therapy was only 11%.

These four outbreaks were not isolated incidents, and similar TB outbreaks continue to occur throughout the United States, some in low-incidence states (*11*). Such outbreaks highlight the need for maintaining response capacity—public health infrastructure for TB control and resources to take action—in all regions. Unanticipated TB cases can arrive with newcomers to a region, or cases can arise sporadically from latent TB infection even in a population that has a low incidence rate. The outbreaks described here also point to the problems of delayed case detection, incomplete contact tracing and treatment, and the need for innovative methods for discovering and containing outbreaks early and for finding and treating latent TB infection in at-risk persons before cases develop.

Program Profiles[§]

Each low-incidence state has a designated TB control officer, or a program manager who has most of the duties and authority of a control officer. Each low-incidence state TB program has a medical consultant either on staff in the health department or under contract. Sixteen state programs employ at least one TB nurse consultant with responsibilities for case management and program oversight; in three of these programs the nurse consultant serves as the TB controller. The median number of full-time personnel who are employed categorically in the state health department for TB control work is three workers per state (range: 1–9). In each low-incidence state, the state program personnel work with both private providers and local public health practitioners in the management of some or all cases.

In 15 of the 22 low-incidence states, a state advisory council for the elimination of TB provides guidance and advocacy for the programs. Affiliates of the American Lung Association (ALA) are located in 18 of the states, and in 10 of these, the ALA affiliate works directly with the state or local health departments in supporting TB control.

The administrative structure for TB control varies among low-incidence states. In some, the authority for TB control is vested entirely in localities (e.g., counties or townships), and the TB program in the state health department serves a supportive role. This structure is characteristic of intermediate-caseload states. Maintaining local TB expertise in this framework is challenging because the health departments in some localities report and manage fewer than one case per year. Therefore, the state TB program must be vigilant for lapses in program activities and for undetected problems, such as protracted TB outbreaks. In other states, authority is shared between the localities and the state health department. In these

[§] The Division of Tuberculosis Elimination, CDC, keeps records about state TB programs as part of the federal TB cooperative agreement funding process. The data about programs are not standardized but are presented here for a general description.

states, the localities are combined into several regions, which enables the state to assign regional TB consultants for efficient oversight and assistance. This structure has intrinsic advantages for providing education updates to local personnel and thereby maintaining expertise. In one state, Maine, all responsibility is vested in the state program because the localities do not have health departments, and officials from the state health department work directly with health-care providers for planning case management.

Unique Challenges to Good Tuberculosis Control in Low-Incidence States

The decrease in TB incidence to historic low levels creates challenges for public health officials who are working to sustain programs and systems, especially when low incidence fails to indicate the full efforts required for comprehensive TB control (Box 2). Responding to low case burdens by prematurely scaling down TB programs will re-create the conditions that make another epidemic TB resurgence likely (*5*). Ongoing investments are needed to retain personnel who have expertise in programmatic methods of prevention and control. Although TB control programs in all states share these challenges, especially that of sustainability, challenges in particular are amplified by circumstances in low-incidence states.

BOX 2. Wyoming: Case counts tell less than half the story

In Wyoming, a state with a very low TB incidence, the health department reported four cases (0.8 per 100,000 population) for 2000. However, that very low case count does not reflect the substantial amount of work required to keep caseloads at this level. There were 231 contacts for these cases, including 171 contacts of a patient with contagious pulmonary TB at the state penitentiary. In addition to the four counted cases, the Wyoming program managed three cases in persons who moved to Wyoming from Massachusetts, Texas, and California after the cases had been counted by those states. (According to national surveillance definitions, these cases are counted by the reporting states, not by the program receiving the patients.) One of these cases posed difficult and expensive management problems, and the three cases together led to more than 60 additional contacts being evaluated in Wyoming.

Two additional patients with clinically suspected TB required public health investigations before the TB diagnosis was excluded. Additional contacts were evaluated for the suspected cases. The experience in this low-incidence state illustrates that case counts alone should not be the basis for projecting resource needs for a TB program.

Loss of Expertise

When TB was more common, primary health-care providers diagnosed and treated it routinely. Now, because of decreasing TB case rates, fewer primary health-care providers or even specialists have diagnosed or treated TB (*11,12*). The current cadre of medical consultants familiar with treating persons with complex and drug-resistant TB will be retiring soon, and there are no systematic plans to replace them. In addition, the complexities of treating HIV-infected patients with TB require oversight from providers trained in both TB and HIV.

Scarcity of Special Facilities for Prolonged Health Care

A few TB patients require prolonged, low-intensity inpatient care or long-term involuntary detention (*13,14*). When TB sanitoria were closed, affordable inpatient bed spaces for these patients were lost (*15*). The expense of a long-term stay in a general hospital for just one patient who does not have third-party funds (*16*) can exceed the entire annual budget of a low-incidence state TB program. Long-term–care facilities generally do not have the experience and engineering features required for TB infection control. Security arrangements for involuntary detention are expensive and sometimes difficult to arrange, and incarceration solves little and raises concerns about human rights (*14,17*). Although large TB programs have developed flexible systems for providing long-term care to special-needs patients (*17*), smaller programs encounter such patients only occasionally and cannot afford comprehensive systems.

Laboratory Costs and Decreased Proficiency

The existence of a state TB laboratory ensures the availability of prompt, flexible, and reliable laboratory services that are essential to TB surveillance and case management. However, justifying a TB laboratory is challenging when fewer specimens are submitted for testing. Additionally, proficiency in laboratory skills (e.g., smears, culture, and species identification) is at risk of declining because of fewer specimens being submitted for evaluation and fewer positive culture results requiring mycobacterial identification and susceptibility testing (*5, 18*). Maintaining a laboratory equipped for a safe working environment is an expensive obligation that remains unchanged even if specimen quantities are decreasing.

Travel in Rural Areas

Some low-caseload, low-incidence states, particularly those of the Great Plains and the Rocky Mountains, require creative solutions for overcoming the long distances that separate health-care providers from their patients and interfere with comprehensive directly observed therapy. Although it is essential that state TB control personnel in these states visit local jurisdictions to furnish critical on-site technical assistance, the time and expense of travel might stretch the program resources beyond current capacity.

Loss of Funds and Personnel Dedicated to Tuberculosis Control

Because they need to reduce costs, some public health administrators might combine specific communicable disease programs—TB, HIV, vaccine-preventable diseases, and sexually transmitted diseases—at the state level, recognizing that these diseases share some general characteristics. However, the state programs necessary for controlling each of these communicable diseases are fundamentally different, with important variations in the underlying epidemiology and interventions for the diseases. Combining these programs may inadvertently decrease the resources and expertise for TB control. In one state where these programs have been combined, funds and personnel have been diverted away from TB control to other programs (*19*). If programs are to be integrated at the state level, core capacity for TB control must be maintained; this includes the ability to shift resources in response to increased needs. In contrast to the situation at the state level, cross-training of personnel at the local level is necessary for providing sufficient public health services to communities served by small health departments.

Recommendations for Tuberculosis Programs in Low-Incidence Areas

ACET makes the following recommendations for sustainable TB control programs and strategies in low-incidence states or regions. Although these recommendations are applicable to any state, they are designed specifically to address the special challenges encountered by programs in low-incidence areas. Therefore, ACET stresses innovation for meeting these challenges, with the understanding that the best solutions will be unique to each state and locality. As observed by the IOM Committee on the Elimination of Tuberculosis, the implementation of some recommendations will not be feasible without additional resources (*5*).

Work Creatively To Ensure the Essential Components of Tuberculosis Control

CDC has recommended six essential components for TB prevention and control (*20*). Sufficient capability in each component is necessary for progress toward TB elimination. Every state health department needs the basic framework for a TB control program that includes all six components, and a designated program director. Following are suggestions for low-incidence states that can help them meet the challenges of implementing all components of a TB control program. These suggestions are made with an understanding that higher-incidence programs will later be addressing the same challenges.

Planning and Developing Policy

The foundation of a state TB control program is its legal mandate to carry out necessary specific activities (e.g., surveillance, treatment, investigations, isolation of contagious patients). However, some states have outdated legal codes for communicable diseases, which can hamper the program (*21*). In low-incidence states, where the health department might not have personnel with the expertise to draft the elements required in updated legislation, updated legislation from neighboring states can serve as templates, and local chapters of ALA can provide technical assistance and legal advocacy.

A state TB control policy manual should be drafted in consultation with an advisory council of TB experts and should be updated at least every 2 years. Although programs in low-incidence states can assist each other by sharing manuals for use as templates, each program can anticipate a need for state-specific policies and procedures because of differences in epidemiology, state administrative structure, and resources. Policies in the manual should cover the following topics: administration of the program; training; reporting practices and surveillance; program evaluation; laboratory testing for mycobacteria; case finding, holding, and management; treatment of persons with TB disease and latent TB infection; contact investigations; targeted testing for latent TB infection; and standard responses to foreseeable adverse situations (e.g., uncooperative patients, outbreaks, and multidrug-resistant TB).

Each state should also have a TB elimination plan designed for local circumstances. In low-incidence states, the plan should emphasize the more challenging elements: maintaining a state TB program with sufficient resources to address the essential components, finding and containing outbreaks in regions lacking personnel with TB expertise, and responding to an influx of persons with increased TB risk, such as immigrants from high-prevalence countries. The elimination plan should include strategies for addressing specific epidemiologic features of TB in the state, including the needs of specific groups at

risk for TB. For example, in some western states, where one third or more of the TB patients are American Indian, TB control services require an approach adapted to cultural and jurisdictional distinctions, ideally, one that has been developed in collaboration with tribal health authorities (*11*) (Box 3).

Finding and Managing Suspected and Confirmed Tuberculosis Cases

A state TB program, through its consultants, can provide the medical expertise that might be lacking in private and public health-care facilities in low-incidence states. However, this can only be done when suspected cases are found and a referral is made to the state public health department. General awareness of TB as a potential cause of cough-illness is difficult to sustain if the disease occurs rarely. Delayed case detection at the local level is a potential factor contributing to TB transmission (see Outbreaks). In addressing this difficult challenge, the state program should maintain a listing of local persons knowledgeable about TB in its policy manual. The list should not be regarded as static but should be updated annually because of provider turnover.

Training should be targeted to expand the diagnostic knowledge of primary care providers, and it should be focused on the localities with gaps in expertise. Many state health departments offer conferences and outreach initiatives to inform local health-care providers about public health issues, and the TB program can take advantage of these events for delivering and updating messages in the context of continuing education.

Tuberculosis case managers face particular challenges when patients are under the care of private medical providers who are unfamiliar with the potential contributions and the overall role of the health department. If private providers are informed about the TB program through state-sponsored outreach and training programs, they will have a better understanding of the current practices and the services offered by the health department even before they encounter suspected cases. One option is to engage private providers in a case management team (Box 3). A management team allows the TB program to monitor the progress of the patient, train the provider, and promote the services of the program by building rapport between public and private sectors. Private providers who otherwise would reject directly observed therapy for their patients might reconsider this option after learning about the services offered by the health department.

Prevention: Finding and Managing Latent Tuberculosis Infection

Tuberculosis controllers in low-incidence states have encountered crucial challenges in the transition from managing cases to preventing cases. Expertise for contact investigations is lacking in some local areas, which contributes to incomplete contact tracing and treatment and, eventually, to the occurrence of TB outbreaks (*7,11*). Tuberculin skin testing skills, even in health departments, have been lost. Local health departments do not have the staff required for monitoring completion of therapy. Private medical providers might be reluctant to treat

BOX 3. New Mexico: Partnerships for tuberculosis case management

With its annual incidence rate of 2.5/100,000, New Mexico became a low-incidence state in 2000. New Mexico shares some of the features of other western low-incidence states: low caseloads (46) were reported in 2000, 27% of cases were in American Indians, and vast rural distances are an obstacle to case management. Other similarities are local health departments with disparate resources and a small state TB control program. Many American Indian TB patients receive their health care through the U.S. Indian Health Service or tribally managed health-care systems, which further complicates surveillance and case management because of conflicts of jurisdiction.

In 1994, the state program began a collaborative case management strategy, which has been successful in facilitating communication among participants. For each new TB case, the state medical director for infectious diseases convenes a management team consisting of the state TB nurse consultant, the state TB case manager, the treating physician, the pharmacist as needed, and a local public health nurse. If the Indian Health Service or a tribal health agency is providing care for the patient, representatives from these agencies are included. The team is convened by a telephone conference. Real-time computer video links also are being established for more areas. Laboratory results and radiographs can be shared by the computer link, which is able to protect patient confidentiality. After planning initial case management, the team reconvenes routinely until the case is closed.

This system has been effective, and all participants endorse it. The rate for completion of therapy within 1 year for 1998, the latest year with data finalized, was 96.5% (1998 national average 79.1%; national objective 90%). The New Mexico strategy not only builds strong liaisons among the participants but is a forum for educating and training health-care providers who do not routinely participate in TB care. The drawbacks have been the substantial time commitment required to convene the case management teams and the expense of telecommunications, an expense which is offset by reduced travel costs.

latent TB infection because of uncertainty about the recommendations and concerns about adverse effects of treatment. Finally, for targeted testing projects, the populations involved can be widely dispersed, which makes the projects less feasible.

Experience in responding to TB outbreaks has shown that innovative methods for contact investigation can be designed to fit unusual situations by forming partnerships, for example, among local communities, local health-care providers, academic medical centers, local and state health departments, and national public health agencies (*9–11*). Flexible methods and the creative use of nontraditional, supplemental resources are required to maintain response capability. Even before outbreaks occur, policymakers must be made aware of gaps in the resources and infrastructure required for response capability.

Targeted-testing activities for finding latent TB infection can be inefficient and expensive if low-risk persons are included because large numbers must be tested and treated to prevent each TB case. Therefore, TB programs in low-incidence states should restrict targeted-testing activities to well-delineated projects (Box 4), ones that have potential for efficiency, and ones that have feasible implementation and evaluation components. General factors that improve efficiency are access to the target population, a high prevalence rate of latent TB infection, a high risk of progression to disease in infected persons, and methods to ensure completion of therapy. Targeted-testing projects must be evaluated for their ability to meet objectives for finding latent infection and ensuring that patients are completely treated. Projects that do not meet objectives should be revised, or they should be discarded in favor of more promising projects. Projects that do meet objectives can be expanded or adapted to other settings.

BOX 4. Maine: Estimating the cost of prevention

Maine, with its TB incidence rate of 1.9/100,000 for 2000, has reported an average of 24 cases per year for the past 8 years, with large annual fluctuations (range: 13–35 cases) but no evident rate trends. In 2000, 33% of Maine's TB patients were foreign born.

From January 1999 to July 2000, three epidemiologically unrelated TB cases were found among employees of a single food-processing plant in Maine. During contact investigations for the first two patients, 295 workers were evaluated; 66 (22%) were found to have latent TB infection. However, only nine of the infected contacts were born in the United States, suggesting that some of the infections discovered in the contact investigations were acquired in the contacts' countries of origin, before exposure occurred in the food-processing plant. Worksite contacts were not sought for the third patient because no transmission to household contacts was found and the likelihood of worksite transmission was very low.

In observance of the recommendations of the Institute of Medicine report (*5*), in 2001, TB control personnel from the Maine Bureau of Health selected the food-processing plant as a feasible site for targeted testing and supervised treatment for persons with latent TB infection. The Bureau established a partnership with representatives from the food processing plant's management, employees, the American Lung Association of Maine, the Maine TB Consultants Group, and local medical providers. Half or more of the plant's 800 workers are foreign born, and 34 languages are spoken as "first languages" by these workers. Employee turnover is frequent, which means that TB-infected employees need to be treated before they leave employment at the plant, and also that the evaluation of new employees for latent TB infection will have to be a continual process.

The anticipated yield from targeted testing is approximately 60 cases of latent TB infection in the first year and 30 per year in subsequent years. These yields were projected from the experience with contact investigations in the plant. If treatment completion rates with directly observed therapy exceed 80%, approximately one TB case per year might be prevented primarily through this project, although additional secondary cases might be averted and resources saved by avoiding contact investigations and controlling outbreaks.

Current funds and resources available to the TB control program in Maine are adequate for only the high-priority activities of case finding, case management, and contact investigations; few resources are available for redirection to the proposed targeted-testing project, which would require an overall funds/resources increase of approximately 25% above the current level.

Exploring this proposed project in Maine has already shown that the inclusion of community partners from the start is a critical investment in meaningful planning. Also, if low-incidence states are to implement the TB-prevention recommendations of IOM (*5*), the efforts must be backed by financial and political support. Finally, because of the large investment required for targeted testing projects, a health department needs to plan its strategy carefully and integrate an evaluation component into projects so that effectiveness is monitored after implementation.

Providing Laboratory and Diagnostic Services

The vital functions provided by the state TB laboratory require substantial fixed investments in facilities, equipment, and personnel. The costs of maintaining the laboratory do not decrease even when the TB burden becomes very low. When proficiency is at stake, the TB laboratory should assess the possibility of certain tests and functions being carried out at contract laboratories or interstate regional public health laboratory reference centers without degrading the quality of the services. Regional centers have proved satisfactory for DNA fingerprinting of *Mycobacterium tuberculosis* isolates, and some state laboratories have arranged for susceptibility testing of isolates through contracts with out-of-state laboratories.

Rapid, reliable communication of laboratory results is a crucial requirement for relocating tests and functions to other sources. Most low-incidence state TB programs have difficulty in assuring reporting from laboratories if private medical providers and hospitals send specimens to local hospital laboratories or to out-of-state contract laboratories for testing. This situation is similar in the remainder of the country. It puts the TB program at a disadvantage because these laboratories might fail to report critical results promptly to the health department. They also might discard *M. tuberculosis* isolates before subsequent testing, such as DNA fingerprinting, can be done. Some states have found solutions to this difficulty that might provide models for other low-incidence areas. In Minnesota, a public health regulation now requires that specimens for TB testing be split, with half of each specimen sent to the state TB laboratory. A different approach is taken in Wisconsin, where the director of the state TB laboratory leads a consortium of directors of TB laboratories located at hospitals throughout the state. This innovative system allows the state program to promote quality assurance and good public health practice through a collaborative effort.

Collecting and Analyzing Data

Data collection is the starting point for both planning a strategy and evaluating a current program. In low-caseload, low-incidence states data collection is often hindered by the scarcity of public health personnel at the local level and the challenges of training these personnel in the methods of systematic and accurate data collection. State TB programs can ease the burden at the local level by limiting requirements for data collection to the minimum needed for assessing epidemiology and program activities. At the state office, the TB program needs an epidemiologist to participate in the analysis and interpretation of results submitted by the localities. Because most TB programs in low-incidence states do not have epidemiologists assigned full-time, the health department should provide part-time support from within the health department or through a contract. This epidemiologic review could also be addressed through interstate regionalization; this option should be studied for its potential to increase capacity.

For low-caseload, low-incidence states, the annual case incidence is generally such that single-digit changes represent large relative shifts; therefore, analyses of yearly trends are inconclusive. The averaged changes over longer periods (e.g., 5-year spans) might be more informative, but these results are less useful for immediate assessments of active problems. Under these circumstances, epidemiologic and programmatic insight can be derived from an ongoing systematic review of anomalous or special cases. Examples include investigations of TB cases with the following features: patients <15 years old; drug-resistant *M. tuberculosis* isolates; extensive or advanced TB disease, which is suggestive of delays in diagnosis; or deaths before patients complete treatment. Sentinel criteria such as these can prompt case reviews as part of program management.

Providing Consultation, Training, and Education

Education and training about TB are essential for sustainable control programs. Training should be directed not only to health-care providers but also to decision makers, especially those who influence health-education curricula, and to the public. All these groups should be kept aware of TB, the goal of elimination, and the means to achieve the goal.

TB controllers in low-incidence states cite consultation, training, and education as both their most important functions and their biggest challenges. Training and education in particular are crucial for maintaining provider competence in both the public health and private medical care sectors. Providers in public health need training to stay current with new guidelines for diagnosis and treatment and maintain mastery of program management. Providers in private practice and other settings outside of health departments need training so they will "think TB" in the first place and become familiar with the advantages of collaborating with the health department. Typically, these providers keep full schedules and are occupied with many other health problems more prevalent than TB. Enticements, such as guest speakers, and incentives, such as continuing education credits, can gain their interest and participation.

Perhaps the greatest difficulties that low-incidence states encounter in the area of training are in obtaining funds and time to travel. When working with private medical providers in particular, the most effective means for building rapport is to visit localities routinely and meet with providers. In states with small health departments, this rapport pays dividends for years, and it can establish some providers as consultants

who assist the TB program. State policymakers need to be informed about the essential role of travel, especially in areas with minimal local expertise. If travel funds are restricted despite the need, the TB program should combine tasks, including training, into occasional trips and should take advantage of the most effective media for long-distance communications (Box 3).

Personnel in local health departments are likely to require cross training for their many tasks. The state TB program should couple its training activities with those of other programs as often as possible to conserve resources. However, new workers in the TB program should receive TB-specific training that prepares them for all aspects of program operations and case management. All public health personnel who provide TB-related services require periodic refresher courses, regardless of whether TB is their main responsibility.

Tuberculosis training is another activity that can be explored for interstate regionalization; this approach has already been implemented in some areas (e.g., the course on TB diagnosis and treatment at the Denver National Jewish Center for Immunology and Respiratory Diseases). Regional TB controllers' meetings are another vehicle for training updates. Drawbacks of the current regional approaches to training are that participants have to travel and that only providers who already have a role in TB are likely to participate.

The three CDC-funded National Tuberculosis Model Centers, located in New Jersey, California, and New York, consolidate treatment and training expertise and offer training curricula, course materials including videotapes, and technical assistance. The training materials are offered at a nominal fee, and their consultation is provided at no cost. The range of their services is listed on their Internet sites.

- New Jersey Medical School National Tuberculosis Center http://www.umdnj.edu/ntbcweb/tbsplash.html
- Francis J. Curry National Tuberculosis Center (California) http://www.nationaltbcenter.edu/
- Charles P. Felton National Tuberculosis Center (New York) http://www.harlemtbcenter.org/

Raise the Priority of Prevention

For programs in low-incidence states to achieve more rapid progress toward elimination, some resources for TB control will have to be directed to TB prevention activities. The higher-priority prevention activities, specifically finding and treating recently infected contacts of contagious TB patients, can turn into long-term, labor-intensive commitments, as shown by the outbreaks described earlier. The intensity and duration of these outbreaks demonstrate the need for the availability of public health personnel who are able to devote a substantial fraction of their time to TB control over a period of months to years.

Gaps in contact evaluation and treatment are a particular problem that can be overcome by a system of "case management" adapted from the standard case-management plans designed for TB patients. Directly observed therapy for latent TB infection can be undertaken where feasible, such as in places of employment, schools, and other institutional settings, especially if the infected contacts have additional risk factors for active TB.

Undertaking prevention activities requires negotiation with policymakers and support from partners to anticipate the eventual increases in the relative cost of prevention as TB becomes rarer (Box 4). An advantage of taking up the cause of prevention is that it increases the visibility of the TB program and demonstrates a need for resources. Inversely, the long-term costs of failing to raise prevention as a priority issue are not only a delay in reaching elimination but a further decrease in resources as active cases become rarer.

Implement a Tuberculosis Elimination Plan

An elimination plan is the conceptual basis for all TB program activities because it lays out the short- and long-term tasks, and it provides a common language for communicating with strategic partners. Low-incidence states, in particular, need to consider how an elimination plan can attract the attention of the public and policymakers who might believe that TB is no longer a public health threat. An effective area for emphasis is the disparity of TB incidence rates between social groups with high and low economic status. This illustrates that TB is not only an issue of public health but also one of social justice.

An elimination plan should address, on an individual state level, the unique challenges to good tuberculosis control in low-incidence states (see previous discussion) and should capture all of the recommendations listed in the section Work Creatively to Ensure the Essential Components of Tuberculosis Control. The plan should integrate these elements into a strategy that fits local and regional circumstances and should provide interim objectives for assessing implementation of the plan and its effectiveness.

Make Progressing Toward Tuberculosis Elimination in Low-Incidence Areas a National Priority

ACET recommends that the nation help low-incidence states to eliminate TB. Doing so now invests in the future of all TB programs because those states not currently at the low-inci-

dence level will be able to build on the experience of those that are. The current low-incidence states have the opportunity to test novel strategies for partnerships, funding, communications, education and training, and regionalization. An investment of national TB resources will benefit TB elimination in other parts of the country.

Roles and Responsibilities

Local and state health departments have the most important role in contributing to the core components for TB control, and most recommendations in this document are directed toward those agencies. The federal government plays a central coordinating role in TB control, and many other agencies and associations can help, especially those working with groups most at risk for TB. The specific contribution of these organizations in complementing state and local TB control efforts are described below:

Federal Government

The U.S. national TB program consists of CDC's Division of Tuberculosis Elimination (DTBE), in the National Center for HIV, STD, and TB Prevention, in collaboration with the Division of AIDS, STD, and TB Laboratory Research and the Division of Global Migration and Quarantine, in the National Center for Infectious Diseases, and with the Division of Laboratory Systems, in the Public Health Practice Program Office (*22*). The national TB program is responsible for assessing TB-control capacity throughout the United States and documenting gaps in this capacity. This program also should sponsor regional agreements among states to share resources when such agreements will enhance services and reserve capacity without weakening the TB control capacity of individual states.

ACET recommends that the national TB program at CDC maintain a national pool of expertise in research, program management, laboratory proficiency, outbreak response, epidemiology, and diagnosis and treatment of TB, especially for drug-resistant disease. CDC also should provide consultative, educational, and financial support for state and regional mycobacteriology laboratories. This might include periodic on-site assessment and consultation as well as assistance in obtaining necessary testing services not available within a given state.

The national TB program should sponsor operational research to discover and test more effective methods for addressing the unique challenges of TB prevention and control in low-incidence states. CDC should also provide technical assistance for TB surveillance and program evaluation in low-incidence states. This assistance should include consultation on the epidemiologic profile used to develop each state's elimination plan. Consistent with these efforts, CDC should provide easy-to-use computer programs for case reporting, morbidity analysis, case and contact management, and related follow-up.

CDC should collaborate on low-incidence initiatives with other member agencies of the Federal Tuberculosis Task Force.[¶] The federal agencies whose missions include ensuring health care services for groups at risk for TB—medically underserved persons, foreign-born persons, American Indians and Alaska Natives, migrant workers, persons in long-term care facilities, inmates of correctional facilities, substance users, and homeless persons—must integrate TB prevention activities into their general performance standards, working with their constituency organizations. Agencies that influence education for health professionals should ensure that TB remains in the curriculum, especially for future health-care providers who will serve in rural areas or work with at-risk groups. Agencies that shape public health research policy should promote or support studies to determine optimal TB control methods for low-incidence areas. Agencies that support basic research should promote studies for new methods of TB diagnosis, treatment, and prevention, including a safe, effective vaccine (*23*).

Nongovernmental Organizations

The National Tuberculosis Controllers Association (NTCA), an organization of all state TB control officers and other interested persons, supports several key functions: conducting surveillance to detect sentinel trends in programmatic issues, acting as a conduit for bringing the concerns of its individual members to national attention, and providing a forum for solving problems and sharing the results of novel strategies in low-incidence areas. As the unified advocacy organization for TB controllers, NTCA seeks to maintain sufficient programs and systems in all health jurisdictions and can play a central role in promoting the TB programs of low-incidence states.

The American Lung Association, the American Thoracic Society (ATS), the Infectious Diseases Society of America, the American Academy of Pediatrics, and the National Coalition for the Elimination of Tuberculosis should specifically incorporate the perspective of low-incidence states when making new recommendations. Tuberculosis controllers in low-inci-

[¶] Health Resources and Services Administration; U.S. Department of Justice, Federal Bureau of Prisons; Indian Health Service; Food and Drug Administration; National Institutes of Health; U.S. Department of Labor, Occupational Safety & Health Administration; U.S. Department of Justice, Immigration and Naturalization Service; Department of Veterans' Affairs; Centers for Medicare & Medicaid Services (Formerly HCFA); Substance Abuse & Mental Health Services Administration; U.S. Department of Housing and Urban Development; U.S. Agency for International Development

dence states should be consulted when these organizations promote activities with partners and coalitions.

For many years, ATS has advanced TB control in the United States through its sponsorship of national guidelines for diagnosis and treatment, its engagement in national planning activities, and its conferences, which provide a forum for communication among TB researchers and pulmonary medicine specialists. More recently, the Infectious Diseases Society of America also has cosponsored the development and dissemination of these national guidelines and, along with the American Academy of Pediatrics, has engaged increasingly in related health-professional activities. Continued participation of these organizations in TB-related work helps foster advancement in technical competence nationally.

Because family practitioners and general internists provide primary health care to patients in rural areas, the American Academy of Family Physicians and the American College of Physicians-American Society of Internal Medicine can be especially influential in low-incidence states. Other specialty professional organizations, such as the American College of Chest Physicians, have members who are knowledgeable about the diagnosis and treatment of TB. All organizations of health-care professionals can reinforce TB awareness by including it on the agenda for specialty training and certification and in conferences for continuing medical education.

Research Agenda for Tuberculosis Low-Incidence Areas

Several potential strategies for TB control in low-incidence states need to be evaluated. Research in these states should focus primarily on evaluating promising strategies, which requires methodical consideration of each one.

Test the Feasibility of Regionalization

Regionalization of TB control within state boundaries is already a programmatic feature in some states. Interstate regionalization among low-incidence states should be studied by creating consortiums focusing on operational research. An interstate consortium could explore, for example, the value of sharing a TB epidemiologist and a nurse consultant among several low-incidence states.

Study Population-Based DNA Fingerprinting

DNA fingerprinting should be done on all isolates of *M. tuberculosis* from several low-incidence states, and the results should be analyzed for their usefulness in revealing unsuspected transmission patterns. The public health value of discovering these transmission patterns should be determined.

Evaluate New Modes of Training

Distance-based learning and self-teaching for TB control are attractive for their affordable convenience, but their impact on programmatic effectiveness remains to be evaluated fully. New modes of training should be compared with traditional face-to-face classroom methods to evaluate their relative effect on improving TB-control knowledge and program impact. This area of research should draw on current efforts to implement and evaluate approaches to distance learning and "virtual classrooms."

Establish Pilot Model Tuberculosis Elimination Programs

The optimal size, structure, and strategy for a TB program under specific epidemiologic and administrative circumstances in a low-incidence state are unknown. Several pilot model programs should be established in low-incidence states, with an integrated evaluation component testing the contributions of various factors in the programs. These model programs also should serve as centers of excellence by providing consultation and education to health departments in other states.

Compare Innovative Case Management Systems

Some health departments have explored novel systems for TB case management (Box 3). These methods should be compared for their effectiveness and benefits, with the goal of making the best methods available to other TB control programs facing similar challenges.

Evaluate Prevention Strategies

The cost and the effectiveness of contact investigations, the obstacles to successful outcomes in these investigations, and the utility of the "concentric circles" model, described previously (*24*), should be determined for low-incidence states. Specific strategies for contact investigations should be described, tested, and compared for their merits.

Targeted testing for latent TB infection has an uncertain role in TB control, especially in low-caseload, low-incidence states. Persons at risk for TB might be few in number and difficult to reach through conventional health-care systems, which would result in low yields and treatment completion rates. Novel strategies for overcoming these challenges should be proposed and tested for their effectiveness in finding and completely treating infected persons.

The benefits and expense of surveillance for latent TB infection have not been determined. A pilot surveillance system, or a state system already in existence, should be evaluated for its potential to aid in case prevention and to guide the strategies of the TB control program.

Conclusion

The United States needs a coordinated commitment to eliminating TB in low-incidence areas as a prelude to eliminating it in the entire nation. Critical to this effort is an understanding that low-incidence areas will require distinctive strategies. On the pathway to TB elimination, all states eventually must confront a dwindling yet lingering TB problem by maintaining TB-control programs and linking systems that can assume some of the functions of TB-control programs. Failure to meet the challenges raises the spectre of a new TB resurgence. The keys to addressing the challenges will lie in maintaining a general public health infrastructure, planning creatively, and integrating and using resources that until now have not played a role in TB control.

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