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Chapter 15: Monitoring tuberculosis program performance

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KEY POINTS

- Program performance monitoring provides evidence of the quality and value of the services that tuberculosis (TB) programs provide.
- All TB programs in Canada are encouraged to monitor the same core indicators of performance using the definitions and suggested targets provided.
- This framework should be considered a minimum standard for monitoring Canadian TB programs; jurisdictions are encouraged to monitor additional indicators relevant to the populations served.
- Assessment against targets produces quantitative measures of performance, which are useful to reallocate efforts and resources.
- Program performance monitoring should be annual, with summaries made available to TB programs and other relevant stakeholders, as well as the public.
- Program performance monitoring requires adequate human resources dedicated to data collection, validation and analyses processes.
- Interpretation of monitoring results should be performed in close collaboration with the physician/nursing leads to ensure clinically relevant judgments are properly considered.
- Solutions to programmatic underperformance should be collaborative, involving members of TB-affected communities, select population groups, and relevant stakeholders.
- TB programs should monitor their capacity to provide patient-centered care and favorably influence long-term outcomes, which, among other program staff, is dependent on having dedicated support of a social worker.

1. Introduction

This new chapter of the Canadian TB Standards (the Standards) is focused on the role of program performance monitoring in the era of TB elimination. This chapter describes a program performance monitoring framework as part of the *Standards* to measure the value, quality and impact of services provided by TB programs across Canada.[1,2] In addition to frontline staff of TB programs, the intended audience for this chapter includes TB program managers, health policy leaders and physician/nursing leads.

2. Background

In 2014, after the full endorsement of its member states through a World Health Assembly resolution, the World Health Organization (WHO) began promoting the new End TB Strategy as the global approach to eliminating TB.[3] This strategy outlines three major pillars: the provision of high-quality, patient-centered prevention and care (Pillar 1); increased political will, and sustained resources for bold action (Pillar 2); and research and innovation (Pillar 3).[4] Implementation of these pillars is meant to help achieve three targets by the year 2035: 1) reduce the number of new TB cases by 90% and 2) the number of TB-attributable deaths by 95%, both as compared to 2015; and 3) have no TB-affected families incurring catastrophic costs due to TB.[4]

To evaluate national progress toward achieving these targets, systematic program performance monitoring is recommended as part of the End TB strategy and has been widely adopted internationally.[5–9] Canada is a signatory to the End TB Strategy and thus has an obligation to implement this recommendation. The purpose of such evaluations is to distinguish programs that promote health and prevent disease from those that do not.[10] In turn, monitoring generates information that can be used to judge the quality and value of public health programs, like TB services.[11] An appropriately designed program performance monitoring framework should document progress toward goals, identify areas for improvement and demonstrate the impact of resource investments.[12]

Although the importance of TB program performance monitoring in Canada has been discussed for more than 20 years, notably by Health Canada, the pan-Canadian Public Health Network and Inuit Tapiriit Kanatami, a national framework does not yet exist.[13–17] In the same period, a substantial reduction in cases has not been achieved, with

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the overall annual incidence of TB in Canada remaining flat for 16 years, as in Figure 1 (see Chapter 1: Epidemiology of Tuberculosis in Canada).

Meanwhile, performance indicators have been adopted in other settings to assess regional and national TB prevention and care services. For example, 1 study from the United States showed marked improvements in outcomes within local health regions that actively monitored and evaluated performance relative to those that passively collected data.[18] In England, where a national standard of performance indicators exists, research has contributed to recommendations for new indicators to improve the overall quality and value of TB services within the context of elimination.[19] In sum, program performance monitoring has been successful elsewhere, and this chapter provides recommendations for use by TB programs in Canada.

3. Design and limitations of a performance monitoring framework

In 2018, the National Collaborating Center for Infectious Diseases conducted a scoping review, compiling reports and TB program performance indicators from 25 distinct programs in other low-incidence countries and regions as well as for 3 TB-affected population groups in Canada: First Nations, Inuit and foreign-born populations. Analysis of these documents led to a list of 105 program performance indicators with potential applicability to Canada. That same year, those indicators were discussed at a national meeting and ranked using a modified Delphi technique.[23,24] The meeting concluded with expert consensus achieved on 8 core indicators of TB program performance relevant to the aforementioned priority populations.[17,24]

These eight core indicators were reviewed by all of the authors of this chapter with additions made during facilitated discussion to produce a more generalizable tool. The end result is a framework of twelve indicators (see Table 1) that can be used to evaluate TB services across Canada.

The resulting framework comprises program performance indicators (actions) that are largely pragmatic and judged to adhere to the following criteria: relevant, well-defined, reliable, technically feasible, practical and have a history of use elsewhere.[25] It is, however, not without limitation. For example, TB programs in provinces and territories that have a high proportion of foreign-born persons may ultimately perform well across most or all program performance indicators, but see limited reduction of incidence.[26,27] This is because replenishment of the reservoir of TB infections may continually occur among those from high-TB-incidence nations.[28–31] (see Chapter 13: Tuberculosis Surveillance and Tuberculosis Testing and Treatment in Migrants). Implementing this framework will require dedicated human resources with requisite qualifications to properly compile and report these data. This investment is justified, as program performance monitoring produces valuable information for programmatic improvement, strengthens program management activities, improves accountability and generates evidence of the value of TB services.[11,18,32]

4. Core program performance indicators

This program performance monitoring framework includes 12 indicators, with accompanying targets. In the absence of preexisting national data, targets were set to strike a balance between being achievable and motivational based on expert

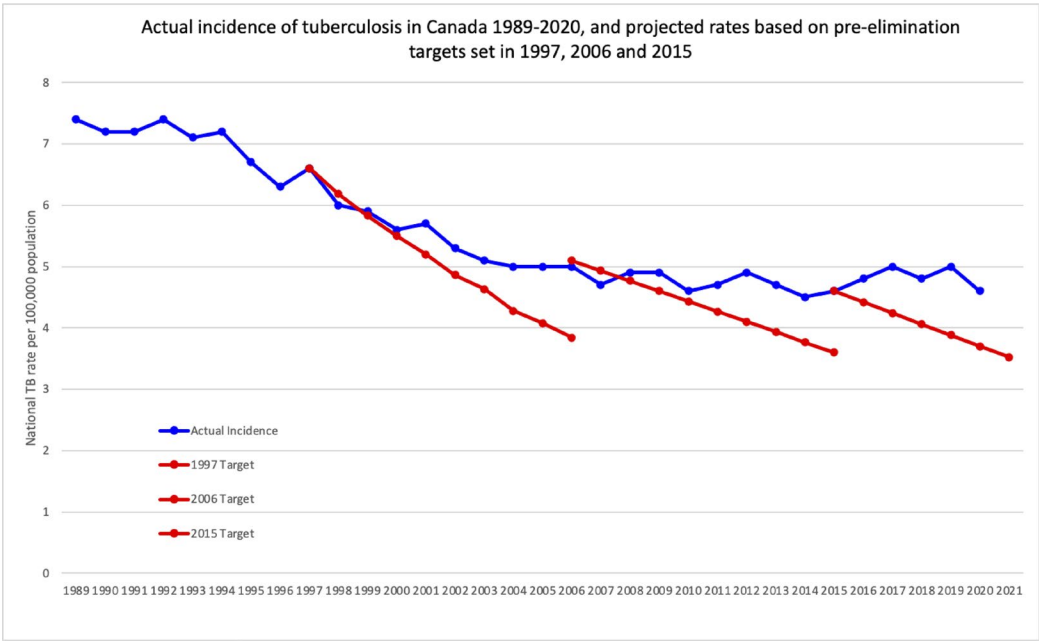

Figure 1. Actual incidence of TB in Canada.
Actual incidence: Reported cases from the Notifiable diseases on-line (PHAC)[20] 1924 to 2019 in Canada
1997 target: 5% annual reduction in cases[21]
2006 target: Reach a target incidence of 3.6 by 2015. A linear relationship was plotted and extended beyond the 2015 goal.[22]
2015 target: Reduce new incident cases by 90% in 2035 as compared to 2015.[4] Note that these case numbers are for Canada overall and differ for select populations within Canada.

Table 1. **Indicators and related targets.**

	Key Indicator	Definition	Target
	Elimination Goals		
1.0	Total annual incidence (crude) rate of tuberculosis (TB), all forms	The total number of people notified with TB in the jurisdiction, expressed as a rate per 100,000 population	**Pre-elimination target set at an active case rate of 1/100,000 or, as above, 10/1,000,000 population by 2035**
	Objectives for examination of immigrants and refugees		
2.0	Of people whose immigration medical examination (IME) indicated follow-up, the proportion (%) of individuals who are evaluated by a TB clinician	The total number of appointments attended among persons whose IME led to a referral to public health for medical surveillance of TB	**≥90%**
	Objectives for case management and treatment		
3.0	Of all people with new, relapse, or retreatment TB, proportion (%) with known human immunodeficiency virus (HIV) status	The number of people with annual incident TB whose HIV status is known at the start date of treatment	**>95%**
3.1	Of all people with smear-positive, pulmonary TB, proportion (%) started treatment within 72 hours of positive nucleic acid amplification test (NAAT)	The number of people with annual incident, smear-positive pulmonary TB cases who are started on anti-TB drugs within 72 hours of a positive NAAT result	**≥95%**
3.2	Of all people with smear-positive, pulmonary TB, proportion (%) started on 4 or more anti-TB drugs to which they are likely to be susceptible[a]	The number of people with annual incident smear-positive, rifampin-susceptible (by NAAT), pulmonary TB who start 4 anti-TB drugs in the absence of any risk factors for resistance, or hepatoxicity	**≥95%**
3.3	Of all people with culture positive, pulmonary TB, proportion (%) with sputum submitted for acid fast bacillus (AFB) smear/culture, and a chest radiograph (CXR) at the end of the initial phase of treatment	The number of people with annual incident culture-positive, pulmonary TB who have sputum submitted for AFB smear and culture, and have a CXR performed within 2 weeks of the end of the initial phase of treatment	**≥95%**
3.4	Of all patients who started treatment for active disease in the preceding 12 months, the proportion (%) who achieved treatment success (cure or completed)[b]	The proportion of patients notified in the preceding 12 months who were cured or completed treatment	**≥90%**
3.5	Does the TB program have dedicated social worker support to provide patient-centered care?	TB disease is considered a biologic expression of social inequity, thereby requiring solutions that consider social and structural factors* *See text below for more details.	**Yes**
	Objectives for contact management		
4.0	Of all close contacts of people with smear-positive, pulmonary TB, proportion (%) whose initial contact encounter is within 3 working days of having been listed as a contact	The number of close contacts of people with smear-positive, pulmonary TB, whose initial contact encounter occurred within 3 working days of having been named as a contact	**≥95%**
4.1	Of all close contacts of people with smear-positive, pulmonary TB, proportion (%) completely assessed	The number of close contacts (household and non-household) of people with smear-positive, pulmonary cases, whose assessments are completed	**≥95%**
4.2	Of all close contacts of people with smear-positive, pulmonary TB with a diagnosis of latent TB infection (LTBI), proportion (%) who began treatment	The number of close contacts of people with smear-positive, pulmonary TB with a diagnosis of LTBI who initiate preventive therapy within 12 months of source diagnosis	**≥90%**
4.3	Of all close contacts of people with smear-positive, pulmonary TB with a diagnosis of LTBI, proportion (%) completed treatment	The number of close contacts of people with smear-positive, pulmonary TB who complete treatment with TB preventive therapy after initiating	**≥90%**

[a]Exclusions listed in definition, and supplement.
[b]Outcomes are available/known only for cases who were diagnosed/initiated treatment in the year prior to reporting of all other indicators.

guidance. Future iterations of this nationally applicable framework should adjust these targets based on actual performance.

Overall, this initial performance monitoring framework focuses on the management of patients with smear-positive pulmonary TB and their contacts, as these groups are considered the highest priorities for optimal program performance. Indicators are grouped according to the following goals/objectives.

4.1. Elimination

The goals for pre-elimination and elimination are set in Canada's international commitments and programs should be monitoring their own year-on-year progress toward meeting them. The pre-elimination target for low-incidence settings is an active case rate of 10/1,000,000 population by 2035, while the elimination target is 1/1,000,000 population by 2050 at the national level. Progress toward elimination depends on achieving a rate of decline that aligns with those targets, but will be influenced by the local epidemiology of TB in the populations served by the program. As a result, the rate of decline will vary by the reporting program.

4.2. Objectives for examination of immigrants and refugees

Foreign-born persons contribute the highest absolute number and proportion (>70%) of TB cases in Canada, which creates pressure on the pace of decline that can be achieved domestically. Therefore, programs should give priority to managing

Immigration Medical Exam referrals (see Chapter 13: Tuberculosis Surveillance and Tuberculosis Testing and Treatment in Migrants).[26,33]

4.3. Objectives for case management and treatment

Timely diagnosis of, and effective treatment initiation in, people with pulmonary TB is paramount in preventing the transmission of TB, and to prevent further morbidity and mortality for these individuals. Maximizing successful treatment (cure or treatment completed) while minimizing unsuccessful treatment outcomes (TB-related death, treatment non-completion loss to follow-up) are key outcomes. In addition, the psycho-social and behavioral needs of people affected by TB may influence local epidemiology and individual outcomes. Addressing these issues is central to the program's ability to provide patient-centered care (see Chapter 5: Treatment of Tuberculosis Disease).

4.4. Objectives for contact management

Preventing the reactivation of latent TB infections is an equally crucial component of TB elimination, particularly for priority contacts — that is, close contacts of persons with smear-positive, pulmonary TB (see Chapter 11: Tuberculosis Contact Investigation and Outbreak Management).

The calculations for each indicator tabulate the number of times the action was completed out of the number of times it was applicable, displayed as a proportion.[34] These proportions are then compared quantitatively to defined targets. Definitions of these actions and targets are provided in Table 1, while methods for analysis and reporting are provided in Table 2.

5. Analytic and action strategies

Table 2 describes how to measure and analyze performance of TB programs based on the indicators in this framework. This analytic strategy is separate from the clinical care of patients, which is covered in other chapters of these standards.

5.1. Reporting schedule

Performance monitoring will be achieved by completing reports on the indicators presented here, according to the formulas provided in Table 2. Program performance indicators for the immediate past calendar year should be reported in February or March of the current year, except for treatment outcomes of all patients diagnosed with TB disease in the previous calendar year, which can be reported only a full year after. Annual program performance reports should be discussed with appropriate local public health representatives and community partners to ensure accountability, determine whether and how actions should be changed to improve outcomes and contextualize the information in a culturally-safe manner.[35] Program managers (leads) are best positioned to implement change. This makes it crucial that program managers oversee the process and develop a mechanism to properly engage stakeholder groups.[36] Annual summary reports should be published online to promote transparency and contribute to benchmarking efforts across the country.

Implementation of this program performance monitoring framework includes the completion of annual reports (to assess local performance over time) that are consistent across jurisdictions (to assess relative performance). Timely completion and sharing of these reports will help minimize delays in making program improvements. TB programs should allocate adequate human resources for data collection and validation to monitor these indicators. Validation should be performed in close collaboration with the physician/nursing leads and relevant community partners.

5.2. Recommended demographic, clinical and social variables

It is recommended that data be analyzed by age, sex/gender and population group to maintain a focus on where there is greatest need for TB services and care and where inequities can be mitigated. These levels of disaggregation align with international and Canadian standards for sex- and gender-based analysis of health data.[37–41] Depending on local decisions for programs to collect or link with other data, analyses can also include other significant social strata of risk, including human immunodeficiency virus (HIV) status, persons experiencing homelessness, persons with limited labor participation and/or high-risk occupations and persons currently or recently incarcerated.

5.3. Role of social work in addressing patient and client needs

Responses to TB-associated social risk factors should be addressed by a dedicated TB-program social worker; the ability of programs to do this should be monitored. Among communicable infectious diseases, TB in particular illustrates how structural barriers imposed by racism, classism and colonialism in Canada require political commitment to make health systems available and accessible to all (see Chapter 12: An Introductory Guide to Tuberculosis Care Serving Indigenous Peoples and Chapter 13: Tuberculosis Surveillance and Tuberculosis Testing and Treatment in Migrants).[42,43] At the same time, psycho-social, behavioral and biological considerations complicate TB disease and its management (eg, substance use disorders, contact network structures, HIV/AIDS (acquired immunodeficiency syndrome), diabetes, undernutrition).[44–55] Because the specific tasks of the dedicated TB-program social worker may vary, programs can assess the impact of this support in various ways, including: 1) reporting the proportion of patients connected to a primary care provider by the end of TB care; 2) reporting the proportion of patients experiencing homelessness who are adequately housed by the end of TB care; and 3) assessing housing conditions among patients with infectious TB.

Table 2. Calculating and presenting TB program performance indicators.

	Goal of Elimination
	How to calculate performance for reporting
1.0	**Numerator:** Number of TB cases who are notified in the jurisdiction between January 1 and December 31, inclusive. **Denominator:** Total mid-year population estimate. **Formula:** $$\left\{\frac{\#\text{ of annual incident TB cases}}{\text{Mid - year population estimate}}\right\} * 100{,}000$$ **In addition,** calculate the necessary annual rate of decline to achieve pre-elimination within the jurisdiction (see below) where "years of difference" is the period between the year of reporting and 2035 and the target of 1 is the numerator. $$\left\{\text{Annual \% Change} = \frac{1(\text{pre-elimination target, per 100,000 population by 2035})}{\text{crude rate per 100,000 population in year of reporting}}\right\}^{\frac{1}{\text{Years of difference}}} - 1 \quad * 100$$
	Objectives for examination of immigrants and refugees
2.0	**Numerator:** Number of Immigration, Refugees, and Citizenship Canada (IRCC) referrals dating from July 1 of the preceding year whose first appointment by a physician or designated public health specialist was achieved within six months of the date the referral was received. **Denominator:** Total number of IRCC referrals to the public health authority in the jurisdiction between July 1 and June 30. **Formula:** $$\left\{\frac{\#\text{ of clients referred by IRCC for medical surveillance assessed within a period 180 days}}{\text{Total \# of clients referred by IRCC for medical surveillance within the previous 12 months}}\right\} * 100$$
	Objectives for case management and treatment
3.0	**Numerator:** Number of TB cases notified between January 1 and December 31 whose human immunodeficiency virus (HIV) status is known at the commencement of treatment. **Denominator:** Total number of TB cases treated. **Formula:** $$\left\{\frac{\#\text{ of annual incident TB cases with known HIV test results}}{\#\text{annual incident TB case treated with} > 1\text{ anti-TB drug}}\right\} * 100$$ HIV results include the following possibilities **HIV-positive:** medical documentation of a positive HIV test at any point in time. **HIV-negative:** medical documentation of a negative HIV test no more than 90 days before the start date of treatment for TB.
3.1	**Numerator:** Number of smear-positive (S), pulmonary TB (PTB) cases notified between January 1 and December 31 who initiate treatment within 72 hours of a positive nucleic acid amplification test (NAAT). **Denominator:** Total number of smear-positive, pulmonary TB cases. **Formula:** $$\left\{\frac{\#\text{ of S+PTB case who initiate treatment within 72 hours of a positive NAAT}}{\text{Total \# of S+PTB cases}}\right\} * 100$$
3.2	**Numerator:** Number of eligible smear-positive (S), rifampin-susceptible (by nucleic acid amplification test (NAAT)) pulmonary TB (PTB) cases notified between January 1 and December 31 who start four anti-TB drugs. **Denominator:** Total number of eligible TB cases treated. Exclusions: Patients judged to be at high risk for hepatoxicity, gout, and/or have a history of overt exposure to a source case who is known to have had drug resistant TB (any first-line anti-TB drug), and patients who have been previously treated will not count in the numerator or denominator. **Formula:** $$\left\{\frac{\#\text{ of rifampin-susceptible (by NAAT) S+PTB cases who initiate 4 anti-TB drugs}}{\#\text{ of eligible S+PTB cases}}\right\} * 100$$
3.3	**Numerator:** Number of all culture positive (C), pulmonary TB (PTB) cases who have sputum submitted for acid fast bacillus (AFB) smear/culture, and a chest radiograph (CXR) within two weeks of the end of the initial phase of treatment. **Denominator:** Total number of culture-positive pulmonary TB cases who are alive and not transferred out at the end of the initial phase of treatment. Exclusions: Patients who die during the initial phase and/or transfer out of the jurisdiction before the end of the initial phase will not count in the numerator or denominator. **Formula:** $$\left\{\frac{\#\text{ of C+PTB cases with AFB smear/culture and CXR with 2 weeks of the end of the initial phase}}{\#\text{ of eligible C+PTB cases who initiated treatment, and are alive at the end of the initial phase}}\right\} * 100$$

Continued

Table 2. Continued.

	Goal of Elimination
3.4	**Numerator:** Number of annual incident TB cases notified in the preceding 12 months who were cured or completed treatment. **Denominator:** Total number of annual incident TB cases notified in the preceding 12 months who were alive at diagnosis, and who started ≥ one anti-TB drug. Exclusions: Patients with rifampin resistance, patients whose treatment was initiated in another Canadian jurisdiction (transferred in), and patients who have transferred out of country during treatment are excluded from the numerator and denominator. **Formula:** $\left\{\frac{\#\text{ of notified cases in the preceding year (all forms) who were cured or completed treatment}}{\#\text{ of notified cases in the preceding year alive at diagnosis, who started} > 1\text{ anti-TB drug}}\right\} *100$
3.5	**Does the TB program have dedicated social worker support?** If yes, their performance should be monitored according to the objective needs of patients and clients in the jurisdiction (See section **5.3** for examples). If no, the program, under the direction of the program manager/lead, should define the objective needs of underserved patients and clients in the program to advocate for dedicate social worker support.
	Objectives for contact management
4.0	**Numerator:** Number of close (household and non-household) contacts of smear-positive (S) pulmonary TB (PTB) cases notified between January 1 and December 31 whose initial contact encounter was within 3 working days of the contact having been listed. **Denominator:** Total number of close contacts of annual incident smear-positive pulmonary TB cases. **Formula:** $\left\{\frac{\#\text{ of close contracts of S+PTB source case whose initial contact encounter occurs within 3 days}}{\#\text{ of close contacts of S+PTB source cases}}\right\} *100$
4.1	**Numerator:** Number of close (household and non-household) contacts of smear-positive (S) pulmonary TB (PTB) cases notified between January 1 and December 31 who are completely assessed*. **Denominator:** Total number of close contacts of annual incident smear-positive, pulmonary TB cases. **Formula:** $\left\{\frac{\#\text{ of completely assessed close contacts of S+PTB source cases}}{\#\text{ of close contacts of S+PTB source cases}}\right\} *100$ * A complete assessment consists of: Testing for LTBI as indicated, a medical evaluation and CXR if indicated, plus sputum exams if needed (For more details, see Chapter 4).
4.2	**Numerator:** Number of close (household and non-household) contacts of smear-positive pulmonary TB cases notified between January 1 and December 31 eligible for TB preventive therapy (TPT) who initiate treatment, **Denominator:** Total number of close contacts of annual incident smear-positive pulmonary TB cases, who are eligible for TPT. **Formula:** $\left\{\frac{\#\text{ of close contacts of S+PTB source case eligible for TPT who initiate}}{\#\text{ of close contacts of S+PTB source eligible for TPT}}\right\} *100$
4.3	**Numerator:** Number of close (household and non-household) contacts of smear-positive (S) pulmonary TB (PTB) cases notified between January 1 and December 31 eligible for TB preventive therapy (TPT) who initiated and complete treatment **Denominator:** Total number of close contacts of annual incident smear-positive pulmonary TB cases, eligible for TPT who initiated treatment of latent TB infection. **Formula:** $\left\{\frac{\#\text{ of close contacts of S+PTB source cases who completed TPT}}{\#\text{ of close contacts of S+PTB source cases who initiated TPT}}\right\} *100$

6. Summary

In a federation, meeting the challenge of TB elimination is made more difficult by inherent differences in the delivery of health services across the country. Accordingly, each province and territory contributes parts of what, in sum, constitutes the national response. Every person with active TB in Canada matters, and by committing to the aspirational End TB targets, there is a recognition that every prevented case counts more than ever. The purpose of this chapter is to encourage TB program leads and staff to provide evidence to communities, the public at large, health authorities and governments of progress toward desired outcomes. The core program performance indicators described in this chapter are considered the minimum standard for all programs.

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Appendix 1: Monitoring tuberculosis program performance

The framework for monitoring tuberculosis program performance outlined in Chapter 15 consists of 12 program performance indicators; a rationale for each is provided below along with international and national history of use or recommendation precedents. As in the text, in 2018, the National Collaborating Center for Infectious Diseases performed a scoping review of TB program performance indicators in epidemiologically similar settings (high-income, low-TB incidence) coupled with general global recommendations. Indicators were selected from this review. As shown in the following data, more recent recommendations and strategies have been reviewed in preparation of this chapter for a history of use. This list of prior use/recommendation is representative, and not exhaustive.

Goal of Elimination	
Indicator, Target and Rationale	**Notes**
1.0 Crude incidence rate of TB: all forms **Target: Report incidence, and rate of decline.** **Rationale:** This is the hard target of pre-elimination and elimination. This measurement establishes the ultimate standard by which the program is performing. Incidence should be monitored and reported annually to inform effective mid-course changes on the path to elimination.[56,57] Canada is responsible for reporting national and subnational data to the global community; therefore, these data should be accessible and reportable.[58]	Program leads should establish a rate of decline that is adequate to achieve elimination targets.
Precedence	
Recommended internationally by: WHO- *Compendium of Indicators for Monitoring and Evaluation of National Tuberculosis Control Programs*;[56] CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025*;[59] Australia - *The Strategic Plan for Control of Tuberculosis in Australia 2011-2015*, and *National Tuberculosis Performance Indicators, Australia 2013-2014*;[5,60] Public Health England - *Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020* (three-year average)[7] Alaska – *Alaska Department of Health and Social Services TB Manual*[1]; Minnesota – *Tuberculosis (TB) Prevention and Control Program*;[62] and California – *CID TB Performance Trends for US, California Objectives*.[63]	**Recommended for Canada by:** Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada*;[15] FNIHB - *Health Canada Strategy against Tuberculosis for First Nations on-Reserve* and *Monitoring and Performance Framework*;[13,14] *Inuit Tuberculosis Elimination Framework*;[16] Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*;[64] and NCCID - *Toward TB Elimination: Shared Priorities for TB Program Performance Measurement in Canada, a Proposal for Discussion*.[17]
Objectives for examination of immigrants and refugees	
Indicator, Target and Rationale	**Notes**
2.0 Proportion of individuals referred for immigration medical surveillance who are evaluated by physician **Target: ≥90%** **Rationale:** Foreign-born persons contribute the absolute highest number of total cases identified in Canada (now >70% nationally), creating pressure on the pace of decline that can be achieved domestically.[26,33] A systematic and meta-review of TB incidence among migrants deemed 'high-risk' in pre-migration screening reported an elevated incidence of active disease in this group. The pooled cumulative incidence of TB post-migration in the study population from 22 cohorts was 2,794 per 100,000 persons (95% CI 2179-3409; $I^2 = 99\%$). The pooled cumulative incidence of TB at the first follow-up visit from ten cohorts was 3,284 per 100,000 persons (95% CI 2173-4395; $I^2 = 99\%$). The pooled TB incidence from 15 cohorts was 1,249 per 100,000 person-years of follow-up (95% CI 924-1574; $I^2 = 98\%$).[65] There is recent debate about whether the phenotypic expression of disease in newcomers poses a significant public health risk, suggesting that the risk of in-country transmission is limited compared to the risk of transmission by people who develop reactivation pulmonary disease from undetected LTBI on arrival.[28,66] As a result, this indicator alone is insufficient for long-term reduction of TB in foreign-born persons. Although referral of foreign-born persons to public health for medical surveillance is understood to be minimal[67] in contributing to elimination, targeted screening for LTBI among immigrants and refugees arriving in Canada has not yet reached its potential.	Despite the limitations, this performance indicator is a measurable aspect of TB prevention and care services and helps generate evidence in support of value (ROI).
Precedence	
Recommended internationally by: CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025*;[59] California – *CID TB Performance Trends for US, California Objectives*[63]; and Public Health England - *Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020*.[61]	**Recommended for Canada by:** Pan-Canadian Public Health Network -*Guidance for Tuberculosis Prevention and Control Programs in Canada*;[15] Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*.[64] Chapter 15 of the sixth Edition of the *Canadian Tuberculosis Standards*, *Immigration and Tuberculosis Control in Canada* records an evaluation of compliance on this indicator done at the national level (average performance reported to be about 50% at the time).[68]

Objectives for case management and treatment	
Indicator, Target and Rationale	**Notes**
3.0 Proportion of all new, relapse, or re-treatment TB cases whose HIV status is known **Target: ≥95%** **Rationale:** A diagnosis of HIV, independent of TB, has individual and public health implications[69] and, in the event of co-infection, has implications for treatment. In Alberta, where >90% of TB patients are HIV tested (attributable to an opt-out strategy), nearly 50% of HIV infections are discovered at the time of a TB diagnosis.[70] A recent systematic review and meta-analysis of the adoption of indicator condition-guided HIV testing in Western nations showed that there has been scarce reporting of HIV testing of TB patients in Canada (4/28 articles), with variability in achievement ranging from 53.6 to 90.6% known HIV status during TB treatment. This indicates both a greater need for reporting as well as implementation of strategies to improve adherence to recommendations at the program level.[71]	The target is to offer an HIV test to all incident TB cases if HIV status is unknown at the time of diagnosis, 100% of the time; it is understood that the rate of acceptance will be lower.
Precedence	
Recommended internationally by: WHO - *Compendium of Indicators for Monitoring and Evaluating National Tuberculosis Programs*;[56] Horsburgh et al. – *Practice Guidelines for the Treatment of Tuberculosis*;[34] WHO – *End TB Strategy*[4]*;* WHO/UNAIDS – *Guide to Monitoring and Evaluation for Collaborative TB/HIV activities;*[72] Australia - *The Strategic Plan for Control of Tuberculosis in Australia 2011-2015*, and *National Tuberculosis Performance Indicators, Australia 2013*-2014;[5,60] Public Health England - *Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020* (three-year average);[7] Alaska – *Alaska Department of Health and Social Services TB Manual*;[61] and, California – *CID TB Performance Trends for US, California Objectives*.[63]	**Recommended for Canada by:** Canadian Tuberculosis Directors of Canada and the Department of National Health and Welfare in consultation with P/T epidemiologists - *Guidelines for the identification, investigation and treatment of individuals with concomitant tuberculosis and HIV infection;*[73] Canadian Tuberculosis Committee, Health Canada - *Recommendations for screening and prevention of tuberculosis in patients with HIV and for screening for HIV in patients with tuberculosis and their contacts;*[74] Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada*;[15] and Haworth-Brockman & Keynan - *Strengthening tuberculosis surveillance in Canada*.[75]
Indicator, Target and Rationale	**Notes**
3.1 Proportion of all smear-positive, pulmonary cases who start treatment within 72 hours of positive NAAT **Target: ≥95%** **Rationale:** Timely treatment initiation provides an individual benefit by limiting increased risk of complications associated with delay as well as a public health benefit, by rapidly reducing infectivity.[76] A prospective cohort study in the United States found an increased risk of transmission to close contacts (outcome = TST positivity) of US-born patients who experienced a delay in treatment initiation ≥90 days (40%) vs those who had a shorter delay in treatment initiation (24%) (aOR 2.34; p = 0.03), and increasing to (aOR 3.29; p = 0.01) among close contacts of US-born patients sputum smear-positive for AFB and whose treatment initiation was delayed.[77] Accordingly, rapid initiation of anti-TB drugs for pulmonary cases is a priority, and program performance should be leading in these patients.	The indicator and related target here is to initiate treatment rapidly (within 3 days), ≥95% of the time. This choice was based on the proficiency turnaround time expectation for labs to perform, and report results of the test within 24 hours of submission. Two additional days are proposed to allow for the possibility that notification of a positive NAAT may occur at the beginning of a long weekend.
Precedence	
Recommended internationally by: CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025;*[59] Alaska – *Alaska Department of Health and Social Services TB Manual*[61]*;* and California – *CID TB Performance Trends for US, California Objectives*.[63]	**Recommended for Canada by:** Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada*.[15]
Indicator, Target and Rationale	
3.2 Proportion of smear-positive pulmonary cases who start four or more anti-TB drugs **Target: ≥95%** **Rationale:** Rapid initiation of anti-TB drugs, especially for smear-positive pulmonary cases, is critical to reduce infectivity and interrupt transmission.[76,78] Given this reality, and in light of the delays associated with obtaining drug susceptibility test results, the greater individual and public health benefits derive from initiating empiric treatment among those infectious cases without risk factors for resistance, suspicion of hepatoxicity or gout. Of note, in Canada, drug resistance is a relatively infrequent phenomenon, but there is variability in the regional epidemiology of drug-resistant forms of TB that could contribute to more frequent exceptions to the numerator that some programs can anticipate.[79]	
Precedence	
Recommended internationally by: CDC -*National Tuberculosis Program Objectives and Performance Targets for* 2025;[59] and Public Health England - *Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020*.[7]	**Recommended for Canada by:** Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada;*[15] FNIHB/Health Canada - *Strategy against Tuberculosis for First Nations on-Reserve,* and related *Monitoring and Performance Framework;*[13,14] NCCID - *Toward TB Elimination: Shared Priorities for TB Program Performance Measurement in Canada, a Proposal for Discussion;*[17] and Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*[64]

Indicator, Target and Rationale

3.3 Proportion of all culture-positive pulmonary cases who have sputum submitted for AFB smear/culture, and a CXR at the end of the initial phase of treatment
Target: ≥95%

Rationale: Sputum culture-conversion at the end of the initial phase is understood to be a good predictor of eventual cure; more significantly, there are implications for treatment.[56] Sustained culture positivity, or having unclosed cavitation on CXR at the end of the initial phase of treatment, may be suggestive of treatment failure/relapse and induced drug resistance.[80] A recent systematic review and meta-analysis of sputum conversion during effective treatment found 12, and 41% of persons with smear-positive disease, remained solid and liquid culture-positive, respectively, at the end of the initial phase of treatment but sub-group analyses by important covariates known to be independently associated with sputum conversion, such as HIV status, and cavitation, were limited.[81] Monitoring adherence to best clinical practice provides useful information to the program relating to efforts that ostensibly improve treatment outcomes by reducing risk of relapse.

Precedence

Recommended internationally by: WHO – *Compendium of Indicators for Monitoring and Evaluation of National Tuberculosis Control Programs;*[56] California – *CID TB Performance Trends for US, California Objectives;*[63] and CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025.*[59]

Recommended for Canada by: Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada;*[15] and FNIHB/Health Canada - *Strategy against Tuberculosis for First Nations on-Reserve,* and related *Monitoring and Performance Framework.*[13,14]

Indicator, Target and Rationale

3.4 Treatment success (cure or completed) within 12 months of starting treatment
Target: ≥90% of cases

Rationale: Treatment success (cure or completed) is essential to eliminating TB by preventing transmission, disease severity and death. Incomplete treatment or loss to follow-up can lead to drug resistance and transmission to others. A 1991 World Health Assembly resolution established a global target for treatment success to be 85%, but in low-HIV-prevalence settings with universal health coverage, a higher rate of achievement should be possible.[82]

Precedence

Recommended internationally by: WHO- *Compendium of Indicators for Monitoring and Evaluation of National Tuberculosis Control Programs;*[56] CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025;*[59] Australia - *The Strategic Plan for Control of Tuberculosis in Australia 2011-2015,* and *National Tuberculosis Performance Indicators, Australia 2013-2014;*[5,60] WHO – *End TB Strategy*[4]*;* Alaska – *Alaska Department of Health and Social Services TB Manual;*[61] Minnesota – *Tuberculosis (TB) Prevention and Control Program*[62]*;* and California – *CID TB Performance Trends for US, California Objectives.*[63]

Recommended for Canada by: Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada;*[15] FNIHB/Health Canada - *Health Canada Strategy against Tuberculosis for First Nations on-Reserve* and *Monitoring and Performance Framework;*[13,14] ITK - *Inuit Tuberculosis Elimination Framework*[16]; and Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*[64]

Indicator, Target and Rationale

3.5 Does the TB program have dedicated social worker support?
Target: Yes

Rationale: This chapter recommends that TB programs have dedicated support of a social worker, and that their associated workflow be evaluated. Some examples of possible measurements of the social worker's performance include: the proportion of patients who are connected to a primary care provider by the end of TB care; the proportion of patients experiencing homelessness, or are underhoused, who are adequately housed through their efforts; monitoring of patients who report crowded housing. The objective psycho-social needs of clients and patients may vary by jurisdiction, and should be clearly defined by the program manager/lead.

Precedence

Recommended by: A specific program performance indicator about whether TB programs have dedicated social worker support could not be located. Recommendations, however, to meet the psycho-social needs of patients and clients who suffer the effects of TB infection and disease are common, but practical guidance about how to achieve this remains limited.[83] As a result, this indicator is included as a means to generate information about the practical steps programs take to address the impacts of structural, and social determinants of health in the lives of clients/patients served.

Objectives for contact management	
Indicator, Target and Rationale	**Notes**
4 Proportion of close contacts of persons with smear-positive pulmonary disease whose initial contact encounter occurs within 3 working days. **Target: ≥95%** **Rationale:** TB programs in Canada generally rely on a stone-in-pond method for unmasking evidence of transmission among contacts of persons with pulmonary TB.[84] This method is considered favorable when the relative risk of transmission to contacts is higher than the risk of infection in the general public.[84,85] A public health benefit of timely contact investigations is limiting transmission into broader circles of contact.[86] The rapid identification and initial encounter of close contacts of infectious source cases provides a mechanism for prioritization. A modification to stone-in-pond is the rapid assessment (prioritization) of vulnerable contacts (young children, and persons with immunocompromising conditions, notably HIV) who have been shown to be at risk of very rapid progression to disease.[87,88]	Three days is considered timely and reasonable, but also somewhat arbitrary.[86] The purpose is to monitor with the ambition to meet and exceed the target, redirecting efforts if underperforming.
Precedence	
Recommended internationally by: CDC - *Guidelines for the investigation of contacts of patients with infectious tuberculosis: Recommendations from the National Tuberculosis Controllers Association and the CDC.*[86]	**Recommended for Canada by:** Chapter 12 of the seventh Edition of the Canadian Tuberculosis Standards, *Contact follow-up and outbreak management in tuberculosis control.*[89]
Indicator, Target and Rationale	
4.1 Proportion of close contacts of persons with smear-positive pulmonary disease who are completely assessed **Target: ≥95%** **Rationale:** Prevention of reactivation TB is equally important to appropriate case management, especially of infectious cases, in its contribution to pre-elimination and elimination goals.	
Precedence	
Recommended internationally by: WHO - *End TB Strategy*[4]*;* CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025;*[59] and Public Health England - *Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020* (in development).[7]	**Recommended for Canada by:** FNIHB/Health Canada - *Strategy against Tuberculosis for First Nations on-Reserve,* and related *Monitoring and Performance Framework;*[12,13] and Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*[64]
Indicator, Target and Rationale	**Notes**
4.2 Proportion of close contacts of persons with smear-positive pulmonary disease eligible for TPT, who initiate treatment **Target: ≥90%** **Rationale:** LTBI is the seedbed of future cases but treatment of LTBI, in the absence of a risk of reinfection, is considered to be fully protective against reactivation TB.[90–95] As a result, pairing the prevention of reactivation with excellent infectious source case management work as hand-in-glove strategies to reduce future incidence of TB.[49,90]	Targets are ambitious, but performance here and with respect to completion are likely to benefit from the current wealth of research aimed at reducing treatment duration and pill burden while maintaining efficacy and safety, as the expanded use of 4 R compared to the long-standing 9INH has shown.[96,97]
Precedence	
Recommended internationally by: WHO- *End TB Strategy;*[4] CDC - *National Tuberculosis Program Objectives and Performance Targets for 2025;*[59] and Public Health England -*Public Health England Tuberculosis Strategy Monitoring Indicators 2015-2020* (in development).[7]	**Recommended for Canada by:** Pan-Canadian Public Health Network – *Guidance for Tuberculosis Prevention and Control Programs in Canada;*[15] FNIHB/Health Canada – *Health Canada Strategy against Tuberculosis for First Nations on-Reserve* and related *Monitoring and Performance Framework;*[13,14] and Heffernan & Long – *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*[64]
Indicator, Target and Rationale	**Notes**
4.3 Proportion of close contacts of persons with smear-positive pulmonary disease who began, and completed, TPT for a diagnosis of LTBI **Target: ≥90%** **Rationale:** As above, successful treatment is protective against reactivation of TB (for the infection it is treating); success is a function of completion and strategies to facilitate completion are encouraged, especially for shorter regimens where each dose is a greater contributor to the effectiveness of the therapy.[96–99]	As in 4.2
Precedence	
Recommended internationally by: CDC – *National Tuberculosis Program Objectives and Performance Targets for 2025.*[59]	**Recommended for Canada by:** Pan-Canadian Public Health Network - *Guidance for Tuberculosis Prevention and Control Programs in Canada;*[15] FNIHB - *Health Canada Strategy against Tuberculosis for First Nations on-Reserve* and *Monitoring and Performance Framework;*[13,14] NCCID - *Toward TB Elimination: Shared Priorities for TB Program Performance Measurement in Canada, a Proposal for Discussion;*[17]and Heffernan & Long - *Would program performance indicators and a nationally coordinated response accelerate tuberculosis elimination in Canada?*[64]

Abbreviations: TB, tuberculosis; NCCID, National Collaborating Center for Infectious Diseases; WHO, World Health Organization; CDC, Centers for Disease Control and Prevention; FNIHB, First Nations and Inuit Health Branch; ROI, return on investment; HIV, human immunodeficiency virus; P/T, provincial and territorial; NAAT, nucleic acid amplification test; CI, confidence interval; aOR, adjusted odds ratio; TST, tuberculin skin test; AFB, acid fast bacillus; CXR, chest radiograph; ITK, Inuit Tapiriit Kanatami; 4R, daily rifampin for 4 months; 9INH, 9-month daily isoniazid regimen; TPT, tuberculosis preventive treatment; LTBI, latent tuberculosis infection