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Epidemiology of Tuberculosis in First Nations Living On-Reserve in Canada, 2000–2008



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LIST OF ACRONYMS

AANDC—Aboriginal Affairs and Northern Development Canada

CCHS—Canadian Community Health Survey

CEGEP—Collège d'enseignement général et professionnel

CI—confidence interval

CMHC—Canada Mortgage and Housing Corporation

CSD—census subdivisions

CTBRS—Canadian Tuberculosis Reporting System

CTC—Canadian Tuberculosis Committee

DOT—Directly Observed Therapy

EMB—ethambutol

ESRD—end-stage renal disease

FNIGC—First Nations Information Governance Committee

FNHIB—First Nations and Inuit Health Branch (Health Canada)

HIV—Human Immunodeficiency Virus

INAC—Indian and Northern Affairs Canada

INH—isoniazid

LTBI—latent tuberculosis infection

M. tuberculosis—*Mycobacterium tuberculosis*

n/a—not available

NOS—National Occupancy Standard

OR—odds ratio

PHAC—Public Health Agency of Canada

ppr—persons per room

PZA—pyrazinamide

QC—Québec

RHS—First Nations Regional Longitudinal Health Survey

RMP—rifampicin

RR—rate ratio

SDOH—social determinants of health

STIR—shelter-cost-to-income ratio

TB—tuberculosis

WHO—World Health Organization

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Members of the former Canadian Tuberculosis Committee and the Provincial and Territorial Tuberculosis Programs
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HIGHLIGHTS

- This report presents epidemiological data on new and re-treatment cases of tuberculosis (TB) in First Nation communities from 2000 to 2008 for the seven regions of Health Canada's First Nations and Inuit Health Branch. Tuberculosis data were obtained from regional data sources and the Canadian Tuberculosis Reporting System of the Public Health Agency of Canada.
- Over the past two decades, the reported incidence rate of active TB cases (new and re-treatment) among First Nations living on-reserve decreased by 60%.
- The active TB reported incidence rate for First Nations living on-reserve in the seven regions of Health Canada's First Nations and Inuit Health Branch was 26.6 per 100,000 in 2008, which was 29.6 times higher than the Canadian-born non-Aboriginal population.
- From 2000 to 2008, regional TB reported incidence rates for First Nations living on-reserve across Canada varied considerably, ranging from 4.2 to 79.4 cases per 100,000 population.
- From 2000 to 2008, the age-standardized active TB reported incidence rates for First Nations living on-reserve were between 32 and 59 times higher than the Canadian-born non-Aboriginal population, and between 2 and 3 times higher than the foreign-born Canadian population.
- Over the reporting period, TB incidence rates reported for First Nations on-reserve were stable in almost all age groups, with the exception of those 65 years of age and older. In this age group, the reported incidence of TB decreased from 83.7 per 100,000 population in 2000 to 36.7 per 100,000 in 2008. Even with this decrease, the reported TB incidence remains highest in this age group in all regions, with the exception of Saskatchewan and Québec.
- Among the regions for which data are available, pulmonary TB was the leading diagnosis of active tuberculosis for all regions, with the exception of Saskatchewan region (where the leading diagnosis was primary TB).

Introduction

Tuberculosis (TB) is a curable and preventable disease. However, TB remains a major global public health threat in terms of its contribution to significant illness and death. The World Health Organization (WHO) estimates that, in 2008, 9.4 million new cases of TB occurred worldwide, resulting in 1.3 million deaths (not including deaths among those who were co-infected with HIV).¹ More than 90% of these cases and deaths were detected in developing countries. While the overall incidence of the disease is decreasing, the number of new cases continues to increase in certain parts of the world, such as Africa and Southeast Asia.

The reported incidence rate of tuberculosis in Canada is among the lowest in the world. According to the Public Health Agency of Canada (PHAC), the reported incidence of TB has steadily declined in the general Canadian population over the past 30 years.² Certain populations in Canada continue to be disproportionately affected, including foreign-born Canadians, persons who abuse substances, the homeless and Aboriginal peoples.²⁻⁴ For example, while the 2006 Census reports that Aboriginal peoples account for just under 4% of the Canadian population, 21% of all TB cases occurred in this population in 2008.^{5,6}

The disparity in TB rates between Aboriginal and non-Aboriginal populations in Canada is to some extent affected by social determinants of health (SDOH). Complex interactions among the SDOH can increase an individual's risk of becoming infected with TB, as well as the risk of progression to active TB disease.⁷⁻⁹ Certain determinants of health increase the level and duration of exposure to infection, while others can weaken an individual's immune system, increasing the likelihood of infection.¹⁰ The relationship between these determinants of health and TB, including how this relationship has the potential to impact First Nations living on-reserve, is reviewed in greater detail in Appendix A.

Background

In Canada, the provinces and territories have the legislative authority for TB prevention and control within their jurisdictions. Territories are solely responsible for TB prevention and control for their entire populations, while the responsibility is shared among partners within the provinces. Health Canada works in partnership with the provinces and communities to assure that TB prevention and control services are either provided for or accessible to First Nations on reserve. The seven regions of Health Canada's First Nations and Inuit Health Branch (FNIHB) are as follows: British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic.

Health Canada's national and regional TB Programs promote access to: (1) equitable, culturally appropriate and timely diagnosis, treatment and follow-up care for those with TB, and (2) health promotion activities related to TB prevention and control. The programs at the regional level assure specific regional priorities and needs are met through TB prevention and control programming that targets regional epidemiology and health care services. Depending on the region, activities are either funded or delivered by Health Canada. Examples of services include:

- identification, treatment and management of TB cases
- management of TB outbreaks
- public education and awareness activities to encourage healthy practices and engagement of communities
- strengthening community capacity through training and education initiatives

The services provided by Health Canada's Tuberculosis Programs are an extension of what is offered off-reserve by provincial governments. Currently, the level of federally funded services varies from region to region depending on needs, epidemiology, accessibility at the provincial level, and the level of integration between the systems on- and off-reserve.

In 1999, Health Canada published a report—*Tuberculosis in First Nations Communities, 1999*— which summarized TB surveillance data for selected regions from 1990 to 1999.¹¹

The objectives of the current report are to:

- summarize and present epidemiological data on tuberculosis in First Nation communities from 2000 to 2008
- communicate and highlight key findings associated with tuberculosis in First Nation communities
- present baseline data that can be used to help evaluate progress made as a result of a revised TB strategy and new initiatives

Due to differences in methodology and population estimates between the 1999 report and this report, the rates presented in the two reports should not be compared.

Methods

Data Sources

Surveillance data presented in this report were obtained from two sources:

1. Canadian Tuberculosis Reporting System
2. Health Canada's FNIHB regional offices

Canadian Tuberculosis Reporting System

The Canadian Tuberculosis Reporting System (CTBRS) is a national tuberculosis surveillance system maintained by the Public Health Agency of Canada's Centre for Communicable Diseases and Infection Control. This system consists of records from provincial and territorial TB registries that capture information on every new active and re-treatment case, as well as outcomes following treatment. All provinces and territories voluntarily submit individual-level data to PHAC on an annual basis, either electronically or in paper form.

The CTBRS captures information on the country of birth and origin for each reported case. For cases identified as "Canadian-born," there is a data field for each of the Aboriginal subgroups, including Status Indian, Inuit and Métis. This information, along with the "Lives on First Nations reserve most of the time" field was used to identify First Nations living on-reserve in the CTBRS. The information collected by the CTBRS can be found in Appendix B, which contains the two PHAC reporting forms: *Active Tuberculosis Case Report Form—New and Re-treatment Cases*, and *Treatment Outcome of a New Active or Re-treatment Tuberculosis Case*.

Data for TB cases among Status Indians that were identified through the CTBRS between 2000 and 2008 were obtained by FNIHB for this report through an inter-departmental letter of agreement with PHAC.

Health Canada's FNIHB regional offices

Most, but not all, Health Canada regional offices hold data on reported active new and re-treatment TB cases occurring in their respective regions as a result of their role in case management. Certain regions do not compile in-house data on TB cases and rely instead on their provincial databases or, in some cases, on the CTBRS for their data. Among those regions that collect TB data, the data sources and collection methods vary considerably from one region to another. In some regions, a formal agreement exists between the Health Canada regional TB control program and its respective province(s) for notification of all First Nation on-reserve cases that are sent to PHAC. In other regions, information on TB cases is assembled through a variety of regional sources, such as reports from regional TB control nurses employed by Health Canada or local First Nations.

For this report, Health Canada's National Tuberculosis Program made a special request to the regions for non-nominal TB data. British Columbia, Alberta, Ontario and Québec regions were able to provide relatively detailed case information on active TB cases from 2000 to 2008 for First Nations living on-reserve, while Manitoba region was able to provide data based on certain data elements only available in provincial databases. In order to include all regions in this current report, regional data were used as the primary data source when available, while CTBRS data were used only if regional data were unavailable. This included all indicators for Saskatchewan and Atlantic regions, and a subset of indicators for Manitoba and Alberta. Table 1 provides a summary of the various indicators requested for the purpose of this report, including their availability and source by region.

To ensure that combining the two data sources would not result in significant differences in TB rates, case counts obtained from the CTBRS were compared to those obtained from the Health Canada regional offices. The results of this comparison suggest that the two data sources are, for the most part, comparable (except where noted otherwise).

Limitations

The data presented in this report are for TB cases that have been diagnosed and reported through the CTBRS and/or Health Canada's regional offices. As a result, there are several scenarios that may have resulted in under-counting the actual number of TB cases among First Nations living on-reserve during this period. First, undiagnosed cases of TB are not captured in this report. Second, TB cases will have been missed if they were not officially reported to Health Canada's regional offices. By law, new cases of TB must be reported in all provinces and territories; however, local public health units and/or provincial health authorities may not always report these cases to their Health Canada regional counterparts. It is also possible that the Aboriginal identifiers (i.e., Status Indian, lives on First Nations reserve most of the time) were not completed, or not completed accurately, by the provinces and territories when TB case data were submitted to the CTBRS. In this instance, although the TB case is captured in the CTBRS database, it may not be possible to identify the case as a First Nations person living on-reserve.

The use of two different data sources based on data availability is also not ideal; however, this methodology made it possible to include all regions in the analysis and to examine a wide range of indicators of interest.

Limited data were available from the regions concerning local outbreaks of TB. The information presented in this report does not allow for interpretation as to how the case counts per region may have been impacted by outbreaks from one year to the next. As well, the definition of an outbreak varies from one region to another, making interpretation difficult. This report does not include information about the incidence and treatment of latent tuberculosis infection (LTBI) or contact tracing, as these data were not readily available from most regions.

Table 1: Tuberculosis indicator data sources and availability, by region

Region	Data source	Active TB cases	Method of case detection	Diagnostic site	Treatment and outcome	Mortality	Drug resistance	TB/HIV co-infection	Outbreaks	Contact tracing	Latent TB infection
British Columbia	FNIHB*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alberta	FNIHB*	Yes	Yes	Yes	Partial (2005-2008) CTBRS used for this analysis	Yes	Yes	Yes	Yes	No	Yes
Saskatchewan	CTBRS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Manitoba	Mixed	Yes (region)	Yes (CTBRS)	Yes (region)	Yes (CTBRS)	Yes (CTBRS)	Yes (CTBRS)	Yes (CTBRS)	Yes (region)	No	No
Ontario	FNIHB*	Yes	Yes (many unknown)	Partial (respiratory breakdown not available)	Yes (many unknown)	Partial	Partial (many unknown)	Yes	Yes	No	No
Québec	FNIHB*	Yes	Yes	Yes	Yes (many unknown)	Partial	Yes	No	Partial (2002-2008)	No	No
Atlantic	CTBRS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No

*Health Canada FNIHB regional office

Case Definitions

Active tuberculosis cases

For the purposes of this report, active TB is defined according to the *Canadian Tuberculosis Standards, 6th Edition*,¹² which identifies two types of active TB cases: a new case and a re-treatment case. (Prior to 2008, the latter was referred to as a relapse case.) The complete definitions for both of these disease types can be found in Appendix C. The year used to classify the occurrence of active TB cases (new or re-treatment) corresponds to the year when it was diagnosed.

Classification of cases

The diagnostic classification of TB in this report follows the classification described in the CTBRS form completion guidelines.¹³ The main diagnoses are divided into two broad categories: respiratory and nonrespiratory. Respiratory diagnoses are further divided into three categories: primary, pulmonary and other. A more detailed breakdown of the diagnostic classification can be found in Appendix D, along with a description of how cases with multiple diagnoses are classified in this report.

Calculation of Rates

In this report, active TB rates are reported as either crude, age-specific, sex-specific or age-standardized incidence rates. Age-standardized TB rates were used to compare the First Nation on-reserve population with the Canadian-born non-Aboriginal population, in order to control for the difference in age composition of the two populations.

Population (denominator)

All rates were calculated using estimates of First Nations living on-reserve from Aboriginal Affairs and Northern Development Canada (AANDC), formerly Indian and Northern Affairs Canada (INAC), which is the federal department responsible for managing the national Indian Register. The Indian Register is the official record of all Status/Registered Indians in Canada, including information about Band membership and whether or not

individuals live on- or off-reserve, and is adjusted for late and under-reported births and deaths.¹⁴ The population estimates used for 2000 to 2004 were the fully adjusted Registered Indian populations, and the estimates used for 2005 to 2008 were the Indian Register population projections based on a medium growth scenario.¹⁵ The INAC projections for 2005 to 2008 were used rather than the population counts available for these years because they have been adjusted for late registration of births and notification of deaths in the population.

Rate calculations

Calculations used in this report are defined as follows:

Crude rate: the total number of reported TB cases (new or re-treatment) divided by the total population, within a particular geographic location and time period, expressed as number of cases per 100,000 population.

Age- or sex-specific rate: the total number of reported TB cases for a specific age group (or sex) divided by the population of the same age group (or sex), within a particular geographic location and time period, expressed as number of cases per 100,000 population.

Age-standardized rate: the sum of *expected* cases within each age group divided by the total standard population (i.e., INAC's 2004 fully adjusted estimate), and expressed as number of cases per 100,000 population. The number of expected cases within each age group is calculated by multiplying the age-specific rate in the comparator population (i.e., Canadian-born non-Aboriginal) by the estimated population size for the same age group in the standard population. See the following formula for the calculation:

$$g = [\sum(f_i \times h_i) / \sum h_i] \times 100,000$$

Where:

g = age-standardized rate

f = age-specific rate in the comparator population

h = standard population

i = age group (0-4, 5-14, . . . , 75+ years)

The age-standardized rate represents what the crude rate would have been in the comparator population (i.e., Canadian-born non-Aboriginal) if that population had the same age distribution as the standard population. In this report, the INAC fully adjusted 2004 First Nation population estimates were used for the standard population.

Three-year moving average: the average number of TB cases for a specified three-year time period, divided by the mid-point population for the three-year time period, within a particular geographic location, expressed as number of cases per 100,000 population.

Comparisons

In this report, the TB crude rates among First Nations living on-reserve (the "standard" population) are compared with the age-standardized Canadian-born non-Aboriginal (or the foreign-born Canadian) rates (the "comparator" population). Presenting the crude rates for First Nations living on-reserve permits the actual burden of disease in the population to be shown, while having the comparator population rate standardized to what it would be if they had the same age distribution as the standard population. Ratios (relative comparisons) were calculated to compare the rates of the two separate population groups, and defined as follows:

Rate ratio: the crude rate of the First Nations population divided by the age-standardized rate for the Canadian-born non-Aboriginal or foreign-born Canadian populations. A ratio of 1.0 indicates that both the First Nations and the comparator population experience the same rate. A ratio greater than 1.0 indicates that rates of TB in First Nations people are higher, while a ratio less than 1.0 indicates that rates of TB in First Nations people are lower than in the comparator population.

Results

This section of the report summarizes the results of TB surveillance data collected and analyzed by the Health Canada FNIHB regions and the CTBRS. Results are shown for new and re-treatment TB cases, and region-specific rates are presented where appropriate.

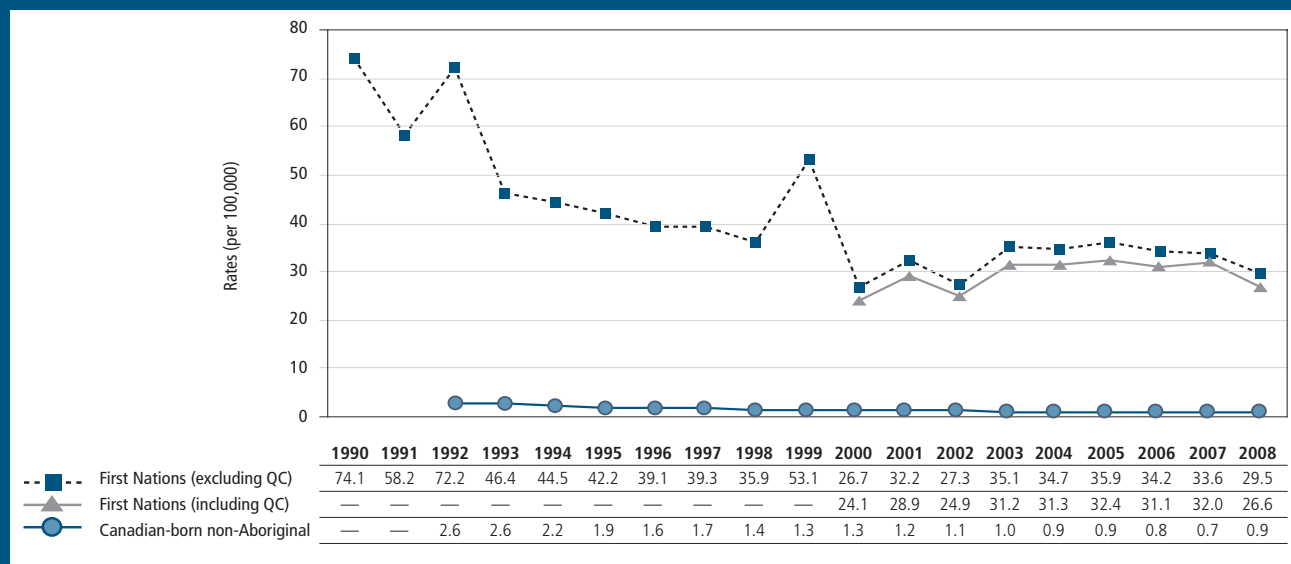
Incidence Rate of Active Tuberculosis (New and Re-treatment)

Figure 1 shows the crude incidence rates of reported active TB for First Nations living on-reserve over a 19-year time period (1990–2008). For comparison, rates for the Canadian-born non-Aboriginal population are also shown.

The reported incidence rate of active TB cases (new and re-treatment) decreased among First Nations living on-reserve, from 74.1 per 100,000 population in 1990 to 29.5 per 100,000 in 2008. This represents a 60% decrease over nearly two decades in this population; however, the rate appears to have stabilized over the nine-year time period that is the focus of this report (i.e., 2000–2008). If Québec regional data are included in the 2008 rate, the reported incidence is 26.6 per 100,000.

The disproportionate burden of TB in this population is evident given that, in 2008, First Nations living on-reserve remained 29.6 times more likely to have active TB than the Canadian-born non-Aboriginal population. Furthermore, while this figure demonstrates progress towards narrowing the gap between on-reserve First

Figure 1: Crude incidence rates* of reported active tuberculosis cases (new and re-treatment) among First Nations living on-reserve in Canada, by year, 1990–2008



*Cells with a dash (—) indicate years for which data were not available

Sources:

First Nation TB cases 1990–1999: CTBRS, except for Ontario (obtained from the First Nations and Inuit Health Information System).

First Nation TB cases 2000–2008: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic.

First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Canadian-born non-Aboriginal rates: Public Health Agency of Canada. *Tuberculosis in Canada, 2008*. Ottawa (Ontario): Minister of Public Works and Government Services Canada; in press 2011.

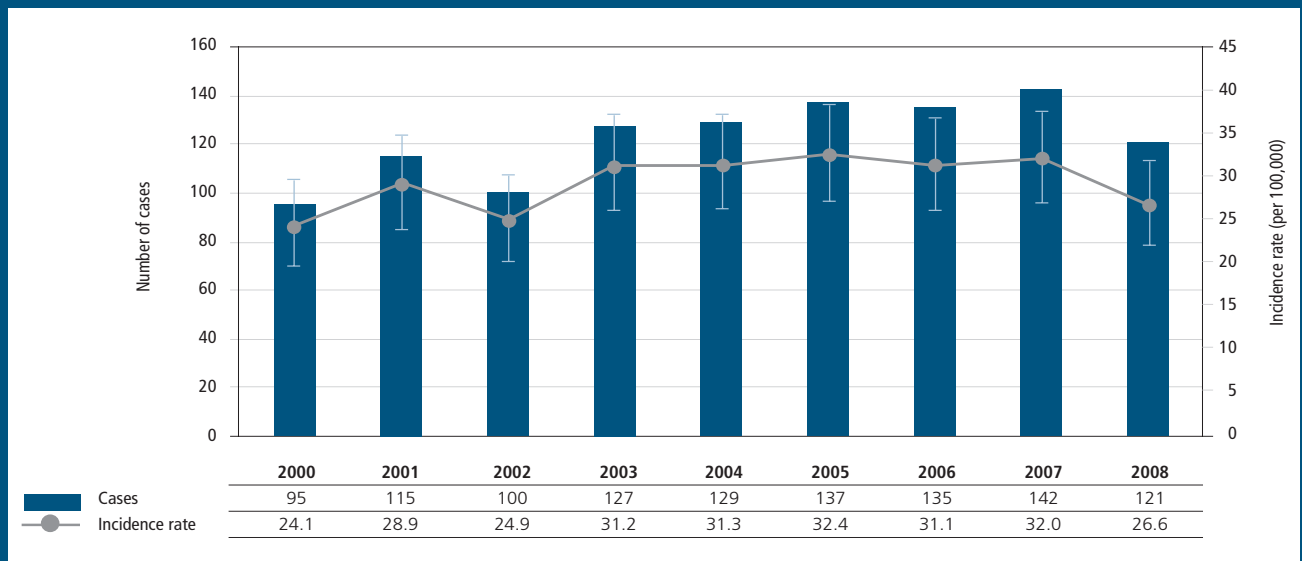
Nation and non-Aboriginal populations, it is important to note that incidence rates are susceptible to fluctuations that can be caused by a variety of factors, such as clusters of disease or outbreaks, variation in the uptake of TB screening practices, and generally low numbers of reported cases in some regions.

A total of 1,101 active TB (new and re-treatment) cases were identified among First Nations living on-reserve in seven Health Canada regions from 2000 to 2008. Figure 2 shows that the TB incidence rate reported in this population fluctuated between 24.1 and 32.4 per 100,000 during this nine-year period. There were no statistically significant differences in the rates over time, suggesting that the TB incidence rate has stabilized in this population.

Table 2 demonstrates that, from 2000 to 2008, the reported age-standardized active TB incidence rates were higher in First Nations living on-reserve than in the Canadian-born non-Aboriginal and foreign-born Canadian populations. When compared to the Canadian-born non-Aboriginal population, the rate ratios ranged from 31.8 to 58.8 during this period. Although the ratios were much smaller, the incidence of TB in First Nations living on-reserve remained two to three times higher than the rates among foreign-born Canadians.

Regional comparisons (excluding Atlantic region) of reported active TB incidence rates are shown in Figure 3. In order to reduce variability and increase stability of the temporal trends, three-year moving average incidence rates were calculated. Figure 3 shows that the reported TB incidence rates varied considerably across the regions during the nine-year time period, ranging from 4.2 to 79.4 cases per 100,000 population.

Figure 2: Number of cases and incidence rates of reported active tuberculosis (new and re-treatment) among First Nations on-reserve in Canada,* by year, 2000–2008



*Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Table 2: Age-standardized incidence rates and rate ratios of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve, Canadian-born non-Aboriginals and the foreign-born population in Canada,* by year, 2000–2008

Year	Age-standardized rate [†]			Rate ratio [‡]	
	First Nations on-reserve [*]	Canadian-born non-Aboriginals [§]	Foreign-born Canadians [§]	First Nations on-reserve versus Canadian-born non-Aboriginals	First Nations on-reserve versus foreign-born Canadians
2000	24.6	n/a	n/a	n/a	n/a
2001	29.3	0.9	14.1	34.2	2.1
2002	25.2	0.8	14.4	31.8	1.7
2003	31.2	0.7	13.0	41.7	2.4
2004	31.3	0.6	12.8	51.0	2.5
2005	32.3	0.6	12.7	50.4	2.5
2006	30.9	0.6	12.6	52.1	2.4
2007	31.6	0.5	11.5	58.8	2.8
2008	26.1	0.6	10.4	40.5	2.5

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

† Direct standardization using INAC fully adjusted First Nations on-reserve population 2004.

‡ Rate ratio (RR) is calculated as the First Nations rate divided by the comparator population rate. For example, if RR = 30, then the First Nation rates are 30 times higher.

§ Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, Yukon, Nunavut and Northwest Territories.

n/a—not available

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

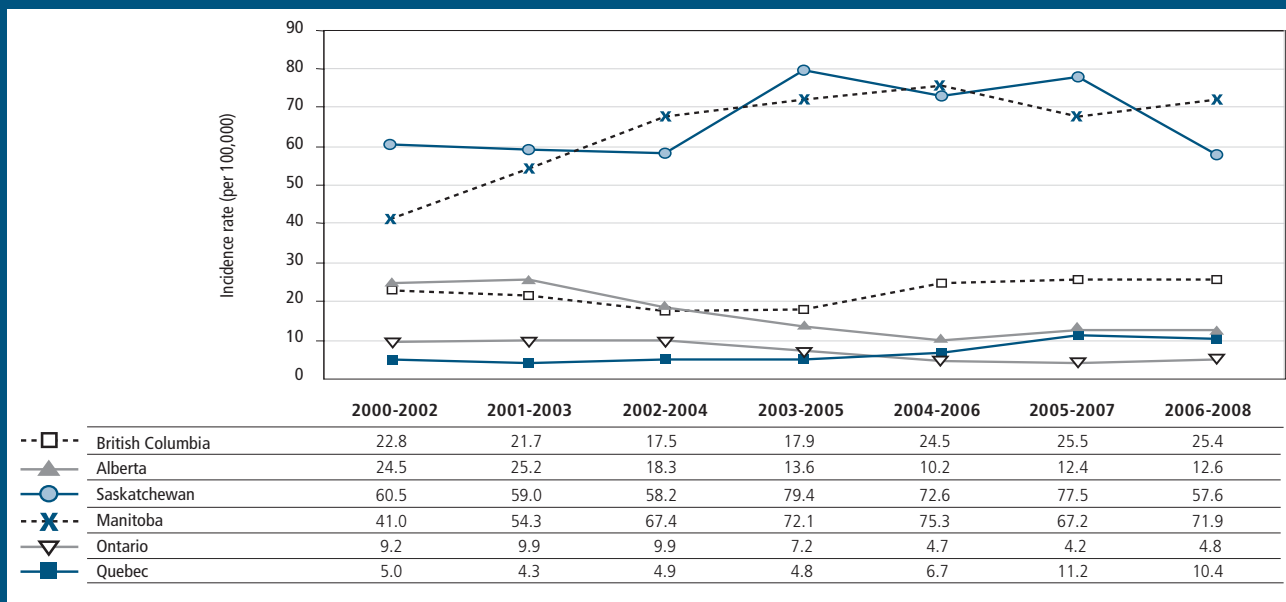
First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Canadian-born non-Aboriginal and foreign-born Canadian rates: Canadian Tuberculosis Reporting System.

When compared to the other regions, Manitoba and Saskatchewan regions showed higher active TB rates over all years. TB cases reported in these two regions accounted for more than two thirds of the overall case count. Some of the disproportionate burden in these two regions could be related to large or ongoing outbreaks in certain communities. In addition, a large proportion of First Nations living on-reserve in these two regions live in remote and isolated communities, where there is a greater likelihood of conditions that can both promote infection with TB as well as its progression to active disease (see Appendix A: Determinants of Health). However, due to data limitations, isolation was not a factor that could be examined in this analysis.

Active TB incidence rates were also examined by sex for all cases reported among First Nations living on-reserve between 2000 and 2008. Figure 4 shows that the national reported incidence rates of active TB were not significantly different when examined by sex, with 32.2 cases per 100,000 population for males and 27.2 cases per 100,000 for females. Although rates appear to be higher for males in Saskatchewan and Manitoba regions, there was no statistically significant difference by sex when the data were analyzed separately for each of the reporting years.

Figure 3: Three-year moving average incidence rates of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada, by region,* 2000–2008



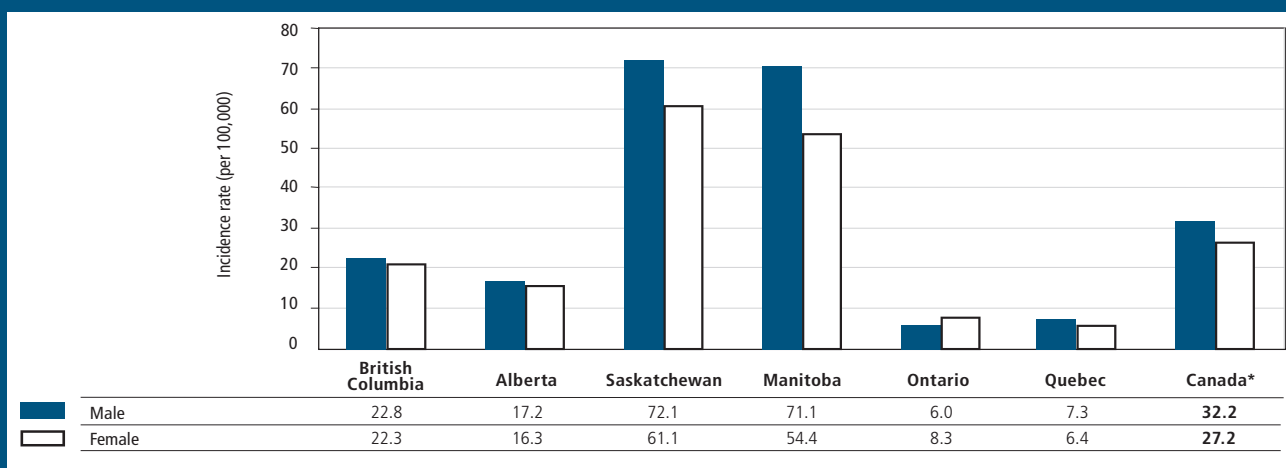
*Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Figure 4: Average annual rates of reported active tuberculosis (new and re-treatment) among First Nations on-reserve in Canada,* by sex and region,† 2000–2008



*Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

†Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

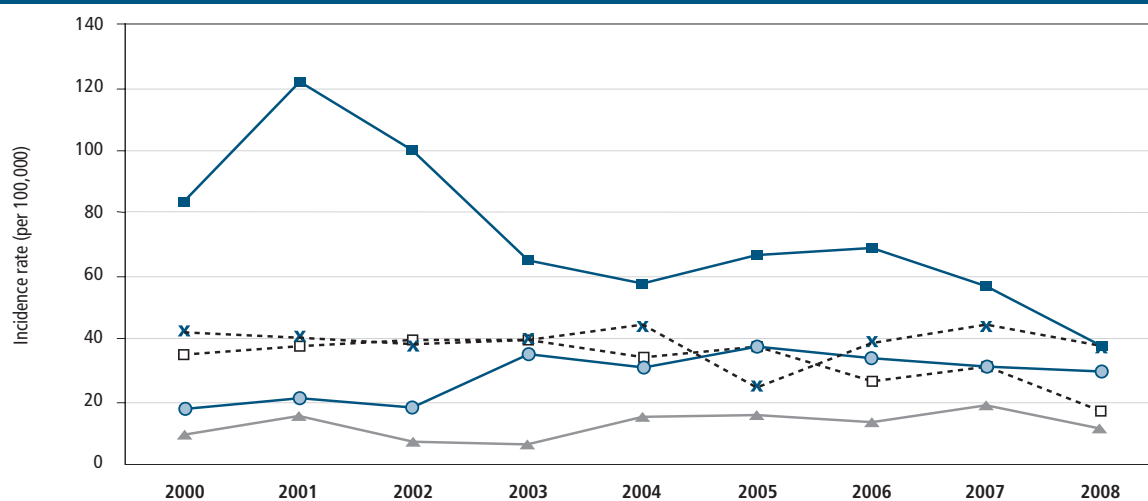
First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Figure 5 shows that reported TB incidence rates have stabilized in almost all age groups over the last eight years, with the exception of those aged 65 years and older. In this age group, rates decreased from 83.7 per 100,000 population in 2000 to 36.7 per 100,000 in 2008. Although the rate for those 15–44 years of age levelled off between 2003 and 2008, it is worth noting that the rate for this age group increased between 2002 and 2003.

The reported TB incidence rate was highest among those 65 years of age and older in all regions with the exception of Saskatchewan and Québec, where the 0 to 4 age group had the highest reported TB incidence rate (see Figure 6).

A closer look at Saskatchewan regional data shows that the high rate reported in the 0 to 4 age group could be due to a combination of factors, such as the application of new screening policies for those less than 6 years of age or, potentially, the misclassification of cases. These results must be interpreted with caution and call for a more in-depth analysis of how TB is classified, reported and analyzed for this age group. It is also important to note that the overall Canadian rate will be affected by the disproportionate rates among those 0–4 years of age in Saskatchewan and those 65 years of age and older in Manitoba and Alberta.

Figure 5: Trends in incidence rates of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada,* by age group, 2000–2008



--□--	0-4	35.1	38.2	39.2	40.2	34.4	38.0	26.8	32.0	17.5
▲	5-14	9.4	15.6	7.3	6.3	15.7	15.6	13.5	18.8	11.5
●	15-44	18.2	21.3	18.8	35.5	31.8	38.1	34.1	31.2	30.5
✕	45-64	42.8	40.9	38.9	40.6	44.0	25.6	39.4	44.7	38.4
■	65+	83.7	122.5	100.7	65.0	57.8	66.7	69.5	57.3	36.7

*Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

Tuberculosis Mortality

Due to incomplete data, a mortality rate was not calculated for this report. While some regions were able to identify cases in which TB was the underlying cause of death, or a contributing factor, this information was not consistently available for all cases in every region. As a result of this under-reporting of TB-related deaths, any rate calculation would be artificial and would not accurately represent TB mortality among First Nations living on-reserve between 2000 and 2008.

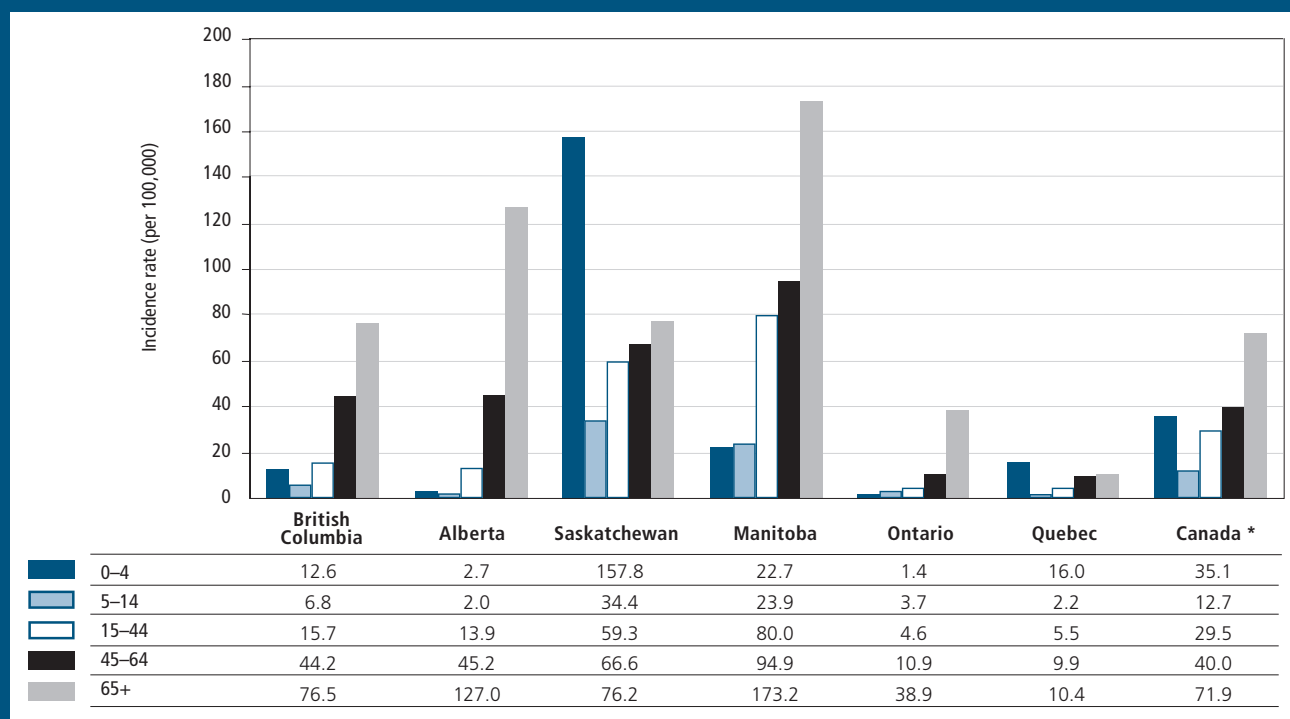
During this period, a total of 48 TB-related deaths were identified among First Nations living on-reserve in all seven regions. Among these, tuberculosis was reported as the underlying cause of death in 17 cases (35%), and as a contributing factor in the remaining 31 cases (65%).

Among the 48 deaths, 60% were women and 65% were aged 55 and older. There were no deaths among those less than 18 years of age during this period. Of the deaths known to be caused by TB (N=17), the breakdown is similar: 59% were women, 65% were aged 55 and older, and there were no deaths among those under the age of 25 years.

Case Detection of Active Tuberculosis (New and Re-treatment)

Pulmonary TB was the leading diagnosis among reported active tuberculosis cases for all regions (range: 57.3% to 83.3%), with the exception of Saskatchewan region

Figure 6: Average annual incidence rates of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada,* by region[†] and age group, 2000–2008



*Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

[†]Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic region.

First Nation populations: Adjusted Registered Indian Population (2000–2004) and Population Projections (2005–2008), Medium Growth Scenario, INAC, 2007.

(38.6%) (see Table 3). While almost a quarter of all cases reported for First Nations living on-reserve in Canada were primary TB, this may be misleading as more than two thirds of these cases were reported from Saskatchewan alone. To illustrate the impact of Saskatchewan cases on Canadian totals, the subtotals for all diagnostic sites *excluding* Saskatchewan counts are also shown in Table 3. For example, primary TB cases account for 23.0% of all cases when Saskatchewan region is included, but only 11.6% when it is excluded. There is some variation across the regions in terms of the distribution of cases with miliary or peripheral lymph node TB. For most regions, miliary TB was the least

frequently reported type of TB from 2000 to 2008. Overall, 83.8% of all TB cases among First Nations living on-reserve from 2000 to 2008 were detected by the presence of symptoms or by contact investigation (see Table 4). While routine screening did not contribute to a high proportion of overall TB detection (6.7% of all cases), Saskatchewan region cases accounted for over 80% of all cases detected by this method. This could be due to differential application of screening guidelines or case definitions that vary from one region to another; however, a comparison was not done to determine if there was a difference.

Table 3: Number of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada,* by major diagnostic classification and region,† 2000–2008

Region	Primary [‡]		Pulmonary [§]		Miliary		Peripheral lymph node		Other ^{††}	
	n	%	n	%	n	%	n	%	n	%
British Columbia	9	7.4	78	64.5	13	10.7	6	5.0	15	12.4
Alberta	8	8.3	55	57.3	5	5.2	18	18.8	10	10.4
Manitoba	61	14.0	267	61.4	10	2.3	24	5.5	73	16.8
Québec	0	0.0	25	83.3	0	0.0	0	0.0	5	16.7
Saskatchewan	162	44.6	140	38.6	<5	—	19	5.2	40	11.0
Subtotal (without Saskatchewan)	—	11.6	425	62.2	28	4.1	48	7.0	—	15.1
Canada*	—	23.0	565	54.1	—	2.9	67	6.4	—	13.7

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Québec and Atlantic regions.

† Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

‡ Includes primary respiratory tuberculosis and tuberculous pleurisy in primary progressive tuberculosis.

§ Includes tuberculosis of the lungs and conducting airways: tuberculous fibrosis of the lung, tuberculous bronchiectasis, tuberculous pneumonia, tuberculous pneumothorax, isolated tracheal or bronchial tuberculosis and tuberculous laryngitis.

†† "Other" includes:

- other respiratory: tuberculous pleurisy (non-primary); tuberculosis of: intrathoracic lymph nodes, mediastinum, nasopharynx, nose (septum), and sinus (any nasal)
- other nonrespiratory: tuberculosis of meninges and central nervous system, intestines, peritoneum and mesenteric glands, bones and joints, genitourinary system, skin, eye, ear, thyroid, adrenal and spleen

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Manitoba and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan and Atlantic regions.

Notes:

- Ontario region data (54 cases) are not included because respiratory cases could not be broken down by diagnostic site.
- Where fewer than five cases were reported (<5), the number and row proportion were suppressed for confidentiality reasons.
- The total number of cases has been suppressed for confidentiality reasons.

Table 4: Number and percentage (%) of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada,* by method of case detection and region,† 2000–2008

Region	Symptoms		Contact investigation		Routine screening		Post-mortem		Other†		Unknown	
	n	%	n	%	n	%	n	%	n	%	n	%
British Columbia	69	57.0	40	33.1	<5	–	5	4.1	<5	–	<5	–
Alberta	62	64.6	19	19.8	0	0.0	<5	–	12	12.5	0	0
Saskatchewan	217	59.8	85	23.4	61	16.8	0	0.0	0	0.0	0	0
Manitoba	224	53.5	127	30.3	8	1.9	<5	–	55	13.1	<5	–
Ontario	24	44.4	15	27.8	0	0.0	<5	–	0	0.0	13	24.1
Québec	24	80.0	<5	–	<5	–	0	0.0	<5	–	0	0
Canada*	–	57.3	–	26.5	73	6.7	13	1.2	73	6.7	16	1.5

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

† Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

‡ "Other" includes incidental findings, common survey, abnormal lab report or X-ray examination.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Saskatchewan, Manitoba and Atlantic regions.

Notes:

- Sixteen cases from Manitoba region are not included in this table as they were not captured by the Canadian Tuberculosis Reporting System.
- Where fewer than five cases were reported (<5), the number and row proportion were suppressed for confidentiality reasons.
- The total number of cases has been suppressed for confidentiality reasons.

Treatment of Active Tuberculosis (New and Re-treatment)

A negative sputum culture at the completion of treatment is required to definitively call a TB case "cured." However, in practice there may be challenges with obtaining such cultures (e.g., inability to produce sputum, cases that are "lost to follow-up"). Information on treatment completion is generally easier to obtain and can be considered an estimate of a "cure."¹⁶ Among First Nations living on-reserve, 86.4% of those with active TB identified from 2000 to 2007 had completed treatment for TB (see Table 5). For two thirds of these cases there was no culture available to confirm a cure.

Mode of treatment

Between 2000 and 2007, data on mode of treatment were available for 880 out of 968 reported active TB

cases (90.9%) included in the analysis on treatment outcome. Among these, 790 cases (89.8%) were reported to receive Directly Observed Therapy (DOT) throughout the course of treatment, while 62 cases (7.0%) reported self-administration of anti-tuberculosis medication. The remaining cases (3.2%) were treated using other modes of treatment such as switching from self-administered to DOT during the course of treatment.

Drug resistance

Between 2000 and 2008, among 760 active (new and re-treatment) TB cases for which drug sensitivity tests were available, 16 were identified as having drug resistance to a single first-line drug. Among these 16 cases, 14 had developed resistance to isoniazid (INH), 1 to ethambutol (EMB) and 1 to pyrazinamide (PZA). Only one case was reported to have multi-drug resistance to INH and rifampicin (RMP).

Table 5: Number and percentage (%) of reported active tuberculosis cases (new and re-treatment) among First Nations on-reserve in Canada,* by treatment outcome and region,† 2000–2007

Region	Cured with negative culture at completion of treatment		Treatment completed without culture at end of treatment‡		Death before or during treatment		Other§		Unknown	
	n	%	n	%	n	%	n	%	n	%
British Columbia	11	10.2	75	69.4	17	15.7	<5	—	<5	—
Alberta	25	27.8	47	52.2	15	16.7	<5	—	0	0
Saskatchewan	110	33.5	193	58.8	13	4.0	10	3.0	<5	—
Manitoba	6	1.7	328	90.6	21	5.8	6	1.7	<5	—
Ontario	6	12.0	18	36.0	11	22.0	<5	—	11	22.0
Québec	16	57.1	0	0	<5	—	0	0	8	28.6
Canada*	174	18.0	—	68.4	—	8.4	27	2.8	24	2.5

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Atlantic regions.

† Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

‡ Status of culture could be: culture not completed, culture completed but results inconclusive, or culture completed but results not submitted.

§ "Other" includes treatment ongoing, treatment failure (continued or recurrent positive cultures after four or more months of treatment), lost to follow-up (before completion of 80% of doses), and transferred to new country (outcome unknown).

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Ontario and Québec regions; Canadian Tuberculosis Reporting System for Alberta, Saskatchewan, Manitoba and Atlantic regions.

Notes:

- Due to unavailability of data for 2008 and the use of a different data source for Alberta and Manitoba regions, 133 cases are not included in this table.
- Where fewer than five cases were reported (<5), the number and row proportion were suppressed for confidentiality reasons.
- The total number of cases has been suppressed for confidentiality reasons.

Tuberculosis Outbreaks

This section summarizes the available data on TB outbreaks, which is subject to region-specific definitions. There is some variability in the outbreak definitions used across the Health Canada regions due to the nature of TB infection, such as it being endemic in certain communities. For this reason, it is not possible to present region-specific data on outbreaks.

Between 2000 and 2008, six of the seven Health Canada regions were able to provide some information on TB outbreaks. Five of the six regions that provided data reported outbreaks during this time. Table 6 summarizes the number of new tuberculosis outbreaks occurring by year.

Table 6: Number of reported new tuberculosis outbreaks among First Nations on-reserve in Canada,* by year, 2000–2008

Year	Number of outbreaks
2000	3
2001	5
2002	1
2003	3
2004	1
2005	2
2006	3
2007	3
2008	6
Total	27

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Québec regions.

Source: Health Canada regional offices reporting for British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Québec regions.

Notes:

- Outbreaks that span more than one calendar year are identified in the year in which the outbreak started.
- Outbreaks are identified as per the definition used in the respective regions.

Tuberculosis and HIV Co-infection

Between 2000 and 2008, HIV reporting among First Nations on-reserve with active tuberculosis fluctuated from 14.3% to 38.5% of cases (see Figure 7). During this same period, HIV reporting among the Canadian-born non-Aboriginal population also fluctuated, showing a general increase over time.

In 2002, the Canadian Tuberculosis Committee (CTC)¹⁷ recommended that:

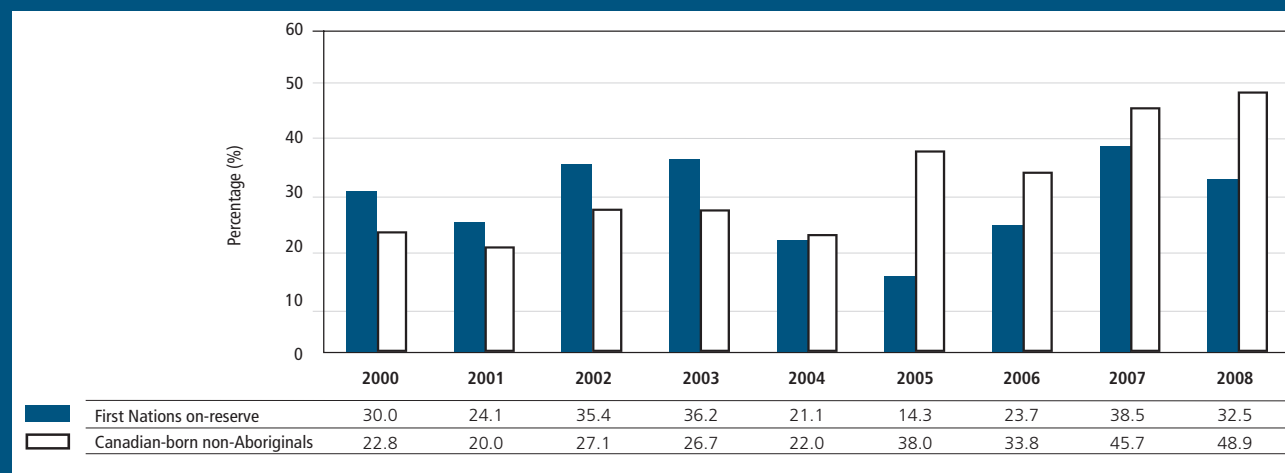
- Individuals with newly diagnosed TB be strongly encouraged to undergo informed HIV serologic testing.
- Every newly identified patient with HIV infection be assessed with regard to history of active tuberculosis and known or likely exposure to TB.

Although these recommendations are in place, reporting of HIV status is less than optimal, not only in First Nations living on-reserve but for all TB cases diagnosed in Canada. This highlights the benefit of consistent collection of ethnicity data as part of HIV testing and improved access to HIV testing for TB patients, and vice versa, through a strong collaboration between TB and HIV control programs.

Table 7 illustrates the relationship of diagnosed active TB cases and known HIV status. Among First Nations living on-reserve diagnosed with active TB between 2000 and 2008, only 28.2% had an HIV status that was known. With considerable variation across Health Canada's regions, this percentage was greatly influenced by counts in Saskatchewan region, for which HIV status was known for less than 5 of the 363 active TB cases. When data from this region are removed, the overall proportion of TB cases with known HIV status increases to 42.8%.

From 2000 to 2008, 6.1% of TB cases with known HIV status were HIV seropositive. Since this proportion was based on a small number of cases with a known HIV test result (28.2%), understanding the real burden of TB-HIV co-infection in First Nations living on-reserve remains a challenge.

Figure 7: Percentage (%) of reported active tuberculosis cases (new and re-treatment) with known HIV status among First Nations on-reserve and Canadian-born non-Aboriginals in Canada, by year, 2000–2008*



* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Atlantic regions.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta and Ontario regions; Canadian Tuberculosis Reporting System for Saskatchewan, Manitoba and Atlantic regions.

Canadian-born non-Aboriginal TB cases: Canadian Tuberculosis Reporting System.

Table 7: Number and percentage (%) of reported active tuberculosis cases (new and re-treatment) with known HIV status and positive HIV test result among First Nations on-reserve in Canada,* by region,† 2000–2008

Region	TB cases	TB cases with known HIV status		Positive HIV status among TB cases with known HIV status	
	n	n	%	n	%
British Columbia	121	56	46.3	7	12.5
Alberta	96	73	76.0	<5	—
Manitoba	419	137	32.7	7	5.1
Ontario	54	29	53.7	0	0.0
Saskatchewan	363	<5	—	<5	—
Subtotal (without Saskatchewan)	—	—	42.8	—	5.7
Canada*	—	297	28.2	18	6.1

* Includes British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Atlantic regions.

† Data for Atlantic region are not shown because the overall tuberculosis case count is less than five.

Sources:

First Nation TB cases: Health Canada regional offices reporting for British Columbia, Alberta and Ontario regions; Canadian Tuberculosis Reporting System for Saskatchewan, Manitoba and Atlantic regions.

Notes:

- Sixteen cases from Manitoba region are not included in this table because they were not reported in the Canadian Tuberculosis Reporting System.
- Where fewer than five cases were reported (<5), the number and row proportion were suppressed for confidentiality reasons.
- The total number of cases has been suppressed for confidentiality reasons.

Conclusion

This report represents the most current data on tuberculosis for First Nations living on-reserve across Canada. Since 2000, the TB rates for this population have stabilized; however, they remain considerably higher than the rates observed in the Canadian-born non-Aboriginal population.

This report highlights that there are important differences in TB activity across the country that are influenced by the geographic region in which First Nations live. It is therefore important that the interpretation of data on a national level keep these variations in mind. These regional differences will be particularly important for planning health promotion activities and educational programs in those regions with a higher reported incidence of TB. This report also provides a breakdown of the classification of TB cases by diagnostic site, which will allow for targeted approaches to TB prevention activities.

A number of gaps still exist in terms of the data available to adequately assess the burden of TB in First Nations living on-reserve across Canada. In order to better understand the impact of TB in this population and to support program activities, particular attention will have to be directed toward improving data collection and surveillance on TB outbreaks, TB/HIV co-infection, deaths related to TB, latent tuberculosis infection (LTBI) and contact tracing. These improvements will only be possible through the cooperation of provincial, federal and First Nation health bodies.

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Glossary

Aboriginal Peoples:

Aboriginal peoples are the descendants of the original inhabitants of North America. The Constitution of Canada recognizes three groups of Aboriginal peoples—Indians, Métis and Inuit. These three separate peoples have unique heritages, languages, cultural practices and spiritual beliefs.

Acceptable Housing and Core Housing Needs On-Reserve:

For households on First Nation reserves in Canada, the term **acceptable housing** refers to housing that is *adequate* in condition and *suitable* in size.

- **Adequate housing** does not require any major repairs, according to residents.
- **Suitable housing** has enough bedrooms for the size and make-up of resident households, according to National Occupancy Standard (NOS) requirements. Enough bedrooms based on NOS requirements means one bedroom for each: cohabiting adult couple; unattached household member 18 years of age and over; same-sex pair of children under age 18; and additional boy or girl in the family, unless there are two opposite sex children under 5 years of age, in which case they are expected to share a bedroom. A household comprised of one individual can occupy a bachelor unit (i.e., a unit with no bedroom).

An on-reserve household is considered to be in need of housing if its housing does not meet one or both of the adequacy and suitability standards, and it would have to spend 30% or more of its before-tax income to pay the shelter costs of alternative local market housing that meets all three standards.

Housing costs for most on-reserve households are paid through Band housing arrangements, so shelter costs are not collected by the census. Affordability (which assesses whether or not a household's shelter costs are 30% or

more of their income) and, by extension, core housing need cannot be determined. However, the adequacy and suitability of housing on-reserve can be examined and, using household incomes, the percentage of households living in housing below standard and unable to access acceptable housing can also be derived. This is similar to the concept of core housing need, but with the notable absence of the affordability standard.

First Nation:

"First Nation" is a term that came into common usage in the 1970s to replace the word "Indian," which many people found offensive. Although the term First Nation is widely used, no legal definition of it exists. Many Indian people have also adopted the term First Nation to replace the word "Band" in the name of their community. Both Status and non-Status Indian people in Canada are referred to as "First Nations people(s)." In the Canadian Census of Population, "North American Indian" is the term used for this population.

Inuit:

An Aboriginal people in northern Canada who live in the Northwest Territories, northern Québec and Labrador, and above the tree line in Nunavut. The word means "people" in Inuktitut, the Inuit language. The singular of Inuit is Inuk.

Métis:

The Métis are one of the Aboriginal peoples in Canada who trace their ancestry to mixed European and First Nations parentage. While the initial offspring of these Indian and European unions were individuals who possessed mixed ancestry, the gradual establishment of distinct Métis communities, outside of Indian and European cultures and settlements, as well as the subsequent intermarriages between Métis women and Métis men, resulted in the genesis of a new Aboriginal people—the Métis.

North American Indian:

See *First Nation*.

Registered Indian:

See *Status (Registered) Indian*.

Status (Registered) Indian:

A Status (Registered) Indian is an Indian person who is registered under the *Indian Act*. The Act sets out requirements for determining who is a Status Indian.

Appendix A: Determinants of Health

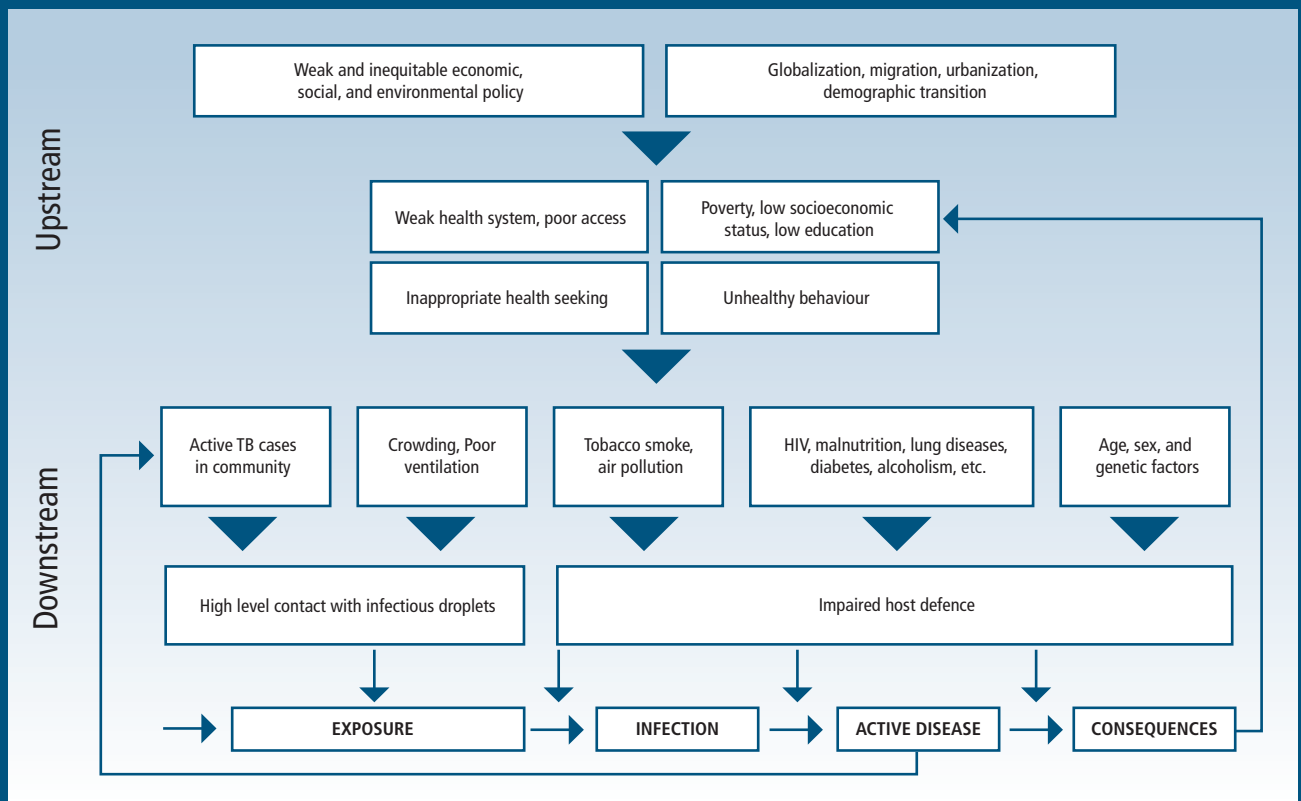
Tuberculosis (TB) infection and disease development is influenced by complex interactions among social determinants of health and these interactions contribute to the disparity in TB rates between Aboriginal and non-Aboriginal Canadians.¹⁻³ Certain determinants of health are important risk factors for TB infection and disease development in the Aboriginal population and can operate in two ways. First, risk factors can increase the level and duration of exposure to infection—for example, elements of the physical environment, such as overcrowded housing, can result in greater exposure to infected individuals. Second, there are also risk factors that can weaken an individual's immune system, such as smoking, HIV infection, malnutrition, alcohol use and diabetes.⁴ These risk factors for TB can, in turn, be

impacted by other social determinants of health, such as low levels of education, low income and unemployment, as shown in Figure A-1.

This section focuses on four social determinants of health—education, income, physical environment and personal health practices—all determinants for which data are available for First Nations people.ⁱ The relationship between these determinants and TB, including how this relationship has the potential to impact First Nations living on-reserve, is reviewed briefly below. This is followed by an overview of the relationship

ⁱ Where data are available, each of the social determinants of health have been presented for First Nations or Status Indians on-reserve.

Figure A-1: Social determinants of health and their influence on tuberculosis infection and disease development



Source: Lönnroth K, et al., 2010.⁴

between TB and specific risk factors such as HIV, diabetes and end-stage renal disease.

Education

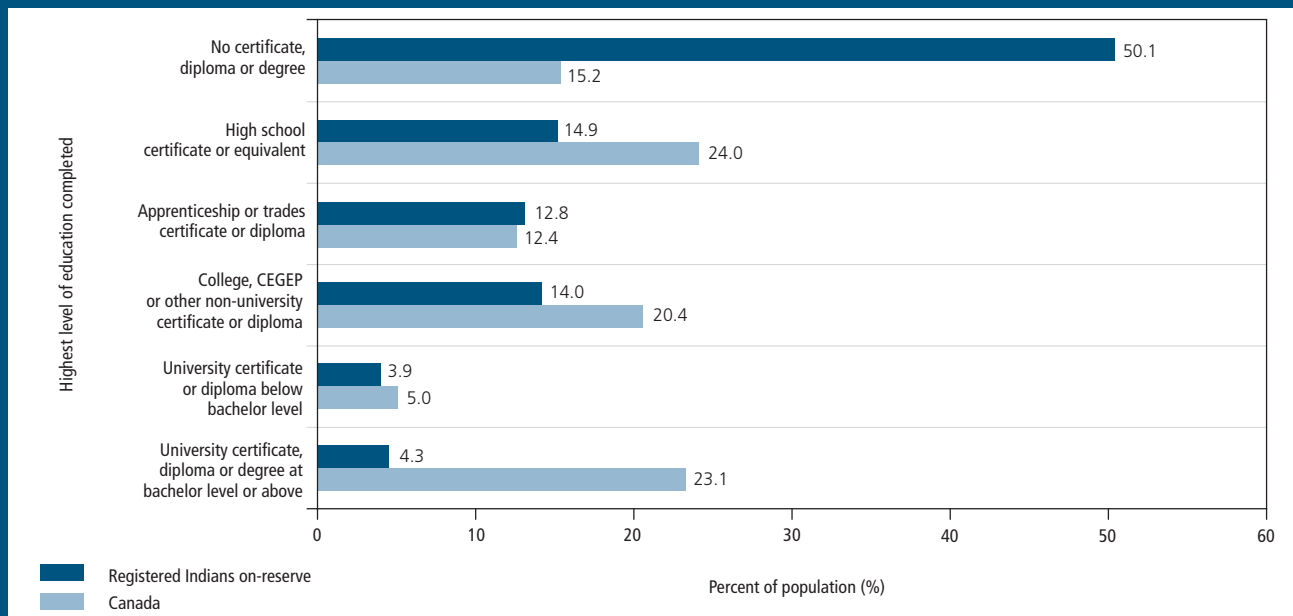
Education level attained by a person is positively associated with that person's health status and health-promoting behaviours.⁵ Poor educational attainment can act as a significant barrier to employment, and can limit one's knowledge and understanding of healthy behaviours.^{6,7} For example, with respect to TB infection, lower educational attainment is associated with certain behaviours such as smoking, alcohol use, poor diet (malnutrition) and unsafe sex (increased risk

of HIV infection).⁴ All of these risk factors increase an individual's risk of progressing from TB infection to active disease.⁴

Figure A-2 shows the level of education completed by both Registered Indians living on-reserve and Canadians living off-reserve, between 25 and 64 years of age, in 2006. This age range reflects the working age population; it excludes younger people, many of whom are still in school, and the elderly.

With the exception of apprenticeships or trades certificates or diplomas, the educational attainment of Registered Indians on-reserve lags behind that of other Canadians. The proportion of Registered Indians

Figure A-2: Level of education completed by Registered Indians on-reserve,* compared to those living off-reserve in Canada,† among adults aged 25 to 64 years, 2006



* Registered Indian status based on self-reporting of the respondent.

† Total Canadian population living off-reserve, including non-Aboriginal and Aboriginal identity peoples.

Source: Statistics Canada. 2006 Census of Population. Ottawa (Ontario): Statistics Canada. Catalogue No. 97-564-XCB2006004.

Note: Totals may not add to 100% due to rounding.

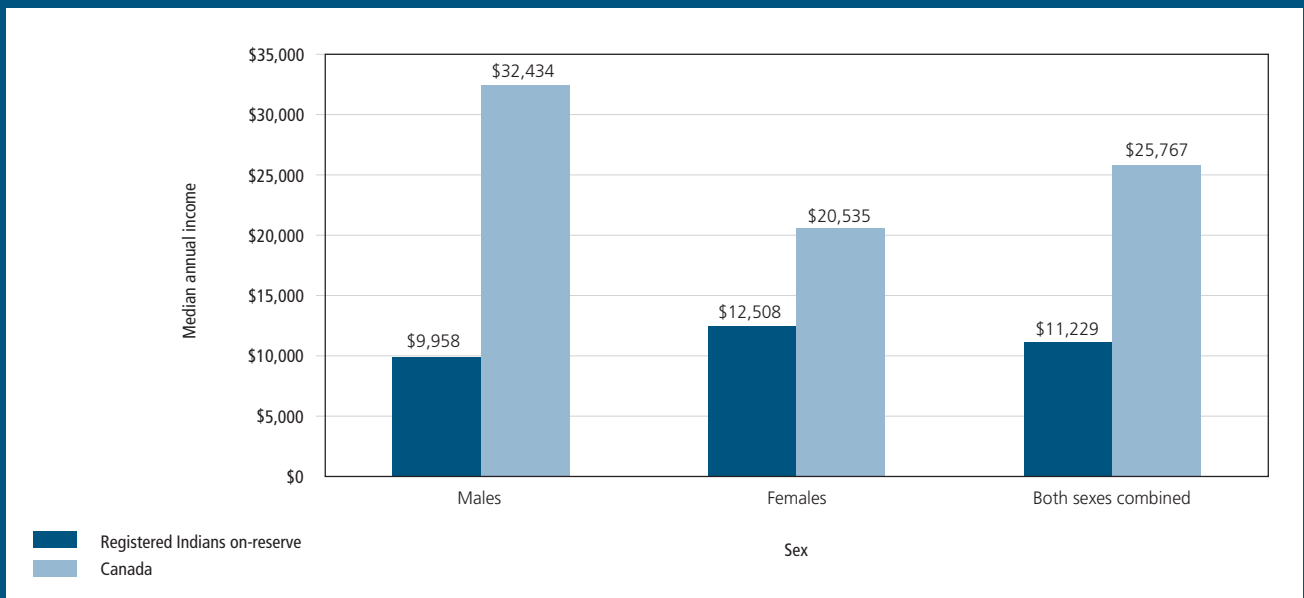
on-reserve that hold a university certificate, diploma or degree at a bachelor's level or above is less than one fifth of that for the general Canadian population living off-reserve. Registered Indians living on-reserve are more than three times as likely to have no certificate, diploma or degree compared to other Canadians.

Low educational achievement contributes to poor health by lowering income, reducing health literacy and increasing the likelihood of unhealthy behaviour—these factors make low educational achievement a risk factor for TB.

Income

Income is also an important contributor to health.⁸ Income influences living conditions, quality of housing and the ability to afford sufficient quality food, all of which affect health status.⁵ Income interacts with a number of risk factors for TB, including residential overcrowding, smoking, and lower levels of health awareness and health literacy.^{4,8} As shown in Figure A-3, in 2006, the median annual income for Registered Indians on-reserve (\$11,229) was \$14,538 lower than that for the Canadian population living off-reserve (\$25,767).

Figure A-3: Median annual income for Registered Indians on-reserve,* compared to those living off-reserve in Canada,† among those aged 15 years and over, 2006



* Registered Indian status based on self-reporting of the respondent.

† Total Canadian population living off-reserve, including non-Aboriginal and Aboriginal identity peoples.

Source: Statistics Canada. 2006 Census of Population. Ottawa (Ontario): Statistics Canada. Catalogue No. 97-564-XCB2006004.

A study conducted in 2002 by Clark et al.,⁹ explored the relationship between housing density, isolation and income with the occurrence of ≥ 1 and ≥ 2 casesⁱⁱ of TB in 298 First Nation reserves in Canada. The analysis revealed a significant association between income level and active TB disease. It also demonstrated that a \$10,000 increase in community household income corresponded to a 75% decrease in the risk of two or more cases of TB in a community. No significant association was found between income and the risk of one or more cases of TB in a community. It should be noted that housing density was not controlled for in the analysis and may act as an effect modifier, meaning that the association between income level and risk of TB may be due to overcrowding.⁹ Alternatively, the combination of overcrowding and lower income levels may interact to increase risk of TB cases in a community.

The relationship between income and tuberculosis is complex and requires consideration of other TB risk factors, including education level, health literacy and housing. The degree of exposure to these TB risk factors is determined to some extent by income.

Physical Environment

Housing

Poor housing can affect the quality of indoor air, and can also allow for the growth of mould or the manifestation of other harmful agents. On-reserve households encounter both poor states of repair and overcrowding much more frequently than households in the rest of Canada.⁵ According to the Canada Mortgage and Housing Corporation (CMHC), housing quality is considered "good" when it is affordable, in good form and large enough for the size of the household.¹⁰ "Overcrowding" is defined by CMHC as not having enough bedrooms for the size and composition of residents in a household.¹⁰

CMHC has developed the following three housing standards for what it calls "core housing needs":

1. *Affordable housing* costs less than 30% of before-tax household income.
2. *Adequate housing* does not require any major repairs as reported by household residents.
3. *Suitable housing* has enough bedrooms for the size and make-up of resident households, according to the National Occupancy Standard (NOS) requirements, as determined by CMHC.

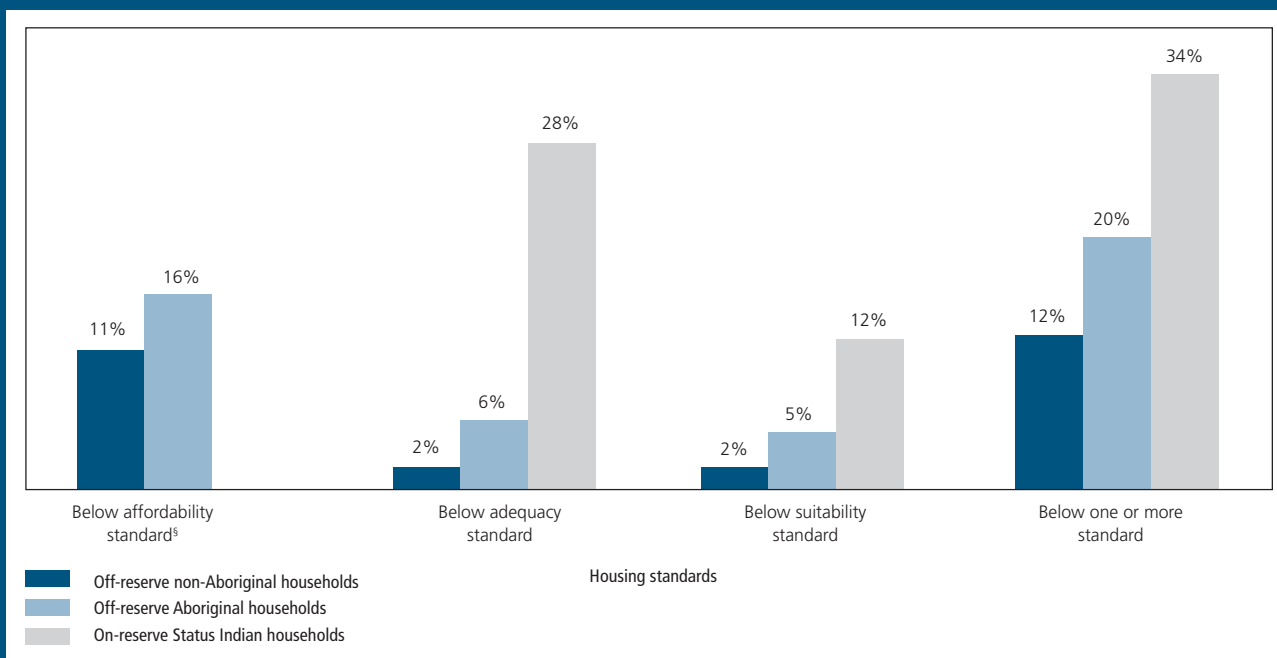
Figure A-4 illustrates the proportion of households that is below each of the CMHC core housing standards for three groups in Canada: Status Indian households on-reserve, Aboriginal households off-reserve and non-Aboriginal households off-reserve. These data show that a substantially greater proportion of on-reserve Aboriginal households are below the CMHC adequacy and suitability standards than off-reserve Aboriginal and non-Aboriginal households. For example, on-reserve Status Indian households are approximately 5 times more likely to be below the CMHC adequacy standard than off-reserve Aboriginal households and approximately 14 times more likely to be below the standard than non-Aboriginal households. They are also more likely to be below one or more of the CMHC housing standards compared to off-reserve households.

Crowding is another risk factor for TB transmission.¹¹ Overcrowded housing conditions can increase the exposure of susceptible people to those infected with TB and, in doing so, increase the probability of transmission.¹¹ The risk of exposure is also increased by poor air quality due to inadequate ventilation which, in turn, results in either inadequate dilution or removal of infectious droplet nuclei.¹¹

The association between overcrowded housing and TB incidence, and mortality due to tuberculosis has long been recognized in First Nation communities.⁹ A 2002 study examined the association between overcrowded housing and TB incidence in Canadian First Nation communities and found that the average number of persons per room (ppr) was a significant predictor of TB rates.⁹ As shown in Table A-1 below, as the average ppr increased, so did the TB incidence rate.

ii The authors of this study did not provide any information as to why these two particular outcomes were chosen for the regression models.

Figure A-4: Percentage (%) of off-reserve* Aboriginal and non-Aboriginal households, and on-reserve Status Indian households,† below CMHC housing standards,‡ Canada, 2006



* Off-reserve households: includes only private, non-farm, non-Band, non-reserve households with incomes greater than zero and shelter-cost-to-income ratios (STIRs) less than 100%.

† On-reserve households: any household found within a Statistics Canada Census Subdivisions (CSD) that is identified as an Indian Reserve, Indian Settlement, Indian Government District, Terres réservées aux Cris, Terres réservées aux Naskapis, Nisga'a Village, Nisga'a Land, and Teslin Land (for more information, see Statistics Canada, 2006 Census Dictionary, available from: <http://www12.statcan.gc.ca/census-recensement/2006/ref/dict/geo012a-eng.cfm>).

‡ See Glossary for more complete definitions.

§ The affordability standard cannot be calculated for Status Indian on-reserve households, since many homes on-reserve are paid for through Band housing arrangements.

Source: Canada Mortgage and Housing Corporation. Census-based housing indicators and data.

Table A-1: Tuberculosis notification rate (per 100,000) and 95% confidence interval (CI), by community housing density, 1997–1999

Average number of persons per room*	TB incidence, per 100,000 and 95% CI
0.4–0.6	18.9 (13.3–24.6)
0.7–0.9	39.0 (33.1–45.0)
1.0–1.2	113.0 (95.4–130.5)
1.3+	225.8 (137.3–314.3)

* "Room" refers to an enclosed area within a dwelling that is finished and suitable for year-round living (Statistics Canada Census definition).

Source: Clark M, et al., 2002.⁹

Poor housing quality and overcrowded living conditions increase the risk of transmission of TB among First Nation residents on-reserve and progression to disease among those who share living space.

Community isolation

Health Canada's First Nations and Inuit Health Branch (FNIHB) classifies First Nation communities into one of four types:

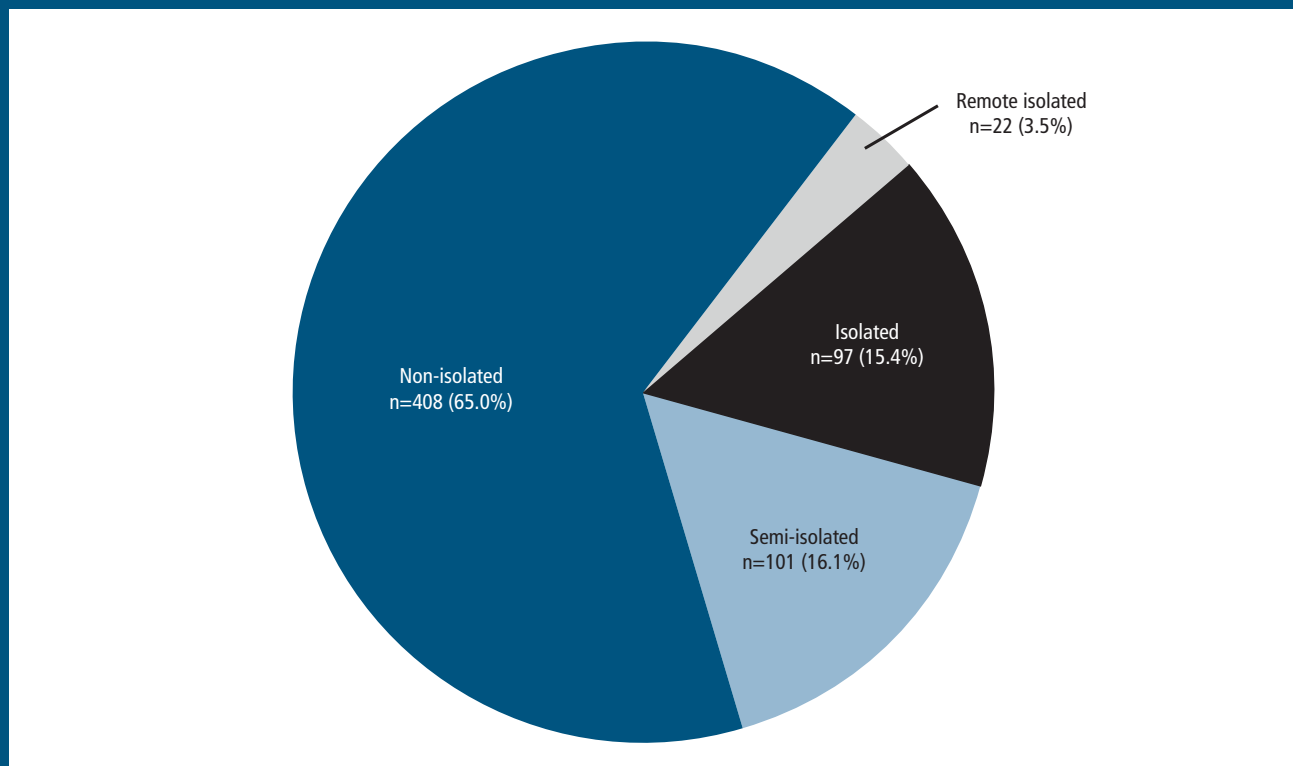
1. **Non-isolated**—communities that are accessible by road and are less than 90 kilometres from physician services.
2. **Semi-isolated**—communities that have road access, but the nearest physician services are farther than 90 kilometres away.
3. **Isolated**—communities that have scheduled flights and good telephone service, but no road access.
4. **Remote isolated**—communities that have no

scheduled flights or road access, and minimal telephone and radio service.⁵

As shown in Figure A-5, the majority (65%) of First Nation communities are non-isolated. Semi-isolated and isolated communities are similar at approximately 16% each, while remote isolated communities make up fewer than 4% of First Nation communities in Canada.

A study looking at the association between community isolation and tuberculosis in Canadian First Nation communities found that the TB incidence between 1997 and 1999 was significantly lower in non-isolated communities than in all categories considered isolated.⁹ The rate in non-isolated communities was 20.0 per 100,000 population (95% CI: 16.7–23.4), while rates for semi-isolated, isolated and remote isolated communities were 89.1 per 100,000 (95% CI: 69.4–108.7), 89.6 per 100,000 (95% CI: 76.5–102.7), and 63.2 per 100,000 (95% CI: 27.4–98.9), respectively.⁹

Figure A-5: Number and percentage (%) of First Nation communities (N=628) in Canada, by degree of isolation, as of December 31, 2009



Source: Health Canada, First Nations and Inuit Health Branch, Community Planning and Management System.

While there is a statistically significant difference between non-isolated and each type of isolated community, the association between isolation and TB incidence may be exaggerated as a result of ascertainment bias. Specifically, it is likely that more TB cases are identified by medical professionals in isolated communities where tuberculosis is endemic, as they would be more likely to consider TB in their differential diagnosis. It is also likely that some cases of active TB in non-isolated communities are missed, as those with active TB disease in these communities are more likely to move off-reserve for treatment and, as a result, these cases would not be captured.⁹ Lastly, when considering these results, it should be noted that Clark et al.⁹ found a correlation between housing density (ppr) and degree of isolation, where the mean ppr was higher in isolated communities than in non-isolated communities. As indicated earlier, higher housing density is a significant predictor of higher TB rates and therefore may be acting as an effect modifier for isolation.⁹

Personal Health Practices

Personal health practices are the health choices individuals make throughout their lives that can have a positive or negative effect on their health status.⁵

Smoking

There is an association between smoking tobacco and tuberculosis; individuals who smoke are more susceptible to TB infection.¹² Smoking damages the natural lining of the lungs resulting in a breakdown of an important defensive barrier against infection from TB. In addition, tobacco smoke weakens the immune system by impairing the ability of macrophages and T-cells to recognize and destroy infectious agents such as TB.^{13,14} Smoking also reduces the effectiveness of treatment for latent TB infection (LTBI) which can lead to longer periods of infection and more severe forms of the disease if active TB disease should occur.¹³

According to data collected during the 2002/03 First Nations Regional Longitudinal Health Survey (RHS), the overall smoking (daily and occasional smoking) prevalence among First Nations living on-reserve was 58.8%, which was almost 2.5 times higher than the prevalence among Canadians living off-reserve of

24.2%.^{15,16} Among those who said they smoke, in both the First Nations on-reserve and the general Canadian populations, the majority reported smoking on a daily basis. Close to half (46.0%) of First Nations living on-reserve aged 18 years and older reported smoking on a daily basis compared to 19.0% in the general population (Figure A-6). Across the lifespan, the highest percentage of smokers was reported among young First Nation adults, with 69.8% of those 18–29 years of age reporting occasional or daily smoking.⁵

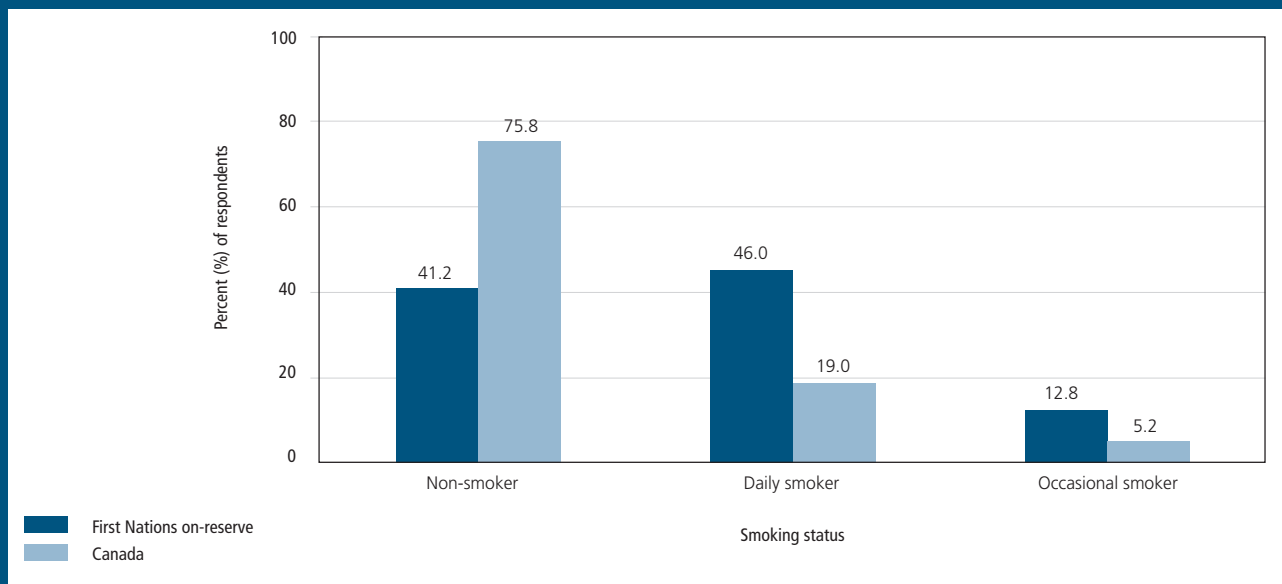
Many studies have found that there is a strong association between tobacco smoke and TB infection and disease even after adjustments for other risk factors, such as gender, alcohol use and low socioeconomic status.^{17–19} Meta-analyses and systematic reviews that have looked at the strength and quality of the causal association between tobacco smoke and TB infection and disease in numerous studies have found significant effects of exposure to tobacco. It was found that the risk of TB infection was one to three times higher if an individual was exposed to active or passive tobacco smoke as compared to individuals who were not exposed to tobacco smoke.^{17–19} After adjusting for alcohol use, the risk was lower (pooled odds ratio (OR) 1.76, 95% CI=1.43–2.16) but still had a positive effect of smoking on TB infection.¹⁸ Similar results were found in an examination of the relationship between exposure to active or passive tobacco smoke and TB disease. The risk of TB disease significantly increased among individuals who smoked or who were around smokers (OR range: 2.3, 95% CI=1.3–4.2 to 9.3, 95% CI=3.14–27.58), even after adjustment for alcohol intake or socioeconomic status.^{17–19}

Alcohol use

There is also a strong association between alcohol use and risk of tuberculosis. Lönnroth et al.²⁰ found that there was a three-fold risk of developing active TB related to consuming more than 40 grams of alcohol per day (three drinks), and/or having an alcohol-use disorder. This association between alcohol consumption and TB may be a result of both an increased risk of infection due to specific social mixing patterns associated with alcohol use and the harmful effect alcohol has on the immune system.^{20,21}

Although the data collected during the 2002/03 RHS indicated there were lower rates of overall alcohol consumption among First Nation adults on-reserve compared to the total general Canadian population

Figure A-6: Smoking status in adults aged 18 years and over among First Nations on-reserve, 2002–2003, compared to those living off-reserve in Canada,* 2003



* Total Canadian population living off-reserve, including non-Aboriginal and Aboriginal identity peoples.

Sources:

First Nations on-reserve (2002–2003): First Nations Information Governance Committee (FNIGC). First Nations Regional Longitudinal Health Survey (RHS) 2002/03. Results for Adults, Youth and Children Living in First Nations Communities. Assembly of First Nations; 2005 Nov.

Canada overall (2003): Statistics Canada. Canadian Community Health Survey (CCHS) 2003.

living off-reserve (66% versus 79%), Figure A-7 shows the proportion of those reporting heavy drinking was higher among First Nations than the general Canadian population.⁵ The proportion of First Nations reporting heavy drinking (defined as having five or more drinks on one occasion) on a weekly basis (16.0%) was double the proportion reported in the general Canadian population (7.9%). The largest difference was among females, with 10.2% of First Nation females reporting heavy drinking on a weekly basis compared to 3.3% of females in the general Canadian population.⁵

Other Risk Factors

HIV co-infection

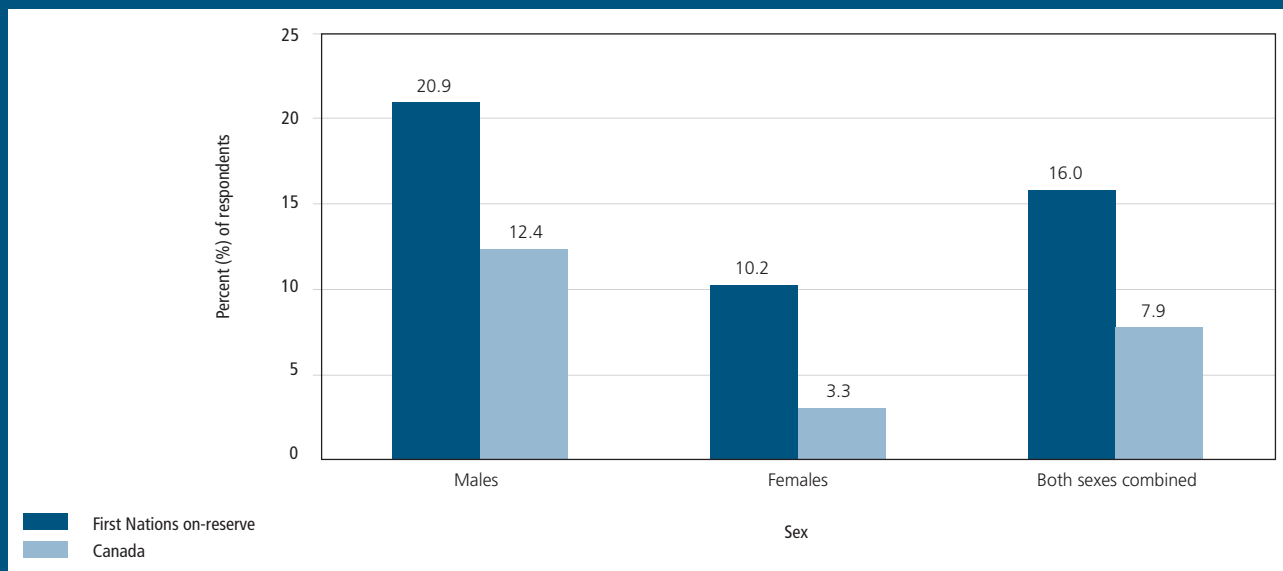
HIV infection is a strong risk factor for development of active disease in those with pre-existing latent TB infection, as well as those who are infected with tuberculosis after becoming infected with HIV. HIV attacks the host's immune system, specifically the cell-

mediated immune response. Cell-mediated immunity is critical in fighting off infection from *M. tuberculosis*, as well as preventing the progression to active TB disease; this compromised cell-mediated immune response may also interfere with the accurate diagnosis of TB infection with the tuberculin skin test.²²

Aboriginal peoples (defined as First Nation, Inuit and Métis) are over-represented in the HIV epidemic in Canada according to analyses conducted by the Public Health Agency of Canada. According to the 2006 Census of Population, Aboriginal persons make up 3.8% of the Canadian population, but account for about 8.0% of all prevalent HIV infections. In 2008, an estimated 4,300 to 6,100 Aboriginal persons were living with HIV in Canada.²³

In Canada, the HIV status of TB cases is largely under-reported, thereby making an accurate determination of TB/HIV co-infection rates difficult to ascertain. TB/HIV co-infection is addressed in more detail earlier in this report.

Figure A-7: Heavy drinking* on a weekly basis in drinkers aged 18 years and over among First Nations on-reserve, 2002–2003, compared to those living off-reserve in Canada,† 2003



* Heavy drinking is defined as having five or more drinks on one occasion.

† Total Canadian population living off-reserve, including non-Aboriginal and Aboriginal identity peoples.

Sources:

First Nations on-reserve (2002–2003): First Nations Information Governance Committee (FNIGC). First Nations Regional Longitudinal Health Survey (RHS) 2002/03. Results for Adults, Youth and Children Living in First Nations Communities. Assembly of First Nations; 2005 Nov.

Canada overall (2003): Statistics Canada. Canadian Community Health Survey (CCHS) 2003.

Notes:

- Includes only those people who reported drinking in the year prior to the survey.
- In the RHS, "heavy drinking on a weekly basis" includes those who reported drinking five or more drinks once a week, more than once a week, and once a day.
- In the CCHS, "heavy drinking on a weekly basis" includes those who reported drinking five or more drinks once a week and more than once a week.

Diabetes

People with diabetes mellitus who are infected with TB are at greater risk of progression to active TB.^{24,25} Research, although limited, indicates that there may be a relationship between diabetes and TB. Active TB can lead to glucose intolerance and, at the same time, diabetes can weaken an individual's cellular immunity, which is required to fight off TB infection.²⁵

It is well known that the burden of illness associated with diabetes in the First Nations population is considerably higher than in the non-Aboriginal population in Canada; however, this is only part of the problem. First Nation peoples generally experience the onset of diabetes at an earlier age, as well as greater severity at diagnosis and higher rates of complications. These disease factors are further compounded by a lack of accessible health services and the increased prevalence of risk factors for

a population already at risk.²⁶ Based on the First Nations Regional Longitudinal Health Survey (RHS) 2002/03, the age-standardized self-reported prevalence of diabetes (type 1 and type 2 combined) among First Nation adults living on-reserve was 19.7%, compared to 5.2% in the general Canadian population.²⁷

End-stage renal disease

Individuals with end-stage renal disease (ESRD) are 10 to 25 times more likely than immunocompetent people to develop active TB.^{28,29} Although it is difficult to know for certain the burden of ESRD in First Nation communities, it has been shown that Aboriginal peoples in Canada (including First Nations) are at increased risk of developing ESRD.^{30–32} The age-standardized incidence of ESRD among Aboriginal peoples is 2.5 to 4.0 times higher than the national rate, primarily because of diabetes mellitus and glomerulonephritis.³⁰

Summary


The determinants of health that Lönnroth et al.⁴ discuss are of concern for the First Nations population. Overcrowded housing in First Nation communities increases the risk of TB infection by prolonging one's exposure to a contagious individual. For individuals who are already infected, their risk of progressing to disease increases depending on personal health practices such as smoking, alcohol consumption, poor diet and unsafe sex. Low levels of education and income can play a role in influencing an individual's physical environment, as well as the material and emotional resources they have available to make positive personal health choices. The epidemiological data summarized in this report must be considered in the context of these determinants of health and the model presented in this appendix.

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Appendix B: Tuberculosis Report Forms



Public Health
Agency of Canada

Agence de la santé
publique du Canada

**Active Tuberculosis Case Report Form –
New and Re-treatment Cases**

CONFIDENTIAL
WHEN COMPLETED

EFFECTIVE JANUARY 2011

Province/Territory/Patient ID

1. Reporting province/ territory	2. Register case number	3. Unique identifier	4. Date of birth Year Month Day	5. Sex Male <input type="checkbox"/> Female <input type="checkbox"/>
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6. Usual residence City/Town/Village _____ Postal code _____
County and Health Unit _____

Lives on First Nation's reserve most of the time? 1 Yes 2 No 8 N/A 9 Unknown

Origin

7. Canadian born? **Yes** No

1 Status Indian (Registered) 2 Métis
3 Inuit 4 Other Aboriginal (specify) _____

5 Canadian born non-Aboriginal Under age 15? Yes No

Country of birth of mother _____
Country of birth of father _____

6 Foreign-born Country of birth _____
Year of arrival in Canada _____ Year

Immigration status at the time of diagnosis:
1 Canadian citizen/Permanent resident
2 Refugee 3 Convention refugee
4 Refugee claimant

Temporary resident:
5 Work 6 Student 7 Visitor
8 Immigration status – Other
If other, specify: _____
9 Unknown

Diagnosis

8. Provincial/territorial case date Year | Month | Day
ICD 9 _____ ICD 10 _____

9. Chest X-Ray 1 Normal 2 Abnormal 3 Not done 9 Unknown
If abnormal → 1 Cavitory 2 Non-cavitory

Bacterial Status

10. Microscopy							11. Culture										
Negative	Positive	Not done	Unknown	Sputum	Bronchial Wash	GI Wash	Negative	Positive	Not done	Unknown	Sputum	Bronchial Wash	GI Wash	Node Biopsy	Urine	CSF	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. Case Criteria 1 Culture positive 2 Clinical diagnosis

13. If initial positive culture – Antibiotic resistance? Other (specify) _____

DRUG	Result			DRUG	Result			Other (specify)		
	Susceptible	Resistant	Not done		Susceptible	Resistant	Not done			
INH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Streptomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
EMB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Kanamycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
RMP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Capreomycin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
PZA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ofloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				Ethionamide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				PAS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				Rifabutin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				Amikacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				Moxifloxacin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
				Linezolid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			

14. Genotyping results? 1 Yes 2 No 9 Unknown Spoiligo Octal Code _____
MIRU _____ RFLP 1 Yes 2 No

Treatment Details

15. Date treatment started Year | Month | Day

16. Initial drugs prescribed (check all that apply)

<input type="checkbox"/> INH	<input type="checkbox"/> RMP	<input type="checkbox"/> Streptomycin	<input type="checkbox"/> Ethionamide	<input type="checkbox"/> Moxifloxacin
<input type="checkbox"/> EMB	<input type="checkbox"/> PZA	<input type="checkbox"/> Kanamycin	<input type="checkbox"/> PAS	<input type="checkbox"/> Linezolid
<input type="checkbox"/> Capreomycin	<input type="checkbox"/> Ofloxacin	<input type="checkbox"/> Rifabutin	<input type="checkbox"/> Amikacin	<input type="checkbox"/> Unknown

17. Death before or during treatment?
1 Yes 2 No 9 Unknown If yes, date of death Year | Month | Day
1 TB was the cause of death
2 TB contributed to death but was not the underlying cause
3 TB did not contribute to death

TB History/Case Finding/Risk Factors/Markers

18. First episode of TB disease?
1 Yes 2 No If no: Year of previous diagnosis _____
Previous diagnosis occurred in: 1 Canada 2 Other country: _____
Previous treatment completed or cured: 1 Yes 2 No 9 Unknown
If yes, and date of previous treatment: Year | Month | Day

Previous treatment with (check all antibiotics used):
 INH EMB RMP PZA
 Streptomycin Ethionamide Moxifloxacin
 Kanamycin PAS Linezolid
 Capreomycin Rifabutin
 Ofloxacin Amikacin
 Other (specify) _____
 Unknown

19. Case finding

1 <input type="checkbox"/> Symptoms compatible with site of disease	2 <input type="checkbox"/> Incidental finding
3 <input type="checkbox"/> Post-mortem	4 <input type="checkbox"/> Contact investigation
5 <input type="checkbox"/> Immigration medical surveillance	7 <input type="checkbox"/> Occupational screening
1 <input type="checkbox"/> Initial immigration medical exam done outside Canada	8 <input type="checkbox"/> Other screening
2 <input type="checkbox"/> Initial immigration medical exam done inside Canada	9 <input type="checkbox"/> Other (specify) _____
10 <input type="checkbox"/> Unknown	

20. Risk factors/Markers

HIV 1 Positive 2 Negative If positive, year of 1st positive test Year _____
If negative, year of most recent test _____

3 Test refused 4 Test not offered 5 Unknown

Contact with person with active TB in past 2 years 1 Yes 2 No 9 Unknown

Diabetes mellitus type 1 or 2 1 Yes 2 No 9 Unknown

End-stage renal disease 1 Yes 2 No 9 Unknown

Homeless (at diagnosis or within the previous 12 months) 1 Yes 2 No 9 Unknown

Lives in correctional setting at time of diagnosis 1 Yes 2 No 9 Unknown

Long-term (≥ 1 month) corticosteroid use (prednisone ≥ 15 mg/day or equivalent) 1 Yes 2 No 9 Unknown

Previous abnormal chest x-ray (fibronodular disease) 1 Yes 2 No 9 Unknown

Substance abuse (known or suspected) 1 Yes 2 No 9 Unknown

Transplant related immunosuppression 1 Yes 2 No 9 Unknown

Travel to high incidence TB country in last 2 years If yes, how long (in weeks) 1 Yes 2 No 9 Unknown

Other (specify) _____ 1 Yes 2 No 9 Unknown

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i For reporting active TB cases (new and re-treatment) and treatment outcomes for the Public Health Agency of Canada's Canadian Tuberculosis Reporting System.

Appendix C: Active Tuberculosis Case Definitions

The following case definitions are taken from the *Canadian Tuberculosis Standards, 6th Edition* (Public Health Agency of Canada, 2007):

1. **New case**—No documented evidence or adequate history of previously active tuberculosis.
2. **Re-treatment case** (prior to 2008, re-treatment cases were called "relapse cases")—Must meet one set of the following criteria:
 - Documented evidence or adequate history of previously active TB which was declared cured or treatment completed by current standards;
 - At least six months have passed since the last day of the previous treatment;ⁱ and
 - Diagnosed with a subsequent episode of TB which meets the active TB case definition.

OR

 - Documented evidence or adequate history of previously active TB which cannot be declared cured or treatment completed by current standards;
 - Inactiveⁱⁱ for six months or longer after the last day of previous treatment;ⁱ and
 - Diagnosed with a subsequent episode of TB which meets the active TB case definition.

i If less than six months have passed since the last day of previous treatment and the case was not previously reported in Canada, report as a re-treatment case. If less than six months have passed since the last day of previous treatment and the case was previously reported in Canada, do not report as a re-treatment case. Submit an additional "Treatment Outcome of New Active or Re-treatment Tuberculosis Case" form at the end of treatment.

ii Inactivity for a respiratory tuberculosis case is defined as three negative tuberculosis smears and cultures with a three-month duration of stability in serial chest radiographs or a six-month duration of stability in serial chest radiographs. Inactivity for a nonrespiratory tuberculosis case is to be documented bacteriologically, radiologically and/or clinically as appropriate to the site of disease.

Appendix D: Active Tuberculosis Case Classification

The diagnostic classification used in this report follows the *Canadian Tuberculosis Standards, 6th Edition* (Public Health Agency of Canada, 2007) and are broken down as follows:

Respiratory: This is further subdivided into three categories:

1. *Primary:* includes primary respiratory tuberculosis and tuberculous pleurisy in primary progressive tuberculosis.
2. *Pulmonary:* includes tuberculosis of the lungs and conducting airways, tuberculous fibrosis of the lung, tuberculous bronchiectasis, tuberculous pneumonia, tuberculous pneumothorax, isolated tracheal or bronchial tuberculosis, and tuberculous laryngitis.
3. *Other respiratory:* includes tuberculous pleurisy (non-primary); and tuberculosis of: intrathoracic lymph nodes, mediastinum, nasopharynx, nose (septum), and sinus (any nasal).

Nonrespiratory: This includes miliary, central nervous system, lymph and other sites.

For cases with multiple diagnoses, the placement of the case into a disease group was determined using the hierarchy below:

1. Primary respiratory TB
2. Pulmonary
3. Other respiratory TB
4. Miliary/disseminated
5. Meninges/central nervous system
6. Peripheral lymph node
7. Other sites (includes tuberculosis of intestines, peritoneum and mesenteric glands, bones and joints, genitourinary system, skin, eye, ear, thyroid, adrenal and spleen)