

The Singapore Tuberculosis Elimination Programme: the first five years

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Abstract The Singapore Tuberculosis Elimination Programme (STEP) was launched in 1997 because the incidence of the disease had remained between 49 and 56 per 100 000 resident population for the preceding 10 years. STEP involves the following key interventions: directly observed therapy (DOT) in public primary health care clinics; monitoring of treatment progress and outcome for all cases by means of a National Treatment Surveillance Registry; and preventive therapy for recently infected close contacts of infectious tuberculosis cases. Among other activities are the revamping of the National Tuberculosis Notification Registry, the discontinuation of BCG revaccination for schoolchildren, the tightening up of defaulter tracing, and the education of the medical community and the public. Future plans include an outreach programme for specific groups of patients who are unable to attend their nearest public primary care clinics for DOT, the detention of infectious recalcitrant defaulters for treatment under the Infectious Diseases Act, the molecular fingerprinting of tuberculosis isolates, and targeted screening of high-risk groups. The incidence of tuberculosis fell from 57 per 100 000 population in 1998 to 48 per 100 000 in 1999 and continued to decline to 44 per 100 000 in 2001. With political will and commitment and the support of the medical community and the public it is hoped that STEP will achieve further progress towards the elimination of tuberculosis in Singapore.

Keywords Tuberculosis, Pulmonary/epidemiology/prevention and control/drug therapy; Patient compliance; Disease notification/methods; BCG vaccine/administration and dosage; Health education; Program evaluation; Singapore (*source: MeSH, NLM*).

Mots clés Tuberculose pulmonaire/épidémiologie/prévention et contrôle/chimiothérapie; Observance prescription; Notification maladie/méthodes; Vaccin BCG/administration et posologie; Education sanitaire; Evaluation programme; Singapour (*MeSH, INSERM*).

Palabras clave Tuberculosis pulmonar/epidemiología/prevenición y control/quimioterapia; Cooperación del paciente; Notificación de enfermedad/métodos; Vacuna BCG/administración y posología; Educación en salud; Evaluación de programas; Singapur (*fuelle: DeCS, BIREME*).

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Voir page 220 le résumé en français. En la página 220 figura un resumen en español.

Introduction

Singapore is an island city-state with a total population of about 4 million, of whom 3.26 million are resident, and 0.74 million non-residents on long-term employment, student or social visit passes. Ethnically the resident population is 77% Chinese, 14% Malay, and 8% Indian, with 1% being of other ethnicities. The proportion of people aged over 60 years is 11%; it is projected that 27% will be in this age group by 2030 (1).

Since 1965 Singapore has made striking social and economic progress. The incidence of tuberculosis declined from 300 per 100 000 in the 1960s to 55 per 100 000 in 1987 as a result of substantial improvements in environmental hygiene, housing and sanitation, the provision of medical services, the advent of short-course tuberculosis chemotherapy, and the national tuberculosis programme. Mortality from tuberculosis declined from 12% of all deaths in 1950 to less than 1% in the 1990s. However, the tuberculosis notification rate remained between 49 and 56 per 100 000 population from 1987 to 1997 (Table 1, Fig. 1) (2).

Pulmonary tuberculosis accounts for around 90% of notified cases. Mycobacteriological culture and sensitivity

testing have been consistently performed on over 90% of these cases, and the rate of positive cultures has been in the range 60–70%. The incidence of primary multidrug-resistant tuberculosis has been below 1%. Over the past decade or so the disease has predominantly affected older men: 50–60% of cases have been men aged over 50 years and approximately twice as many males as females have contracted tuberculosis (Fig. 2) (2).

Non-residents entering Singapore for long-term stays are required to undergo chest radiograph screening for active disease. Tuberculosis notifications among non-residents constituted 31% of all notified cases in 2000 (3). The corresponding proportion was 38% in 1997, when the Singapore Tuberculosis Elimination Programme (STEP) was introduced (2).

The low incidence of tuberculosis in childhood and early adulthood and the steep rise in incidence with age suggest a low level of transmission in the community. Endogenous reactivation in an aging population appears to be a major factor contributing to the leveling off of tuberculosis rates. The possibility of increased transmission among older people, however, should not be ignored. The impact of infection with

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Fig. 1. Incidence of tuberculosis among Singapore residents, 1960–2001

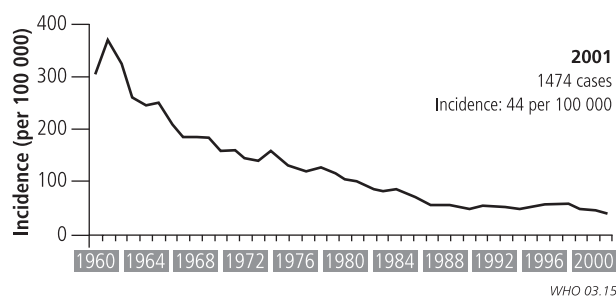
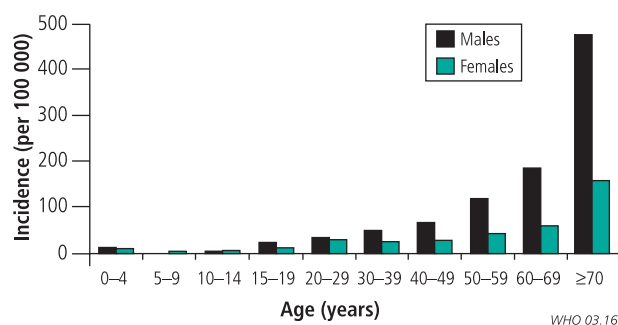


Fig. 2. Incidence of tuberculosis among Singapore residents, by age and sex, 2001



human immunodeficiency virus (HIV) on the tuberculosis rate is not believed to be significant, as Singapore has a relatively low HIV rate of 71 per million population and under 10% of HIV-infected patients have tuberculosis (2).

The Ministry of Health conducted a review of the national tuberculosis programme in response to the decade-long stagnation in the tuberculosis rate and the growing global epidemics of tuberculosis and HIV. STEP was launched with a mission to eliminate tuberculosis from Singapore by detecting and diagnosing all infectious (sputum-positive) cases in the community; curing all cases; detecting and treating all infected tuberculosis contacts; and preventing the emergence of multidrug-resistant tuberculosis (4).

Organizational structure of the Singapore Tuberculosis Elimination Programme

STEP is overseen and directed by a committee appointed by the Ministry of Health. An international advisory panel comprising four tuberculosis experts from Canada, the USA, and International Union Against Tuberculosis and Lung Disease provides advice and assistance. It is led by the Programme's national tuberculosis adviser, Professor Lee B. Reichman, Executive Director, New Jersey Medical School National Tuberculosis Center.

Components of the Programme

The two main arms of STEP are the epidemiological component under the Department of Clinical Epidemiology and the clinical component under the Tuberculosis Control Unit, Tan Tock Seng Hospital. The epidemiological component is essentially a surveillance system comprising the revamped National Tuberculosis Notification Registry, the treatment surveillance module and the registry for contact investigation. The Tuberculosis Control Unit functions as the clinical arm of STEP and serves as the national centre for contact investigation, preventive therapy, the management of tuberculosis patients and the training and education of health care workers and the public.

Diagnosis and treatment

Singapore has had a national tuberculosis control programme since the 1950s. There is good laboratory support for the diagnosis of the disease, acid-fast bacillus smear examinations being performed in several designated laboratories. The central tuberculosis laboratory performs all mycobacteriological cultures; drug susceptibility testing is conducted on every positive isolate. Second-line drug susceptibility testing is

available for isolates resistant to first-line drugs. Short-course tuberculosis chemotherapy has been the standard treatment since the mid-1980s. Treatment was mostly self-administered before the introduction of STEP.

Tuberculosis is diagnosed mainly by passive case-finding when patients present with symptoms. The principal sources of notification are the restructured public hospitals and the Tuberculosis Control Unit, accounting for 56% and 34% of notifications, respectively (3). The main treatment centres are the Tuberculosis Control Unit, functioning as the national referral centre and treating about 50% of cases, followed by the restructured hospitals, private chest specialists, and the Singapore Anti-Tuberculosis Association (SATA), a local nongovernmental organization, treating 35%, 5%, and 4% of cases, respectively (3).

Key interventions

The key interventions of STEP have been the following: the promotion of directly-observed therapy (DOT) as the treatment delivery mode of choice for tuberculosis patients; the implementation of a National Treatment Surveillance Registry to monitor treatment progress and outcome for all tuberculosis cases; and a national policy of preventive therapy for recently infected close contacts of infectious tuberculosis patients.

Outpatient directly observed therapy

Before 1997 fewer than 10% of tuberculosis patients were treated using DOT. A major priority of STEP was the aggressive utilization of DOT in polyclinics (public primary care clinics) so as to ensure adherence until treatment was completed. A system of liaison was established between the Tuberculosis Control Unit and the country's 16 polyclinics. With the close cooperation of these clinics, the Tuberculosis Control Unit has been able to treat between 60% and 70% of its patients by DOT and to achieve one-year treatment completion rates close to 90%. From October 2000, DOT was also made available in polyclinics to patients in treatment centres other than those of the Tuberculosis Control Unit (e.g. patients attending public restructured hospitals). In 2001 the utilization of DOT was 40% nationally.

National Treatment Surveillance Registry

The National Tuberculosis Notification Registry was created in 1957, and notification is compulsory under the Infectious Diseases Act. However, there was no systematic surveillance of the success rate of treatment or of the outcomes of treated

cases. STEP set up a computerized National Treatment Surveillance Registry in which data on monthly treatment progress are entered for every tuberculosis patient treated until an outcome is achieved. Physicians treating tuberculosis patients are required to submit returns indicating compliance, treatment regimen, and mode of treatment delivery at each clinic visit. The registry not only serves to monitor treatment outcome and success rates but also alerts physicians if patients default on treatment or do not respond as expected. Consequently, timely corrective measures can be taken.

Preventive therapy for close contacts of infectious tuberculosis cases

Before STEP was introduced, contact investigation consisted mainly of radiological screening for the detection of active disease in family and household contacts of notified tuberculosis cases, regardless of the infectiousness of the index cases. Tuberculin skin testing for the identification of infected contacts with a view to preventive therapy was performed only for children who were household contacts. There was no comprehensive national policy for the treatment of latent tuberculosis infection in high-risk candidates. In 1998, contact investigation at the Tuberculosis Control Unit was reorganized and screening was prioritized in accordance with the infectiousness of index cases. All identified close contacts now receive a tuberculin skin test. Chest radiography is performed on those who react positively or who are symptomatic (irrespective of the results of the skin test). Thus active case-finding is conducted and infected contacts of all ages who would benefit from preventive therapy are identified. Contact screening now includes not only close household and family members but also close contacts in workplaces and in other settings where considerable numbers of people come into close contact with one another, e.g. prisons, drug rehabilitation centres, nursing homes for the elderly, and mental institutions. Over the last three years an average of approximately four contacts per infectious index case have been identified and screened, and an average of one contact per index case has received preventive therapy. Since 1998 over 1000 close contacts have been given such therapy every year.

Other interventions and activities

Revamping the National Tuberculosis Notification Registry

The notification form was revised to include information on immigration status, country of origin, year of arrival and other matters related to the changing epidemiology of tuberculosis attributable to increased immigration. The revised notification form is also used to gather information on treatment plans for patients and on the centres to which patients have been referred for treatment, because it often happens that the notifying person is not the treating physician. The notification registry is linked to the Treatment Surveillance Registry in order to ensure that each notified case is tracked until an outcome to treatment has been achieved.

Discontinuation of BCG revaccination

Mass BCG vaccination at birth and revaccination at 12 or 16 years of age for tuberculin non-reactors were introduced in

the mid-1950s. Revaccination was discontinued on 1 July 2001 for the following reasons: there was no scientific evidence that it had a protective effect; WHO had recommended discontinuation in 1995 (5); and revaccination confounded the interpretation of the tuberculin skin test used in STEP's newly-implemented strategy of contact screening for the identification of candidates for preventive therapy. BCG vaccination at birth continues with nationwide coverage of 97%.

Distribution of tuberculosis guidebooks to the medical community

In order to raise awareness in the medical community in Singapore, a guidebook on tuberculosis was produced for general practitioners and distributed in 1998. An updated and expanded version for specialists was distributed in 2002.

Tightening up on the tracing of defaulters

For many years, nurses from the Tuberculosis Control Unit have been making home visits in order to recall patients who have defaulted on treatment and have failed to attend in response to telephone calls and letters. A retrospective study at the unit, undertaken before STEP was introduced, found that defaulters were more likely to be of non-Chinese ethnicity and to be living on their own or with friends, i.e. probably without family support (6). This study showed that 41% of home visits by the unit's nurses did not result in contact with patients or any other persons in their homes. In these instances, written details of rescheduled appointments were left at the patients' homes and 68% of the defaulters subsequently attended for follow-up. This approach to tracing defaulters was clearly inadequate. STEP has therefore obtained the help of enforcement officials from the Ministry of the Environment in the tracing of recalcitrant defaulters when home visits by the unit's staff are unsuccessful.

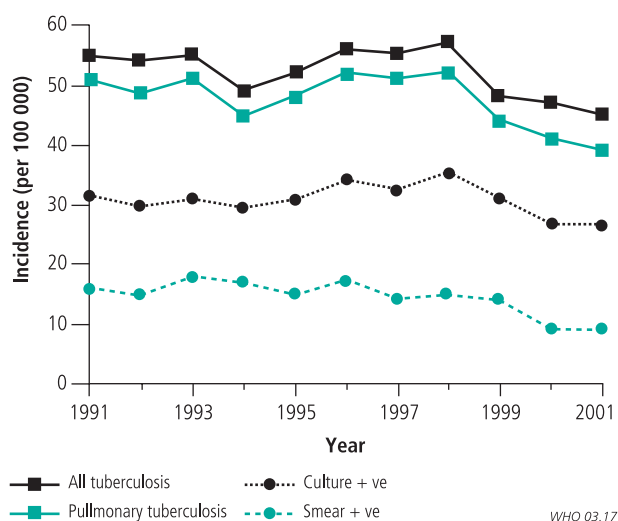
Public education

The tuberculosis public education programme highlights the warning signs and symptoms of the disease and explains the importance of full compliance with treatment by DOT. With the collaboration of SATA this programme was strengthened. It continues throughout the year and intensifies around WHO's World Tuberculosis Day on 24 March, with special activities including the provision of advice in the form of press releases.

Impact of STEP

Under the influence of STEP the incidence of tuberculosis appears to be declining again. In 1999 it was 48 per 100 000 population, representing a 16% drop from 57 per 100 000 the previous year. This trend continued in 2000 and 2001, when there were incidences of 47 and 44 per 100 000, respectively (7) (Fig. 3). However, much still needs to be done. An outreach DOT programme is planned in which specific groups of patients who are unable to attend their nearest polyclinic can receive DOT at more convenient locations. It is intended to use the Infectious Diseases Act for the detention of infectious recalcitrant defaulters for treatment, to carry out molecular fingerprinting of tuberculosis isolates, and to target screening on high-risk groups.

Fig. 3. Incidence of all notified tuberculosis, pulmonary tuberculosis, sputum-culture positive and smear-positive tuberculosis among Singapore residents, 1991–2001



With the continued commitment of the government and support from the medical community and the public, it is hoped that STEP will continue to reduce the incidence of tuberculosis. ■

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Conflicts of interest: none declared.

Résumé

Le Programme singapourien d'élimination de la tuberculose

Le Programme singapourien d'élimination de la tuberculose (STEP) a été lancé en 1997 car l'incidence de la maladie était restée comprise entre 49 et 56 cas pour 100 000 résidents au cours des 10 années précédentes. Il comprend les interventions majeures suivantes : traitement sous observation directe (DOT) dans les dispensaires publics de soins de santé primaires, surveillance des progrès et de l'issue du traitement pour tous les cas au moyen d'un registre national de surveillance des traitements, et administration d'un traitement préventif pour les proches contacts récemment infectés des cas infectieux. Parmi les autres activités figurent la rénovation du registre national de la tuberculose, l'arrêt de la revaccination des écoliers par le BCG, le renforcement de la recherche des sujets perdus de vue et l'éducation de la communauté médicale et du public. Les plans

pour l'avenir prévoient un programme destiné aux groupes de patients dans l'incapacité de se rendre au dispensaire le plus proche pour y recevoir un traitement sous surveillance directe, la mise en détention, dans le cadre de la loi sur les maladies infectieuses, des sujets infectieux systématiquement absents aux rendez-vous, l'identification moléculaire des isolats de bacilles de la tuberculose, et le dépistage ciblé des sujets à haut risque. L'incidence de la tuberculose est tombée de 57 cas pour 100 000 résidents en 1998 à 48 pour 100 000 en 1999 et à 44 pour 100 000 en 2001. Avec une volonté et un engagement politiques et le soutien de la communauté médicale et du public, il est possible d'espérer que le programme STEP parviendra à de nouveaux résultats sur la voie de l'élimination de la tuberculose à Singapour.

Resumen

El Programa de Eliminación de la Tuberculosis de Singapur

El Programa de Eliminación de la Tuberculosis de Singapur se lanzó en 1997 ante la constatación de que la incidencia de la enfermedad se había mantenido entre 49 y 56 por 100 000 habitantes residentes durante los 10 años anteriores. El Programa en cuestión comprende las siguientes intervenciones clave: tratamiento bajo observación directa (DOT) en los dispensarios públicos de atención primaria; vigilancia de los progresos y resultados del tratamiento de todos los casos por medio de un Registro Nacional de Vigilancia del Tratamiento; y terapia preventiva para los contactos próximos y recién contagiados de los casos de tuberculosis infecciosa. Entre otras actividades cabe citar la modernización del Registro de Nacional de Notificación de la Tuberculosis, la interrupción de la revacunación de los escolares con BCG, un seguimiento más estricto de los incumplidores del tratamiento, y la educación de la

comunidad médica y el público. Los futuros planes incluyen un programa de extensión para grupos específicos de pacientes incapaces de acudir a los dispensarios públicos de atención primaria más cercanos para recibir DOT, el arresto de los incumplidores contumaces infecciosos para someterlos a tratamiento -de acuerdo con la Ley de Enfermedades Infecciosas-, la determinación de las huellas moleculares de las cepas del bacilo aisladas, y el cribado selectivo de grupos de alto riesgo. La incidencia de tuberculosis descendió así de 57 por 100 000 habitantes en 1998 a 48 por 100 000 en 1999, y siguió descendiendo hasta 44 por 100 000 en 2001. Con voluntad política y compromiso y con el apoyo de la comunidad médica y el público, se espera que el Programa logre nuevos avances hacia la eliminación de la tuberculosis en Singapur.

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