

# Canadian Tuberculosis Standards

7<sup>th</sup> Edition

## Chapter 1: Epidemiology of Tuberculosis in Canada



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# CHAPTER 1

## EPIDEMIOLOGY OF TUBERCULOSIS IN CANADA

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### KEY MESSAGES/POINTS

- In Canada, the overall rate and annual number of cases of tuberculosis have continued to decline.
- However, disparities are pronounced in certain population groups and geographic regions; foreign-born individuals and Aboriginal peoples in particular are disproportionately affected by TB.

### BACKGROUND

#### GLOBAL EPIDEMIOLOGY OVERVIEW

The World Health Organization (WHO) estimated that there were 8.8 million incident cases of TB worldwide in 2010, for an incidence rate of 128 cases per 100,000 population.<sup>1</sup> As a result of improvement in general living conditions and overall population health,<sup>2</sup> coupled with intensive efforts by the global Stop TB Strategy, the number of annual incident cases has been falling since 2006. Similarly, the incidence rate has been decreasing since it peaked at 141 cases per 100,000 population in 2002.<sup>3</sup> In 2010, one-eighth of incident cases were coinfecting with HIV, 82% of whom were in the African Region of the WHO.<sup>4</sup> Furthermore, there were an estimated 1.4 million people who died as a result of TB in 2010, 25% of whom were coinfecting with HIV.<sup>4</sup> The Stop-TB Partnership target of reducing mortality by 50% from 1990 to 2015 is likely to be met in all WHO regions except the African Region, but mortality rates continue to have a significant impact: nearly 10 million children were orphaned as a result of TB deaths in 2009 alone.

Of the 8.8 million estimated incident cases in 2010, 5.7 million were actually reported, for an estimated case detection rate of 65%.<sup>4</sup> Of cases detected in 2009, the treatment success rate for smear-positive cases was 87%, which is the highest success rate ever reported.<sup>4</sup> From 1995 through 2010, 46 million individuals were successfully treated, and an estimated 6.8 million deaths were averted in programs that adopted the DOTS (Directly Observed Treatment Short Course)/Stop TB Strategy.<sup>4</sup>

Multidrug-resistant (MDR) TB remains a significant challenge, 150,000 annual deaths being estimated in 2008 and 650,000 prevalent cases in 2010.<sup>4</sup> While it is estimated that 3.4% of new and 20% of retreatment cases starting treatment in 2010 had MDR-TB, only 16% of these cases were treated for the condition.<sup>1</sup> This can be attributed to the fact that less than 5% of new and previously treated TB patients were tested for MDR-TB in most countries.<sup>1,4</sup>

### SURVEILLANCE OF ACTIVE TB IN CANADA

It is a requirement of local public health authorities to report all cases of TB to their respective provincial/territorial TB program. Provincial and territorial TB programs then voluntarily submit reports of TB cases that meet the case definition for national-level surveillance to the Canadian TB Reporting System (CTBRS). The CTBRS is managed by the Public Health Agency of Canada and maintains selected non-nominal information for each case of active TB, including, but not limited to, demographic, clinical, diagnostic, treatment and outcome details.

The most recent TB reports for Canada are available at:

<http://www.phac-aspc.gc.ca/tbpc-latb/surv-eng.php>

The most recent WHO reports on TB are available at:

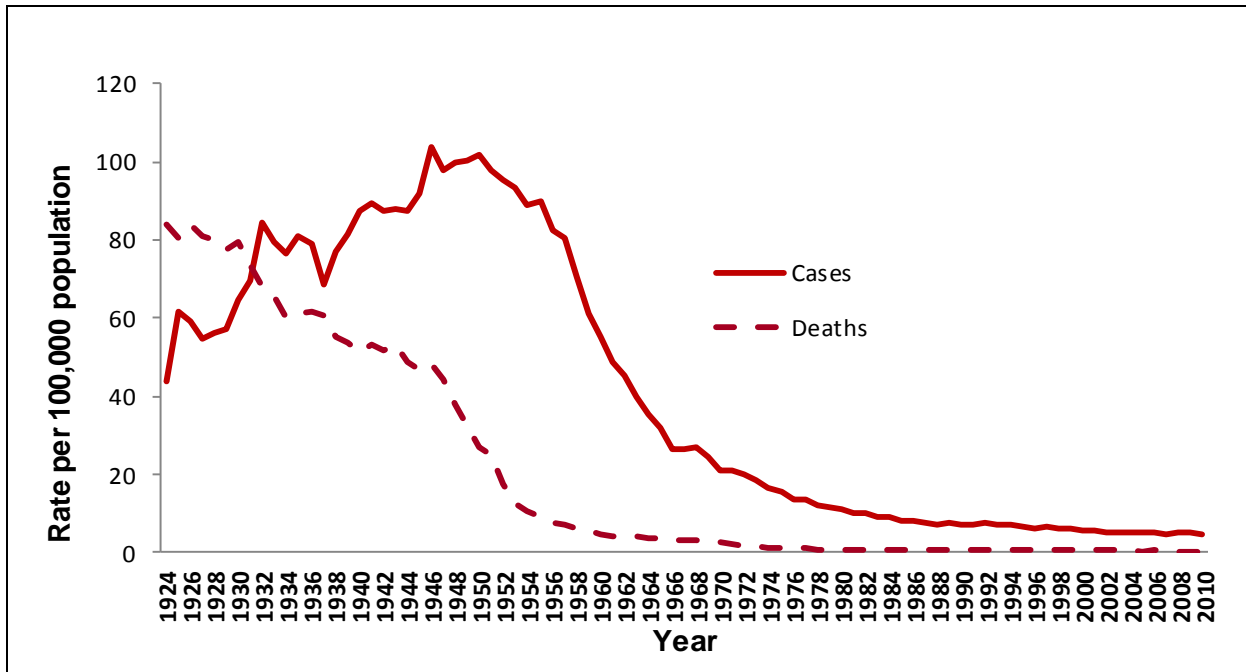
<http://www.who.int/tb/country/en/index.html>

### INCIDENCE AND MORTALITY

In the first half of the 20<sup>th</sup> century, TB was a major cause of morbidity and mortality in Canada. Historical data on the reported number of cases of TB and the number of deaths attributed to TB are available from 1924. As illustrated in Figure 1, deaths from TB appeared to outnumber new diagnoses each year during the 1920s. This may reflect incomplete reporting of all cases, or it may indicate that reported cases only reflected hospitalized cases, whereas deaths captured all terminal cases of TB whether they were hospitalized or not. Systematic reporting of TB cases was instituted on a national basis in 1933, providing a more accurate and complete record of the burden of TB in Canada through the century.

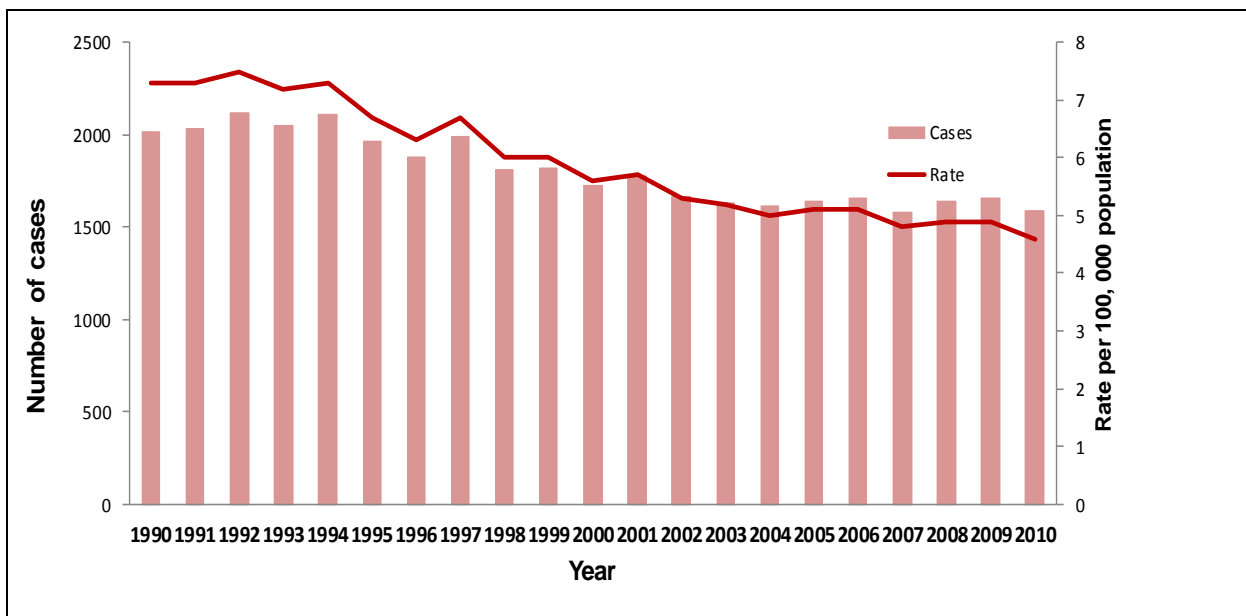
From the available reports, in 1926, 1 in 13 of all reported deaths in Canada was due to TB, a number slightly higher than the number of deaths reported for cancer.<sup>5</sup> As a result of improved living conditions and isolation of some infectious cases in sanatoria, incidence and mortality rates began to fall in subsequent years, and rates further declined with the introduction of effective antibiotic treatment in the mid-20<sup>th</sup> century (Figure 1).

Figure 1. Reported tuberculosis incidence and mortality rates in Canada, 1924-2010



Over the past two decades, both the number of reported TB cases and the overall Canadian incidence rate have continued to decline, albeit much more gradually than the drop observed between 1950 and 1990. In 1990, the rate was 7.0 per 100,000 population (Figure 2), which fell to an all-time low in 2010 of 4.6 per 100,000 population (1,577 cases reported for 2010).

Figure 2. Reported TB cases and incidence rates in Canada, 1990-2010

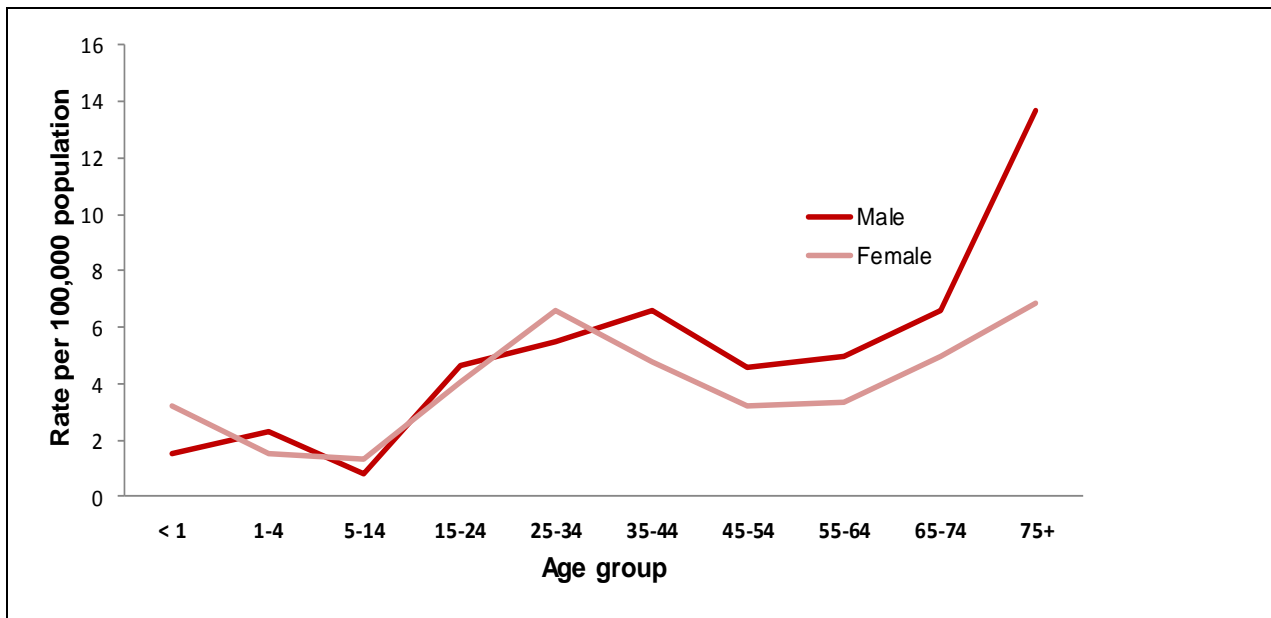


## AGE AND SEX DISTRIBUTION

The reported TB incidence rate has always been higher among males than females in Canada; however, the differential has decreased over time. In 2010, the male to female ratio was 1:0.8.

Between 2000 and 2010, individuals in the 25-34 and 35-44 year age groups accounted for the largest number of cases relative to other age groups. However, the highest age-specific rate was found in the 75+ age group. For 2010, 35% of the cases were between the ages of 25 and 44, whereas the highest age-specific rate, at 9.6 per 100,000, occurred among those aged 75 years or older (Figure 3). Overall, by age and sex, males 75 years of age and over had the highest rate, at 13.6 per 100,000 population.

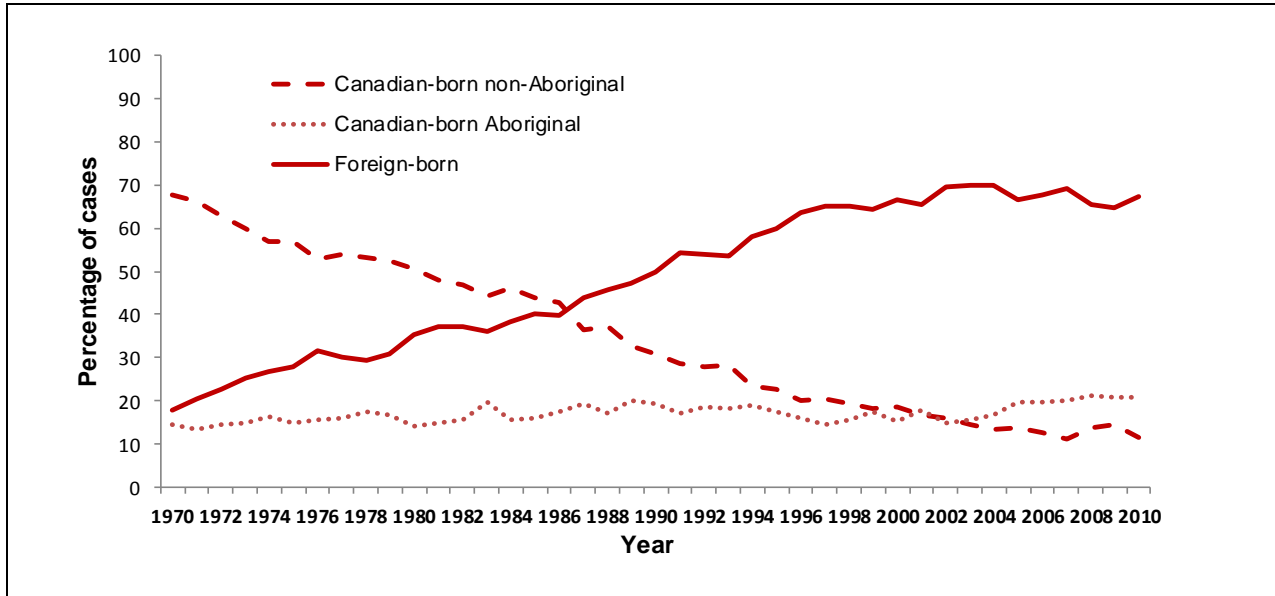
**Figure 3. Reported TB incidence rate by sex and age group in Canada, 2010**



## DISTRIBUTION BY POPULATION GROUP AND PROVINCE/TERRITORY

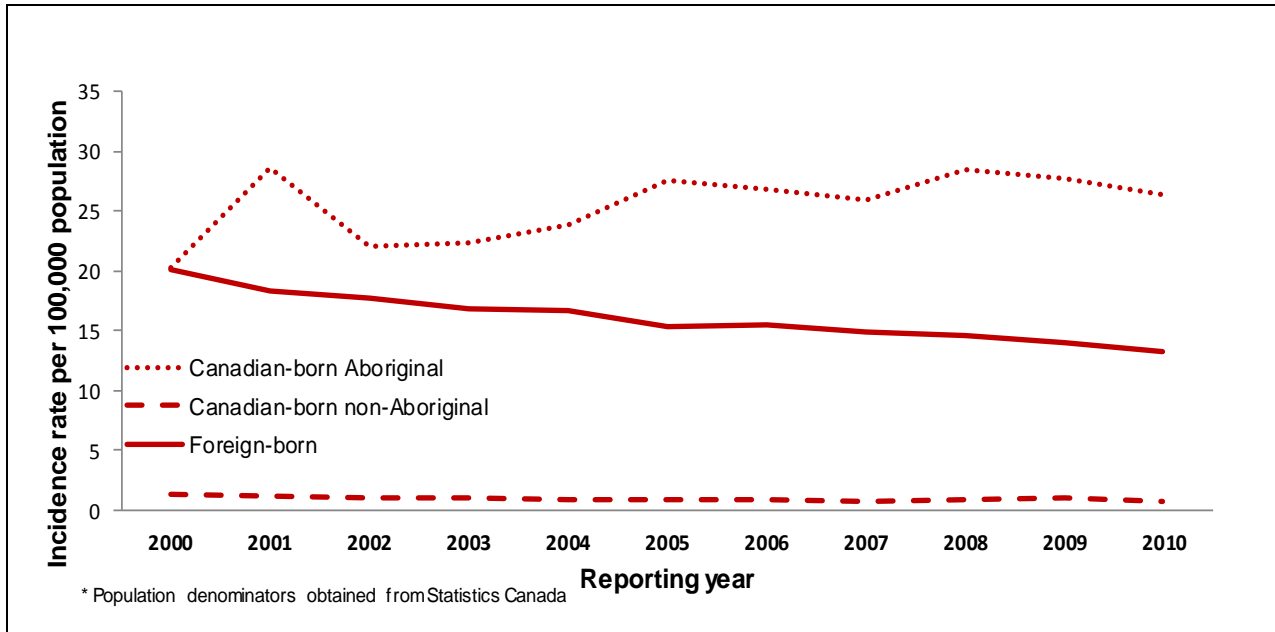
Although the overall rate in Canada continues to decline, the TB burden is not shared equally.<sup>6</sup> In particular, Canadian-born Aboriginal peoples and foreign-born individuals are disproportionately affected (Figure 4). From 1970 to 2010, the proportion of active TB cases in the Canadian-born non-Aboriginal population decreased significantly, from 67.8% to 11.8%. During the same period, the proportion among foreign-born individuals increased significantly, from 17.7% to 67.0%, and the proportion among Canadian-born Aboriginal peoples increased from 14.7% to 21.2%.

**Figure 4. Percentage of reported TB cases by population group in Canada, 1970-2010**



Cases among Canadian-born non-Aboriginal people continue to drop. In 2010, this population group had an incidence rate of 0.7 per 100,000 population (Figure 5).

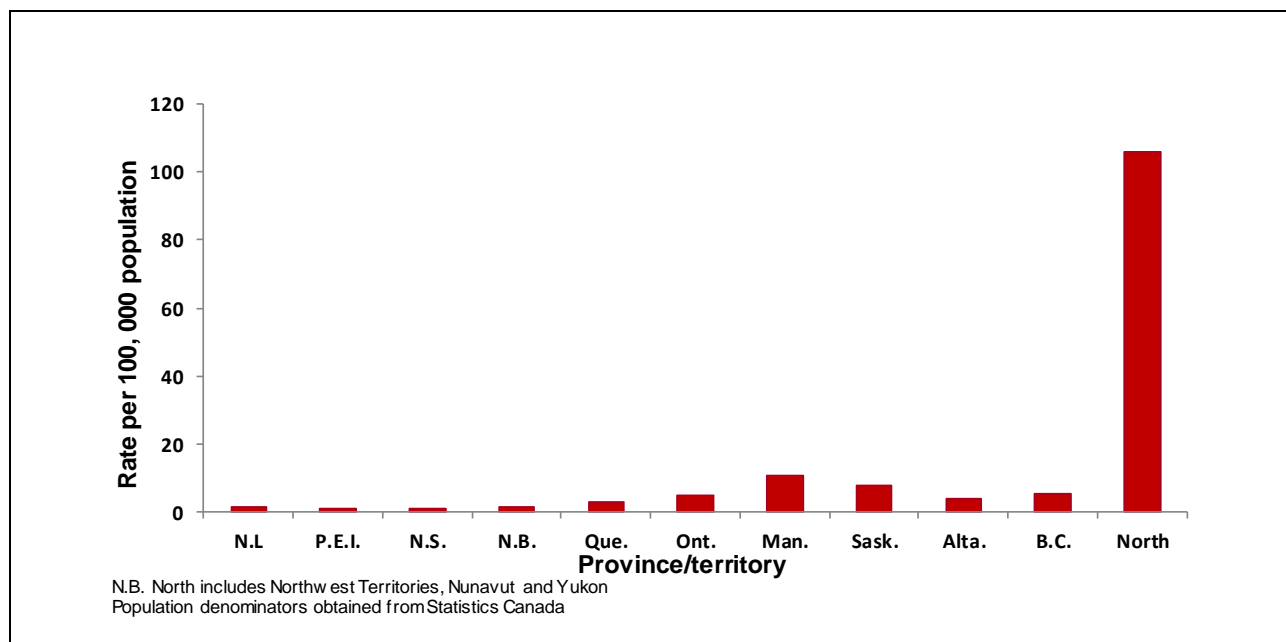
**Figure 5. Reported TB incidence rate by population group in Canada, 2000-2010\***





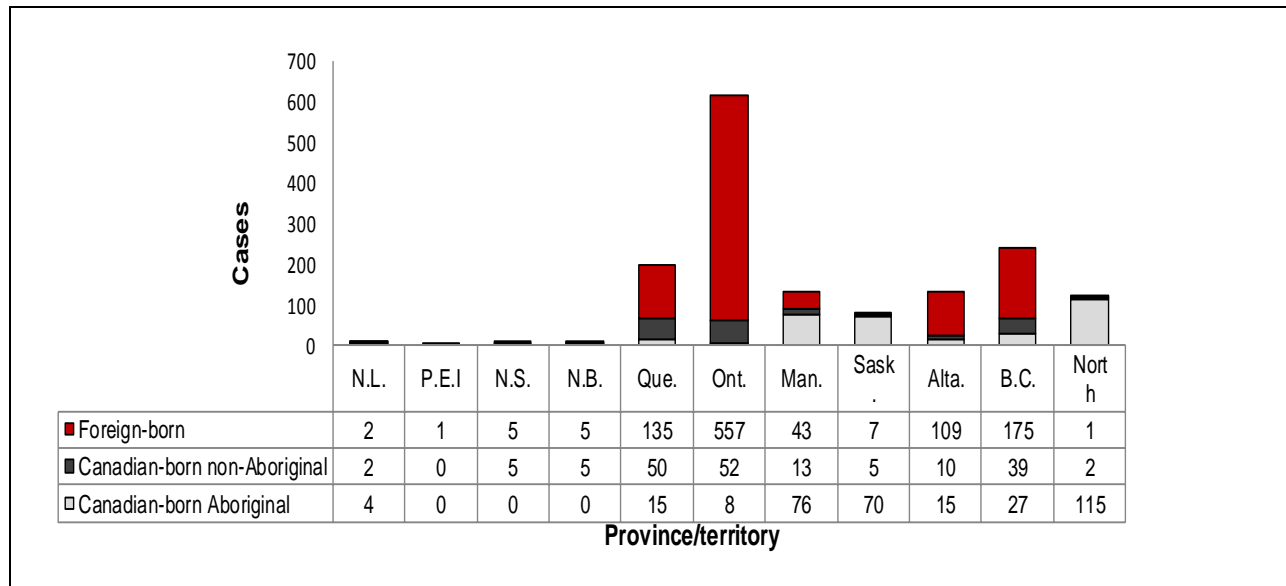
In addition to differential incidence rates by population group, TB case patterns also reveal pronounced disparities based on geographic region within Canada. In 2010, incidence rates ranged from a low of 0.7 per 100,000 population in Prince Edward Island to a high of 106.1 per 100,000 population in Northern territories combined (Figure 6). The three most populous provinces in Canada, namely British Columbia, Ontario and Quebec, with 75% of the population, accounted for 69% of all TB cases in 2010.

**Figure 6. Reported TB incidence rates by province/territory, Canada, 2010**



Distribution of TB cases by population group also varies significantly by jurisdiction. As depicted in the graphs below (Figure 7), the majority of cases in Alberta, British Columbia, Ontario and Quebec occurred in foreign-born individuals, whereas in Manitoba, Saskatchewan and the Northern territories most cases occurred largely in Aboriginal people. These varied geographic patterns in part reflect differences in the populations among jurisdictions: there are more foreign-born individuals in Ontario, Quebec, British Columbia and Alberta in particular, whereas Aboriginal communities make up a higher proportion of the general population in the prairies and in the North.

**Figure 7. Number of reported TB cases by population group and province/territory in Canada, 2010\***



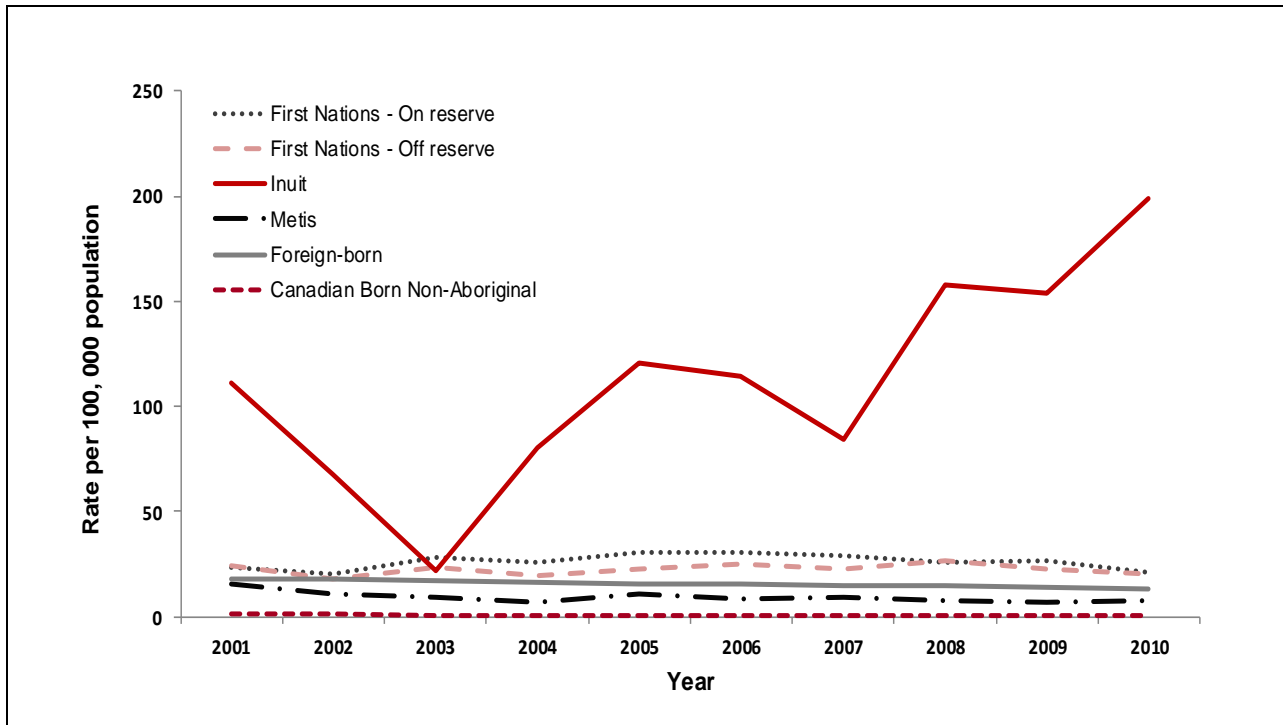
\*Population denominators obtained from Statistics Canada

## TUBERCULOSIS IN CANADIAN-BORN ABORIGINAL PEOPLES

While the greatest number of cases is reported among foreign-born individuals, the reported incidence rate has consistently been highest among Canadian-born Aboriginal individuals over the past decade (Figure 8).

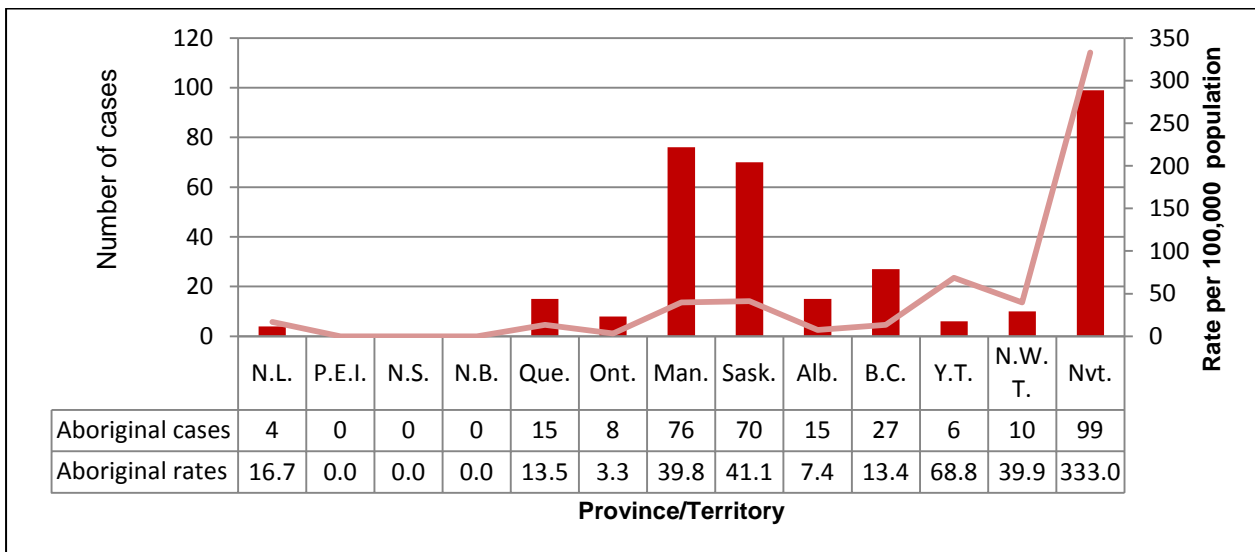
“The *Constitution Act* of 1982 recognizes three major groups of Aboriginal Peoples in Canada: Indian (more commonly referred to as First Nations), Inuit and Métis. First Nations (on- and off-reserve) and Inuit account for the vast majority of incident cases of TB in Aboriginal peoples in Canada.”<sup>7</sup> From 2001 to 2010, the rate of TB was highly variable in the Inuit population and peaked in 2010 at approximately 200 cases per 100,000 population. In contrast, the rates were relatively stable for First Nations (on- and off-reserve) and Métis (Figure 8).

**Figure 8. Reported TB disease incidence rates in Canada by population group, 2001-2010**

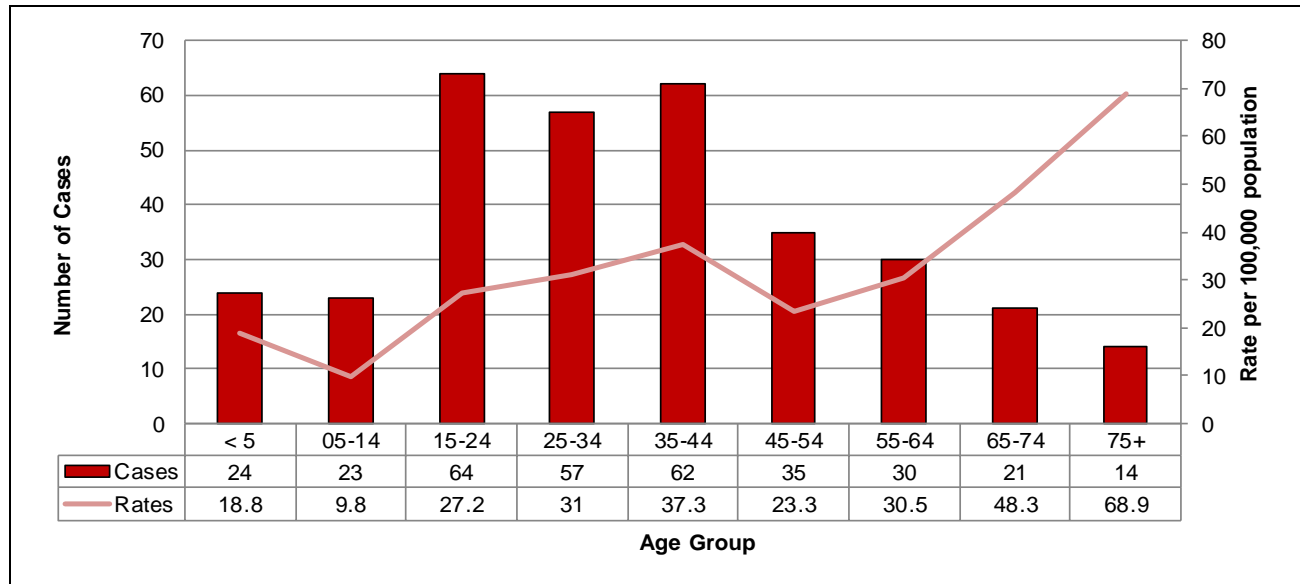


The burden of TB disease among Aboriginal populations varies by jurisdiction. In terms of both overall cases as well as rates, TB cases in Aboriginal individuals in 2010 were significantly higher in Nunavut, Saskatchewan and Manitoba (Figure 9).

**Figure 9. Distribution of active TB cases and incidence rates for Aboriginal populations, 2010**



**Figure 10. TB cases and incidence rates among Canadian-born Aboriginal populations by age group, 2010**

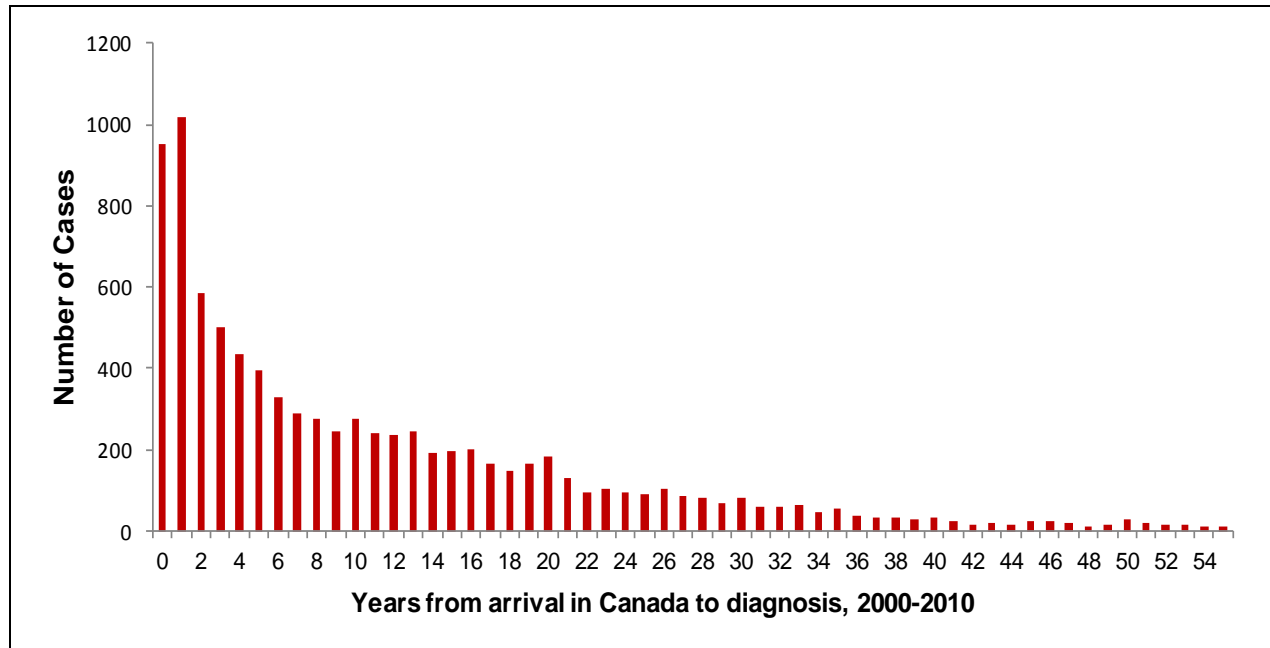


The majority of all cases in Aboriginal individuals were reported in adolescents and young adults in the 15-44 year age groups (Figure 10). A substantial number of cases in Canadian-born Aboriginal individuals were reported in children, and the incidence rate was much higher than that seen in other Canadian populations. This suggests ongoing transmission in some Aboriginal communities.

## TUBERCULOSIS IN THE FOREIGN-BORN POPULATION

While the proportion of all TB cases in Canada among the foreign-born has increased significantly in the past 40 years, the annual number of reported cases has not changed substantially, averaging 1,000 cases per year. Over the past 11 years, however, the incidence rate has declined slowly but steadily, reaching 13.3 per 100,000 in 2010 (Figure 8). Of the foreign-born TB cases reported in Canada from 2000 to 2010 for which the date of arrival was known, 11% were reported within the first year of arrival, 22% within the second year of arrival and 44% within 5 years (Figure 11).

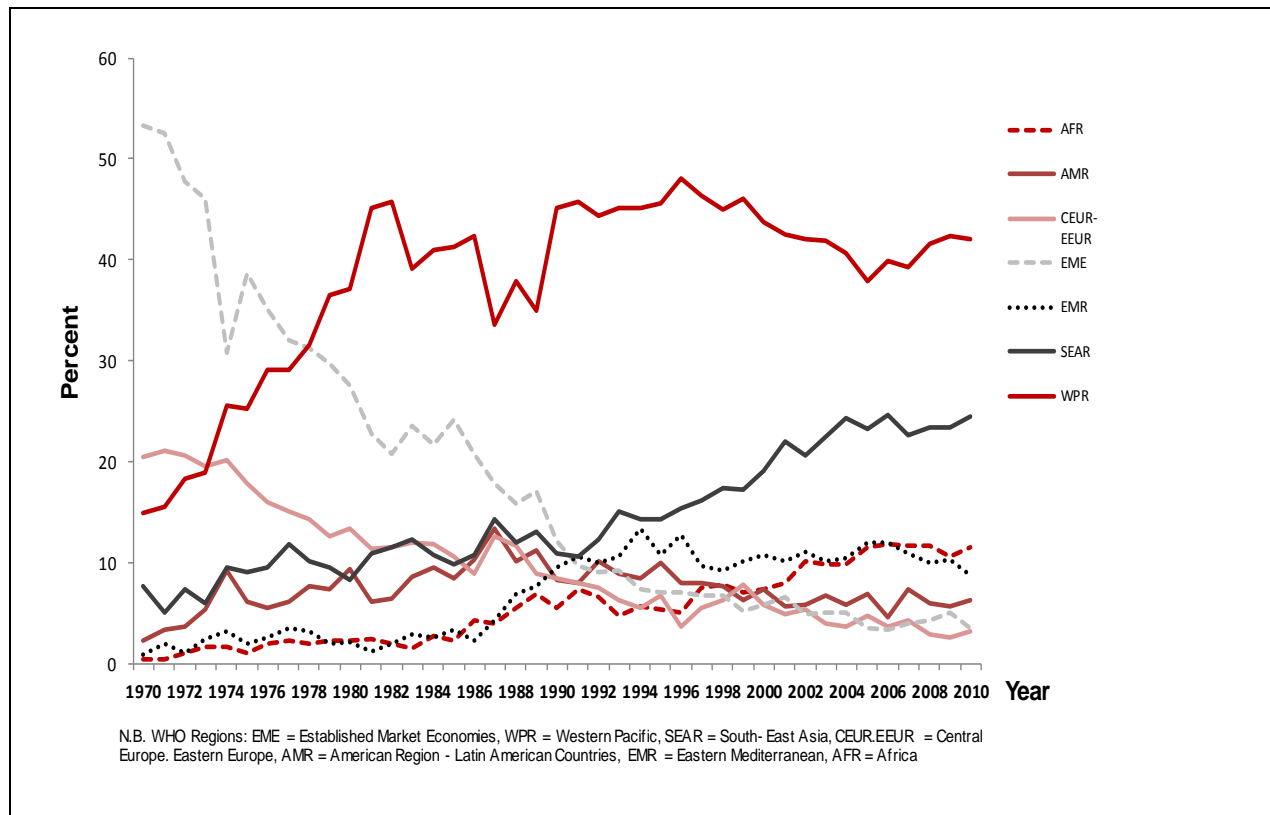
**Figure 11. Reported foreign-born TB cases in Canada, 2000-2010: time from arrival in Canada to diagnosis, in years**



Each foreign-born TB case was assigned to a WHO TB epidemiologic region<sup>8</sup> on the basis of the individual's country of birth. (These regions differ from the WHO's standard administrative regions.) Figure 12 depicts changes over time in the distribution of the region of origin of all foreign-born TB cases reported in Canada. During the period 1970 to 2010 the proportion of cases from established market economies<sup>§</sup> decreased, whereas the proportion of cases reported from the Western Pacific and South-East Asia regions increased.

<sup>§</sup> "Established market economies" is defined by the WHO as including the following countries: Andorra, Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Israel, Italy, Japan, Luxembourg, Malta, Monaco, Netherlands, New Zealand, Norway, Portugal, San Marino, Singapore, Spain, Sweden, Switzerland, United Kingdom and the USA.

**Figure 12. Percentage of reported foreign-born TB cases in Canada by WHO TB epidemiologic region, 1970-2010**



Changing immigration patterns account for some of the changes to this distribution. In addition to increased migration to Canada of people from African, Asian and Pacific regions, these regions also have the highest TB incidence rates (Table 1), which results in a corresponding shift in Canada's distribution. Rates within Canada are calculated as the number of cases in Canada among people born in a certain region divided by the total population in Canada born in that region. Rates within Canada are significantly lower across people from all WHO regions compared with respective rates within the regions. People in Canada who emigrated from the two African Regions\*\* (high and low HIV prevalence), as well as the South-East Asia Region and the Western Pacific Region, show the highest rates, mirroring patterns seen within the regions themselves. Almost one-half of TB cases typically occur within 5 years of arrival in Canada.

\*\* A list of countries included in the WHO African Region can be found at: <http://www.afro.who.int/en/countries.html>.

**Table 1. Comparison of reported foreign-born TB incidence rate in Canada by WHO TB epidemiologic region of birth (per 100,000 population) with WHO estimated TB incidence rate in the respective region**

WHO region*	Reported rate in Canada, 2010	WHO estimated TB incidence rate in regions, 2010**
Africa, High HIV Prevalence	37.4	306.3
Africa, Low HIV Prevalence	21.5	194.4
American Region – Latin American Countries	7.0	42.9
Eastern Europe	4.9	93.4
Eastern Mediterranean	11.8	109.0
Established Market Economies and Central Europe	1.9	9.8
South-East Asia	30.3	194.1
Western Pacific	22.8	98.4
Overall	13.3	128.2

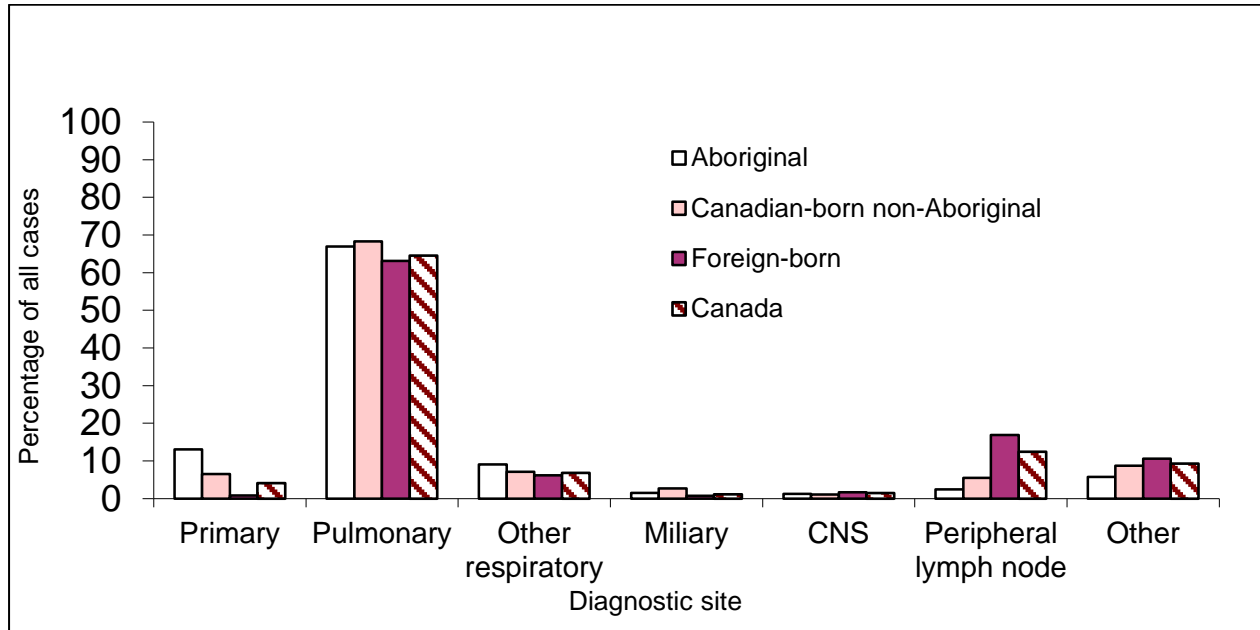
\*Source: The Stop TB Partnership and World Health Organization. Global Plan to Stop TB 2006-2015. Geneva, World Health Organization, 2006 (WHO/HTM/STB/2006.35).

\*\*Source: Global Tuberculosis Control: Surveillance, Planning, Financing. WHO Report 2011. Geneva, World Health Organization (WHO/HTM/TB/2011.16).

## DISEASE SITE

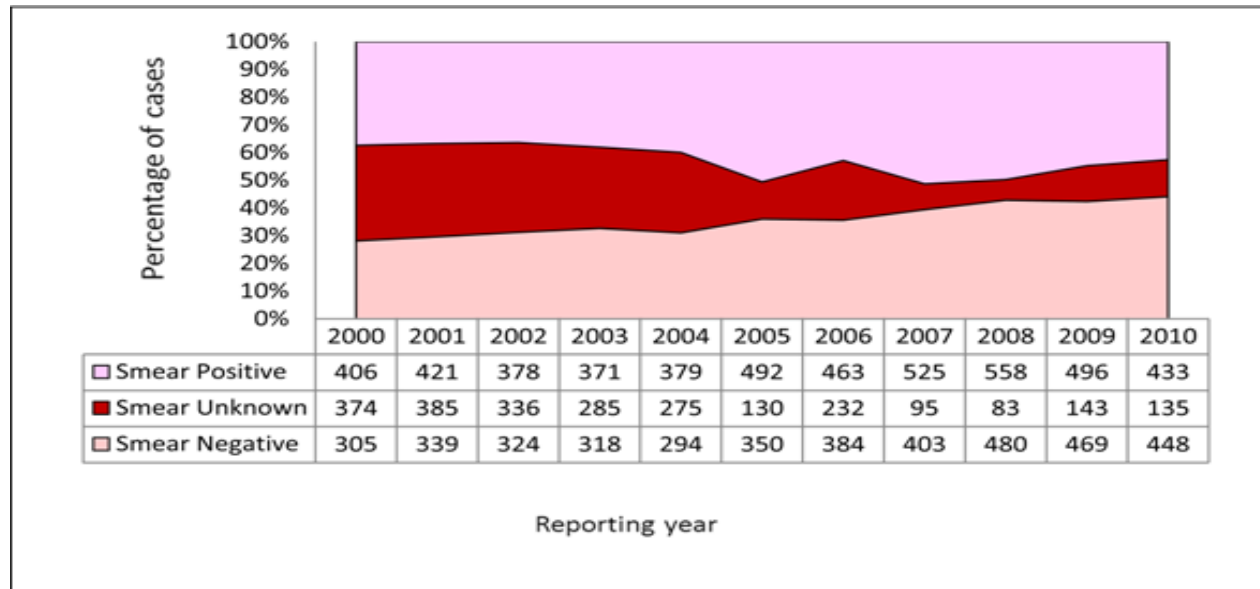
The majority of reported TB cases in 2010 (64%) were diagnosed as pulmonary TB. Peripheral lymph node was the second most commonly reported site, at nearly 13% of cases in the same year. Slight differences were observed when comparing the three origin groups. A greater proportion of cases in Aboriginal individuals were due to primary disease, and a greater proportion of foreign-born individuals received a diagnosis of peripheral lymph node TB (Figure 13).

**Figure 13. Percentage of reported cases by diagnostic site and origin in Canada, 2010**



The majority of TB cases in Canada are diagnosed by culture confirmation. In 2010, 1,261 (80%) were culture-confirmed. Figure 14 presents data on the proportion of pulmonary TB cases that were smear-positive (indicating a higher level of infectivity) and smear-negative, and the proportion of cases for which laboratory data were not reported. Between 2000 and 2010, an average of 41% of all reported pulmonary TB cases were smear-positive, 34% were reported as smear-negative, and for 25% laboratory microscopy results were not reported.

**Figure 14. Percentage of pulmonary cases by sputum smear microscopy result: Canada, 2000-2010**

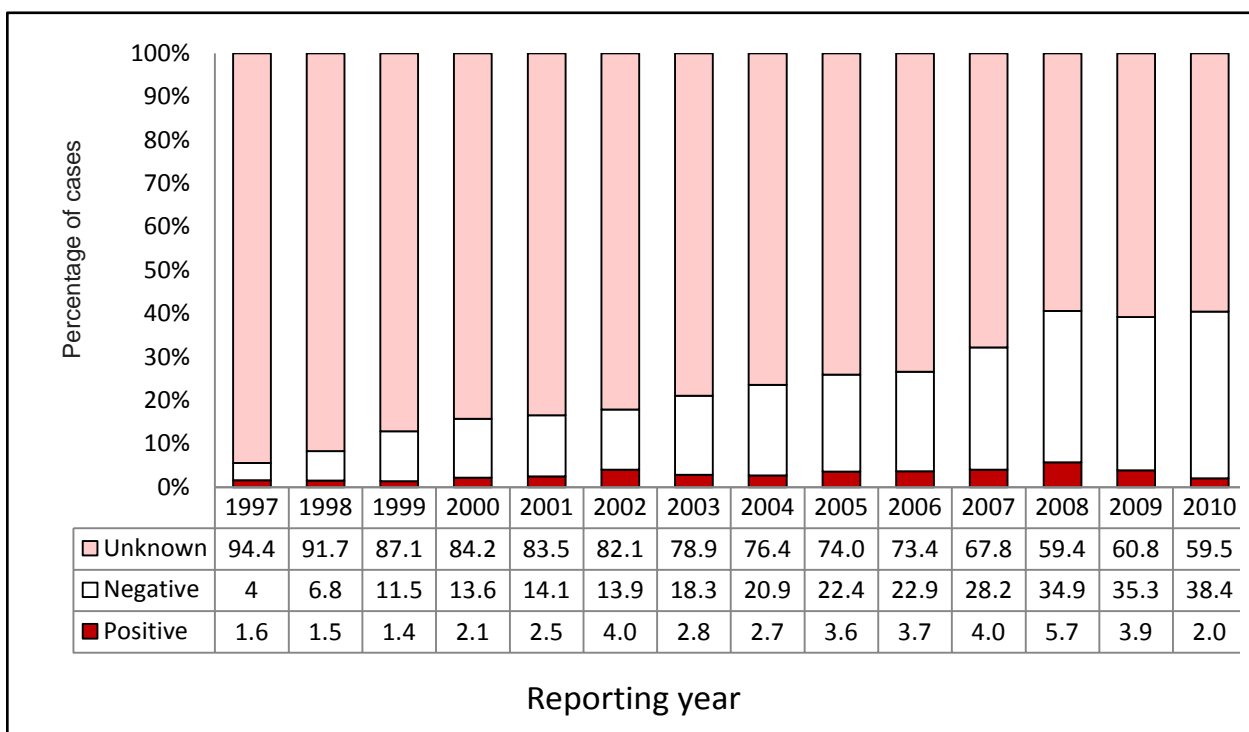




## TB-HIV COINFECTION

Canada's national HIV/AIDS and TB surveillance systems have their own limitations regarding their ability to estimate TB-HIV coinfection. However, information on HIV status is increasingly included in TB cases reported to the CTBRS. In 2000, HIV status was reported for only 16% of TB cases, but that figure had increased to 40% in 2010 (Figure 15). Among cases for which HIV status was reported, the coinfection rate in 2010 was 5%. This percentage is possibly biased towards HIV testing among those individuals with known risk factors for HIV infection. In the unlikely event that these were the only coinfecting cases, the overall coinfection rate was 2%. The true coinfection rate probably lies somewhere in the 2%-5% range. The WHO has estimated the Canadian rate in 2007 to be 5.7%.<sup>9</sup> Underreporting imposes serious limitations on the interpretation of HIV-TB coinfection in Canada.

**Figure 15. Percentage of reported TB cases by HIV status, Canada, 1997-2010**



## DRUG RESISTANCE

Data and trends on TB drug resistance in Canada are detailed in Chapter 8, Drug-Resistant Tuberculosis.

## TREATMENT AND CASE OUTCOMES

Of 1,658 cases of active TB disease diagnosed in 2009, 1,599 (96%) had a treatment outcome. Of these, 1,399 (87%) were deemed cured or treatment completed, 129 (8%) died before or during treatment, and 31 (2%) transferred out of Canada at some point during their treatment with final outcome unknown. Of the remaining 3% of cases reporting an outcome, 18 absconded and were lost to follow-up, 1 had a treatment failure, and treatment was discontinued for 1 case because of adverse reactions to the medications. For the 4% of the total number of reported cases in 2009 for which treatment was not completed, treatment was ongoing in 42 cases and was unknown at the time of writing in the remaining 17 cases.

Drug regimen was reported for 1,249 reported cases in 2009. Of these, 89% were reported to have received three or more drugs. Fifty-nine percent of the individuals were reported to have received directly observed therapy (DOT), 32% self-administered therapy and 8% unspecified or other.

Between 2000 and 2009, 8.6% of diagnosed cases were reported to have died before or during treatment. TB was reported to have been the cause of death in 18% of these cases and contributed to but was not the underlying cause of death in an additional 41% of the cases. TB was reported not to have contributed to death but was an incidental finding in 28% of cases. For 12% of cases, the cause of death was not reported. However, it is important to note that identification of the precise cause of death can be inaccurate, and the WHO recommends that the most important indicator is death (of any cause) during treatment.

Between 2000 and 2009, of those individuals with a diagnosis of active TB disease, 1,429 were reported to have died before or during treatment. Males accounted for 63% of these deaths and had a median age of 73 years at the time of death. Females accounted for 37% and had a median age of 74 years at the time of death. Ten percent had had a previous episode of TB disease. HIV status was known for 17% of all deaths during this period; of these, 39% were HIV-positive. Of the 1,429 TB-attributed deaths reported, 170 (12%) were found to have TB on post-mortem examination.

## SUMMARY OF SALIENT TRENDS

Both the overall rate and annual number of reported cases of TB continue to slowly decline in Canada. Nevertheless, pronounced disparities are observed in certain population groups and in several geographic regions. The high proportion of cases in foreign-born individuals presents unique challenges, in particular because of changing demographic patterns. Also of concern are the continued high rates observed among Aboriginal peoples born in Canada, particularly in Inuit communities.

## CONCLUSIONS

TB partners in Canada aim to reduce the national TB incidence rate, and in particular to reduce the burden of TB disease among Canadian-born Aboriginal peoples and the foreign-born. In order to achieve reduction in these key populations, prevention and control interventions should target those determinants of health that contribute to the disease. The public health community has long recognized that economic, social, cultural and environmental factors play a role in TB infection and disease. As detailed in this chapter, certain Canadian populations experience greater risk of TB than others. In addition to foreign-born and Aboriginal communities in Canada, those who are incarcerated or homeless also show higher rates, as outlined in subsequent

chapters of the *Standards*. There are numerous determinants of health that relate to TB, which include education, employment, physical environment, social support, access to health care, personal health practices and culture.<sup>7</sup> Addressing the underlying determinants of health is universally recognized by TB experts as being an integral component of the response, both in Canada as well as globally.<sup>10,11</sup>

■ ■ ■

## REFERENCES

1. World Health Organization. WHO Report 2011 – Global Tuberculosis Control. Geneva: World Health Organization, 2011. WHO/HTM/TB/2011.16.
2. Oxlade O, Schwartzman K, Behr MA, Benedetti A, Pai M, Heymann J, et al. Global tuberculosis trends: a reflection of changes in tuberculosis control or in population health? *Int J Tuberc Lung Dis* 2009;13(10):1238-46. Epub 2009/10/02.
3. World Health Organization & Stop TB Partnership. The Stop TB Strategy – building on and enhancing DOTS to meet the TB-related Millennium Development Goals. Geneva: World Health Organization, 2006. WHO/HTM/TB/2006.368.
4. World Health Organization. 2011/2012 Tuberculosis global facts. Geneva: World Health Organization, 2012.
5. Brancker A, Enarson DA, Grzybowski S, Hershfield ES, Jeanes CW. A statistical chronicle of tuberculosis in Canada: Part I. From the era of sanatorium treatment to the present. *Health Rep* 1992;4(2):103-23. Epub 1992/01/01.
6. Jensen M, Lau A, Langlois-Klassen D, Boffa J, Manfreda J, Long R. A population-based study of tuberculosis epidemiology and innovative service delivery in Canada. *Int J Tuberc Lung Dis* 2012;16(1):43-9, i. Epub 2012/01/13. doi: 10.5588/ijtld.11.0374.
7. Pan-Canadian Public Health Network. Guidance for tuberculosis prevention and control programs in Canada. Ottawa: Government of Canada, 2013. <http://www.phn-rsp.ca/pubs/index-eng.php>
8. World Health Organization & Stop TB Partnership. The global plan to stop TB 2006-2015 – actions for life – towards a world free of tuberculosis. Geneva: World Health Organization, 2006. WHO/HTM/STB/2006.35.
9. World Health Organization. Global tuberculosis control, 2009: epidemiology, strategy, financing. Geneva: World Health Organization, 2009. WHO/HTM/TB/2009.411.
10. Rasanathan K, Sivasankara Kurup A, Jaramillo E, Lonroth K. The social determinants of health: key to global tuberculosis control. *Int J Tuberc Lung Dis* 2011;15(Suppl 2):S30-6. Epub 2011/07/16. doi: 10.5588/ijtld.10.0691.
11. Lonroth K, Raviglione M. Global epidemiology of tuberculosis: prospects for control. *Semin Respir Crit Care Med* 2008;29(5):481-91. Epub 2008/09/24. doi: 10.1055/s-0028-1085700.