Chest radiography versus tuberculin skin testing for tuberculosis screening of immigrants to Canada

Advisory Committee statement of the Canadian Tuberculosis Committee and its Immigration Subcommittee

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The total number of cases of tuberculosis (TB) reported each year in Canada declined steadily from the beginning of the 20th century until the mid-1980s, but the rate of decline has since slowed considerably.1 This is due to several factors, including the fact that the number of cases among foreign-born Canadians increased by 30% between 1985 and 1995.1 This increase reflects both growing numbers and changes in the countries of origin of immigrants to Canada. Until 1960, immigration to this country was largely from Western Europe, where the incidence of TB was similar to that in Canada.2 In the past decade about 250 000 immigrants and refugees have taken up permanent residence in Canada each year, of whom more than 80% came from countries with much higher rates of TB than that found here. Because the incidence of active TB among foreign-born people parallels that of their country of origin,3 and because the number of cases in the non-Aboriginal Canadian-born population continued to decline steadily over these years, the proportion of total cases accounted for by foreign-born people has risen dramatically.1,4

Mycobacterium tuberculosis is a very unusual pathogen in that infection can be acquired yet remain dormant or latent for many years before reactivation. While the infection is latent, the person has no symptoms and usually no detectable signs of infection, except for a positive tuberculin skin test reaction. In countries with a high incidence of TB (classified by the World Health Organization as greater than 100 per 100 000 population5), almost half of the population will have acquired TB infection by the age of 20 years, and as many as 80% will have acquired it by the age of 30.4 If a person with latent infection moves to another country, the infection may reactivate and active TB may develop there at a later time.5

Radiographic screening of immigrants to Canada for TB was implemented shortly after World War II.6 With the development of new diagnostic tools and therapeutic strategies for the disease, this screening approach has been questioned. Critics have pointed out that, despite screening at entry, immigrants from countries with high rates of TB continue to have a high incidence of TB for many years after arrival in Canada.7

Chest radiography

Chest radiography requires complex and expensive equipment and well-trained technicians and has high material costs. Prevalent active pulmonary TB can be detected, although the yield of radiographic screening is generally low, ranging from 5 cases9,10 to 15 cases11 per 10 000 individuals screened. The prevalence among refugees recently arrived from a war-torn region may be higher.12 If detection of prevalent active cases were the only benefit of chest radiographic screening of immigrants, it is likely that this screening method would be abandoned, given the low yield and low cost-effectiveness (much less than contact investigation).11 However, chest radiographic screening also detects stable radiographic abnormalities compatible with previous TB infection, termed inactive TB, in 3%–5% of all immigration applicants.11,12 Inactive TB is associated with a risk of reactivation of pulmonary TB that is 4–6 times greater than that of people with normal findings on chest radiography12,13 and accounts for 14%–33% of all cases of active pulmonary TB over the succeeding 5–10 years.13–15 Treatment of latent TB infection can provide substantial individual and public health benefits and makes chest radiographic screening much more cost-effective. However, most immigrants in whom pulmonary TB later develops have a normal chest radiograph at the time of entry.

Tuberculin skin testing

At first glance, tuberculin skin testing seems attractive because it is inexpensive and simple to perform and can potentially detect all carriers of latent TB infection, who could then be treated. In theory, all cases of TB could be prevented. Largely on the basis of these theoretical considerations, the US Institute of Medicine has recommended the tuberculin skin test screening of all applicants to the United States for immigrant visas from countries with high rates of TB.16 The institute has also recommended that those with a positive reaction be required to complete therapy for latent TB infection “when indicated” before receiving their permanent residency card.16 This recommendation has been se-
verely criticized as unjust and potentially harmful. Indeed, this strategy would have several major limitations.

The first problem is the sensitivity and specificity of the tuberculin skin test. Sensitivity would be reduced by the occurrence of false-negative reactions in immigrants with HIV infection, particularly advanced infection. Poor specificity is a greater potential problem. In most countries with intermediate and high rates of TB, nontuberculous mycobacteria are highly prevalent, and the BCG (bacille Calmette–Guérin) vaccine is given to all newborns. In many countries BCG vaccine is given again at school entry, or even repeatedly. BCG vaccination and nontuberculous mycobacteria are important causes of false-positive tuberculin reactions and account for one-third to one-half of all positive tuberculin skin test results in immigrants from countries with high and intermediate rates of TB.

A second consideration is the burden on health care services. Although the tuberculin skin test is simple and inexpensive, each person with a positive reaction detected requires further medical evaluation, investigation and, in most cases, treatment with isoniazid for 9 months. Over the past 20 years, each person with a positive reaction detected requires further medical evaluation, investigation and, in most cases, treatment with isoniazid for 9 months.26,27 Over the past decade most of the 250 000 immigrants who arrived each year in Canada were adults, and more than 80% came from countries with a high incidence of TB. Given the prevalence of TB infection of almost 50% by the age of 20 and 80% by the age of 30 among such people, it can be estimated that over 100 000 tuberculin-positive immigrants arrive in Canada each year. At present, a far smaller number are referred to provincial public health authorities for follow-up of TB-related problems detected by chest radiographic screening. Yet 2 evaluations have documented substantial problems in their management owing to insufficient public health resources. Clearly, implementation of tuberculin skin test screening would place an enormous organizational, logistic and cost burden on existing health care services and would require massive investments in Canada’s public health infrastructure.

Such investments would be justified if the strategy of tuberculosis skin test screening and treatment of reactors provided substantial benefit to the immigrants’ health and were cost-effective. However, a risk–benefit analysis showed that tuberculin screening of immigrants from countries with low and intermediate rates of TB (annual incidence less than 100 per 100 000 population) would actually result in a small net loss of life because of the hazards of isoniazid prophylaxis and because many of the positive results would be falsely positive. Among immigrants from high-incidence countries, screening resulted in an average net gain of only a few days of life. In the accompanying cost–benefit analysis, tuberculin screening was found to be far less cost-effective than radiographic screening. This is because false-positive reactions are common and because more than 80% of those with true-positive reactions would be at very low risk for disease. On average, the cumulative lifetime risk of active TB is 7% for people aged 20 years with latent TB infection and declines progressively with increasing age. This means that about 30 people would have to be given 9 months of isoniazid therapy to prevent 1 case of TB, assuming 90% efficacy of this therapy. In patients with latent TB infection but no risk factors for reactivation (“low-risk reactors”), several risk–benefit studies have shown that the margin of benefit of therapy is a matter of only a few days. For this reason, screening of low-risk reactors is no longer recommended in Canada.

In a recent analysis Khan and colleagues concluded that tuberculin skin test screening of immigrants to the United States followed by therapy prescribed to those with a positive reaction would be cost-effective and would result in a substantial reduction in rates of TB following immigration. This analysis has limited applicability to Canada. The authors assumed that the rates of physician adherence in screening and in prescribing therapy and of patient adherence with screening would be 100%. Patient adherence with therapy was based on findings from randomized clinical trials, in which adherence is generally much higher than that observed under program conditions. Achieving high rates of physician and patient adherence is not easy and requires intensive efforts. Yet the analysis assumed very low program costs, even lower than those in earlier Canadian studies, and did not include the investment required for the public health infrastructure to coordinate and execute such a massive program. Low-cost programs and inadequate public health infrastructure are associated with poor adherence by patients and providers. In earlier Canadian studies of immigrant screening, these were key determinants of effectiveness and cost-effectiveness. Adherence could be improved with legal coercion, as proposed in the United States, but this seems unlikely to be adopted in Canada.

Which strategy is preferable?

Both of the currently available strategies for TB screening have limitations. First, screening is not performed (nor is it feasible) for the large number of foreign-born people who enter Canada annually as visitors. Accurate figures are not available for this country, but in the United States about 800 000 landed immigrants are screened and enter as permanent residents annually. Yet 32 million other foreign-born people enter the country annually (as short-term visitors, illegal immigrants and students) and are not screened. These people may cause substantial transmission of TB infection as well as considerable TB-related illness and health care costs. A second problem is TB exposure and infection during travel by Canadians to countries with a high incidence of TB and re-exposure to TB during visits by landed immigrants to their country of birth, which can account for as many as one-third of all cases among foreign-born people. As with short-term visitors to Canada, it would not be feasible to implement screening programs for returning residents and travellers.

Of the 2 screening strategies, chest radiography is preferable. Despite the greater initial cost, this method is more cost-effective because relatively few people require further investigation of significant abnormalities. Although the yield
of prevalent active TB detected will be low, a far greater number of people will be identified with inactive TB. These people are at high risk for active TB in the future and can derive important benefit from therapy. However, administrative and individual barriers may reduce the potential benefit of screening considerably. The results of screening chest radiography and other investigations must be reported, along with identifying information, by Citizenship and Immigration Canada to provincial health authorities in a timely manner. The latter need to have in place a system to ensure that people with inactive TB are referred for medical evaluation. Individual barriers include physician or patient noncompliance with recommendations for latent TB infection therapy. If immigrants with inactive TB are referred appropriately for surveillance, evaluated promptly after arrival and prescribed appropriate therapy for latent TB infection, and complete this therapy, chest radiographic screening could provide substantial individual and public health benefits.

In contrast, tuberculin skin testing detects many people with false-positive reactions, in whom therapy for latent TB infection provides no benefit and may result in harm. Of those with true-positive reactions, more than 80% are low-risk reactors, in whom therapy for latent TB infection provides only modest benefits. However, selective tuberculin skin testing of people at high risk for reactivation — those with medical problems such as diabetes mellitus, renal failure, HIV infection or other immune-compromised conditions, those receiving immunosuppressant medications and those with recent contact with a person who has a contagious form of active TB — is strongly recommended.

**Recommendations**

1. Of the currently available methods of screening for TB among immigrants to Canada, chest radiography remains the best option.
2. The limitations of chest radiography should be recognized.
3. A high priority should be placed on ensuring appropriate follow-up and treatment of all people identified as having inactive TB, for the individual as well as public health benefits.
4. Tuberculin skin testing is not recommended as a routine screening procedure for all immigrants.
5. However, tuberculin screening is recommended for people with risk factors for reactivation, such as recent contact with a known contagious case of active TB, diabetes, renal failure, HIV infection or immunosuppressant therapy. Tuberculin testing is very strongly recommended for immunosuppressed people arriving from countries with a high incidence of TB or who have had recent contact with a person known to have or strongly suspected of having active TB.
6. Tuberculin skin testing of people with medical risk factors for reactivation of TB need not be part of routine screening of immigrants. However, mechanisms are needed to increase tuberculin screening of this group by primary care physicians in Canada.
7. It is important to emphasize that the decision to perform tuberculin skin testing must include a commitment to undertake the appropriate evaluation, therapy and follow-up of all those with a positive reaction.

**Future priorities**

The greatest limitation of current screening for TB is the lack of an adequate tool. Chest radiography is not sensitive enough. Tuberculin skin testing is nonspecific, and most people who have positive reactions are at very low risk for disease. The ideal screening tool would identify only people with latent TB infection who are at high risk for active pulmonary or extrapulmonary disease.

More than two-thirds of all cases of TB in Canadians occur among those born overseas. Therefore, the best long-term strategy for control of TB in Canada is participation in a global TB elimination program.

This article has been peer reviewed.

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This statement has been approved by the Centre for Infectious Disease Prevention and Control, Population and Public Health Branch, Health Canada.

The Immigration Subcommittee of the Canadian Tuberculosis Committee provides evidence-based advice to the committee regarding tuberculosis (TB) prevention and control for immigrants to Canada. The Canadian Tuberculosis Committee provides Health Canada with ongoing timely and scientifically based advice on national strategies and priorities with respect to TB prevention and control in Canada. Health Canada acknowledges that the advice and recommendations set out in this statement are based on the best currently available scientific knowledge and medical practices and is disseminating this document for information purposes to the medical community involved in the care of people with active TB and latent TB infection.

**References**

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Online-4

JAMC • 11 NOV 2003 • 169 (10)