

EVALUATION OF A TUBERCULOSIS SCREENING PROGRAM FOR HIGH-RISK STUDENTS IN TORONTO SCHOOLS

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Abstract • Résumé

- Objective:** To evaluate the effectiveness of a tuberculosis (TB) screening program for high-risk students in elementary and secondary schools.
- Design:** Cross-sectional study of the 1992-93 school screening program conducted by the Department of Public Health of the City of Toronto. Program costs were calculated with the use of 1993 wages, and costs for medical care were based on the 1993 fee schedule of the Ontario Medical Association.
- Setting:** Elementary and secondary schools in the City of Toronto.
- Participants:** Students enrolled for the first time in any grade who were born in a country where TB is endemic or who were aboriginal Canadians were eligible. Of 44 179 students in Toronto schools 1775 met the eligibility criteria.
- Intervention:** Students were administered a Mantoux skin test, and those with a significant reaction (an induration of 10 mm or more in diameter) were advised to consult a physician for follow-up.
- Outcome measures:** Participation rate, number of participants with a significant reaction, percentage of these who were prescribed isoniazid and who completed chemoprophylaxis, potential number of preventable cases and costs associated with preventing each case.
- Results:** Of 1775 eligible students 42.9% (761) agreed to participate, and 40.6% (720) were screened. Significant skin-test reactions were detected in 22.5% (162/720) of the participants screened. Of these, 87.7% (142/162) saw a physician; subsequently, 2 cases of TB (1 active and 1 inactive) were detected. Of the remaining 140 students 44.3% (62) were prescribed isoniazid, of whom 9.7% (6/62) refused chemoprophylaxis. Of the remaining 56 students 82.1% (46) completed at least 6 months of chemoprophylaxis and 10.7% (6) were completing treatment at the end of the study. An estimated 3.2 cases were prevented, at a cost of \$13 493.15 per case, whereas the undiscounted cost of treatment for an uncomplicated active case of TB in a patient under 19 years of age was \$4503.82.
- Conclusions:** The effectiveness of this screening program was significantly reduced by poor participation and poor rates of prescription of isoniazid by physicians. Appropriate strategies are needed to reduce barriers to the implementation of these programs.

- Objectif :** Évaluer l'efficacité d'un programme de dépistage de la tuberculose (TB) chez les étudiants à risque élevé dans des écoles primaires et secondaires.
- Conception :** Étude transversale du programme de dépistage scolaire de 1992-1993 mise en oeuvre par le Service de santé publique de la Ville de Toronto. Les coûts du programme ont été fondés sur les salaires de 1993 et les coûts des soins médicaux, sur la grille des honoraires de 1993 de l'Association médicale de l'Ontario.
- Contexte :** Écoles primaires et secondaires de la Ville de Toronto.
- Participants :** Les étudiants originaires d'un pays où la TB est endémique ou les étudiants canadiens autochtones de n'importe quelle année inscrits pour la première fois étaient admissibles. Sur 44 179 étudiants fréquentant les écoles de Toronto, 1 775 répondaient aux critères d'admissibilité.

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Intervention : On a administré aux étudiants une cutiréaction de Mantoux et l'on a conseillé à ceux qui ont réagi fortement (induration de 10 mm ou plus de diamètre) de consulter un médecin.

Mesures des résultats : Taux de participation, nombre de participants qui ont réagi pour la peine, pourcentage de ceux à qui l'on a prescrit de l'isoniazide et qui ont terminé une chimioprophylaxie, nombre possible de cas évitables et coûts à encourir pour prévenir chaque cas.

Résultats : Sur 1 775 étudiants admissibles, 42,9 % (761) ont consenti à participer à l'étude et 40,6 % (720) ont fait l'objet d'un dépistage. On a constaté une cutiréaction chez 22,5 % (162/720) des participants examinés, dont 87,7 % (142/162) ont consulté un médecin. Deux cas de TB (un actif et un inactif) ont été dépistés par la suite. Sur les 140 étudiants restants, on a prescrit de l'isoniazide à 44,3 % (62), dont 9,7 % (6/62) ont refusé la chimioprophylaxie. Sur les 56 étudiants restants, 82,1 % (46) ont suivi une chimioprophylaxie d'au moins 6 mois et 10,7 % (6) terminaient leur traitement à la fin de l'étude. On estime avoir prévenu 3,2 cas à un coût de 13 493,15 \$ par cas, tandis que le coût non réduit du traitement d'un cas actif de TB sans complication chez un patient de moins de 19 ans s'est établi à 4 503,82 \$.

Conclusions : L'efficacité de ce programme de dépistage a été réduite considérablement par la faiblesse de la participation et du nombre d'ordonnances d'isoniazide établies par les médecins. Il faut établir des stratégies appropriées pour réduire les obstacles à la mise en oeuvre de ces programmes.

Tuberculosis (TB) continues to be an important cause of illness and death worldwide. In Canada, approximately 2000 active cases are reported annually, and the incidence rate is 7.1 cases per 100 000 population.¹ Although the incidence of TB has declined in the general population, there is an increasing proportion of cases among immigrants and refugees born in countries where TB is endemic. In the early 1970s, 20% of cases in Canada were among foreign-born residents, as compared with 47% of cases in 1989.² More than 200 000 immigrants enter Canada each year,³ and their risk of TB developing is greatest during the first 5 years after immigration.^{4,5} Studies have shown that TB incidence rates among immigrants parallel those in their countries of origin.⁶⁻⁸

The Canadian Thoracic Society has recommended screening of high-risk groups when indicated by local TB incidence rates.⁹ Similar recommendations have been made by the Advisory Committee for the Elimination of Tuberculosis and by the American Thoracic Society.¹⁰⁻¹² The rationale for such programs is to prevent TB through the early detection of people with *Mycobacterium tuberculosis* infection and the provision of chemoprophylaxis for those infected.

Preventive therapy is recommended for all people under 35 years of age from countries where TB is endemic who have a significant reaction to a Mantoux skin test, regardless of previous vaccination with bacillus Calmette-Guérin (BCG).¹² Significant reactions among such people likely represent true infection rather than hypersensitivity resulting from previous BCG vaccination.^{9,13} Chemoprophylaxis with isoniazid for people with *M. tuberculosis* infection is more than 90% effective in preventing TB when taken as prescribed.¹⁴ In Ontario, drugs for prophylaxis and treatment of TB are provided free of charge by the Ministry of Health.

Children are important to consider for TB screening, since they are more likely than adults to have serious forms of TB — such as tubercular meningitis or miliary

TB — after infection.¹⁵ In Ontario routine TB screening of school children was abandoned in the early 1980s, when the incidence of TB fell. However, it has continued to be offered to students with a high risk of the disease in the City of Toronto, where the incidence is 28 cases per 100 000 population (approximately four times the national incidence) and where 80% of cases occur among foreign-born residents.¹⁶

The City of Toronto Department of Public Health routinely offers the Mantoux skin test to all new school entrants who are at greatest risk of TB (recent immigrants from a country where TB is endemic and aboriginal Canadians). This study was conducted to evaluate the effectiveness of the 1992-93 TB screening program in schools in the City of Toronto and to compare the cost of preventing a case of TB with the cost of treating an uncomplicated active case.

METHODS

During 1992-93 school health records of pupils enrolling for the first time in City of Toronto schools were reviewed by nurses from the Department of Public Health. Each health record contained the following information, collected at the time of school registration: country of birth, year of immigration to Canada, vaccination history, aboriginal status and results of previous Mantoux skin tests. New school entrants who did not have results of a previous Mantoux skin test and who were either born in a country where TB is endemic or were aboriginal Canadians were eligible. Countries where TB is endemic were defined as any country other than the United States, a country in Western Europe, Australia and New Zealand. Participation in the TB screening program was entirely voluntary.

Consent cards and fact sheets on TB, available in eight languages (English, Chinese, Vietnamese, Cambodian, French, Italian, Greek and Spanish), were given

to students to take home to their parents or guardians or for their own review if they were over 16 years of age. Parents, guardians or students who did not return consent cards within 2 to 3 weeks were telephoned at least twice by a nurse to remind them.

Two nurses from the Department of Public Health who had received training in Mantoux skin testing technique and interpretation administered the tests to consenting students in the schools and measured and recorded the results 48 to 72 hours later. The Mantoux skin test involves intracutaneous administration of 5 units of *M. tuberculosis* purified protein derivative. An induration of 10 mm or greater in diameter at the injection site 48 to 72 hours after administration is considered significant.⁹ Most students who consented to participate were tested at school, but a few were absent from school on testing days or chose to have the test performed by their own physician. Only students tested by the Department of Public Health were included in the analysis.

Students with significant reactions to the skin test were asked to consult their physician for follow-up. The Department of Public Health provided the physicians of these students with a referral letter, TB management recommendations from existing guidelines and a treatment decision form which the physician was asked to complete and return in an addressed, stamped envelope provided. If a student did not have a physician, names of several available physicians were provided. Physicians who did not prescribe isoniazid were contacted by a nurse to determine the reasons for nonprescription. In the year following the screening program, physicians who prescribed isoniazid were also contacted to determine whether their patient had completed treatment.

The following outcomes were examined in the evaluation: the proportion of eligible students who were screened and the prevalence of significant reactions as well as the proportion of students with significant reactions who consulted a physician, who were prescribed isoniazid and who completed at least 6 months of chemoprophylaxis. Countries of birth were grouped by continent, which were then compared in the analysis. We performed a multivariate logistic regression analysis of the association between specific factors and a significant skin-test reaction.¹⁷ The increased risk of such a reaction associated with being born in Asia, Africa, the Caribbean and Latin America was estimated, with birth in Eastern Europe as the baseline for comparison.

To examine the effectiveness of the program the number of preventable cases were calculated on the basis of (1) the prevalence of students with a significant reaction, (2) the positive predictive value of a significant reaction to a Mantoux skin test, which has a sensitivity and a specificity of 90%,¹⁸ (3) a lifetime risk of TB of 10% among people with *M. tuberculosis* infection¹⁹ and

(4) the assumption that 6 months of therapy with isoniazid is 100% effective in preventing TB.

To compare the cost of preventing a case with the cost of treating an uncomplicated case in a patient less than 19 years of age, the typical cost of management of TB in such a child was calculated in consultation with an expert on TB in children. The cost per preventable case was calculated for four different situations: (1) current program conditions, (2) ideal conditions, with full participation of eligible students, prescription of isoniazid for those with a significant skin-test reaction and patient completion of chemoprophylaxis, (3) 50% participation in screening and (4) 50% prescription of isoniazid for those with a significant skin-test reaction. Program costs were based on the estimated time for each program component and the mean 1993 City of Toronto wages for associated staff (\$17.50/hour for clerks, \$24.30/hour for registered nurses and \$27.25/hour for public health nurses). Costs for physician visits and medical services were based on the 1993 fee schedule of the Ontario Medical Association.

The χ^2 test was used to determine the statistical significance of categorical variables, and Student's *t*-test and analysis of variance were used for continuous variables.²⁰ Analyses were conducted with the use of SAS software (SAS Institute Inc., Cary, NC) and QuattroPro for Windows (Borland International Inc., Scotts Valley, Calif.). A *p* value of less than 0.05 was considered statistically significant.

RESULTS

The total enrolment in the 20 secondary and 72 elementary schools in the City of Toronto is 44 179 students, of which 670 secondary and 1105 elementary pupils met the eligibility criteria for the screening program. Twenty-two eligible students were aboriginal Canadians, and the others were foreign born. In terms of age, 35% were less than 10 years of age, 54% were 10 to 19, and 11% were 20 or older (range 3 to 47 years, mean 12.6 years and standard deviation 5.4 years).

Of the 1775 eligible students 761 (42.9%) agreed to participate, and 720 (40.6%) underwent Mantoux skin testing conducted by the Department of Public Health. Participants were significantly more likely than nonparticipants to have been born in Asia, to be older, to have lived in Canada for a shorter period, to have been older when they immigrated to Canada and to know their BCG vaccination status (Table 1). Aboriginal Canadian students were the least likely to participate, with only one of the eligible students participating.

Significant reactions to the skin test were detected in 162 (22.5%) of the 720 students tested. All of the students with a positive result of the skin test were foreign

born. Students from regions of the world where TB is highly endemic were more likely to have significant reactions to the skin test than those from regions of the world with intermediate endemicity of TB^{21,22} (Table 2). In addition, the prevalence of significant reactions increased with age at immigration (Table 2), but did not differ between the sexes. Among students with significant skin-test reactions, 42% reported previous BCG vaccination, compared with 30% of those with nonsignificant reactions ($p = 0.003$). Multivariate analysis showed that increasing age at immigration, birth in a country where TB

is endemic and previous BCG vaccination were positively associated with a significant reaction (Table 3).

In total, 87.7% (142/162) of the students with significant skin-test reactions saw a physician for follow-up. One active and one inactive case of pulmonary TB were diagnosed as a result. The active case involved a girl 10 years of age with a skin-test reaction 20 mm in diameter. The girl had immigrated to Canada from Africa 1 year previously. Her BCG vaccination status was unknown. The inactive case was diagnosed in a boy 17 years of age with a skin-test reaction 14 mm in diameter who had recently arrived

Table 1: Demographic characteristics of participants and nonparticipants in the tuberculosis (TB) screening program in schools in the City of Toronto, 1992-93

Characteristic	All eligible students <i>n</i> = 1775	Participants <i>n</i> = 761	Nonparticipants <i>n</i> = 1014	<i>p</i> value*
Sex, no. (and %) female	803 (45.2)	332 (43.6)	471 (46.5)	NS
BCG† vaccination status known, no. (and %)	637 (35.9)	351 (46.1)	286 (28.2)	< 0.00001
Mean age (and standard deviation [SD]), yr	12.6 (5.4)	14.1 (5.6)	11.5 (5.0)	< 0.00001
Mean age at immigration (and SD), yr	9.7 (5.9)	11.6 (6.0)	8.3 (5.3)	< 0.00001
Mean time in Canada (and SD), yr	2.0 (1.9)	1.7 (2.0)	2.2 (1.9)	< 0.00001
Continent or region of birth, except where otherwise stated, no. (and %)				
Asia	1156 (65.1)	536 (70.4)	620 (61.1)	0.0002
Canada (aboriginal heritage)	22 (1.2)	1 (0.1)	21 (2.1)	0.0003
Africa	157 (8.8)	64 (8.4)	93 (9.2)	NS
Latin America	189 (10.6)	67 (8.8)	122 (12.0)	NS
Eastern Europe	113 (6.4)	38 (5.0)	75 (7.4)	NS
Caribbean	85 (4.8)	35 (4.6)	50 (4.9)	NS

*For comparison of participants and nonparticipants. NS = not significant.
†BCG = bacillus Calmette-Guérin.

Table 2: Prevalence of significant reactions (induration of 10 mm or more in diameter) by region of birth and by age at immigration among the participants who underwent a Mantoux skin test

Characteristic	No. (and %) of students with significant
Region of birth	
Asia	123/521 (23.6)
Africa	23/59 (39.0)
Latin America	9/62 (14.5)
Eastern Europe	6/37 (16.2)
Caribbean	1/30 (3.3)
Age at immigration, yr	
< 10	33/254 (13.0)
10-14	35/190 (18.4)
15-19	64/179 (35.8)
≥ 20	23/60 (38.3)

Table 3: Adjusted odds ratios (ORs) of factors associated with a significant reaction to a Mantoux skin test among new school entrants tested

Factor	Adjusted OR	95% confidence interval
Continent or region of birth*		
Asia	1.43	0.52-3.91
Africa	6.51	0.92-46.25
Latin America or Caribbean	1.14	0.29-4.42
1-year increase in age at immigration	1.14	1.09-1.18
BCG vaccination status†		
Previous vaccination	2.92	1.30-6.53
Status unknown	1.03	0.53-2.02

*Odds when compared with birth in Eastern Europe.
†Odds when compared with no previous vaccination.

from Asia and had reported previous vaccination with BCG. Both students were subsequently treated.

Of the students who saw a physician but were not diagnosed with TB 44.3% (62/140) were prescribed isoniazid for prophylaxis of TB. Of those prescribed chemoprophylaxis 9.7% (6/62) refused treatment. In following up the 55.7% (78/140) of students who were not prescribed isoniazid we found that the most common reason physicians gave for not prescribing chemoprophylaxis was that the significant skin-test reaction could be attributed to previous BCG vaccination.

Fourteen months after the completion of the screening program, among students who were prescribed isoniazid and had not refused it, physicians reported that 82.1% (46/56) had completed at least 6 months of treatment and 10.7% (6/56) had started therapy, for a total of 93%. Of the remaining four students three had discontinued treatment on their own and one had discontinued the prescription on the advice of his physician. No instances of hepatitis or other serious side effects of isoniazid were reported among the students. A flow chart (Fig. 1) shows the disposition of eligible students at each stage of the program.

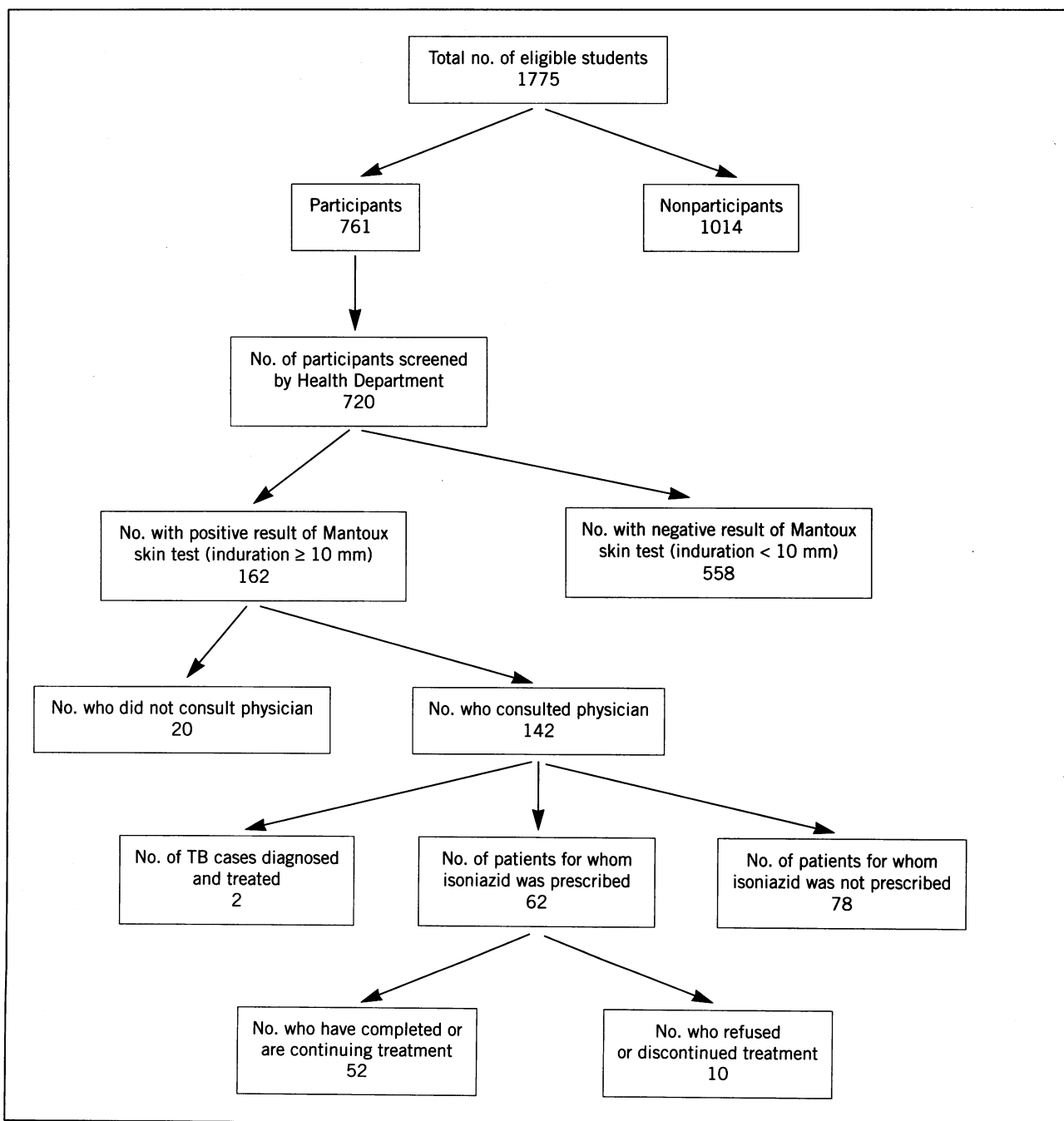


Fig. 1: Disposition of eligible students in elementary and secondary schools in the City of Toronto who were enrolled in a voluntary tuberculosis screening program during 1992-93.

One of the students with a positive result of the skin test who was not prescribed chemoprophylaxis was diagnosed with active pulmonary TB in August 1994. The student was an Asian man 21 years of age; he had had a skin-test reaction 16 mm in diameter and had no known BCG vaccination.

We calculated that the 1992–93 TB screening program in Toronto schools prevented a potential 3.2 cases of TB (Table 4). As participation in screening and prescription of isoniazid for those with positive results increase, the number of preventable cases also increases. Under ideal conditions — full participation, prescription of isoniazid for those with positive results and patient completion of chemoprophylaxis — 25 cases of TB could have been prevented.

We calculated the health care costs of the program to be \$43 178.09 (Table 5). Thus, the cost of preventing a single case was \$13 493.15. Costs per preventable case in four different program situations are shown in Table 4. This analysis showed that it would be more costly to implement a program with poor rates of prescription of isoniazid by physicians than one with poor participation in screening. Under existing program conditions it was significantly more expensive to prevent a case than to treat one. However, under ideal program conditions the cost to prevent a case (\$6737.12) would approximate the cost to treat a case in a child or adolescent under 19 years of age (\$4503.82 [Table 6]) or in an adult (reported costs range from \$1800 to \$9182.25).^{23,24}

DISCUSSION

The prevalence of significant skin-test reactions in our study (22.5%) is similar to that reported in Los Angeles

Table 5: Estimated cost of current TB screening program*

Activity	Cost, \$
Determination of 1775 eligible students, follow-up of participants and nonparticipants	5 550.53
Performance of 720 Mantoux skin tests	3 343.30
Materials and supplies (including costs of printed materials, tuberculin solution, syringes, etc.)	1 000.00
Follow-up of 162 students with significant reactions by Department of Public Health (including counselling and education)	3 285.90
Medical consultation for 140 students with significant skin-test reactions, excluding one active and one inactive case of TB (cost of initial intermediate assessment, chest radiograph and return visit for radiograph results = \$112.95 per person)	15 813.00
Medical follow-up of 56 students prescribed isoniazid (cost of monthly physician follow-up, cost of isoniazid and associated administrative costs to Department of Public Health = \$253.31 per person)	14 185.36
Total	43 178.09

*Program costs were based on a wage of \$17.50/hour for clerks, \$24.30/hour for registered nurses and \$27.25/hour for public health nurses. Costs for medical consultation were based on the 1993 Ontario Medical Association fee schedule. Estimated time spent on the program was 35 hours by clerks, 333.6 hours by registered nurses and 127 hours by public health nurses.

Table 4: Number of preventable cases of TB, calculated for four situations

Variable	Situation			
	Current program conditions	Ideal conditions*	50% participation in screening program	50% of those with significant skin-test reaction prescribed isoniazid
No. of students eligible	1775.0	1775.0	1775.0	1775.0
No. (and %) screened	720.0 (40.6)	1775.0 (100.0)	887.5 (50.0)	1775.0 (100.0)
No. of participants with a significant reaction (assuming a rate of positive results of 22.5%)	162.0	399.5	199.7	399.5
No. (and %) of those with significant reactions who consult a physician	142.0 (87.7)	399.5 (100.0)	199.7 (100.0)	399.5 (100.0)
No. (and %) prescribed isoniazid	62.0 (43.7)	399.5 (100.0)	199.7 (100.0)	199.7 (50.0)
No. (and %) who start taking isoniazid	56.0 (90.3)	399.5 (100.0)	199.7 (100.0)	199.7 (100.0)
No. (and %) who complete isoniazid therapy	52.0 (93.0)	399.5 (100.0)	199.7 (100.0)	199.7 (100.0)
No. estimated to be infected†	32.4	249.2	124.6	124.6
No. of cases of TB prevented‡	3.2	25.0	12.5	12.5
Cost of screening program, \$\$	43 178.09	168 428.00	87 565.68	117 245.00
Cost per prevented case, \$	13 493.15	6 737.12	7 005.25	9 379.62

*See text for details.

†Assuming test has positive predictive value of 62.4% and sensitivity and specificity of 90%.

‡Assuming 10% lifetime risk among those with infection and 100% effectiveness of isoniazid therapy if patients complete 6 months of treatment.

§See Table 5 for details of this calculation.

(20.5%),²⁵ higher than that reported in Boston (8.9%)²⁶ and lower than those reported in Montreal (32.4%)²⁷ and Denver (42%).²⁸ In keeping with other studies^{8,26,29} we observed an increased prevalence of significant skin-test reactions among students from countries where TB was highly endemic, and a prevalence that increased with an increase in the student's age at immigration.

The prevalence of significant reactions reported here may overestimate the true prevalence because participants were generally older when they immigrated to Canada than were nonparticipants. Information from school health records could have been incomplete, and eligible students could have been missed. We may have exaggerated the benefits of isoniazid prophylaxis by assuming that a completed course of treatment is 100% effective and that patients would experience no side effects of the drug. Our calculated treatment cost was conservative, since indirect costs of TB and the cost of treating secondary cases were not included.

This evaluation illustrates the difficulties in imple-

menting a voluntary school-based TB screening program for "high-risk" students. Participation in the program was only 43% even after a letter was sent to eligible students and at least two follow-up telephone calls were made. Language barriers, mistrust of government, unfounded fears that a diagnosis of TB would result in deportation and the stigma attached to TB in some cultures³⁰ could have impeded participation.

Of concern is the finding that only 44.3% of students with significant reactions were prescribed isoniazid. This result is similar to reports from the US Centers for Disease Control and Prevention, Atlanta, which indicated that less than 60% of infected contacts of cases were given preventive therapy.¹⁴ The rate of prescription of isoniazid was probably reduced by physicians' attribution of significant skin-test reactions to previous BCG vaccination and their concerns about side effects of the drug.³¹ However, those with a significant skin-test reaction are at risk of TB. In a cohort of 1192 students in San Francisco who had a positive result of a skin test but did not receive chemoprophylaxis 25 TB cases developed in the subsequent 9 years.³² In the Toronto program a case of TB was diagnosed in 1 of the 78 students with a significant reaction who were not prescribed isoniazid 1 year previously. These findings reinforce current recommendations that isoniazid prophylaxis is the preferred strategy when a person with a significant reaction is less than 35 years of age.^{9,13,14,33}

Although one active and one inactive case of TB were diagnosed through this program, and three potential cases were prevented, 22 potential cases were not prevented. Unless patient participation and physician prescription of isoniazid are improved the effectiveness of this program is compromised. Culturally sensitive information about TB, available in appropriate languages, and greater efforts to allay fears about the disease are needed. Some health departments in Ontario have instituted mandatory TB screening for high-risk students as a requirement of school entry to ensure participation. Misconceptions among physicians about the effect of previous BCG vaccination on reactions to the Mantoux skin test and concerns about the side effects of isoniazid also need to be addressed through such avenues as continuing medical education courses and medical school curricula. In some TB screening programs all patients with significant reactions have been referred to a single TB clinic in order to ensure consistent follow-up.²⁸

Screening of people at a high risk of TB is an important component of TB control. It offers an opportunity to prevent the disease through early detection and through chemoprophylaxis for those with *M. tuberculosis* infection. These programs should undergo regular evaluation; barriers to implementation need to be identified and appropriate strategies developed to improve their effectiveness.

Table 6: Cost of managing an uncomplicated case of TB in a child or adolescent under 19 years of age*

Activity	Cost, \$
General assessment by family physician	74.15
Three chest radiographs	149.55
Six sputum cultures and sensitivity tests	301.40
Referral to consultant	162.20
Complete blood count	8.50
Four follow-up visits at 1, 2, 4 and 6 mo	100.00
Treatment with isoniazid (300 mg/d for 6 mo), rifampin (600 mg/d for 6 mo) and pyrazinamide (1.5 g/d for 2 mo)	179.90
Admission to hospital (44% of such patients have a hospital stay of 1 week),† at \$500/d	1540.00
Three urinalyses and one serologic test for viruses	20.23
Consultation upon admission and daily visits for 1 week	155.32
Bronchoscopic examination (conducted for 33% of such patients)	87.17
Subtotal	2778.52
Contact follow-up‡	
Referral of 8 household contacts to physician	1046.00
Testing of 25 school contacts by health unit	679.30
Subtotal	1725.30
Total	4503.82

*Cost estimates are based on medical management of a case of TB at the Hospital for Sick Children, Toronto (Dr. Elaine Wang: personal communication, 1994). Calculations assume that there are no deaths due to TB or hepatitis and that there are no cases of hepatitis induced by isoniazid.

†Estimate based on proportion of children under 18 years of age admitted to hospital for TB in Ontario, 1990-93 (Ontario Ministry of Health: unpublished data).

‡Eight household contacts per case with seroconversion rate of 10% and 25 school contacts with seroconversion rate of 6%. (City of Toronto Department of Public Health: unpublished data.)

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