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Canada

Tuberculosis Surveillance in Canada

2010 – 2020 Summary Report

TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP, INNOVATION AND ACTION IN PUBLIC HEALTH.

— Public Health Agency of Canada

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Surveillance de la Tuberculose au Canada : Rapport Sommaire de 2010-2020

Authors: Aboubakar Mounchili, Reshel Perera, Carly Henry, Hafid Soualhine, Meenu Sharma, Catherine Yoshida, Melissa Rabb, and Maureen Carew

To obtain additional information, please contact:

Public Health Agency of Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: publications-publications@hc-sc.gc.ca

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INTRODUCTION

The Public Health Agency of Canada (PHAC) and Health Canada are collaborating with provincial and territorial governments and other federal departments and agencies to reduce the incidence of active Tuberculosis (TB) in Canada to no more than one case per 100,000 population as per *the End TB Strategy* of the World Health Organization (WHO) target (1). This report provides the descriptive epidemiology of active TB in Canada from 2010 to 2020, with a specific focus on data from 2020, the incidence of drug-resistant TB disease, and treatment outcomes, including the success rate of TB treatment from 2009 to 2019.

METHODS

Data Collection

PHAC, in collaboration with provincial and territorial public health authorities, monitors TB in Canada through the Canadian Tuberculosis Reporting System (CTBRS), a national case-based surveillance system that collects and maintains non-nominal data on persons diagnosed with active TB. Active TB is a condition in which *Mycobacterium tuberculosis* infects an individual, usually in the lungs although other organs or systems may be involved. For the purpose of surveillance, a case of active TB is defined as an individual in whom one or a combination of the following has been established:

- signs and symptoms or diagnostic imaging compatible with active TB,
- pathological or post-mortem evidence of active TB, and/or
- a favourable response to anti-TB drug treatment.

Cases that meet this definition are submitted to the CTBRS by the respective provincial and territorial public health authorities on a voluntary basis. Information is additionally collected for the following variables:

- diagnostic classification based on the disease site (respiratory or non-respiratory),
- demographic data (age, sex, ethnicity, country of birth, and place of residence),
- clinical information (medical co-morbidity: HIV, diabetes, end-stage renal disease, abnormal chest X-ray, transplant-related immunosuppression, and corticosteroid use),
- selected social determinants of health (e.g. housing and substance use),
- other potential risk factors (e.g. contact with active TB and travel history to a high burden TB country, history of incarceration, etc.).

Active TB is classified as either respiratory or non-respiratory. Respiratory TB includes infection of the lungs and conducting airways (pulmonary), intrathoracic or mediastinal lymph nodes, larynx, nasopharynx, nose or sinuses (2). Non-respiratory TB, also referred to as extra-pulmonary TB, includes all other disease sites (the peripheral lymph nodes, central nervous system and meninges, intestines, peritoneum and mesenteric glands, bones and joints, genito-urinary system, miliary, eyes, etc.). Pulmonary TB is the most common form of respiratory TB and includes

tuberculous fibrosis of the lung, tuberculous bronchiectasis, tuberculous pneumonia and tuberculous pneumothorax, isolated tracheal or bronchial TB, and tuberculous laryngitis (2).

Due to the time period required for TB treatment, data on the success of treatment and treatment outcomes are submitted to the CTBRS 12-18 months following the submission of the initial case report. When treatment is still ongoing at the time of data submission, the reporting jurisdiction submits an interim report followed by subsequent annual updates until the case file is resolved or closed. Updated data from previous years are always reflected in the most current surveillance report. The surveillance definition of treatment success includes cured (i.e., culture-negative samples were taken at the end of treatment) or completion of the full-prescribed course of TB treatment.

Antimicrobial resistance data included in this report were captured through a different component of PHAC TB surveillance using the Canadian Tuberculosis Laboratory Surveillance System (CTBLSS), which monitors TB drug-resistance among active TB cases across Canada annually. The following types of TB drug-resistance are monitored:

1. Mono-resistance, defined as resistance to one first-line anti-TB drug only (isoniazid, rifampin, ethambutol or pyrazinamide);
2. Poly-resistance, defined as resistance to more than one first-line anti-TB drug, not including the combination of isoniazid and rifampin;
3. Multidrug-resistance, which is the resistance to isoniazid and rifampin with or without resistance to other anti-TB drugs; and
4. Extensive drug-resistance, defined as resistance to first-line agents (isoniazid and rifampicin), AND any fluoroquinolone, AND to one or more second-line injectable drug (amikacin, kanamycin, or capreomycin).

Together with basic non-nominal demographic data (sex, age and place of residence), the results of culture-based, phenotypic drug susceptibility testing of isolates from active TB cases are submitted voluntarily to the CTBLSS by provincial TB laboratories every year. The present report covers the 2010-2020 time period.

Data Analysis

Incidence rates of active TB in this report were calculated as cases per 100,000 population. Denominator data used to calculate these rates came from multiple sources. Canadian population data were based on midyear estimates of the Canadian population from Statistics Canada (unpublished data). For the foreign-born, data were obtained from population projections based on the 2016 Canadian Census (3). Estimates of the population of Indigenous groups, namely First Nations, Métis and Inuit, came from the National Household Survey (4).

Data received from the provinces and territories were maintained according to PHAC's Directive for the Collection, Use and Dissemination of Information Relating to Public Health. Data were cleaned and analyzed using SAS™ Enterprise Guide and Microsoft™ Excel 2016. No statistical procedures were used for comparative analyses, nor were any statistical techniques applied to account for missing data. It should be noted that British Columbia has not submitted information on Indigenous status of cases since 2016; therefore, cases from British Columbia are identified as either Canadian or foreign-born from 2016 onwards.

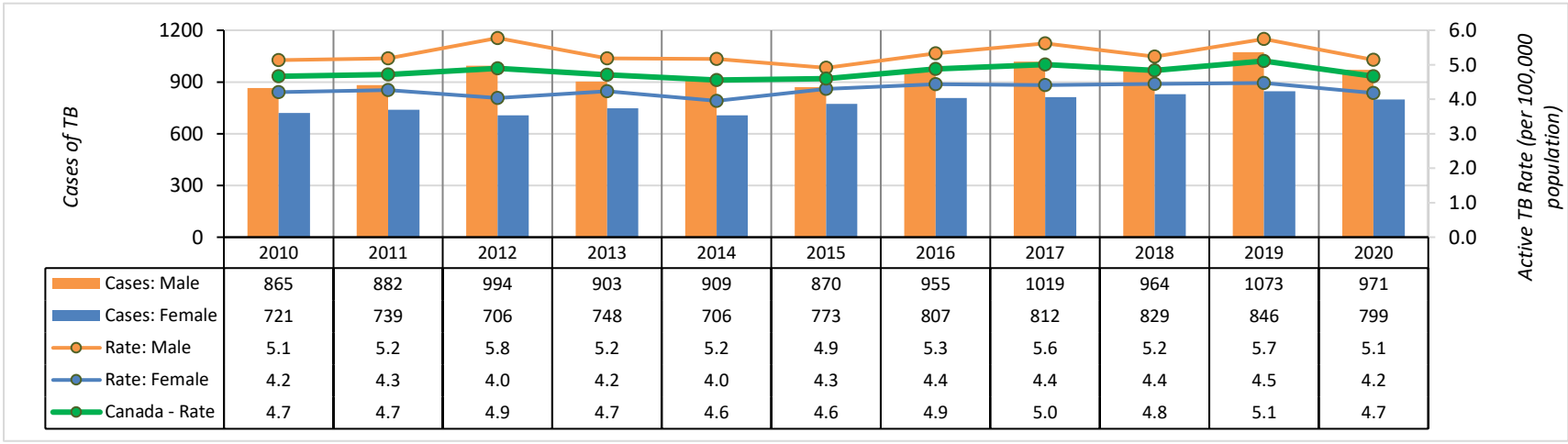
To calculate the true treatment success rate (percentage), deaths unrelated to TB and cases lost to follow-up were removed from the denominator, and the numerator was the reported number of active TB cases cured or who completed treatment.

RESULTS

Age and Sex

The incidence rate of active TB in Canada in 2020 was 4.7 cases per 100,000 population, with males (5.1 cases per 100,000 population) recording a higher rate compared with females (4.2 cases per 100,000 population **Figure 1**). These rates minimally changed over the 2010-2020 period. The overall rate fluctuated within an interval with a minimum of 4.6 per 100,000 population to a maximum of 5.1; whereas the corresponding intervals (per 100,000) for males and females were [5.1, 5.8] and [4.0, 4.5], respectively (**Figure 1**).

Figure 1: Reported number and rate (per 100,000 population) of incident active TB in Canada, CTBRS: 2010-2020[1]



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cases: Male	865	882	994	903	909	870	955	1019	964	1073	971
Cases: Female	721	739	706	748	706	773	807	812	829	846	799
Rate: Male	5.1	5.2	5.8	5.2	5.2	4.9	5.3	5.6	5.2	5.7	5.1
Rate: Female	4.2	4.3	4.0	4.2	4.0	4.3	4.4	4.4	4.4	4.5	4.2
Canada - Rate	4.7	4.7	4.9	4.7	4.6	4.6	4.9	5.0	4.8	5.1	4.7

[1] In 2020, two cases did not specify sex; in 2019, two cases did not specify sex; in 2018 one case did not specify sex

The proportion of active TB cases occurring by age group has changed minimally over the past decade (**Table 1**). In 2020, the overwhelming majority of cases (1,705; 96.2%) occurred in individuals fifteen years of age or older, with the highest proportion of cases (n=330; 18.6%) reported among persons aged 25-34 years of age (**Table 1**). In the same year, individuals aged 75 years and older had the highest rate of active TB (8.0 cases per 100,000 population; **Figures 2_A & 2_B**) with more pronounced gender differences: 6.0 cases per 100,000 in females and 10.7 cases per 100,000 in males (**Figure 3**).

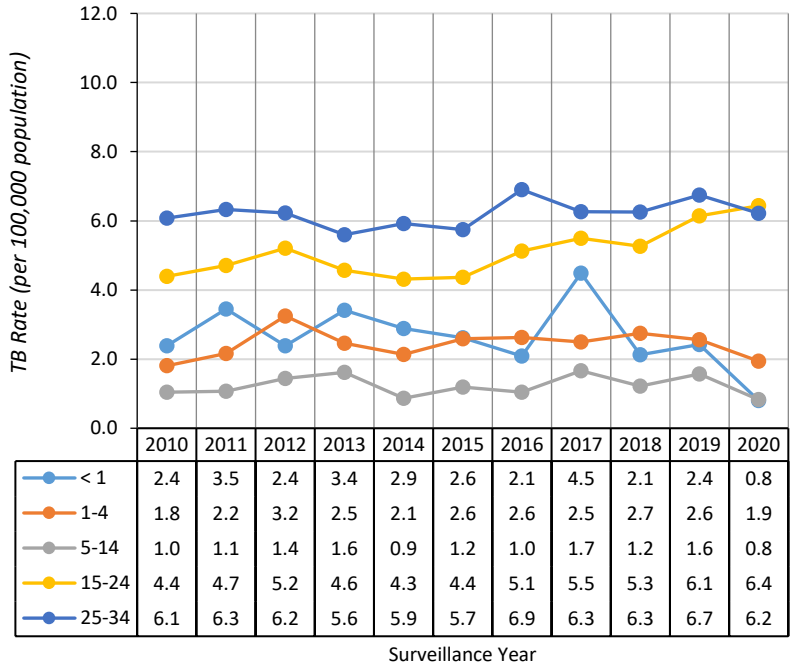
Table 1: Cases and proportion of incident active TB across different age groups over time, CTBRS: 2010-2020

	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
Age Group	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
< 1 years old	9	(0.6%)	13	(0.8%)	9	(0.5%)	13	(0.8%)	11	(0.7%)	10	(0.6%)	8	(0.5%)	17	(0.9%)	8	(0.4%)	9	(0.5%)	3	(0.2%)
1-4 years old	27	(1.7%)	33	(2.0%)	50	(2.9%)	38	(2.3%)	33	(2.0%)	40	(2.4%)	41	(2.3%)	39	(2.1%)	43	(2.4%)	41	(2.1%)	30	(1.7%)
5-14 years old	39	(2.5%)	40	(2.5%)	54	(3.2%)	61	(3.7%)	33	(2.0%)	46	(2.8%)	41	(2.3%)	66	(3.6%)	49	(2.7%)	64	(3.3%)	34	(1.9%)
15-24 years old	201	(12.7%)	216	(13.3%)	239	(14.1%)	209	(12.7%)	196	(12.1%)	196	(11.9%)	229	(13.0%)	247	(13.5%)	239	(13.3%)	282	(14.7%)	297	(16.8%)
25-34 years old	282	(17.8%)	297	(18.3%)	296	(17.4%)	269	(16.3%)	288	(17.8%)	281	(17.1%)	342	(19.4%)	315	(17.2%)	321	(17.9%)	353	(18.4%)	330	(18.6%)
35-44 years old	272	(17.2%)	251	(15.5%)	269	(15.8%)	244	(14.8%)	241	(14.9%)	247	(15.0%)	245	(13.9%)	269	(14.7%)	257	(14.3%)	267	(13.9%)	260	(14.7%)
45-54 years old	214	(13.5%)	224	(13.8%)	234	(13.8%)	238	(14.4%)	222	(13.7%)	212	(12.9%)	204	(11.6%)	216	(11.8%)	221	(12.3%)	236	(12.3%)	219	(12.4%)
55-64 years old	176	(11.1%)	168	(10.4%)	155	(9.1%)	189	(11.4%)	198	(12.3%)	187	(11.4%)	194	(11.0%)	195	(10.6%)	201	(11.2%)	209	(10.9%)	200	(11.3%)
65-74 years old	149	(9.4%)	173	(10.7%)	178	(10.5%)	169	(10.2%)	162	(10.0%)	174	(10.6%)	188	(10.7%)	197	(10.8%)	192	(10.7%)	197	(10.3%)	168	(9.5%)
75+ years old	217	(13.7%)	206	(12.7%)	216	(12.7%)	221	(13.4%)	231	(14.3%)	250	(15.2%)	270	(15.3%)	270	(14.7%)	263	(14.7%)	263	(13.7%)	231	(13.0%)

As presented below, the overall rate of active TB in individuals aged 65 to 74 years and over age 74 has been declining progressively since 2017 (cumulative decrease of 25.0% and 22.6%, respectively (Figure 2_B). In contrast, the corresponding rate of active TB for persons aged 15-24 increased incrementally from 4.4 cases per 100,000 population in 2015 to 6.4 per 100,000 in 2020 (Figure 2_A).

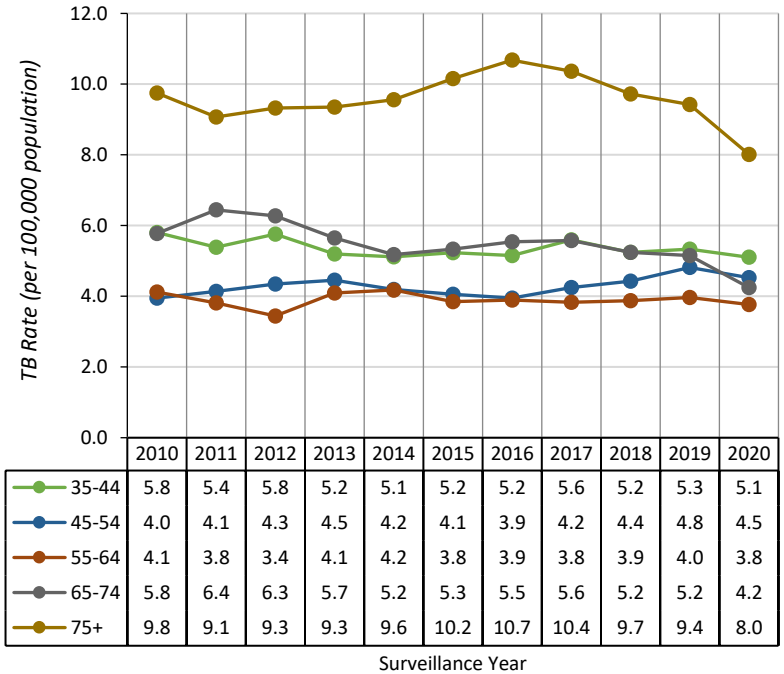
Figures 2: Incidence rate (per 100,000 population) of active TB by age group, CTBRS: 2020

Figure 2_A (0 - 34 years old)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
< 1	2.4	3.5	2.4	3.4	2.9	2.6	2.1	4.5	2.1	2.4	0.8
1-4	1.8	2.2	3.2	2.5	2.1	2.6	2.6	2.5	2.7	2.6	1.9
5-14	1.0	1.1	1.4	1.6	0.9	1.2	1.0	1.7	1.2	1.6	0.8
15-24	4.4	4.7	5.2	4.6	4.3	4.4	5.1	5.5	5.3	6.1	6.4
25-34	6.1	6.3	6.2	5.6	5.9	5.7	6.9	6.3	6.3	6.7	6.2

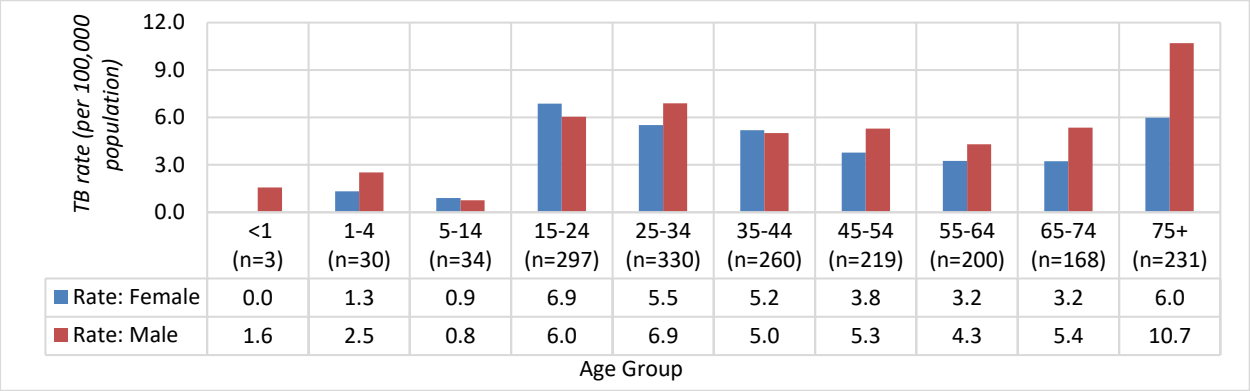
Figure 2_B (35 - 75+ years old)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
35-44	5.8	5.4	5.8	5.2	5.1	5.2	5.2	5.6	5.2	5.3	5.1
45-54	4.0	4.1	4.3	4.5	4.2	4.1	3.9	4.2	4.4	4.8	4.5
55-64	4.1	3.8	3.4	4.1	4.2	3.8	3.9	3.8	3.9	4.0	3.8
65-74	5.8	6.4	6.3	5.7	5.2	5.3	5.5	5.6	5.2	5.2	4.2
75+	9.8	9.1	9.3	9.3	9.6	10.2	10.7	10.4	9.7	9.4	8.0

When examining age and sex, in 2020, the incidence rate of active TB was higher among males compared with females within the 25 to 34 and 45+ age groups; the difference was more pronounced in individuals aged 75+ years old (**Figure 3**).

Figure 3: Incidence rate (per 100,000 population) of active TB by age and sex, CTBRS: 2020

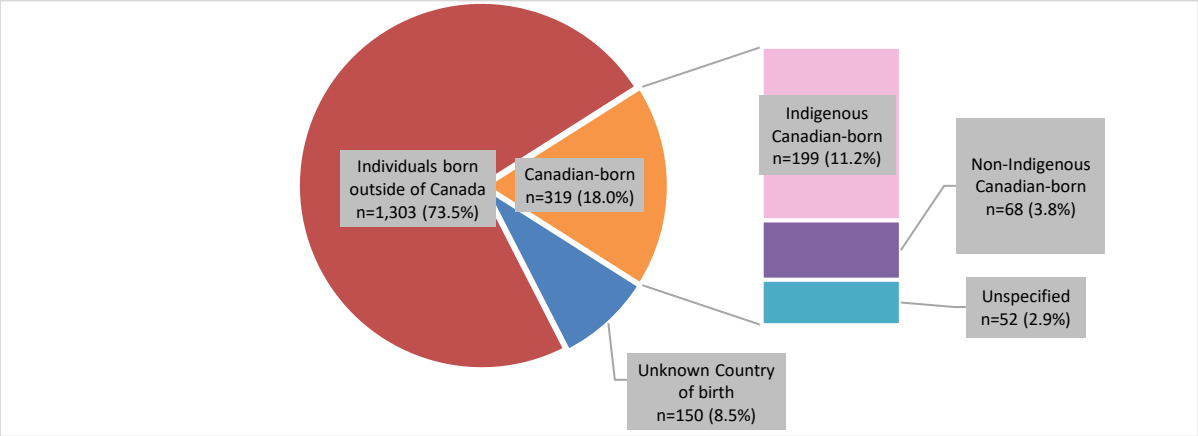


	<1 (n=3)	1-4 (n=30)	5-14 (n=34)	15-24 (n=297)	25-34 (n=330)	35-44 (n=260)	45-54 (n=219)	55-64 (n=200)	65-74 (n=168)	75+ (n=231)
Rate: Female	0.0	1.3	0.9	6.9	5.5	5.2	3.8	3.2	3.2	6.0
Rate: Male	1.6	2.5	0.8	6.0	6.9	5.0	5.3	4.3	5.4	10.7

Birthplace of individuals reported with active TB

Examining active TB according to place of birth, there were 1,772 incident active TB cases reported in 2020 of which 73.5% (n=1,303) were diagnosed in foreign-born individuals and 18.0% (n=319) in persons born in Canada (**Figure 4**). The remaining 8.5% (n=150) had missing information on birthplace. For cases that were Canadian-born, 62.4% (n=199) self-identified as Indigenous, another 21.3% (n=68) were non-Indigenous and the remaining 16.3% (n=52) did not specify Indigenous status (**Figure 4**).

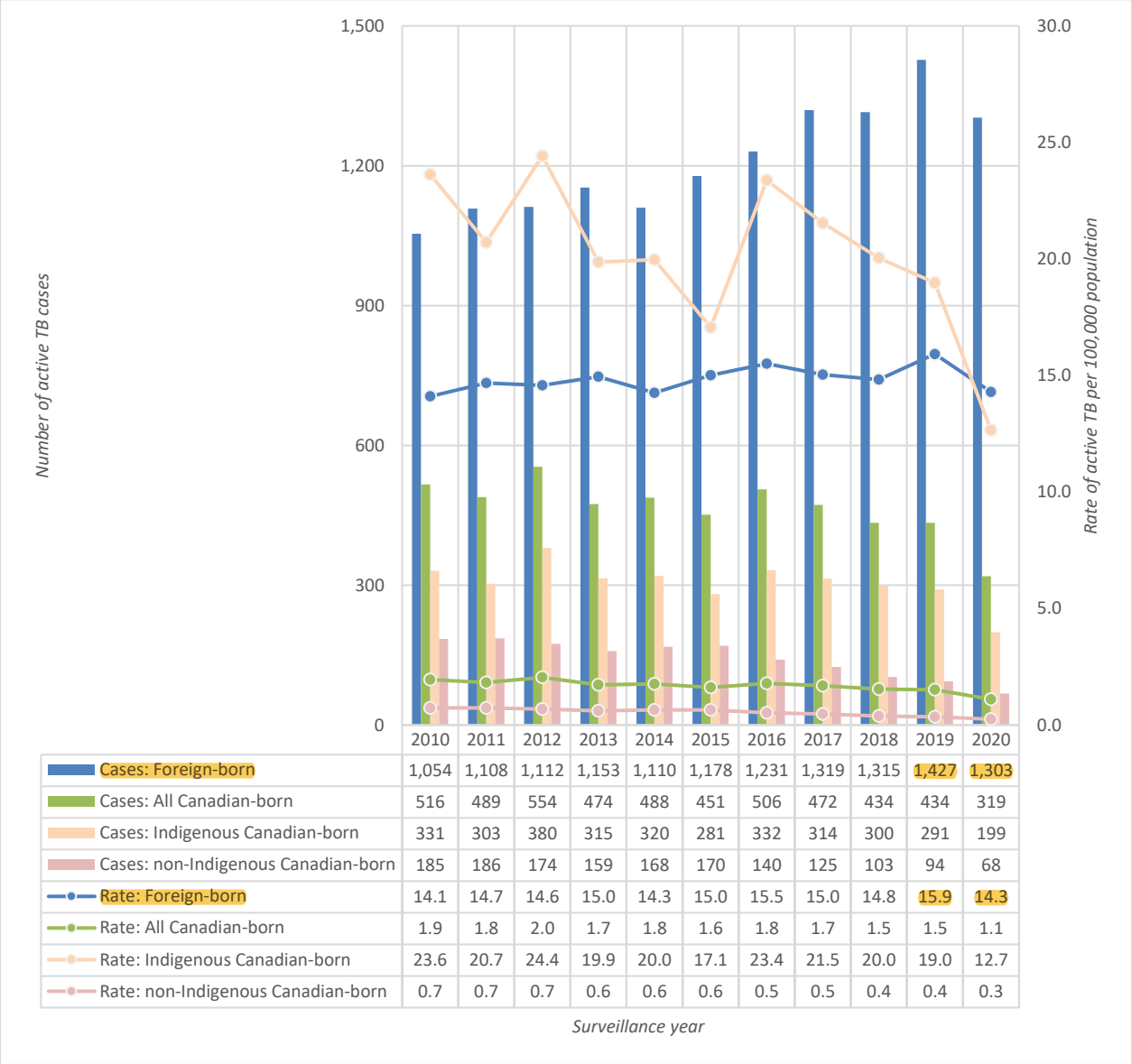
Figure 4: Proportion of incident active TB cases by place of birth, CTBRS: 2020



As outlined in figure 5, the incidence rate of active TB in foreign-born individuals has minimally changed over time: from 14.1 per 100,000 cases in 2010 to 14.3 in 2020 (**Figure 5**). In comparison, the rate of active TB among all Canadian-born individuals decreased progressively during the same time period to 1.1 per 100,000 in 2020 (**Figure 5**).

The rate of active TB for Indigenous populations has fluctuated over time, but there has been a declining trend since 2016 (**Figure 5**) which had one of the highest rates of active TB in the last ten years (23.4 cases per 100,000 population in 2016). The incidence of active TB for Indigenous Canadian-born populations declined progressively to 19.0 per 100,000 in 2019 and further to 12.7 per 100,000 in 2020, however it is too early to accurately interpret a change of this magnitude between 2019 and 2020 (**Figure 5**). Differences have been observed among different Indigenous Peoples during 2010-2020 as summarized in **Figure 6**. Inuit continue to have the highest rates of TB in Canada. Figure 6 shows a substantial one-year decrease in the rate of active TB (from 188.7 cases per 100,000 population in 2019 to 72.2 per 100,000 in 2020) for Inuit communities, however, it is too early to accurately interpret a change of this magnitude for this time period. The second highest active TB rate among Indigenous Peoples has been for First Nations, and it has progressively declined from 22.2 cases per 100,000 population in 2010 to 13.6 per 100,000 in 2020. Also, in the last two years of reporting (2019 and 2020), the rate of active TB among First Nations was marginally lower than for foreign-born individuals: at 15.3 and 13.6 cases per 100,000 population for First Nations respectively in 2019 and 2020 (**Figure 6**), compared to 15.9 and 14.3 per 100,000 for foreign-born populations (**Figure 5**).

Figure 5: Reported cases and incidence rate (per 100,000 population) of active TB by place of birth, CTBRS: 2010-2020

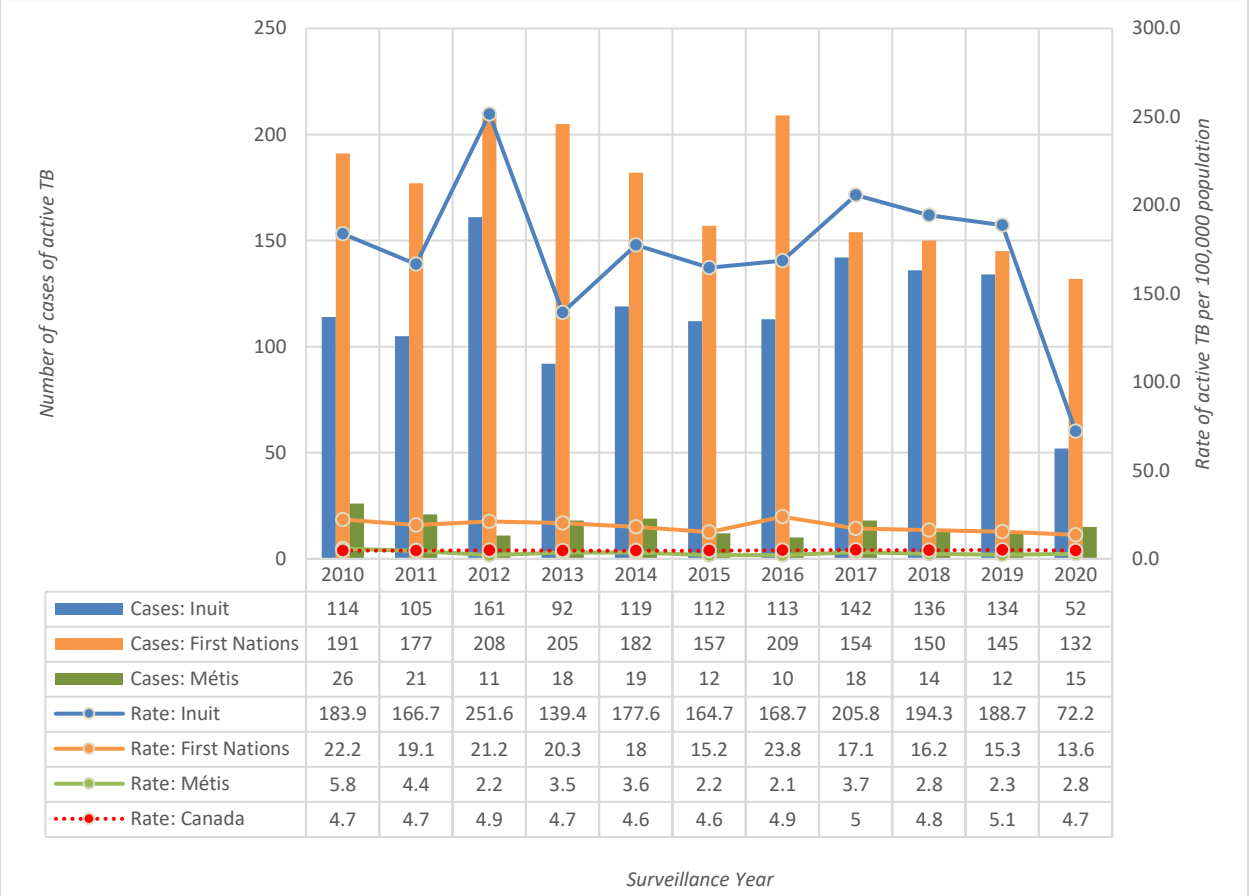


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cases: Foreign-born	1,054	1,108	1,112	1,153	1,110	1,178	1,231	1,319	1,315	1,427	1,303
Cases: All Canadian-born	516	489	554	474	488	451	506	472	434	434	319
Cases: Indigenous Canadian-born	331	303	380	315	320	281	332	314	300	291	199
Cases: non-Indigenous Canadian-born	185	186	174	159	168	170	140	125	103	94	68
Rate: Foreign-born	14.1	14.7	14.6	15.0	14.3	15.0	15.5	15.0	14.8	15.9	14.3
Rate: All Canadian-born	1.9	1.8	2.0	1.7	1.8	1.6	1.8	1.7	1.5	1.5	1.1
Rate: Indigenous Canadian-born	23.6	20.7	24.4	19.9	20.0	17.1	23.4	21.5	20.0	19.0	12.7
Rate: non-Indigenous Canadian-born	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3

Métis communities have been the least affected Indigenous Peoples, with active TB rates consistently lower than the national average since 2011 (**Figure 6**).

For non-Indigenous Canadian-born populations, there was a steady decline in the incidence of active TB during the 2010-2020 time period from 0.7 per 100,000 population to 0.3 per 100,000 population (**Figure 5**).

Figure 6: Reported cases and incidence rate (per 100,000 population) of active TB in Indigenous populations, CTBRS: 2010-2020[2]



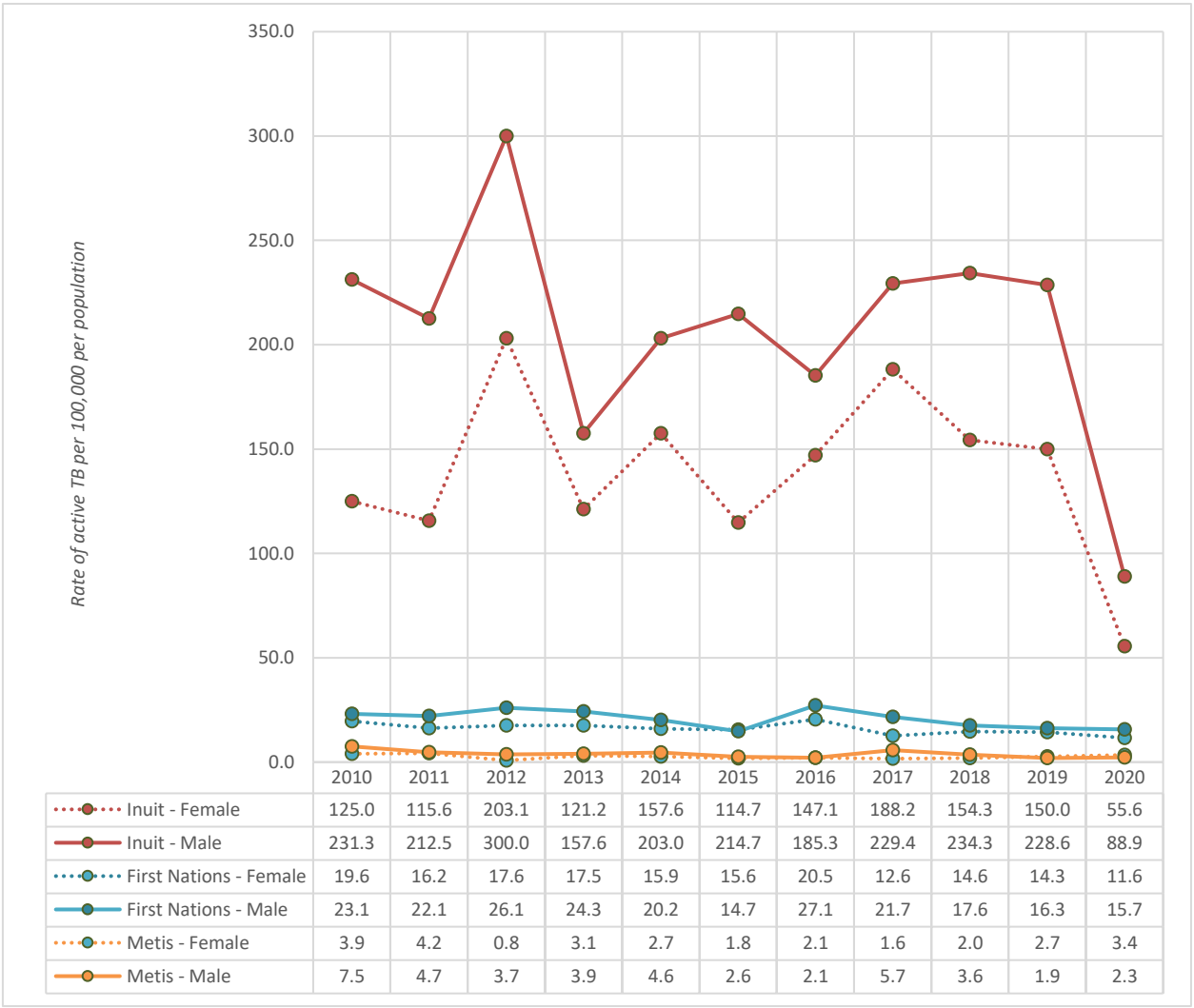
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cases: Inuit	114	105	161	92	119	112	113	142	136	134	52
Cases: First Nations	191	177	208	205	182	157	209	154	150	145	132
Cases: Métis	26	21	11	18	19	12	10	18	14	12	15
Rate: Inuit	183.9	166.7	251.6	139.4	177.6	164.7	168.7	205.8	194.3	188.7	72.2
Rate: First Nations	22.2	19.1	21.2	20.3	18	15.2	23.8	17.1	16.2	15.3	13.6
Rate: Métis	5.8	4.4	2.2	3.5	3.6	2.2	2.1	3.7	2.8	2.3	2.8
Rate: Canada	4.7	4.7	4.9	4.7	4.6	4.6	4.9	5	4.8	5.1	4.7

The data shown in **Figure 7** present TB rates for Indigenous Peoples in Canada by gender over time. The data suggests that the rate of active TB among males has been consistently higher compared with females (between 2010 and 2020). Additionally, while Inuit communities have had the highest rates of active TB in both males and females over time, the incidence dropped

[2] British Columbia has not reported on Indigenous status since 2016, and therefore did not contribute into these data.

substantially in 2020 to 55.6 cases per 100,000 for females, and 88.9 cases per 100,000 for males (**Figure 7**). As noted earlier in this report regarding declining rates of TB between 2019 and 2020, it is too early to accurately interpret changes of this magnitude occurring over this one-year period; subsequent data sets from upcoming years will provide more insight into the dynamics of active TB in these communities, especially in light of the potential effects of the COVID-19 pandemic on TB prevention, diagnosis, and reporting.

Figure 7: Rate of active TB in Indigenous Peoples in Canada by sex, CTBRS: 2020

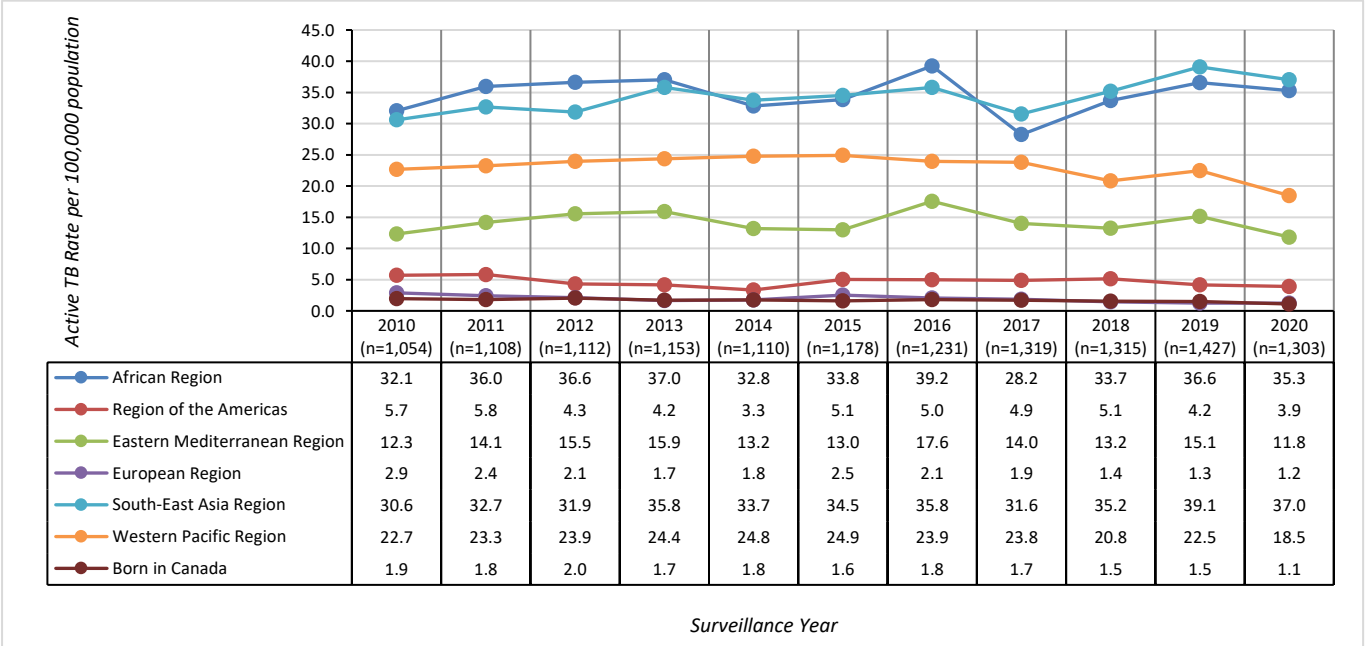


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Inuit - Female	125.0	115.6	203.1	121.2	157.6	114.7	147.1	188.2	154.3	150.0	55.6
Inuit - Male	231.3	212.5	300.0	157.6	203.0	214.7	185.3	229.4	234.3	228.6	88.9
First Nations - Female	19.6	16.2	17.6	17.5	15.9	15.6	20.5	12.6	14.6	14.3	11.6
First Nations - Male	23.1	22.1	26.1	24.3	20.2	14.7	27.1	21.7	17.6	16.3	15.7
Metis - Female	3.9	4.2	0.8	3.1	2.7	1.8	2.1	1.6	2.0	2.7	3.4
Metis - Male	7.5	4.7	3.7	3.9	4.6	2.6	2.1	5.7	3.6	1.9	2.3

Tuberculosis in Foreign-born individuals

As noted earlier and in Figure 5, the rate of TB in foreign-born individuals was the second highest in Canada, at 14.3 per 100,000 population in 2020. However, among foreign-born individuals, the rate of active TB varied by WHO geographic defined area (**Figure 8**) with the South-East Asia Region (SEAR) having the highest incidence in 2020 (37.0 cases per 100,000 population), followed by the African (AFR; 35.3 per 100,000), the Western Pacific (WPR; 18.5 per 100,000), and the Eastern Mediterranean (EMR; 11.8 per 100,000) Regions. The Region of the Americas (AMR; 3.9 per 100,000) and European Region (EUR; 1.2 per 100,000) had the lowest reported rates (**Figure 8**). There was minimal change in these rates over time.

Figure 8: Incidence rate (per 100,000 population) of active TB by WHO region of birth, CTBRS: 2010-2020



	2010 (n=1,054)	2011 (n=1,108)	2012 (n=1,112)	2013 (n=1,153)	2014 (n=1,110)	2015 (n=1,178)	2016 (n=1,231)	2017 (n=1,319)	2018 (n=1,315)	2019 (n=1,427)	2020 (n=1,303)
African Region	32.1	36.0	36.6	37.0	32.8	33.8	39.2	28.2	33.7	36.6	35.3
Region of the Americas	5.7	5.8	4.3	4.2	3.3	5.1	5.0	4.9	5.1	4.2	3.9
Eastern Mediterranean Region	12.3	14.1	15.5	15.9	13.2	13.0	17.6	14.0	13.2	15.1	11.8
European Region	2.9	2.4	2.1	1.7	1.8	2.5	2.1	1.9	1.4	1.3	1.2
South-East Asia Region	30.6	32.7	31.9	35.8	33.7	34.5	35.8	31.6	35.2	39.1	37.0
Western Pacific Region	22.7	23.3	23.9	24.4	24.8	24.9	23.9	23.8	20.8	22.5	18.5
Born in Canada	1.9	1.8	2.0	1.7	1.8	1.6	1.8	1.7	1.5	1.5	1.1

Type of active TB diagnosed

In 2020, irrespective of place of birth or ethnicity, pulmonary TB was the most common type of active TB diagnosed. This form of TB accounted for 75.2% (n=240) of all cases for individuals born in Canada (**Table 2**) and 62.2% (n=904) of foreign-born cases (**Table 3**). Further breakdown

of the results shows that the proportion of pulmonary TB cases was similar among Indigenous (77.4%; n=154) and non-Indigenous (75.0%; n=51) populations. All other forms of respiratory and non-respiratory TB diagnosed in Indigenous and in Canadian-born non-Indigenous populations (**Table 2**) did not exceed 5.0% (n≤16).

Table 2: Reported cases of incident active TB in Canadian-born populations, CTBRS: 2020

Diagnostic Sites		Indigenous		Non-Indigenous		Unknown Indigenous status		Total	
		n	(%)	n	(%)	n	(%)	n	(%)
Respiratory TB	Pulmonary	154	(77.4%)	51	(75.0%)	35	(67.3%)	240	(75.2%)
	Primary	12	(6.0%)	0	(0.0%)	1	(1.9%)	13	(4.1%)
	Pleura	9	(4.5%)	0	(0.0%)	1	(1.9%)	10	(3.7%)
	Intrathoracic lymph nodes	1	(0.5%)	1	(1.5%)	0	(0.0%)	2	(0.6%)
	Other Respiratory	0	(0.0%)	0	(0.0%)	5	(9.6%)	5	(1.6%)
	Subtotal: respiratory	176	(88.4%)	52	(76.5%)	42	(80.8%)	270	(84.6%)
Non-Respiratory TB	Peripheral Lymph Nodes	6	(3.0%)	7	(10.3%)	3	(5.8%)	16	(5.0%)
	Intestines, Peritoneum & mesenteric glands	2	(1.0%)	3	(4.4%)	0	(0.0%)	5	(1.6%)
	CNS & Meninges	3	(1.5%)	1	(1.5%)	0	(0.0%)	4	(1.3%)
	Bones & Joints	3	(1.5%)	0	(0.0%)	1	(1.9%)	4	(1.3%)
	Miliary	2	(1.0%)	0	(0.0%)	2	(3.8%)	4	(1.3%)
	Eyes	2	(1.0%)	2	(2.9%)	0	(0.0%)	4	(1.3%)
	Endocardium, myocardium, pericardium, oesophagus & thyroid gland	0	(0.0%)	2	(2.9%)	0	(0.0%)	2	(0.6%)
	Genito-urinary system	0	(0.0%)	1	(1.5%)	0	(0.0%)	1	(0.3%)
	Other non-respiratory	0	(0.0%)	0	(0.0%)	4	(7.7%)	4	(1.3%)
	Subtotal: non-respiratory	18	(9.0%)	16	(23.5%)	10	(19.2%)	44	(13.8%)
Diagnostic Site Unknown		5	(2.5%)	0	(0.0%)	0	(0.0%)	5	(1.6%)
Total TB cases in 2020		199	(100%)	68	(100%)	52	(100%)	319	(100%)

Overall, 73.5% (n=1,303) of individuals with active TB in 2020 were foreign-born. The most predominant type of active TB in this group was pulmonary TB (64.0%; n=834; **Table 3**) as was found with Canadian-born cases. With 16.6% (n=216) representation, peripheral lymph nodes were the second most commonly reported diagnostic site of infection among foreign-born

populations, distantly followed by the intestines, peritoneum and mesenteric glands (2.6%; n=34), pleura (2.8%; n=37), and bones and joints (2.3%; n=30; **Table 3**).

Table 3: Reported cases of incident active TB in foreign-born and populations with unknown place of birth, CTBRS: 2020

Diagnostic Sites		Foreign-born		Unknown place of birth		Total	
		n	(%)	n	(%)	n	(%)
Respiratory TB	Pulmonary	834	(64.0%)	70	(46.7%)	904	(62.2%)
	Pleura	37	(2.8%)	1	(0.7%)	38	(2.6%)
	Intrathoracic lymph nodes	13	(1.0%)	0	0.0%	13	(0.9%)
	Primary	10	(0.8%)	3	(2.0%)	13	(0.9%)
	Other Respiratory site	12	(0.9%)	0	0.0%	12	(0.8%)
	Subtotal: respiratory	906	(69.5%)	74	(49.3%)	980	(67.4%)
Non-Respiratory TB	Peripheral Lymph Nodes	216	(16.6%)	9	(6.0%)	225	(15.5%)
	Intestines, Peritoneum & mesenteric glands	34	(2.6%)	5	(3.3%)	39	(2.7%)
	Bones & Joints	30	(2.3%)	5	(3.3%)	35	(2.4%)
	CNS & Meninges	20	(1.5%)	4	(2.7%)	24	(1.7%)
	Skin and subcutaneous tissue	17	(1.3%)	2	(1.3%)	19	(1.3%)
	Endocardium, myocardium, pericardium, oesophagus & thyroid gland	17	(1.3%)	4	(2.7%)	21	(1.4%)
	Genito-urinary system	16	(1.2%)	1	(0.7%)	17	(1.2%)
	Miliary	11	(0.8%)	0	0.0%	11	(0.8%)
	Eyes	8	(0.6%)	1	(0.7%)	9	(0.6%)
	Other non-respiratory	15	(1.2%)	0	(0.0%)	15	(1.0%)
	Subtotal: non-respiratory	384	(29.5%)	31	(20.7%)	415	(28.6%)
Diagnostic Site Unknown		13	(1.0%)	45	(30.0%)	58	(4.0%)
Total TB cases reported in 2020		1,303	(100%)	150	(100%)	1,453	(100%)

One hundred and fifty cases (8.5%) of TB were reported in 2020 with no available information on place of birth (**Table 3**). Diagnostic sites were known for 70.0% (n=105) of them and pulmonary sites were the most predominant at 46.7% (n=70) (**Table 3**).

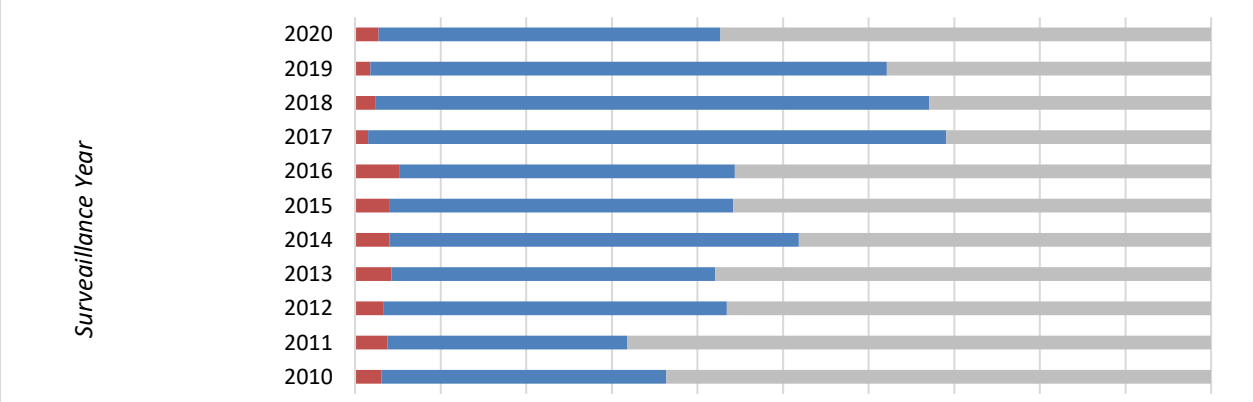
Potential risk factors

In 2020, report of HIV status was available for 756 (42.7%) of 1,772 reported cases of active TB in Canada. Of these, 49 (6.5%) were identified as positive and 707 negative. In comparison, from 2017 to 2019 when the reporting of HIV status was at its best of the decade, the proportion of HIV-positive was at its lowest: between 2.2% and 3.5% per year (**Table 4**). The proportion of HIV-positive diagnoses among TB cases decreases as reporting improves as illustrated in **Figure 9**.

Table 4: Reported Incident active TB cases with known HIV status, CTBRS: 2010-2020

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HIV-status known	Positive	**n**	49	61	56	70	65	67	92	28	42	34	49
		(%)	(8.5%)	(11.8%)	(7.6%)	(10.1%)	(7.8%)	(9.2%)	(11.8%)	(2.2%)	(3.5%)	(2.9%)	(6.5%)
	Negative	**n**	528	454	682	625	772	659	690	1,237	1,161	1,159	707
		(%)	(91.5%)	(88.2%)	(92.4%)	(89.9%)	(92.2%)	(90.8%)	(88.2%)	(97.8%)	(96.5%)	(97.2%)	(93.5%)
	Subtotal with known status	n	577	515	738	695	837	726	782	1,265	1,203	1,193	756
		(%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)	(100%)

Figure 9: Reporting of HIV status of active TB cases in Canada, CTBRS: 2010-2020



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
% with positive HIV diagnosis	3.1%	3.8%	3.3%	4.2%	4.0%	4.1%	5.2%	1.5%	2.3%	1.8%	2.8%
% with negative HIV diagnosis	33.3%	28.0%	40.1%	37.9%	47.8%	40.1%	39.2%	67.6%	64.7%	60.3%	39.9%
% unknown HIV diagnosis	63.6%	68.2%	56.6%	57.9%	48.2%	55.8%	55.6%	30.9%	32.9%	37.9%	57.3%

Statistics on other potential risk factors for active TB reported in 2020 are summarized in **Table 5**. Diabetes mellitus, contact with an active TB case two years before TB diagnosis, and travel to a high-incidence TB country for more than a week in the previous two years were the most common risk factors reported in 2020. However, due to missing information on risk factors for a considerable proportion of cases, these findings should be interpreted with caution.

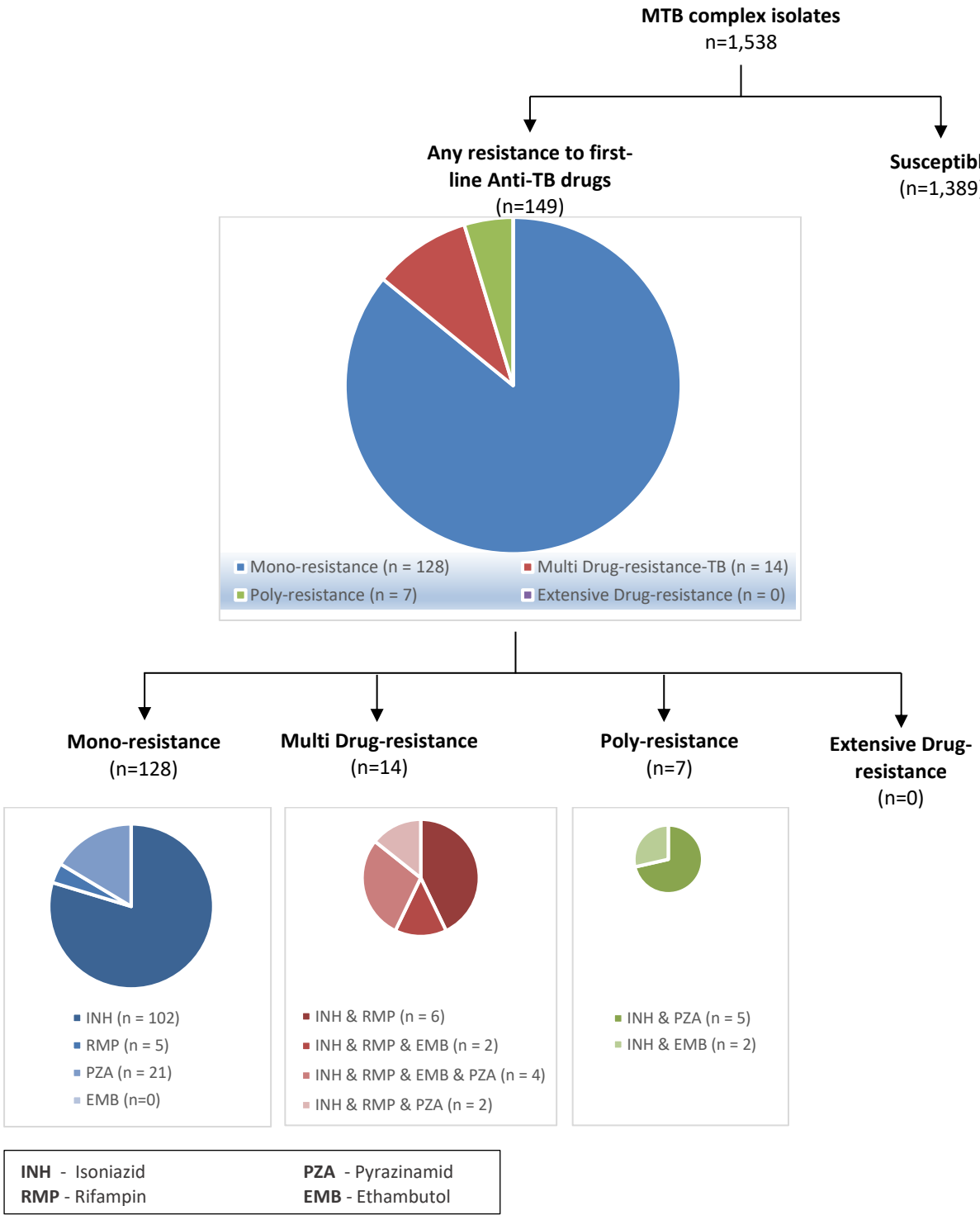
Table 5: Cases and proportion of individuals with other risk factors potentially associated with active TB, CTBRS: 2020

	Positive		Negative		Information not provided	
Potential Risk Factors	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Diabetes Mellitus	223	(12.6%)	549	(31.0%)	1,000	(56.4%)
Travel to high-incidence TB country for > 1 week in last 2 years	208	(11.7%)	315	(17.8%)	1,249	70.5%
Contact with an active TB case in the last two years	140	(7.9%)	388	(21.9%)	1,244	(70.2%)
Previous abnormal chest x-ray	90	(5.1%)	498	(28.1%)	1,184	(66.8%)
History of previous TB disease	63	(3.5%)	446	(25.2%)	1,263	(71.3%)
Substance abuse	62	(3.5%)	503	(28.4%)	1,207	(68.1%)
End-stage renal disease	33	(1.9%)	672	(37.9%)	1,067	(60.2%)
Homelessness at the time TB diagnosis or 12 months before	27	(1.5%)	665	(37.5%)	1,080	(60.9%)
Long-term (>1 month) corticosteroid use	25	(1.4%)	660	(37.2%)	1,087	(61.3%)
Transplant-related immunosuppression	14	(0.8%)	672	(37.9%)	1,086	(61.3%)
Recent history of incarceration	10	(0.6%)	460	(26.0%)	1,302	(73.5%)

Drug-Resistance

In 2020, susceptibility testing to TB medication was performed on 1,538 TB isolates and resistance to any first-line anti-TB drug (isoniazid-INH, rifampin-RMP, ethambutol-EMB, and pyrazinamide-PZA) was detected in 9.7% (n=149) of the isolates. In addition, mono-, poly-, and multidrug-resistant forms of TB were detected in 128 (8.3%), seven (0.5%), and 14 (0.9%) isolates, respectively (**Figure 10**).

Figure 10: *Mycobacterium tuberculosis* isolates (MTB) from active TB cases tested for anti-TB drug susceptibility, CTBLSS: 2020



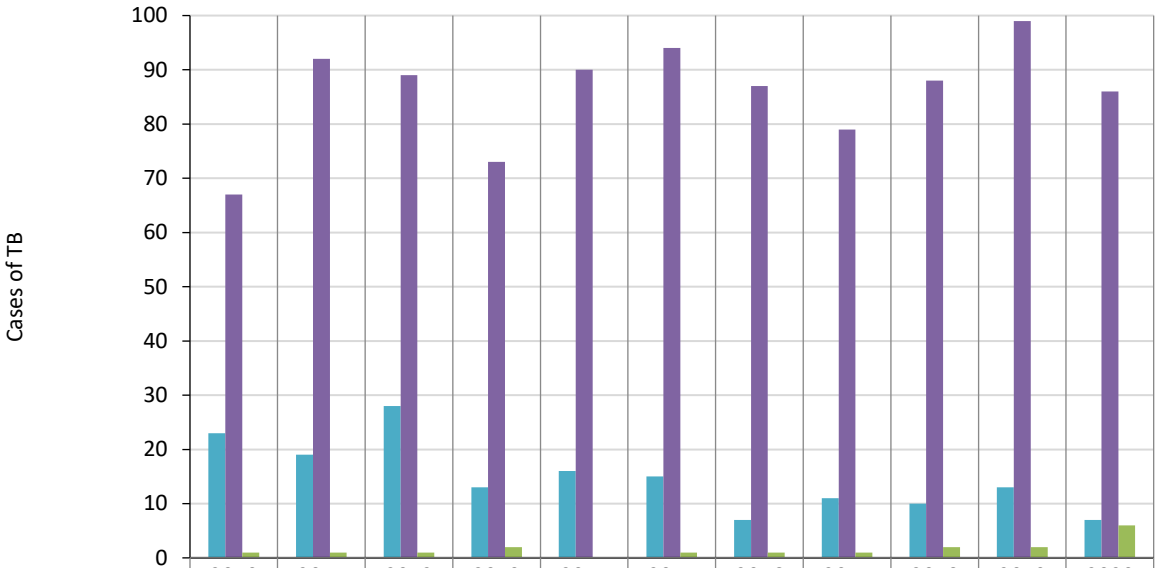
No extensively drug-resistant (XDR) TB was detected from any of the 1,538 TB isolates subjected to susceptibility testing in 2020. Moreover, in the last six years, XDR TB was detected in only one isolate in 2018 (**Table 6**). Overall, there has been little change since 2010 in the proportions of active TB isolates that exhibited other forms of drug-resistance (**Table 6 & Figures 10$_{A-C}$**) and the majority of drug-resistant TB has been detected in isolates from cases born outside of Canada (**Figures 10$_{A-C}$**).

Table 6: Cases and proportion of drug-resistant TB isolated from active TB cases, CTBLSS: 2010-2020

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mono-resistant	n	88	119	128	93	107	114	108	101	121	146	128
	(%)	(6.9%)	(9.0%)	(9.1%)	(6.8%)	(7.8%)	(8.5%)	(7.4%)	(6.6%)	(8.3%)	(9.0%)	(8.3%)
Poly-resistant	n	6	1	2	4	4	3	5	6	5	5	7
	(%)	(0.5%)	(0.1%)	(0.1%)	(0.3%)	(0.3%)	(0.2%)	(0.3%)	(0.4%)	(0.3%)	(0.3%)	(0.5%)
Multidrug-resistant	n	18	19	9	15	19	22	17	14	22	20	14
	(%)	(1.4%)	(1.4%)	(0.6%)	(1.1%)	(1.4%)	(1.6%)	(1.2%)	(0.9%)	(1.5%)	(1.2%)	(0.9%)
Extensively drug-resistant	n	1	1	1	1	1	0	0	0	1	0	0
	(%)	(0.1%)	(0.1%)	(0.1%)	(0.1%)	(0.1%)	(0.0%)	(0.0%)	(0.0%)	(0.1%)	(0.0%)	(0.0%)

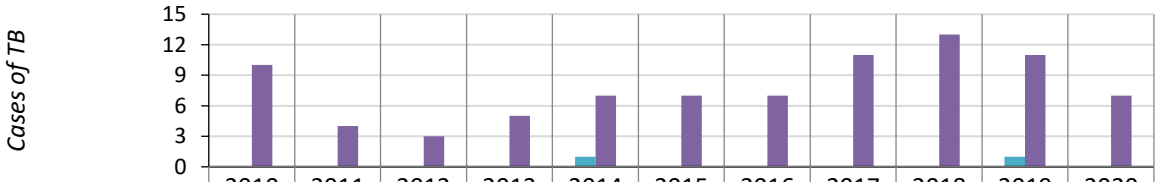
Figure 11: Cases of drug-resistant TB detected in active TB isolates, CTBRS: 2010-2020

Figure 10_A: Mono-resistance to TB drugs, CTBLSS 2010 - 2020



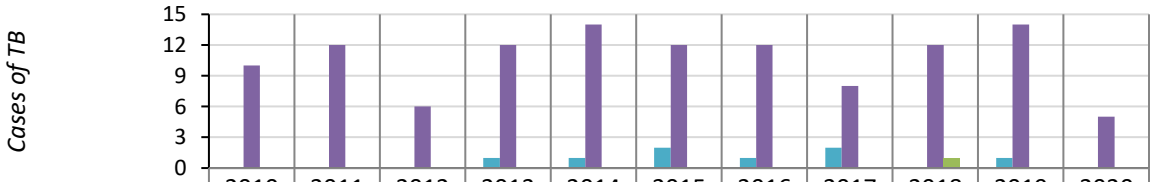
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canadian-born	23	19	28	13	16	15	7	11	10	13	7
Foreign-born	67	92	89	73	90	94	87	79	88	99	86
Unknown	1	1	1	2	0	1	1	1	2	2	6

Figure 10_B: Poly-resistance to TB drugs, CTBLSS 2010 - 2020



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canadian-born	0	0	0	0	1	0	0	0	0	1	0
Foreign-born	10	4	3	5	7	7	7	11	13	11	7

Figure 10_C: Multidrug-resistance, CTBRS: 2010 - 2020



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Canadian-born	0	0	0	1	1	2	1	2	0	1	0
Foreign-born	10	12	6	12	14	12	12	8	12	14	5
Unknown	0	0	0	0	0	0	0	0	1	0	0

Tuberculosis Treatment Outcomes

Treatment outcomes for active TB cases in Canada between 2009 and 2019 are presented in **Table 7**. In 2020, TB treatment outcome data on all 1,921 active TB cases recorded in 2019 were submitted to the CTBRS. Treatment was declared successful for the majority of these cases (n=1,519; 79.1%), meaning they were either cured or successfully completed the full course of treatment prescribed (**Table 7**). About 5% (n=89) of cases were still receiving ongoing treatment at the time of data submission to PHAC. With 10% (n=193 cases) lost to follow-up, coupled with 2.7% (n=51) deaths unrelated to TB, the true treatment success rate for cases reported in 2019 was 90.6% (1,519/1,677) and was in alignment with rates reported in past years (**Table 7**).

Table 7: Outcome of incident active TB cases, CTBRS: 2009 - 2019

	Successful treatment		Treatment ongoing		Lost to Follow up		TB-related death		Death not related to TB		Total cases reported	Treatment success rate
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	%
2009	1,434	(86.7%)	9	(0.5%)	83	(5.0%)	82	(5.0%)	46	(2.8%)	**1,654**	94.0%
2010	1,372	(86.5%)	38	(2.4%)	54	(3.4%)	71	(4.5%)	51	(3.2%)	**1,586**	92.6%
2011	1,228	(75.8%)	52	(3.2%)	201	(12.4%)	103	(6.4%)	37	(2.3%)	**1,621**	88.8%
2013	1,415	(83.2%)	74	(4.4%)	82	(4.8%)	79	(4.6%)	50	(2.9%)	**1,700**	90.2%
2013	1,378	(83.5%)	72	(4.4%)	75	(4.5%)	82	(5.0%)	44	(2.7%)	**1,651**	89.9%
2014	1,361	(84.3%)	49	(3.0%)	83	(5.1%)	91	(5.6%)	31	(1.9%)	**1,615**	90.7%
2015	1,382	(84.1%)	35	(2.1%)	84	(5.1%)	107	(5.1%)	35	(2.1%)	**1,643**	90.7%
2016	1,406	(79.8%)	75	(4.3%)	146	(8.3%)	89	(4.9%)	46	(2.6%)	**1,762**	89.6%
2017	1,484	(81.0%)	72	(3.9%)	147	(8.0%)	90	(4.9%)	38	(2.1%)	**1,831**	90.2%
2018	1,464	(81.6%)	46	(2.6%)	146	(8.1%)	98	(5.5%)	40	(2.2%)	**1,794**	91.0%
2019	1,519	(79.1%)	89	(4.6%)	193	(10.0%)	69	(3.6%)	51	(2.7%)	**1,921**	90.6%

In addition to data presented on treatment outcomes for active TB cases, information on mortality (**Table 8**) shows there were 120 (6.2%) individuals who died either before or during the prescribed TB treatment among active TB cases reported in 2019. However, tuberculosis was deemed the underlying cause of death in only 22 cases, and was a contributing factor in another 47 other cases (**Table 8**).

Table 8: Cause of death, Active TB cases by age-group and sex - CTBRS, 2019

	TB was the underlying cause of death		TB was a contributing factor to death		Death not related to TB; TB detected incidentally		Unknown if TB contributed to death		Total	
AGE Group	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1-14 years old	1 (0.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.8%)**	**0 (0.0%)**
15-24 years old	0 (0.0%)	1 (0.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**0 (0.0%)**	**1 (0.8%)**
25-64 years old	1 (0.8%)	4 (3.3%)	10 (8.3%)	0 (0.0%)	4 (3.3%)	3 (2.5%)	1 (0.8%)	4 (3.3%)	**16 (13.3%)**	**11 (9.2%)**
65-74 years old	5 (4.2%)	0 (0.0%)	5 (4.2%)	1 (0.8%)	6 (5.0%)	3 (2.5%)	1 (0.8%)	1 (0.8%)	**17 (14.2%)**	**5 (4.2%)**
75+ years old	7 (5.8%)	3 (2.5%)	19 (15.8%)	12 (10.0%)	11 (9.2%)	8 (6.7%)	4 (3.3%)	5 (4.2%)	**41 (34.2%)**	**28 (23.3%)**
Overall	**14 (11.7%)**	**8 (6.7%)**	**34 (28.3%)**	**13 (10.8%)**	**21 (17.5%)**	**14 (11.7%)**	**6 (5.0%)**	**10 (8.3%)**	**75 (62.5%)**	**45 (37.5%)**

The majority (n=52; 75.4%) of deaths for which TB was either the underlying cause or a contributing factor among active TB cases reported in 2019 (n=69), were among individuals 65 years of age or older. Of the remaining 17 (24.6%), 15 (21.7%) were among 25-64 year old adults, one (1.4%) was in the 15-24 year old age group and one (1.4%) was among the 1-14 year old age group (**Table 8**).

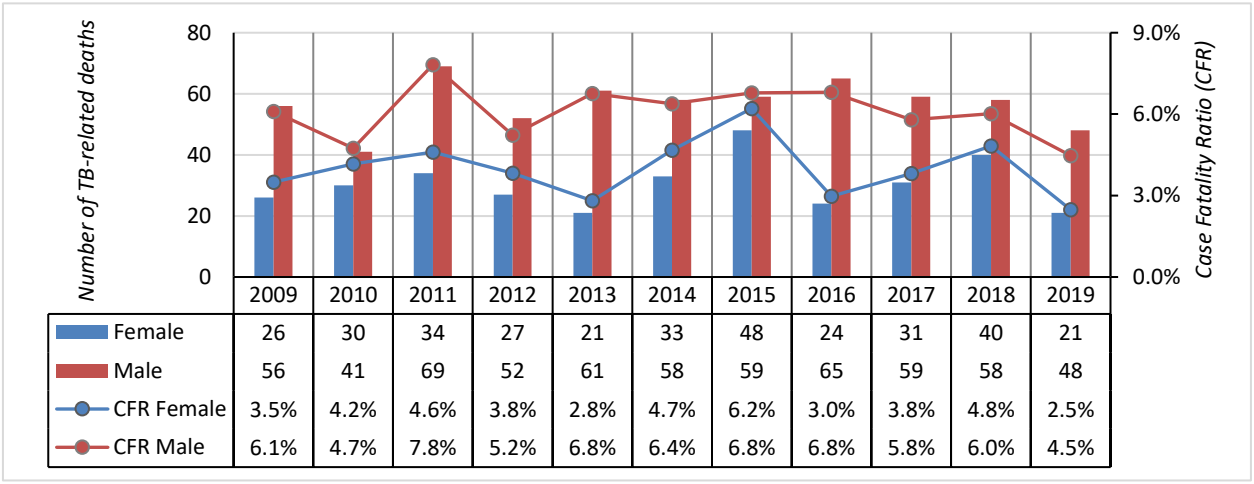
Table 9: Tuberculosis-related mortality among active TB cases by age and ethnicity/place of birth - CTBRS, 2019

	Foreign-born		Canadian-born						Unknown		Total	
			Non-Indigenous		Indigenous		Unknown if Indigenous or not					
AGE Group	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	**Male**	**Female**
1-14 years old	0 (0.0%)	0 (0.0%)	0 (0.0%	0 (0.0%	1 (1.4%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	**1 (1.4%)**	**0 (0.0%)**
15-24 years old	0 (0.0%)	1 (1.4%)	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	**0 (0.0%)**	**1 (1.4%)**
25-64 years old	8 (11.6%)	1 (1.4%)	1 (1.4%	0 (0.0%	1 (1.4%	3 (4.3%	0 (0.0%	0 (0.0%	1 (1.4%	0 (0.0%	**11 (15.9%)**	**4 (5.8%)**
65-74 years old	9 (13.0%)	0 (0.0%)	1 (1.4%	1 (1.4%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	0 (0.0%	**10 (14.5%)**	**1 (1.4%)**
75+ years old	19 (27.5%	12 (17.4%	3 (4.3%	2 (2.9%	0 (0.0%	0 (0.0%	1 (1.4%	1 (1.4%	3 (4.3%	0 (0.0%	**26 (37.7%)**	**15 (21.7%)**
Overall	**36 (52.2%**	**14 (20.3%**	**5 (7.2%**	**3 (4.3%**	**2 (2.9%**	**3 (4.3%**	**1 (1.4%**	**1 (1.4%**	**4 (5.8%**	0 (0.0%	**48 (69.6%)**	**21 (30.4%)**

Foreign-born individuals accounted for 72.5% (n=50) of all TB-related deaths (**Table 9**), compared with 21.7% (n=15) for Canadian-born, including 7.2% (n=5) Indigenous. The remaining 5.8% percent (n=4) were individuals with missing information on place of birth (**Table 9**).

Overall, TB-related mortality has been moderately higher in males compared with females over the years. After remaining stable at about 7.0% from 2013 to 2016, the case fatality rate for men steadily declined to reach 4.5% in 2019 (**Figure 12**). While TB mortality rates in women have been lower than in men, the rates have fluctuated over time with a minimum of 2.5 deaths per 100 active TB cases in 2019 and a maximum of 6.2 deaths per 100 in 2015 (**Figure 12**).

Figure 12: Tuberculosis-related mortality[3] (and case fatality rate), CTBRS: 2009-2019



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Female	26	30	34	27	21	33	48	24	31	40	21
Male	56	41	69	52	61	58	59	65	59	58	48
CFR Female	3.5%	4.2%	4.6%	3.8%	2.8%	4.7%	6.2%	3.0%	3.8%	4.8%	2.5%
CFR Male	6.1%	4.7%	7.8%	5.2%	6.8%	6.4%	6.8%	6.8%	5.8%	6.0%	4.5%

[3] TB-related mortalities defined as TB contributing to death, or TB being the underlying cause of death.

CONCLUSION

From 2010 to 2020, the overall annual incidence of active TB in Canada has remained stable. The majority of active TB cases occurred in individuals born outside Canada; however, Inuit, First Nations, and Métis communities continued to be disproportionately affected compared to Canadian-born non-Indigenous populations. Males also have had higher rates of active TB in comparison to females. Given the unknown impact of the ongoing global COVID-19 pandemic on detection and reporting of TB and other diseases, changes noted in the reported 2020 TB surveillance data should be interpreted with caution.

Achieving TB elimination as per *the End TB Strategy* of the WHO will require a multi-pronged, collaborative approach, as outlined in the 2018 Chief Public Health Officer (CPHO) report on eliminating TB in Canada (5). This report also called for sustained engagement with communities and at-risk populations by all levels of government, to tailor interventions that address social and health inequities and improve the prevention, diagnosis, treatment and monitoring of TB. In particular, ongoing collaboration and coordination of TB surveillance and programmatic responses across jurisdictions can help to:

- identify key risk factors associated with TB outbreaks in Canada,
- determine predictors of active TB for persons migrating to Canada,
- address TB comorbidities and drug-resistance,
- tailor programmatic interventions/strategies to address TB and social inequities for vulnerable populations (Indigenous Peoples and certain foreign-born populations), and
- monitor the progress of these efforts and evaluate their effectiveness.

As noted in the 2018 CPHO report on eliminating TB, solutions to this complex disease will be driven by jurisdictions and the communities themselves, with ongoing engagement from many players, including governments, academics, experts, and other stakeholders. The contribution of surveillance cannot be overemphasized; it must be customized and comprehensive to inform tailored policies and interventions across affected populations, which will help ensure elimination of TB in Canada. Although the CTBRS has limitations, enhancing timely and complete collection of data and developing more efficient data integration systems at the national, provincial and territorial levels level will help improve the quality of surveillance information and provide

meaningful data to help assess progress in addressing disproportionate impacts of TB and ultimately eliminating TB in Canada. Transforming the existing CTBRS through enhancement and integration of its other components (laboratory, drug-resistance, and the treatment outcome surveillance) would ensure that the best surveillance evidence is produced for robust TB programs and quality health care systems for vulnerable populations.

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