epiREPORT

SURVEILLANCE UPDATE: ACTIVE TUBERCULOSIS IN MANITOBA

2000-2012

Epidemiology & Surveillance Unit
Public Health

Public Health and Primary Health Care Division

Manitoba

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ABBREVIATIONS

AFB	Acid-fast Bacilli
DOT	Direct-observed therapy
DPIN	Drug Program Information Network
FN	First Nations
HIV	Human Immunodeficiency Virus
INH	Isoniazid
MB-TBSC	Manitoba Tuberculosis Steering Committee
MDR TB	Multidrug-resistant Tuberculosis
MH	Manitoba Health
MTBC	Mycobacterium tuberculosis complex
PCR	Polymerase Chain Reaction
PHAC	Public Health Agency of Canada
PPD	Purified Protein Derived
RHA	Regional Health Authority
RMP	Rifampin
TB	Tuberculosis
TST	Tuberculin Skin Technique
WHO	World Health Organization
WRHA	Winnipeg Regional Health Authority
XDR-TB	Extreme drug-resistant Tuberculosis

Acknowledgments

The *Surveillance Update: Tuberculosis in Manitoba (2000-2012)* is the result of the ongoing efforts and expertise of many dedicated individuals throughout the Province of Manitoba. Thank you for your continued dedication and support.

Let us know what you think. We appreciate your feedback! If you would like to comment on any aspect of the report, please send an email to:

outbreak@gov.mb.ca

Executive Summary

From 2000 to 2012, there were 1616 Tuberculosis (TB) cases reported to Manitoba Health. The number of cases per year ranged from 98 to 156 with an average of 125 cases per year over the 13 year span. During that same time period, the crude incidence rates of TB ranged from 9 to 13 cases per 100,000 persons. The average rate was 11 cases per 100,000 persons.

Manitoba continues to have incidence rates well above the national average. From 2001-2011, the Manitoba TB rates were almost double the national rates. For example, in 2009 Manitoba had a crude incidence rate of 13 cases per 100,000 persons compared to a national incidence rate of 5 cases per 100,000 persons. Additionally, the trends in incidence are not the same; Manitoba experienced a slight increase in TB from 2000 to 2012, whereas the TB rates across Canada showed a decreasing trend.

Over the 13-year period:

- More men than women were reported to have TB infection (men=892 cases; women=724 cases).
- The majority of TB infections were reported in adults between the ages of 15-44 with the highest number of cases in persons aged 30 to 34 years old.
- The majority of TB infections were reported in First Nation (FN) persons (n=972; 60.0%). Foreign-born individuals made up about 28% of cases (n=445) and non-FN persons made up the remainder.
- Between 2008 and 2011, over 90% of persons with TB successfully completed TB treatment.
- There was an all-cause mortality rate of 5% over the 13-year period (n=82); TB was either the underlying cause of death in 23 cases or a contributing factor to the death in 26 cases.
- Multidrug resistance was found in 7 cases over the 13-year study period: 3 cases before 2008 and 4 cases in 2010 and 2011.
- The majority of TB cases (67%) were diagnosed as ***single site respiratory*** TB, 17% were diagnosed as ***single site non-respiratory*** TB, and 14% were diagnosed as ***two sites*** TB (either respiratory sites or a combination of respiratory and non-respiratory sites).
- Approximately one-third (n=665; 38%) of the individuals with TB received an HIV test. Eight percent of these individuals tested positive for HIV virus.

There are distinct differences in TB case counts and age-standardized incidence rates by Regional Health Authority (RHA) in Manitoba. While the highest *number* of cases was reported in the Winnipeg Health Region, the highest *incidence rates* were consistently found in Northern Health Region. The incidence rates of active TB cases the Northern Health Region ranged from 26 to 106 cases per 100,000 persons and were shown to be significantly higher than the overall rates for Manitoba and all other health regions.

Introduction

Tuberculosis (TB) has been identified as one of the main causes of death from an infectious disease in the world[1]. In particular, extensively drug-resistant TB is considered one of the top five global infectious threats[2]. In 2011 there were approximately 8.7 million new cases of TB and 1.4 million deaths attributed to TB around the world[1]. Globally the burden of TB is greatest in Asia and Africa, though almost half of TB cases (40%) were located in India and China. The average incidence rate of TB in high-burden countries was 163 cases per 100,000 persons in 2011. Following a decade (1990 – 2001) of stable global incidence rates, a steadily decreasing global trend in TB has been observed since 2002. The World Health Organization (WHO) reported a 2.2% decline of global TB incidence rates between 2010 and 2011.

Canada's TB incidence rates were once similar to those noted for the Americas but dropped substantially once an effective antibiotic TB treatment was introduced in the mid-20th century[3]. During the past two decades, the overall TB incidence rates in Canada decreased from 7.0 cases per 100,000 persons in 1990 to 4.6 cases per 100,000 persons in 2010[4].

While significant progress has been made in lowering incidence rates, TB rates are still higher than expected in Canada. Over the past decades the burden of TB has become increasingly concentrated among three populations: First Nations (FN) persons, foreign-born Canadians, and socially marginalized individuals. Among the total reported TB cases in Canada, the majority were among foreign-born individuals (67%), followed by FNs (19%), and the Canadian-born non-FNs (12%)[4].

Across Canada, TB incidence rates have shown a slight increase since 2002 in FN people, from approximately 20 cases per 100,000 persons in 2000 to over 26 cases per 100,000 persons in 2010 (24 cases per 100,000 persons in 2011) nationwide. In contrast, TB incidence rates showed a gradual decline in both foreign-born populations (from close to 20 cases per 100,000 persons in 2000 to 15 cases per 100,000 persons in 2010) and Canadian-born non-FN populations (from less than 2 cases per 100,000 persons in 2000 to 0.7 cases per 100,000 persons in 2010).

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[1] WHO. Global tuberculosis report 2012. Geneva. Switzerland: WHO; 2012.
[2] Christian et al. What we are watching – five top global infectious disease threats, 2012: a perspective from CDC's Global Disease Detection Operations Center. Emerging Health Threats Journal, 2013, 6:20632.
[3] Halverson et al. Epidemiology of Tuberculosis in Canada. Can Respir J, 2013, 20 (suppl A): 4A-8A.
[4] Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012.

Manitoba's experience with TB is in contrast with the declining global and national rates. For example, FN people living in the Canadian Prairies have experienced an increase in TB infections, especially in the communities North of the 53rd parallel[5]. In a study of 11 FN communities in northern Manitoba, the TB incidence rates were greater than 300 cases per 100,000 persons. This is significantly higher than the Canadian incidence rate that is approximately 5 cases per 100,000 persons. There remains limited information on the baseline trends of TB rates in Manitoba by risk factors and sub-populations.

This report focuses on **Manitoba's experience with TB[6] from 2000-2012**. The overarching goal of this report is to provide accurate information on the current epidemiology and trends of TB in Manitoba, with a view to informing TB prevention and management programs in Manitoba. The specific objectives are as follows:

1. To provide a baseline and overview of current TB epidemiology and risk factors of TB in Manitoba by:
    a. analyzing the trends of TB infections in Manitoba and at regional level; and
    b. describing the demographic and geographic characteristics of TB cases in Manitoba.
2. To examine the role of geographic or demographic characteristics as risk factors in the spread of TB over time.

[5] Long et al. Marked disparity in the epidemiology of tuberculosis among Aboriginal peoples on the Canadian prairies: The challenges and opportunities. Can Respir J, 2013, 20 (4): 223-230.
[6] This report focuses only on **active TB** which will be described as "TB" throughout the report and the terms "case" and "disease" are used interchangeably.

Methodology

In Manitoba, Tuberculosis is a Schedule A disease under *The Public Health Act Reporting of Diseases and Conditions Regulations*[7]; both health care professionals and laboratories are required to complete a report to Manitoba Health under these conditions:

- **Physician/Health Care Professional**
  - Any case that has been confirmed by culture, TB Probe or Polymerase Chain Reaction (PCR) (i.e., laboratory-confirmed cases)
  - Clinically-confirmed cases
  - Cases that have been committed to treatment (whether laboratory-confirmed or not)
  - Contacts of cases with infectious TB disease
- **Laboratories**
  - All clinical specimens smear positive for acid-fast bacilli (AFB)
  - All clinical specimens culture positive for mycobacterium tuberculosis complex (MTBC)
  - All pathology sample findings suggestive of TB disease

Manitoba Health maintains the provincial TB Registry which captures essential demographic information, bacteriology and x-ray results, course and outcome of treatment, and identified drug sensitivities.

The methods, including case definitions, used in this report are described below. All data in this report were extracted from the TB Registry on June 10, 2013.

Case definitions

TB Case

TB cases can be either lab-confirmed or clinically diagnosed. Both lab-confirmed and clinically diagnosed TB cases are included in this report.

The diagnostic classification of tuberculosis is based upon the ICD-9[8] code. For this report, TB cases were divided into two broad categories (respiratory and non-respiratory) based on the main diagnostic sites[9]. Additionally, the case was counted as pulmonary TB if the smear results, sputum culture, bronchial wash or gastric wash

[7] Manitoba Health Communicable Disease Control. Manitoba Tuberculosis Protocol. January 2014.
[8] International Classification of Diseases, 9th Edition.

cultures were positive; this classification is consistent with the Public Health Agency of Canada (2012) and is applied regardless of ICD site designation.

Table 1: Tuberculosis Classifications by Sub-Type and ICD-9 Code

TB	Sub-type	ICD-9
Respiratory	Primary	010, 010.0 – 010.9
	Pulmonary [10]	011, 011.0 – 011.9 012.2, 012.3
	Other respiratory	012.0, 012.1, 012.8
Non-respiratory	Miliary	018, 018.0-018.9
	Central nervous system	013, 013.0-013.9
	Peripheral lymph nodes	017.2
	Other sites	014, 014.0-014.8 015, 015.0-015.9 016, 016.0-016.9 017, 017.0-017.1, 017.3-017.8

Case Mortality Rate

Case mortality rate is the proportion of deaths in the TB cases between 2000 and 2012. The all-cause case mortality rates as well as the TB-attributable case mortality rates were calculated.

Treatment Outcomes

1) ***Treatment success***: If persons with TB disease completed the two-phase regimen of treatment[11] and cleared all symptoms and/or had a mycobacterium tuberculosis complex (MTBC) negative sputum culture, then they were considered a "treatment success".
2) ***Multidrug-resistant (MDR) TB***: MDR-TB is defined as a strain of TB that is resistant to at least two drugs such as isoniazid (INH) and rifampin (RMP), with or without resistance to other first-line drugs. Extreme drug-resistant (XDR-

[9] If one TB case has more than one diagnostic site or the ICD9 codes, one main diagnostic site is assigned and TB cases count is based on main diagnostic site according to PHAC hierarchy TB standard.
[10] PHAC, Tuberculosis in Canada 2011, Miliary cases with smear positive results were grouped into pulmonary TB.
[11] Treatment is a two-phase anti-tuberculosis medication treatment regimen which includes (a) initial/intensive phase of a two-month of three or four anti-tuberculosis medications administered daily, at least initially by direct-observed therapy (DOT); and (b) continuation phase of four to seven-month of at least two anti-tuberculosis medications administered either daily by DOT or at a higher doses two or three times weekly by DOT.

TB) strains of TB are resistant to INH, RMP, and any fluoroquinolone and at least one of three injectable "second-line" medications (e.g., amikacin).

First Nations Identifier

The FN identifier in the TB registry is particular to those individuals who self declare as First Nations and have this declaration verified. Throughout the TB assessment and treatment process, there are a number of stages where information, including that of on or off-reserve status, is provided by the individual and verified by the public health or clinic nurse. As there are multiple contact points, this information is rarely incomplete. Six individuals that self-identified **b**ut were not verified were excluded from FN analysis. The FN variable was used to group TB cases by "FN on-reserve" and "FN off-reserve" at time of diagnosis.

Foreign-born Canadian Identifier

The foreign-born identifier was also collected by public health nurses, clinicians and clinic nurses. It is reported as a single variable. This variable includes immigrants and refugees. Records with missing birth country data were investigated by public health nurses and data were added based on TB case investigation and notification form.

Data Sources

Manitoba TB Registry

Laboratory-confirmed and clinically-diagnosed cases are sent to the Manitoba Health Public Health Branch Surveillance Unit where data is entered into the TB Registry database. Collation and finalization of provincial data is an iterative process. Prior to the data entry process, data are checked and duplicates are identified. The duplicated or questionable cases are returned to the Health Regions which in turn provide feedback to MH before finalization. This process ensures complete and accurate data. Once data is verified, cases are assigned unique identifying numbers.

The TB Registry collects the following information about each person diagnosed with TB disease:

- ICD-9 code(s) according to physicians' diagnoses and disease sites
- demographic characteristics
- geographic region
- detection method

- lab test results (AFB smear test, MTBC culture test, Drug Susceptibility Test (DST)
- HIV test
- 12-locus MIRU-VNTR genotyping result
- X-ray examination result
- other relevant clinical therapy and management information

A multitude of documents are used to inform the TB Registry. Health care providers, laboratories, and RHAs provide documents such as:

- TB notification reports
- lab reports
- medical records
- case investigation results
- case management and treatment summaries
- prescriptions
- contact lists
- contact investigation documents

Furthermore, TB prescription data is submitted to the Provincial Drug Program Information Network (DPIN)[12]. The drug data and TB registry data are reconciled to ensure all treated persons with TB disease and individuals with TB prophylactic treatment are recorded in the TB Registry database.

Manitoba Population Data

The Manitoba population data was generated based on Manitoba Health insurance registry. Manitoba population data for the mid-year point of each year at provincial, regional health authorities, and First Nation (Flag) level were provided by Manitoba Health's *Health Information Management* Branch.

As noted previously, only individuals who have self-declared their First Nations status to Manitoba Health when registering for coverage (or updating their registration) were included in the FN populations. As a result, Manitoba Health's First Nation populations are known to undercount the actual number of First Nations residents of Manitoba when compared to First Nations population information from more comprehensive sources. Only First Nations individuals who are analytically determined to reside on reserve land belonging to the First Nation to which they

[12] DPIN is an electronic, online, point-of-sale prescription drug database containing records for all prescription drugs dispensed within Manitoba (with some exclusions). DPIN is comprehensive for all Manitobans and all classes of prescription drugs.

belong are identified as *FN on-reserve.* FN off-reserve may include First Nations individuals living on a reserve other than their home reserve.

Statistical analysis

Annual tuberculosis incidence rates were calculated by dividing the total number of cases by the total mid-year population or to the relevant sub-population of Manitoba corresponding to the same time period. All calculated rates were directly age-standardized to the Manitoba population in 2000 to minimize the effect of age structure variations among the population. Ninety-five per cent confidence intervals for all age-standardized rates were calculated based on the gamma distribution[13].

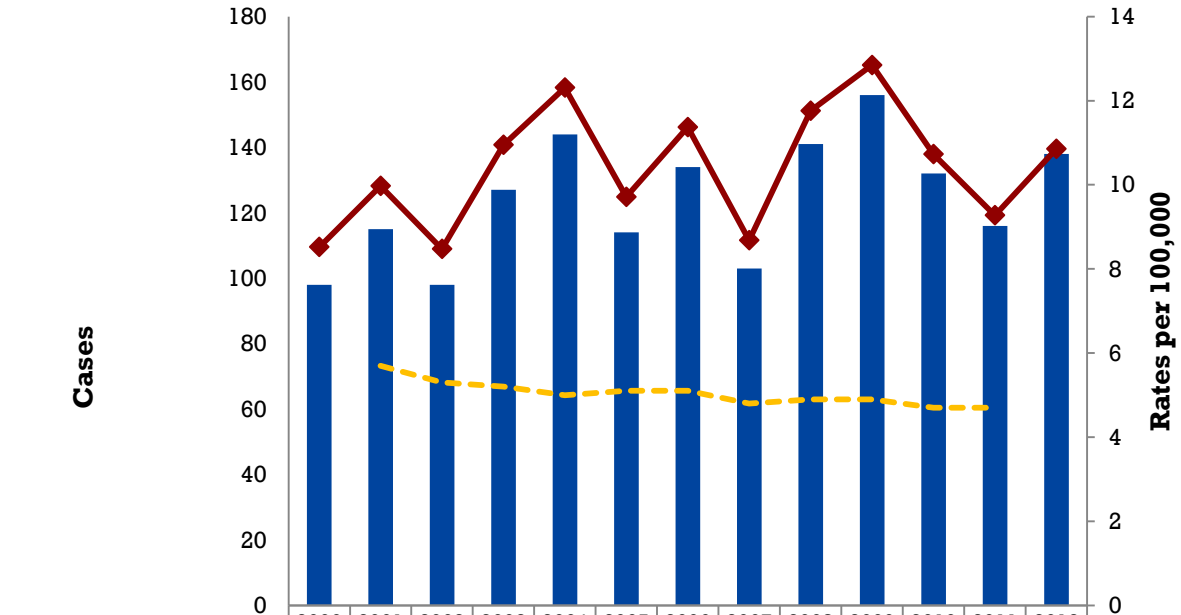
[13] Fay & Feuer, Confidence intervals for directly standardized rates: a method based on the gamma distribution, Statistics in Medicine, 1997, 16,791-801.

Results

Incidence

From 2000 to 2012, there were 1616 TB cases reported to Manitoba Health. The number of cases per year ranged from 98 to 156, with an average of 124.3 cases per year over the 13-year span. During that same time period, the crude incidence rates of TB ranged from 8.5 to 12.8 cases per 100,000 persons. The average rate was 10.4 cases per 100,000 persons.

From 2000-2012, the Manitoba TB rates have consistently been about *double* the national rates (Figure 1). For example, in 2009 Manitoba had a crude incidence rate of 12.8 per 100,000 persons compared to a national average of 4.9 cases per 100 000 persons. When comparing Manitoba and Canada, the trends in incidence rates have not been the same; Manitoba experienced a slight increase in TB rates from 2000 to 2012 whereas the TB rates across Canada showed a gradual decrease over the same period.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
MB TB Case Counts	98	115	98	127	144	114	134	103	141	156	132	116	138
MB Crude Rates	8.5	10.0	8.5	11.0	12.3	9.7	11.4	8.7	11.8	12.8	10.7	9.3	10.9
CDA Crude Rates		5.7	5.3	5.2	5.0	5.1	5.1	4.8	4.9	4.9	4.7	4.7	

Figure 1: Number of TB cases per 100,000 persons in Manitoba and Canada (2000-2011)

Regional Health Authority

There are distinct differences in TB case counts and age-standardized incidence rates by regional health authority. While the highest *number* of cases was reported in the Winnipeg Health Region, the highest *incidence* rates were consistently found in Northern Health Region. Combined, the Northern and Winnipeg Regional Health Authorities reported about nine out of ten of the province's TB.

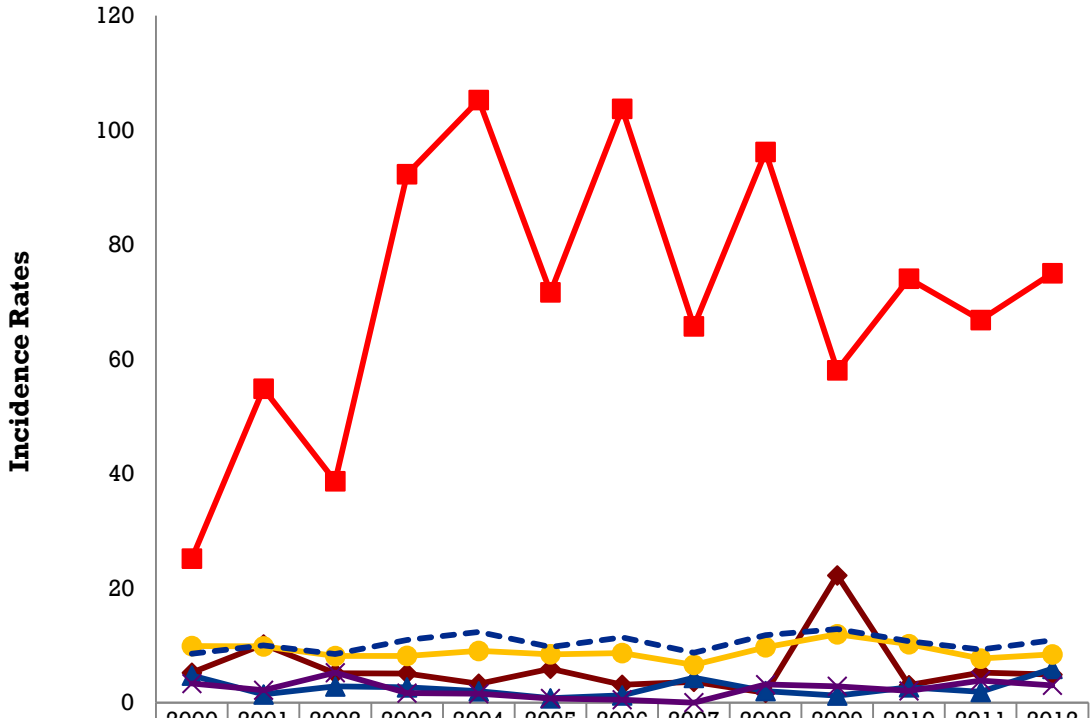
In the North, incidence rates were shown to be significantly higher than the overall rates of Manitoba as well as in comparison to each of the other health regions. In the Northern Health Region, incidence rates ranged from 25.1 to 105.2 per 100,000 persons (2000-2012) (see Table 2).

Table 2: Case counts and age-standardized incidence rates (cases per 100,000 persons) with 95 % confidence intervals by Regional Health Authority, Manitoba (2000-2012)

	Interlake Eastern		Northern		Southern		Prairie Mountain		Winnipeg	
	Cases	Age-Standardized	Cases	Age-Standardized	Cases	Age-Standardized	Cases	Age-Standardized	Cases	Age-Standardized
2000	6	5.2 (1.9- 11.7)	13	25.1 (12.1- 51.6)	7	4.7 (1.9-9.8)	6	3.3 (1.2-7.6)	66	9.9 (7.6-12.6)
2001	12	10.1 (5.2- 18.2)	31	54.8 (33.7-88.4)	2	1.4 (0.2-5.1)	4	2.2 (0.6-6.0)	66	9.8 (7.6-12.5)
2002	6	5.1 (1.9- 11.7)	26	38.7 (23.7-65.4)	4	2.8 (0.8-7.3)	8	5.2 (2.2-10.6)	54	8.1 (6.1- 10.6)
2003	6	5.1 (1.8- 11.8)	59	92.3 (68.6-126.6)	4	2.7 (0.7-7.0)	3	1.7 (0.3- 5.4)	55	8.2 (6.1-10.7)
2004	4	3.3 (0.9- 9.2)	73	105.2 (80.6- 140.4)	3	2.0 (0.4-6.0)	3	1.5 (0.3-5.3)	61	9.0 (6.9-11.6)
2005	7	5.9 (2.3- 12.9)	47	71.7 (50.4- 104.3)	1	0.7 (0.0-4.1)	1	0.7 (0.0-4.3)	58	8.4 (6.4-11.0)
2006	4	3.1 (0.8-8.9)	68	103.7 (78.0- 140.2)	2	1.2 (0.2-4.8)	1	0.5 (0.0-3.8)	59	8.6 (6.6-11.2)
2007	4	3.6 (1.0- 9.9)	46	65.7 (47.4-95.0)	7	4.3 (1.7-9.2)	0	0.0 (0.0-3.1)	46	6.6 (4.8-8.9)
2008	2	1.7 (0.2-7.0)	65	96.2 (73.2-129.6)	3	2.0 (0.4-6.1)	5	3.1 (1.0-7.8)	66	9.7 (7.5-12.4)
2009	23	22.2 (14.0-33.8)	40	58.0 (40.8-86.2)	2	1.2 (0.1-4.8)	5	2.8 (0.9-7.2)	86	11.9 (9.5-14.8)
2010	3	3.0 (0.6- 9.2)	48	74.0 (53.1-105.9)	5	2.7 (0.9-6.6)	4	2.0 (0.5-5.9)	72	10.2 (8.0-12.9)
2011	5	5.2 (1.7- 12.5)	45	66.8 (47.6-96.7)	3	1.9 (0.4-5.7)	6	3.9 (1.4-8.7)	57	7.7 (5.8-10.0)
2012	5	4.9 (1.5- 11.9)	56	75.0 (56.0-103.9)	11	5.9 (2.9-10.8)	4	3.0 (0.8-7.7)	62	8.4 (6.4-10.9)
Total	**87**		**617**		**54**		**50**		**808**	

Note: * adjusted to the mid-year Manitoba population in 2000.

After age standardization[14], the highest incidence rates were still consistently found in the Northern Health Region (range 25.1 to 104 cases per 100,000 persons), persistently higher than the Manitoba overall rates (8.5 to 13 cases per 100,000 persons) and other Health Regions. In the Northern Health Region, the incidence rates peaked around 2004 (105 TB cases per 100,000 persons) and fluctuated from 2004 to 2011 (72 to 75 TB cases per 100,000 persons).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Interlake Eastern	5.2	10.1	5.1	5.1	3.3	5.9	3.1	3.6	1.7	22.2	3.0	5.2	4.9
Northern	25.1	54.8	38.7	92.3	105.2	71.7	103.7	65.7	96.2	58.0	74.0	66.8	75.0
Southern	4.7	1.4	2.8	2.7	2.0	0.7	1.2	4.3	2.0	1.2	2.7	1.9	5.9
Prairie Mountain	3.3	2.2	5.2	1.7	1.5	0.7	0.5	0.0	3.1	2.8	2.0	3.9	3.0
Winnipeg	9.9	9.8	8.1	8.2	9.0	8.4	8.6	6.6	9.7	11.9	10.2	7.7	8.4
Manitoba	8.5	10.0	8.5	11.0	12.3	9.7	11.4	8.7	11.8	12.8	10.7	9.3	10.9

Figure 2: Age-standardized TB incidence rates (cases per 100,000 persons) by RHA (2000-2012)

[14] Age-standardization is a calculation made to statistically control for different age distributions among groups. We use age-standardization to ensure that the rates for all groups can be fairly compared. The adjusted values are those that the group would have had if their age distribution was the same as for a standard population, which is usually the Manitoba population.

Sex

Males had both higher case counts as well as higher incidence rates of TB than did females.

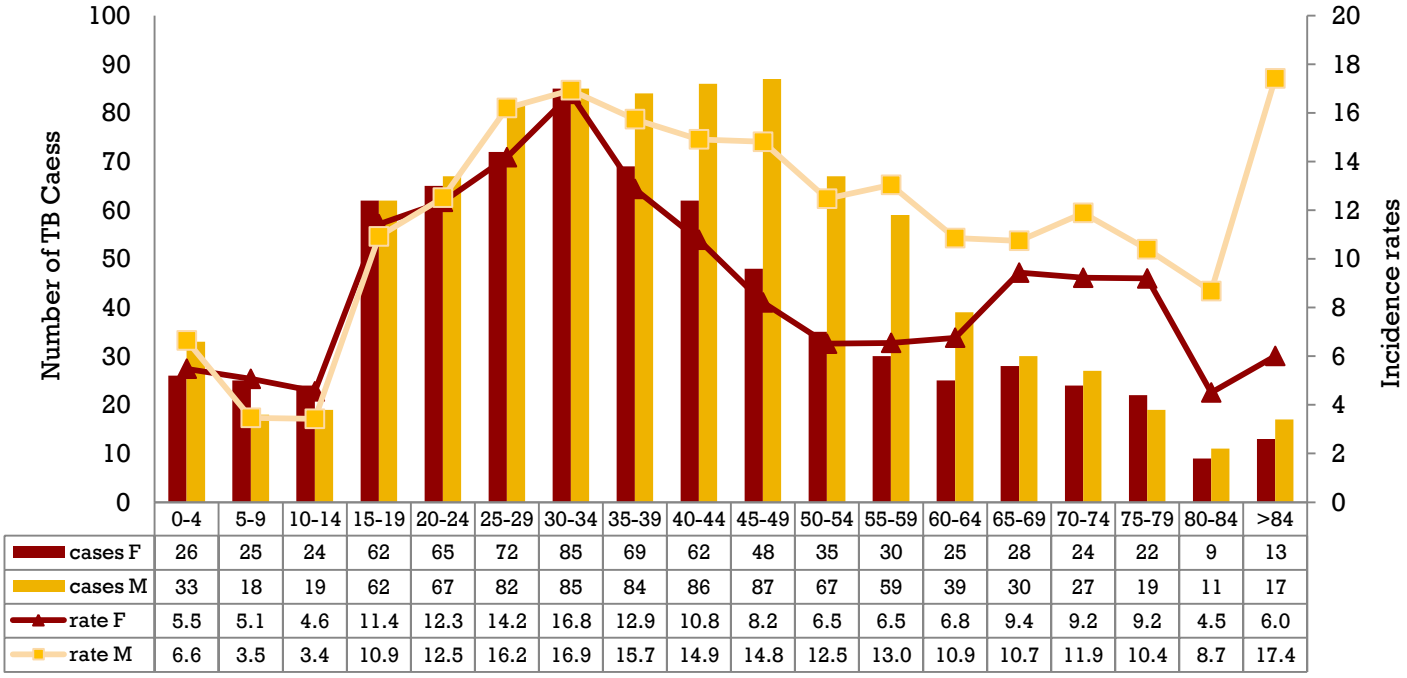
Table 3: Annual crude and age-standardized TB incidence rates (cases per 100,000 persons) by sex in Manitoba, 2000 – 2012

	Males			Females		
Year	**Cases**	**Crude rate**	**Adjusted rate (95% CI)**	**Cases**	**Crude rate**	**Adjusted rate (95% CI)**
2000	57	10.1	10.3 (7.8, 13.5)	41	7.0	6.9 (5.0, 9.4)
2001	61	10.7	11.0 (8.4, 14.2)	54	9.2	9.3 (7.0, 12.2)
2002	51	9.0	9.0 (6.7, 12.0)	47	8.0	8.1 (5.9, 10.7)
2003	73	12.8	12.8 (10.0, 16.1)	54	9.2	9.4 (7.1, 12.3)
2004	70	12.1	12.2 (9.5, 15.5)	74	12.5	12.8 (10.1, 16.2)
2005	66	11.4	11.3 (8.7, 14.5)	48	8.1	8.2 (6.0, 10.9)
2006	79	13.6	13.7 (10.8, 17.1)	55	9.2	9.4 (7.0, 12.2)
2007	62	10.6	10.6 (8.1, 13.7)	41	6.8	6.9 (4.9, 9.4)
2008	86	14.6	14.6 (11.7, 18.2)	55	9.0	9.6 (7.2, 12.5)
2009	87	14.5	14.6 (11.7, 18.1)	69	11.2	11.7 (9.1, 14.9)
2010	71	11.7	12.0 (9.4, 15.2)	61	9.8	10.0 (7.6, 12.9)
2011	57	9.2	9.2 (7.0, 12.0)	59	9.3	9.3 (7.1, 12.1)
2012	72	11.4	11.3 (8.8, 14.3)	66	10.3	10.5 (8.1, 13.4)

Note: Rates are age-standardized to Manitoba's mid-year population in 2000.

Age

The average age of TB cases was 39.1 years, with men being on average older (40.2 years) than women (37.8 years). The median age of TB cases was 35.0 years for women and 39.0 years for men. The age distribution for males with TB was different than that of females with TB (Figure 2). Males from age 20 years to 74 years had higher numbers of cases as well as higher incidence rates in comparison to women.



	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	>84
cases F	26	25	24	62	65	72	85	69	62	48	35	30	25	28	24	22	9	13
cases M	33	18	19	62	67	82	85	84	86	87	67	59	39	30	27	19	11	17
rate F	5.5	5.1	4.6	11.4	12.3	14.2	16.8	12.9	10.8	8.2	6.5	6.5	6.8	9.4	9.2	9.2	4.5	6.0
rate M	6.6	3.5	3.4	10.9	12.5	16.2	16.9	15.7	14.9	14.8	12.5	13.0	10.9	10.7	11.9	10.4	8.7	17.4

Figure 3: TB cases and average TB incidence rates in Manitoba by age and sex, 2000-2012

More information on demographic characteristics of TB cases in Manitoba can be found in Appendix B.

Diagnosis Site

Of the total TB cases (N=1616), approximately two-thirds (n=1081, 66.9%) were diagnosed as *single site respiratory TB;* 277 cases (17.1%) were diagnosed as *single site non-respiratory TB*; 225 cases (13.9%) were diagnosed with *dual diagnoses*; and a small proportion of TB cases (n=33, 2.0%) were diagnosed with *multiple site* TB (more than two sites).

Table 4: Number and proportion (%) of TB cases by diagnosis site in Manitoba, 2000-2012

Clinical feature		Cases	% of total
Single diagnosis: respiratory	Primary	118	7.3
	Pulmonary	818	50.6
	Other Respiratory	145	9.0
	Sum	1081	66.9
Single diagnosis: non-respiratory	CNS	8	0.5
	Miliary	13	0.8
	Peripheral Lymph Nodes	149	9.2
	Other	107	6.6
	Sum	277	17.1
Dual diagnoses	Two Respiratory	106	6.6
	Two non-Respiratory	9	0.6
	Respiratory and non-Respiratory	110	6.8
	Sum	225	13.9
Multiple diagnoses	Sum	33	2.0
Total		**1616**	**100**

About eight out of ten people with TB have "respiratory TB." Respiratory TB is most frequently found in the age group 25-44 years (31% of total TB cases). Slightly more men than women have respiratory TB (767 vs. 555) (Table 5). About two-thirds (63%) of the respiratory TB cases were reported in FN populations.

Conversely, among the smaller sample of people with non-respiratory TB (n=294), slightly more women than men have the disease (169 vs. 125). About half of the non-respiratory TB cases were reported in foreign-born individuals.

Table 5: Demographics of Non-Respiratory and Respiratory TB Cases in Manitoba, 2000-2012

Demographic Characteristics	**Non-respiratory**	**Respiratory**	**Total**
	Cases (%)	Cases (%)	Cases (%)
Total	**294 (18.2)**	**1322 (81.8)**	**1616 (100)**
Sex			
Female	169 (57.5)	555 (42.0)	724 (44.0)
Male	125 (42.5)	767 (58.0)	892 (56.0)
Age Groups			
0-14	12 (4.1)	133 10.1)	145 (9.0)
15-24	46 (15.6)	210 (15.9)	256 (16.0)
25-44	117 (39.8)	508 (38.4)	625 (38.0)
45-64	80 (27.2)	310 (23.4)	390 (24.0)
>=65	39 (13.3)	161 (12.2)	200 (12.0)
Origin*			
Canadian-born non-FN	45 (15.3)	177 (13.4)	222 (13.7)
Foreign-born Canadian	139 (47.3)	306 (23.1)	445 (27.5)
FN	109 (37.1)	838 (63.4)	947 (58.6)
Missing	1 (0.3)	1 (0.1)	2 (0.1)

*data missing for 2 cases

Country of Birth

This report focused on three populations by country of birth: foreign-born Canadians, FN people, and Canadian born non-FN people. The proportional distribution of TB cases varied across these populations.

In 2000 about one in four (27%) people with TB were Canadian-born non-FN, and by 2012, this proportion had decreased to 7%.

The proportion of foreign-born individuals with TB was slightly more stable: from 33% in 2000 to 18% in 2006 and back to 33% in 2012. Because we do not have the total number of foreign-born persons in Manitoba to provide denominator data, it is not possible to calculate incidence rates of TB infections for that sub-population. However, the proportion of TB cases that were FN (either on or off reserve) has continuously increased from a 51% in 2000 to a high of 61% in 2012 (see Figure 4 and Appendix D).

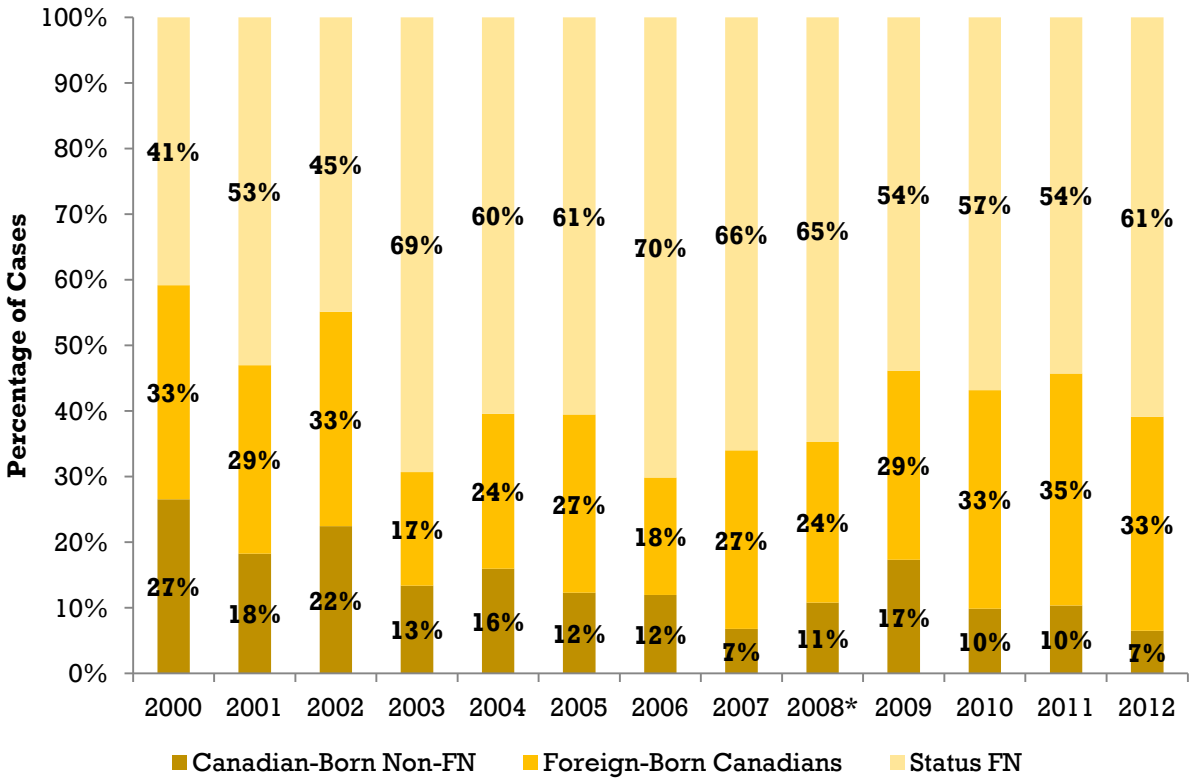


Figure 4: Percentage of TB cases by population group in Manitoba, 2000-2012

Among the total foreign born TB cases (n=445), over half (51%) of them were from Western Pacific region (Figure 5). About two in ten cases were originally from Africa and about one in ten cases from South-East Asia.

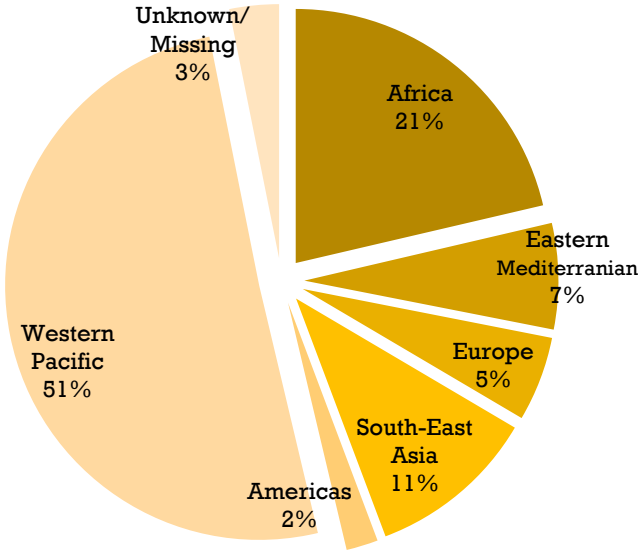
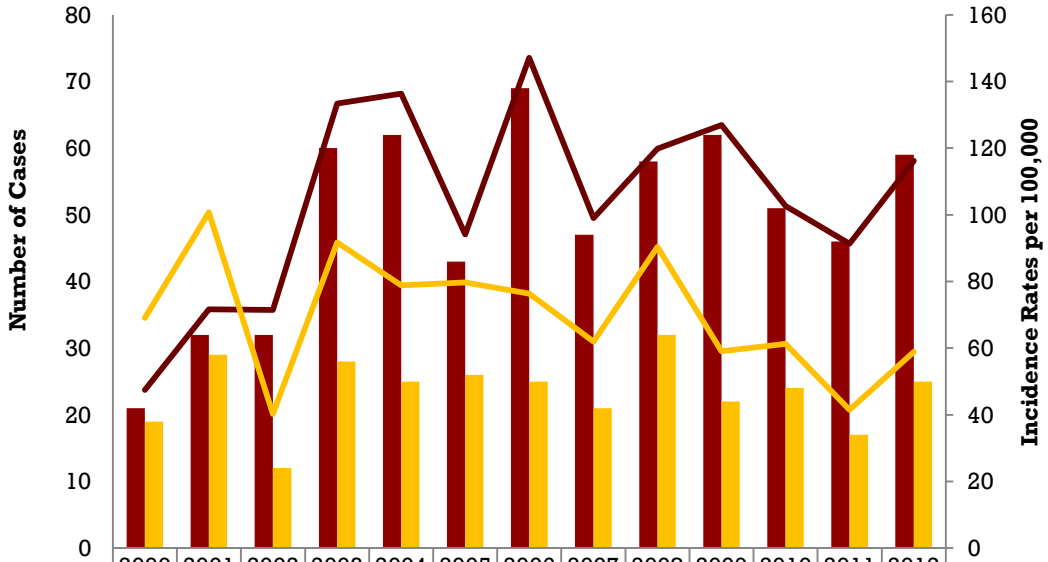


Figure 5: Region of origin for foreign-born TB cases Manitoba, 2000-2012 (n=445)

FN community (on or off-reserve)

Both on- and off-reserve FN communities had high incidence rates of TB diseases (Figure 6). These rates are higher than both the provincial and national population incidence rates. On average there were 23 and 49 TB cases per year among off-reserve and on-reserve First Nations people respectively, for a total of 947 cases during the 13-year period. This accounted for 59% of the total TB cases (N=1616) in Manitoba.

The crude incidence rates of TB within the First Nations on-reserve population were consistently higher compared to those in the off-reserve First Nations population, from 2003 to 2012. The incidence rates in the on-reserve First Nations population were highest at 147 cases per 100,000 persons in 2006, and then fluctuated between 91 and 116 cases per 100,000 persons in later years (e.g, 2011-2012). The incidence rates of TB in the off-reserve First Nations population was highest in 2001 at 101 cases per 100,000 persons, and then fluctuated between 40 and 90 cases per 100,000 persons. There was an apparent downward trend from 2003 to 2012 and further monitoring will be useful to evaluate if this trend will be sustained.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
On-Reserve Cases	21	32	32	60	62	43	69	47	58	62	51	46	59
Off-Reserve Cases	19	29	12	28	25	26	25	21	32	22	24	17	25
On-Reserve Rates	47.5	71.6	71.5	133.4	136.4	94.1	147.1	99.0	119.8	127.0	102.6	91.3	116.2
Off-Reserve Rates	69.0	100.8	40.2	91.7	78.9	79.7	76.4	61.9	90.3	59.1	61.2	41.5	58.9

Figure 6: Tuberculosis Cases and Crude Rates in FN Populations in Manitoba (2000-2012)

HIV Status

Over the 13-year period, 665 (41%) of the TB cases had the results of an HIV test recorded in the TB Registry. Of those 665 individuals, 54 tested positive for HIV (8% of tested cases). Among the TB cases, HIV testing rates varied from 17% to 77% during the report period (Figure 7).

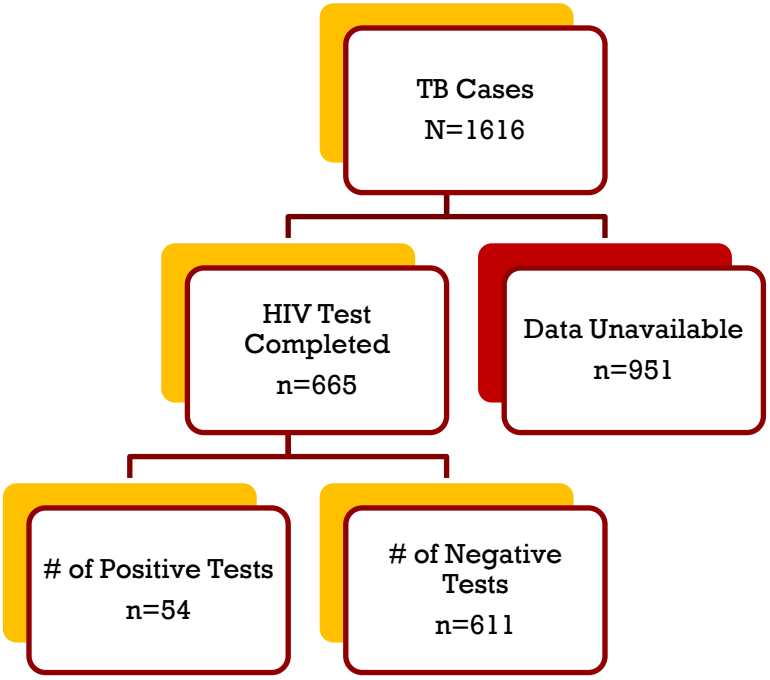


Figure 7: HIV Status of the TB Cases tested for HIV (n=665)

Of the 54 people with active TB who tested positive for HIV, 42% (n=23) were foreign-born, 45% (n=22) were FN (on or off-reserve), and 13% (n=7) were Canadian-born non-FN (data not shown).

Treatment Outcomes and All-cause Mortality

Complete TB treatment data was available for the four year period from 2008-2011[15]. The treatment outcomes analyses were based on this period.

From 2008 to 2011, over 90% of persons with TB were considered "treatment successes" (Table 6). This success rate was consistent over the four year period and was also consistent with the national success rate (2011 national success rate= 89%)[2].

Table 6: Treatment outcomes of persons with TB in Manitoba, 2008-2011

	Treatment Success		Ongoing Treatment		Deaths		Other*	
Year	Cases	%	Cases	%	Cases	%	Cases	%
2008	128	90.8	0	0.0	6	4.3	7	5.0
2009	144	92.3	0	0.0	10	6.4	2	1.3
2010	122	92.4	1	0.8	5	3.8	4	3.0
2011	103	88.8	1	0.9	11	9.5	1	0.9
Total	497	91.2	2	0.4	32	5.9	14	2.6

* "Other" includes data unknown or missing, treatment absconded or moved to new jurisdiction.

Seven cases of multidrug-resistant (MDR) TB were identified over the 13-year study period; 3 cases before 2008 and 4 cases in 2010 and 2011. All seven cases were identified in individuals who were foreign-born. Of the seven MDR cases, six were diagnosed as respiratory TB. One case was also identified as Extensive Drug Resistance TB (XDR-TB).

Case mortality data was available for the entire period. From 2000-2012, 82 people with TB died before or during treatment resulting in an all-cause case mortality rate of 5%. TB was attributable to 60% of those deaths as either the underlying cause (28%) or a contributing cause (32%). (More data on mortality can be found in Appendix E.)

[15] About half of the 2012's cases with TB were still undergoing treatment. Data for 2012 was not included in the analysis as it was considered "incomplete."

Discussion

The objective of this report is to provide information on the demographic and epidemiologic characteristics and geographic trends of TB disease at both the provincial level and in populations of greater interest and to advise evidenced-based program planning and policy in Manitoba. The discussion highlights five areas for future consideration.

1. Trends of TB infections

Between 2000 and 2012, Manitoba had TB incidence rates above the national average; Manitoba's incidence rates were 2 to 2.5 times the national rates from 2001 to 2011. Additionally, Manitoba experienced a slightly increasing trend of TB infections from 2000 to 2012, whereas the TB rates across Canada showed a decreasing trend.

In Manitoba, there are distinct differences in TB case counts and age-standardized incidence rates by regional health authority in Manitoba. Most notably were the incidence rates found in the Northern Health Region. Here, incidence rates of TB in the Northern Health Region were comparable to those (42 – 118 cases per 100,000 persons) of Brazil, China, Russian Federation, and Nigeria, and just slightly lower than those (169-993 cases per 100,000 persons) of other TB high-burden countries (countries in Southeast Asia, the Middle East and Africa)[1]. In Manitoba, the TB rates in Northern Health Region were higher than all of the other health regions.

2. TB High-Risk Populations in Manitoba

PHAC reported that TB rates in FN people were almost six times that of the general Canadian population[4]. In Manitoba, the same trend was evident as the conservative estimate indicated that six in ten TB cases were reported to be in FN people. Additionally, the rates of TB in on-reserve FN persons were 0.7 to 2.2 times higher than those of off-reserve FN persons, and 6 to 13 times those of the general population in Manitoba.

The reasons behind the higher incidence of TB in FN communities are not very clear. TB registry data alone cannot provide evidence as to why FN persons experience higher rates than the general population. Previous studies have proposed that housing, access to health care, difference in circulating strains, presence of comorbidities, etc, all play a role. Because of the size of the FN population (recent provincial estimates indicating approximately 50,000 on-

reserve and 42,000 off-reserve FN people) and the higher rates of morbidities (e.g. diabetes) [16,17,18], gaining more insight into a crucial issue.

Proportional data of TB counts showed that foreign-born Canadians and refugees were also at higher risk. In 2000, about one-third of TB cases were reported in foreign-born individuals. This proportion dropped to 17% in 2006 and returned to 33% in 2012. The data that shows stable TB rates among foreign-born persons indicates that the screening of new immigrants and refugees is consistent.

Communicable disease research often refers to "core groups" or at risk communities to describe a small subset of the population characterized as having increased burden of certain communicable diseases or higher risk for acquiring certain communicable diseases[19],[20],[21]. It is important to understand the function of core groups/communities to better understand transmission. While core groups/communities can be determined by geographic areas, they can also be defined by risk level. In Manitoba, the persons with active TB infections in either the FN population (on or off-Reserve), or the foreign-born Canadians and those in the Northern Health Region fit the core group/community definition[22]. Creating targeted interventions for different core groups/communities has been an approach used by the TB Management and Control in Manitoba[6], Canada[23] and around the world[24].

A better understanding of the similarities and differences between high risk "core groups/communities" is necessary. One molecular epidemiological study reported that the FN and foreign-born cases in Manitoba can be clustered

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[16] Manitoba Health. Diabetes in Manitoba 1989 to 2006 – Report of Diabetes Surveillance, 2009. https://www.gov.mb.ca/health/primarycare/diabetes/docs/diabetes100.pdf.

[17] Yu et al, Epidemiology of lower-limb amputations in the diabetic compared to non-diabetic controls: A Manitoba population-based study. Canadian Public Health Association annual meeting, 2010.

[18] Manitoba Health (unpublished internal report), Burden of Diabetes in Manitoba, Manitoba Health. 2010.

[19] Garcia-Garcia et al, The role of core groups in transmitting Mycobacterium tuberculosis in a high prevalence community in Southern Mexico. Int J Tuberc Lung Dis, 1999, 4(1):12-17.

[20] Blanchard et al, The Evolving epidemiology of Chlamydia and Gonococcal infections in response to control programs in Winnipeg, Canada. Am J Public Health, 1998, 88(10): 1496-1502.

[21] Oren et al, Area-based socio-economic disadvantage and tuberculosis incidence. Int J Tuberc Lung Dis, 2012, 16(7):880-885.

[22] Roghenbert & Voigt. Epidemiologic aspects of control of penicillinase-producing Neisseria gonorrhoease. Sex Transm. Dis, 1988, 15:211-216.

[23] PHAC. Guidance for tuberculosis prevention and control programs in Canada. 2012. http://publications.gc.ca/collections/collection_2013/aspc-phac/HP40-81-2013-eng.pdf

[24] WHO. Guidelines on tuberculosis. http://www.who.int/publications/guidelines/tuberculosis/en/

into two separate groups based on TB strain[25]. Recent DNA analysis further confirm the existing of different TB DNA strains among FN and foreign-born TB cases (data not shown). Genetic differences could affect transmission and potentially explain a portion of the higher incidence in certain populations. TB genotyping analysis has shown different patterns between strains identified in foreign-born persons clustered mainly in Winnipeg and strains identified in cases from the northern regions. Ongoing research in this field is of great interest.

3. Respiratory versus Non-Respiratory TB

Respiratory TB was shown to be most common in Manitoba; eight out of ten TB cases were classified as "respiratory. In order to better understand the implications of respiratory and non-respiratory TB in different populations, there will be considerable attention paid to current research. For example, research has shown a significant association between the number of people living in a residential dwelling and the presence of self-reported TB in that dwelling[26]. If built environment emerges as a significant issue to consider, qualitative and quantitative data will be required to provide baseline information on housing conditions in the province, by region, and by populations of interest.

4. HIV Testing in TB Cases

Over the thirteen year period, an average of four in ten TB cases had record of an HIV test in the TB Registry. The proportion of those having record of an HIV test did change over time from a low of one in ten in 2006 to a high of almost eight out of ten in 2010. Reasons for not having an HIV test or for the lack of an HIV test record in the Registry were not documented. The changes over time were also not easily explained nor was it clear if those changes were related to policy directives.

People living with HIV/AIDS have a much greater risk (12 to 20 times higher) than those without HIV/AIDS infection of having a TB co-infection[27]. Thus, it is

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[25] Blackwood et al, Conventional and molecular epidemiology of tuberculosis in Manitoba, 2003, BMC Infectious Diseases, 2003, 3:18

[26] Larcombe et al, Housing conditions in 2 Canadian First Nations communities, International Journal of Circumpolar Health, 70:2, 2011.

[27] WHO. Tuberculosis and HIV. http://www.who.int/hiv/topics/tb/about_tb/en/index.html

important that all cases of TB are tested for HIV and that this is part of the TB protocol ongoing.

5. TB Treatment, Case Mortality, and Multiple Drug Resistance

The treatment data showed that over 90% of persons with TB completed treatment which is in alignment with national treatment data. During the 13-year period, the TB all-cause case mortality rate was 5%, lower than the national TB case mortality rate (8%).

Inadequate treatment or improper use of the anti-tuberculosis medications remains an important cause of drug-resistant TB. Drug-resistant TB is difficult and costly to treat and can be fatal. In Manitoba, there were a total of seven drug-resistant cases in Manitoba, and all seven cases occurred in foreign-born Canadians. What the available data could not identify was where acquisition of TB occurred (in country of birth or Canada). Since an entire strain of bacteria inherits the capacity to resist the effects of the various treatments[28], drug-resistant bacteria can be spread from one person to another.

Reactivation of TB is also a concern to consider in treatment. In Manitoba, the Latent TB Infection (LTBI) data in Manitoba TB registry have not (yet) been validated. Without population-based LTBI data for the province, it is not possible to accurately feasible to describe the burden of reactivation TB cases. Some researchers have predicted that reactivation of TB in cases could pose a special challenge to TB elimination for a number of years. In order to improve the 90% completion rates and further eliminate reactivation of LTBI, further review of the LTBI data is necessary.

The TB Surveillance Report (2000-2012) provides a provincial overview of TB in Manitoba. We hope that it will assist practitioners, clinicians, academics, and policy-makers alike as we work together to change the trajectory of this disease.

[28] American Lung Association. Extensively drug-resistant Tuberculosis (XDR TB) fact sheet. http://www.lung.org/lung-disease/tuberculosis/factsheets/extensively-drug-resistant.html, online accessed February 18, 2014.

Appendix Data and Tables

Appendix A: TB Program Update

On April 1, 2011, Manitoba adopted a new delivery model for TB services. Under this model, each RHA is responsible for the provision of public health case and contact management for TB. The Winnipeg Regional Health Authority (WRHA) is also responsible for providing consultation on case and contact management for all RHAs. Manitoba Health continues to receive and refer reports of laboratory-confirmed or clinical cases, be responsible for protocol and policy development, provide provincial surveillance, and for providing overall direction for the provincial TB prevention and management program.

Manitoba Health has adopted four important principles to guide and shape the provincial TB services:

1. Expertise for TB services is to be accessible across the province, and is to be provided according to the level of service needed.
2. The unique attributes of TB, like those of other complex communicable diseases, require generalist and specialist roles for both medical and public health management of cases and contacts.
3. Each RHA is responsible for the provision of public health case and contact management for TB.
4. Medical Clinicians/Nurse Practitioners in each RHA will continue to be responsible for the medical management of TB within the region with referral to TB Specialist Clinicians as required.

Manitoba Health, Public Health Branch in consultation with the MB-TB Steering Committee, as a provincial platform for overseeing the TB program's plans and activities, has identified the following strategic pillars to reduce the TB incidence and transmission in Manitoba:

1. Provincial coordination and strategic program planning and management.
2. Strengthening the surveillance and outbreak management.
3. Capacity building and providing technical assistance and guidance to RHAs and service providers.
4. Facilitate quality patient care through early detection, best management and timely treatment on both central and front lines levels.
5. Increase public awareness towards TB prevention and management

These strategic pillars are intended to guide decision-makers and service providers in their day-to-day operations. The program approach will continue to be patient centered, community designed and team delivered and will be continue to be a collaborative effort involving relevant stakeholders and departments.

Appendix B: Demographic characteristics of TB cases in Manitoba, 2000-2012

Socio-demographics	Total	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Cases (%)	1616	98 (6.1)	115 (7.1)	98 (6.1)	127 (7.9)	144 (8.9)	114 (7.1)	134 (8.3)	103 (6.4)	141 (8.7)	156 (9.7)	132 (8.2)	116 (7.2)	138 (8.5)
Males	892 (55.2)	57 (58.2)	61 (53.0)	51 (52.0)	73 (57.5)	70 (48.6)	66 (57.9)	79 (59.0)	62 (60.2)	86 (61.0)	87 (55.8)	71 (53.8)	57 (49.1)	72 (52.2)
Females	724 (44.8%)	41 (41.8)	54 (47.0)	47(48.0)	54 (42.5)	74 (51.4)	48 (42.1)	55 (41.0)	41 (39.8)	55 (39.0)	69 (44.2)	61 (46.2)	59 (50.9)	66 (47.8)
Median Age (years)														
Females	35	43	35	33	33	30	38	34	32	39	37	35	33	35
Males	39	43	46	49	32	33	32	40	41	39	39	41	43	34
Overall	37	43	41	40	32	31	36	38	38	39	38	39	39	35
Age group [No. (%)]														
<15	145 (9.0)	5 (5.1)	14 (12.2)	8 (8.2)	5 (3.9)	17 (11.8)	11 (9.6)	17 (12.7)	6 (5.8)	13 (9.2)	16 (10.3)	15 (11.4)	7 (6.0)	11 (8.0)
15-24	256 (15.8)	11 (11.2)	11 (9.6)	21 (21.4)	21 (16.5)	30 (20.8)	27 (23.7)	19 (14.2)	18 (17.5)	15 (10.6)	17 (10.9)	17 (12.9)	16 (13.8)	33 (23.9)
25-44	625 (38.7)	34 (34.7)	41 (35.7)	27 (27.6)	61 (48.0)	60 (41.7)	38 (33.3)	51 (38.1)	41 (39.8)	63 (44.7)	59 (37.8)	53 (40.2)	45 (38.8)	52 (37.7)
45-64	390 (24.1)	27 (27.6)	32 (27.8)	23 (23.5)	28 (22.0)	27 (18.8)	22 (19.3)	33 (24.6)	28 (27.2)	37 (26.2)	48 (30.8)	27 (20.5)	27 (23.3)	31 (22.5)
65+	200 (12.4)	21 (21.4)	17 (14.8)	19 (19.4)	12 (9.4)	10 (6.9)	16 (14.0)	14 (10.4)	10 (9.7)	13 (9.2)	16 (10.3)	20 (15.2)	21 (18.1)	11 (8.0)
Origin [No. (%)]														
Canadian-born non-FN	197(12.2)	22 (22.4)	19 (16.5)	20 (20.4)	17 (13.4)	20 (13.9)	13 (11.4)	14 (10.4)	7 (6.8)	10 (7.2)	25 (16.0)	12 (9.1)	11 (9.5)	7 (5.1)
Foreign-born	445(27.6)	32 (32.7)	33 (28.7)	32 (32.7)	22 (17.3)	34 (23.6)	31 (27.2)	24 (17.9)	28 (27.2)	34 (24.5)	45 (28.8)	44 (33.3)	41 (35.3)	45 (32.6)
Ab off-reserve	328(20.3)	23 (23.5)	30 (27.0)	14 (14.3)	28 (22.0)	28 (19.4)	27 (23.7)	27 (20.1)	21 (20.4)	36 (25.9)	24 (15.4)	25 (18.9)	18 (15.5)	26 (19.6)
Ab on-reserve	644(39.9)	21 (21.4)	33 (27.8)	32 (32.7)	60 (47.2)	62 (43.1)	43 (37.7)	69 (51.5)	47 (45.6)	59 (42.4)	62 (39.7)	51 (38.6)	46 (39.7)	59 (42.8)

*There were two cases reported in 2008 with missing origin.

Appendix C: Case counts and age specific incidence rates (per 100,000 persons) of TB by sex in Manitoba, 2000-2012

Age Group	Cases *rates*	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Women														
0-14	**cases**	1	6	5	3	9	7	9	3	6	8	10	4	4
	rates	*0.9*	*5.1*	*4.3*	*2.6*	*7.8*	*6.1*	*8.0*	*2.7*	*5.3*	*7.0*	*8.8*	*3.5*	*3.4*
15-24	**cases**	5	7	12	8	16	7	10	11	6	7	10	10	18
	rates	*6.5*	*9.0*	*15.3*	*10.1*	*20.0*	*8.6*	*12.2*	*13.3*	*7.2*	*8.3*	*11.6*	*11.5*	*20.3*
25-44	**cases**	15	24	18	26	32	17	20	14	25	30	19	23	25
	rates	*8.9*	*14.3*	*10.9*	*15.8*	*19.5*	*10.5*	*12.5*	*8.8*	*15.7*	*18.7*	*11.8*	*14.0*	*14.9*
45-64	**cases**	11	12	7	12	11	9	9	7	10	19	10	9	12
	rates	*8.6*	*9.2*	*5.2*	*8.7*	*7.7*	*6.1*	*6.0*	*4.5*	*6.3*	*11.7*	*6.0*	*5.4*	*7.1*
65+	**cases**	9	5	5	5	6	8	7	6	8	5	12	13	7
	rates	*9.9*	*5.5*	*5.5*	*5.5*	*6.6*	*8.8*	*7.6*	*6.5*	*8.5*	*5.3*	*12.5*	*13.4*	*7.0*
Men														
0-14	**cases**	4	8	3	2	8	4	8	3	7	8	5	3	7
	rates	*3.2*	*6.5*	*2.5*	*1.7*	*6.6*	*3.4*	*6.8*	*2.5*	*5.9*	*6.7*	*4.2*	*2.5*	*5.7*
15-24	**cases**	6	4	9	13	14	20	9	7	9	10	7	6	15
	rates	*7.5*	*5.0*	*11.1*	*15.9*	*16.9*	*23.9*	*10.7*	*8.2*	*10.5*	*11.5*	*7.9*	*6.7*	*16.3*
25-44	**cases**	19	17	9	35	28	21	31	27	38	29	34	22	27
	rates	*11.2*	*10.1*	*5.4*	*21.3*	*17.1*	*13.0*	*19.4*	*17.1*	*24.0*	*18.2*	*21.2*	*13.5*	*16.2*
45-64	**cases**	16	20	16	16	16	13	24	21	27	29	17	18	19
	rates	*12.7*	*15.4*	*12.0*	*11.6*	*11.3*	*8.9*	*16.0*	*13.7*	*17.2*	*18.0*	*10.4*	*10.8*	*11.3*
65+	**cases**	12	12	14	7	4	8	7	4	5	11	8	8	4
	rates	*18.2*	*18.1*	*21.0*	*10.4*	*5.9*	*11.8*	*10.2*	*5.7*	*7.0*	*15.1*	*10.8*	*10.5*	*5.1*

Appendix D: Region of origin for foreign-born Tuberculosis cases in Manitoba, 2000-2012.

WHO Region		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Africa	Cases	4	6	9	7	11	10	9	6	6	7	8	7	5	95
	%	12.5	18.2	28.1	31.8	32.4	32.3	37.5	21.4	17.7	15.6	18.2	17.1	11.1	21.3
Eastern	Cases	1	1	0	2	0	3	2	5	4	6	2	2	2	30
Mediterranean	%	3.1	3.0	0.0	9.1	0.0	9.7	8.3	17.9	11.8	13.3	4.6	4.9	4.4	6.7
Europe	Cases	3	5	1	1	0	0	2	2	1	1	0	5	3	24
	%	9.4	15.2	3.1	4.6	0.0	0.0	8.3	7.1	2.9	2.2	0.0	12.2	6.7	5.4
South-East Asia	Cases	0	3	3	1	6	3	1	1	3	4	6	9	8	48
	%	0.0	9.1	9.4	4.6	17.7	9.7	4.2	3.6	8.8	8.9	13.6	22.0	17.8	10.8
Americas	Cases	3	0	0	3	1	0	1	0	1	0	0	0	0	9
	%	9.4	0.0	0.0	13.6	2.9	0.0	4.2	0.0	2.9	0.0	0.0	0.0	0.0	2.0
Western Pacific	Cases	21	17	19	8	16	14	9	13	17	24	23	18	26	225
	%	65.6	51.5	59.4	36.4	47.1	45.2	37.5	46.4	50.0	53.3	52.3	43.9	57.8	50.6
Unknown /Missing	Cases	0	1	0	0	0	1	0	1	2	3	5	0	1	14
	%	0.0	3.0	0.0	0.0	0.0	3.2	0.0	3.6	5.9	6.7	11.4	0.0	2.2	3.1
Total	Cases	32	33	32	22	34	31	24	28	34	45	44	41	45	445

Appendix E: All-cause and TB-attributable mortality in TB cases in Manitoba (2000-2012)

Variable		Number	Percent
Demographics			
Sex	Male	51	62.2%
	Female	31	37.8%
Age	0-14	0	0.0%
	15-24	5	6.1%
	25-44	17	20.7%
	45-64	33	40.2%
	>=65	27	32.9%
Country or Ethnic origin	Canadian-born non-FN	10	12.2%
	Foreign-born	19	23.2%
	FN	53	64.6%
Cause of death			
TB was underlying cause		23	28.0%
TB contributed but was not cause		26	31.7%
TB did not contribute to death		32	39.0%
Missing		1	1.2%

Appendix F: Crude and age-standardized* (95 % CI) incidence rates (per 100,000 persons) by RHA (2000-2012)

	Interlake Eastern			Northern			Southern			Prairie Mountain			Winnipeg		
Year	**Cases**	**rate**	**Adj rate**	**Cases**	**rate**	**Adj rate**	**Cases**	**rate**	**Adj rate**	**Cases**	**rate**	**Adj rate**	**Cases**	**rate**	**Adj rate**
2000	6	5.3	5.2 (1.9, 11.7)	13	18.6	25.1 (12.1, 51.6)	7	4.6	4.7 (1.9, 9.8)	6	3.7	3.3 (1.2, 7.6)	66	10.1	9.9 (7.6, 12.6)
2001	12	10.5	10.1 (5.2, 18.2)	31	44.4	54.8 (33.7, 88.4)	2	1.3	1.4 (0.2, 5.1)	4	2.5	2.2 (0.6, 6.0)	66	10.1	9.8 (7.6, 12.5)
2002	6	5.2	5.1 (1.9, 11.7)	26	37.3	38.7 (23.7, 65.4)	4	2.6	2.8 (0.8, 7.3)	8	5.0	5.2 (2.2, 10.6)	54	8.2	8.1 (6.1, 10.6)
2003	6	5.2	5.1 (1.8, 11.8)	59	84.8	92.3 (68.6, 126.6)	4	2.6	2.7 (0.7, 7.0)	3	1.9	1.7 (0.3, 5.4)	55	8.3	8.2 (6.1, 10.7)
2004	4	3.4	3.3 (0.9, 9.2)	73	104.1	105.2 (80.6, 140.4)	3	1.9	2.0 (0.4, 6.0)	3	1.9	1.5 (0.3, 5.3)	61	9.2	9.0 (6.9, 11.6)
2005	7	6.0	5.9 (2.3, 12.9)	47	66.8	71.7 (50.4, 104.3)	1	0.6	0.7 (0.0, 4.1)	1	0.6	0.7 (0.0, 4.3)	58	8.7	8.4 (6.4, 11.0)
2006	4	3.4	3.1 (0.8, 8.9)	68	96.5	103.7 (78.0, 140.2)	2	1.2	1.2 (0.2, 4.8)	1	0.6	0.5 (0.0, 3.8)	59	8.8	8.6 (6.6, 11.2)
2007	4	3.4	3.6 (1.0, 9.9)	46	64.9	65.7 (47.4, 95.0)	7	4.2	4.3 (1.7, 9.2)	0	0.0	0.0 (0.0, 3.1)	46	6.8	6.6 (4.8, 8.9)
2008	2	1.7	1.7 (0.2, 7.0)	65	91.7	96.2 (73.2, 129.6)	3	1.8	2.0 (0.4, 6.1)	5	3.1	3.1 (1.0, 7.8)	66	9.7	9.7 (7.5, 12.4)
2009	23	19.2	22.2 (14.0, 33.8)	40	55.8	58.0 (40.8, 86.-2)	2	1.2	1.2 (0.1, 4.8)	5	3.1	2.8 (0.9, 7.2)	86	12.5	11.9 (9.5, 14.8)
2010	3	2.5	3.0 (0.6, 9.2)	48	66.1	74.0 (53.1, 105.9)	5	2.8	2.7 (0.9, 6.6)	4	2.5	2.0 (0.5, 5.9)	72	10.3	10.2 (8.0, 12.9)
2011	5	4.1	5.2 (1.7, 12.5)	45	61.1	66.8 (47.6, 96.7)	3	1.7	1.9 (0.4, 5.7)	6	3.7	3.9 (1.4, 8.7)	57	8.0	7.7 (5.8, 10.0)
2012	5	4.0	4.9 (1.5, 11.9)	56	75.5	75.0 (56.0, 103.9)	11	6.0	5.9 (2.9, 10.8)	4	2.4	3.0 (0.8, 7.7)	62	8.6	8.4 (6.4, 10.9)
Total	87	5.7		617	66.8		54	2.5		50	2.4		808	9.2	

Note: * Age-standardized rates were adjusted to the Manitoba population in 2000