TUBERCULOSIS:

DRUG RESISTANCE IN CANADA 2014

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ACRONYMS AND ABBREVIATIONS

Alta.	Alberta
AK	Amikacin
B.C.	British Columbia
BCG	Bacillus Calmette-Guérin
CI	Confidence interval
CLSI	Clinical and Laboratory Standards Institute
CM	Capreomycin
CPHLN	Canadian Public Health Laboratory Network
CTBLSS	Canadian Tuberculosis Laboratory Surveillance System
CTLTN	Canadian Tuberculosis Laboratory Technical Network
EMB	Ethambutol
ETH	Ethionamide
INH	Isoniazid
KM	Kanamycin
LIN	Linezolid
M. africanum	*Mycobacterium africanum*
M. bovis	*Mycobacterium bovis*
M. canetti	*Mycobacterium canetti*
M. caprae	*Mycobacterium caprae*
M. microti	*Mycobacterium microti*
M. pinnipedii	*Mycobacterium pinnipedii*
M. tuberculosis	*Mycobacterium tuberculosis*
Man.	Manitoba
MDR-TB	Multidrug-resistant tuberculosis
MOX	Moxifloxacin
MTBC	*Mycobacterium tuberculosis* complex
N.B.	New Brunswick
N.L.	Newfoundland and Labrador
NRCM	National Reference Centre for Mycobacteriology
N.S.	Nova Scotia
Nvt.	Nunavut
N.W.T.	Northwest Territories
OFL	Ofloxacin
Ont.	Ontario
PAS	*Para*-aminosalicylic acid
PHAC	Public Health Agency of Canada
P.E.I.	Prince Edward Island
ProvLab	Provincial Laboratory of Public Health (Alberta)

PZA	Pyrazinamide
Que.	Quebec
RBT	Rifabutin
RMP	Rifampin
Sask.	Saskatchewan
SM	Streptomycin
TB	Tuberculosis
XDR-TB	Extensively drug-resistant tuberculosis
Y.T.	Yukon

INTRODUCTION

Drug-resistant strains of tuberculosis (TB) pose a serious threat to Canadian TB prevention and control efforts. Although drug-resistant TB has not yet been identified as a major problem in Canada, it is a potential issue both because Canadians frequently travel abroad and because many individuals migrate to Canada from countries with high TB rates and associated drug resistance.

The Canadian Tuberculosis Laboratory Surveillance System (CTBLSS) was created in 1998 as part of Canada's response to a growing worldwide concern about TB drug resistance. It was established by Health Canada's Division of Tuberculosis Prevention and Control in the Bureau of HIV/AIDS, STD and TB at the Laboratory Centre for Disease Control in collaboration with the Canadian Tuberculosis Laboratory Technical Network (CTLTN) and participating laboratories. The CTBLSS was designed to monitor emerging trends and patterns in anti-tuberculosis drug resistance in Canada and is currently managed by the Public Health Agency of Canada (PHAC).

This report is part of an annual surveillance report series that describes data collected through the CTBLSS. Specifically, this report provides details on the overall level of TB drug resistance in Canada for the period 2004 to 2014, with a focus on 2014.

The data presented in this report is intended to inform public health action as well as policy and program development and assessment.

BACKGROUND

PATTERNS OF DRUG RESISTANCE

TB drug resistance is determined through susceptibility testing of clinical specimens obtained from individuals with culture-positive TB.[1] People with TB are said to have drug-resistant TB if the strain of *Mycobacterium tuberculosis* causing their disease is resistant to one or more of the four first-line drugs, isoniazid, rifampin, pyrazinamide or ethambutol. The following resistance patterns are described in this report:

- *Monoresistance*—defined as resistance to one first-line anti-TB drug only (isoniazid, rifampin, ethambutol or pyrazinamide).
- *Polyresistance (other patterns)*—defined as resistance to more than one first-line anti-TB drug, not including the isoniazid and rifampin combination.
- *Multidrug-resistant tuberculosis (MDR-TB)*—defined as resistance to isoniazid and rifampin with or without resistance to other anti-tuberculosis drugs.
- *Extensively drug-resistant TB (XDR-TB)*—defined as resistance to isoniazid and rifampin and any fluoroquinolone and at least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin).[2]

TB DRUG RESISTANCE STANDARDS AND TESTING IN CANADA

The mission of the CTLTN is to promote excellence, standardization and quality assurance in mycobacteriology services. The CTLTN is a pan-Canadian network of technical and scientific heads of provincial and territorial TB laboratories (**Appendix I**).

The goals of the CTLTN are to:

- standardize laboratory methodologies;
- improve biosafety operational practices and physical requirements;
- implement biosafety guidelines;
- participate in national surveillance and proficiency programs; and
- exchange services and information about new technologies.

Laboratory testing methods in Canada, including drug selection and the critical concentrations used for routine drug susceptibility testing, are in line with recommended laboratory standards.[i,3,4] Participating CTLTN laboratories perform routine susceptibility testing of *Mycobacterium tuberculosis* or *Mycobacterium tuberculosis* complex (MTBC) isolates against first-line anti-tuberculosis drugs using fluorometric proportion method BACTEC® MGIT 960. **Table 1** provides a list of recommended first-line and second-line anti-tuberculosis drugs and the recommended critical concentrations to be used for testing.[3,4]

Second-line drug susceptibility testing varies across jurisdictions. Typically, isolates are tested for resistance to amikacin, kanamycin, capreomycin, ethionamide, linezolid, ofloxacin, moxifloxacin, *para*-aminosalicylic acid and rifabutin.

METHODS

OVERVIEW OF THE CANADIAN TUBERCULOSIS LABORATORY SURVEILLANCE SYSTEM

The CTBLSS is an isolate-based surveillance system designed to collect data on TB drug resistance across Canada. Drug susceptibility test results of all unique isolates tested in the previous calendar year are voluntarily submitted annually to PHAC by provincial TB laboratories for inclusion in the CTBLSS. Participating laboratories are members of the CTLTN (representing all provinces and territories).

[i] The Clinical and Laboratory Standards Institute (CLSI) offers practical operating guidelines that lead to consistent laboratory practices, precision, and efficient use of resources. The CLSI recommends that, once drug-resistance testing against first-line anti-tuberculosis agents is complete, isolates found to be monoresistant to rifampin or to any two of the first-line anti-tuberculosis drugs be tested against a panel of second-line drugs. When fluoroquinolones are added to the drug regimen for cases monoresistant to isoniazid, second-line antimicrobial drug resistance testing is recommended.

Data for the CTBLSS are collected either through the manual completion of a standard reporting form (**Appendix II**) or electronically. Standardized data recoding procedures are applied to all data to create a national dataset. The following information is submitted to PHAC:

- the date the isolate or specimen was received at the laboratory;
- the specimen identification number provided by the laboratory;
- the province/territory where the isolate was tested;
- the province/territory from which the isolate originated;
- the sex of the individual from whom the isolate originated;
- the date of birth or age at time of testing of the individual from whom the isolate originated; and
- drug susceptibility results (drug tested, including concentration of the drug tested).

Data are submitted for confirmed cases of MTBC demonstrated on culture, including *M. tuberculosis, M. africanum, M. canetti, M. caprae, M. microti, M. pinnipedii* or *M. bovis.* Results may be submitted at the species level or for MTBC only without species identification. Some laboratories also submit results for the *M. bovis* BCG strain, a complication of TB vaccination often found in immunocompromised patients. These results are excluded from this report because this strain is not infectious.

All participating laboratories test for resistance to the first-line antibiotics isoniazid, ethambutol, and rifampin. Although the *Canadian Tuberculosis Standards* (7th edition) recommends that laboratories perform drug susceptibility testing to pyrazinamide[1], British Columbia does not routinely test for resistance to this drug. If resistance to any first-line drug is detected, British Columbia will subsequently test the isolate for resistance to pyrazinamide.

Results of second-line drug susceptibility testing are submitted for isolates showing resistance to isoniazid and rifampin. To rule out XDR-TB, laboratories are asked to report results for at least one of the fluoroquinolones (ofloxacin, moxifloxacin or levofloxacin) and at least one of the injectable agents (amikacin, kanamycin and capreomycin).

Not all provinces and territories have the capacity to perform drug susceptibility testing. Those without this capacity prepare the isolates and forward them to other provincial laboratories for testing. In some instances, the laboratory that tests the sample submits the results to PHAC on behalf of the originating province or territory.

The British Columbia Public Health Microbiology and Reference Laboratory at the British Columbia Centre for Disease Control tests and reports first-line susceptibility results for British Columbia and Yukon. The Provincial Laboratory of Public Health (ProvLab) in Alberta tests and reports isolates for Alberta and Northwest Territories, and the Central Public Health Laboratory in Ontario tests and reports results for Ontario and Nunavut. The National Reference Centre for Mycobacteriology (NRCM)[ii] located in Manitoba conducts first-line susceptibility testing for Newfoundland and Labrador, Manitoba, New Brunswick, Nova Scotia and Prince Edward Island. In this case, the NRCM returns test results to the originating province and the originating

[ii] For more information about the NRCM please see: www.nml-lnm.gc.ca/eb-be/myco-eng.htm

province submits their results to PHAC. All remaining provinces conduct their own first-line testing and do not routinely report results for any other jurisdiction.

Four laboratories in Canada conduct second-line drug susceptibility testing: the ProvLab in Alberta, the Central Public Health Laboratory in Ontario, the Laboratoire de santé publique du Québec and the NRCM. The NRCM tests the susceptibility of isolates to second-line drugs for all provinces and territories that do not conduct such testing at their laboratories. Upon request, the NRCM also tests isolates submitted by any provincial laboratory to confirm resistance patterns. Results from testing done by NRCM are returned to the provincial laboratory that submitted the isolates for testing and the provincial laboratory then submits these results to PHAC.

TABULATION AND PRESENTATION OF RESULTS

This report provides an overview of TB drug resistance in Canada for the period 2004 to 2014. Select data are presented by province/territory and by age and sex where feasible. Data from 2014 (the most recent reporting year for which data are available) are highlighted as well as important trends over time.

The data presented in this report were extracted from the CTBLSS database on March 30, 2015 and have been validated by the reporting laboratory. Results from cultures that grow in a given year are included in the statistics for that calendar year, otherwise the results are reflected in the subsequent year's report. For example, if a specimen was received by the laboratory on December 20, 2014 and the culture did not grow *M. tuberculosis* until January 2015, these results would be reflected in the 2015 report.

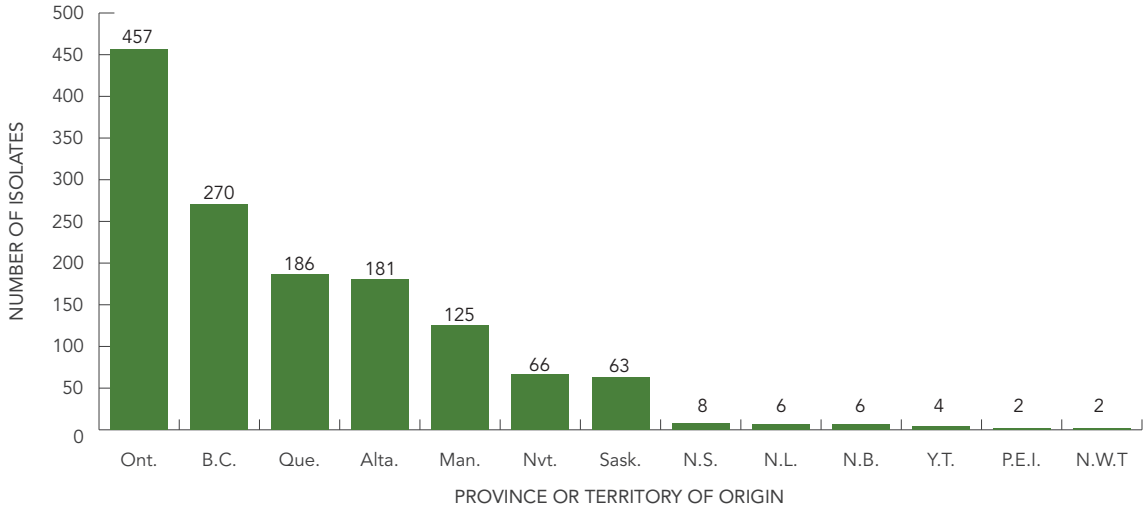
Samples submitted to the laboratory for drug susceptibility testing may be obtained at the time of the individual's diagnosis or at any time during treatment. Depending on the treatment duration, an individual may be tested multiple times over several years. The number of isolates described in this report, therefore, is not equal to the number of culture-positive cases reported through the case-based surveillance system over the same time period. That is because an individual with culture-positive TB is only reported once in the year of diagnosis but may be tested repeatedly for drug resistance over the course of several years until cured or until the prescribed treatment is completed. In the event that two specimens are confirmed to be from the same individual in a given calendar year, only the most recent susceptibility result is retained.

No statistical procedures were used for comparative analyses in this report, nor were any statistical techniques applied to account for missing data. Data in tables with small cell sizes ($n \leq 5$) were not suppressed, since disclosure is not deemed to pose any risk of identifying individuals. These procedures are consistent with PHAC's *Directive for the collection, use and dissemination of information relating to public health*.[5]

RESULTS

In 2014, anti-tuberculosis drug susceptibility test results for 1,393 isolates were reported to PHAC. Of these, 790 (56.7%) were reported as MTBC where the species was known (786 were *M. tuberculosis*, two were *M. africanum* and two were *M. bovis*) and 586 (42.1%) were MTBC of an unknown species. Seventeen (1.2%) isolates were identified as *M. bovis* BCG (13 originating from Ontario, three from Alberta and one from Manitoba) and were excluded from further analyses (data not shown). Laboratory results for 1,376 MTBC isolates were analyzed for this report. **Table 2** provides a breakdown of the number of isolates by reporting and originating province or territory. **Figure 1** shows the number of MTBC isolates tested by the province or territory of origin.

FIGURE 1: Number of *Mycobacterium tuberculosis* complex isolates tested by province or territory of origin, 2014



For the period 2004 to 2014, drug susceptibility test results were reported for 14,813 isolates (**Table 3**). Of the results received between 2004 and 2014, 1,382 (9.3%) were resistant to one or more of the first-line medications, 168 isolates (1.1%) were identified as multidrug-resistant and seven (< 0.1%) were identified as extensively drug-resistant (**Table 3**).

ANY FIRST-LINE DRUG RESISTANCE

In 2014, all 1,376 MTBC isolates were tested for resistance to isoniazid, rifampin and ethambutol and 1,143 (83%) were tested for resistance to pyrazinamide (**Table 4**). One hundred and seven (7.8%) of the isolates tested were resistant to isoniazid, 30 (2.6%) were resistant to pyrazinamide, 24 (1.7%) were resistant to rifampin and six (0.4%) were resistant to ethambutol (**Figure 2**).

FIGURE 2: Percentage of isolates tested with any resistance to isoniazid, pyrazinamide, rifampin and ethambutol, 2014

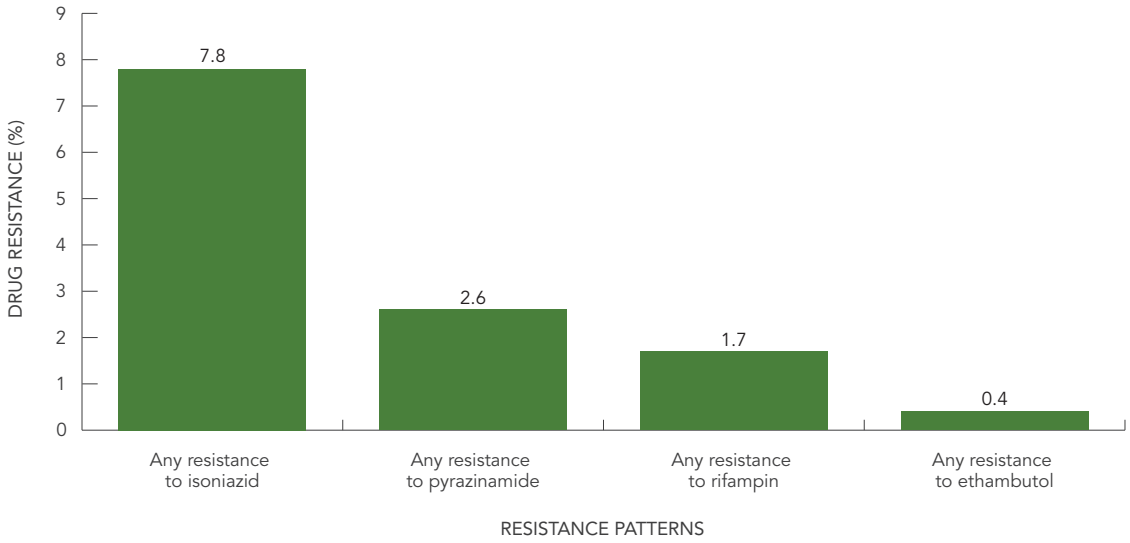
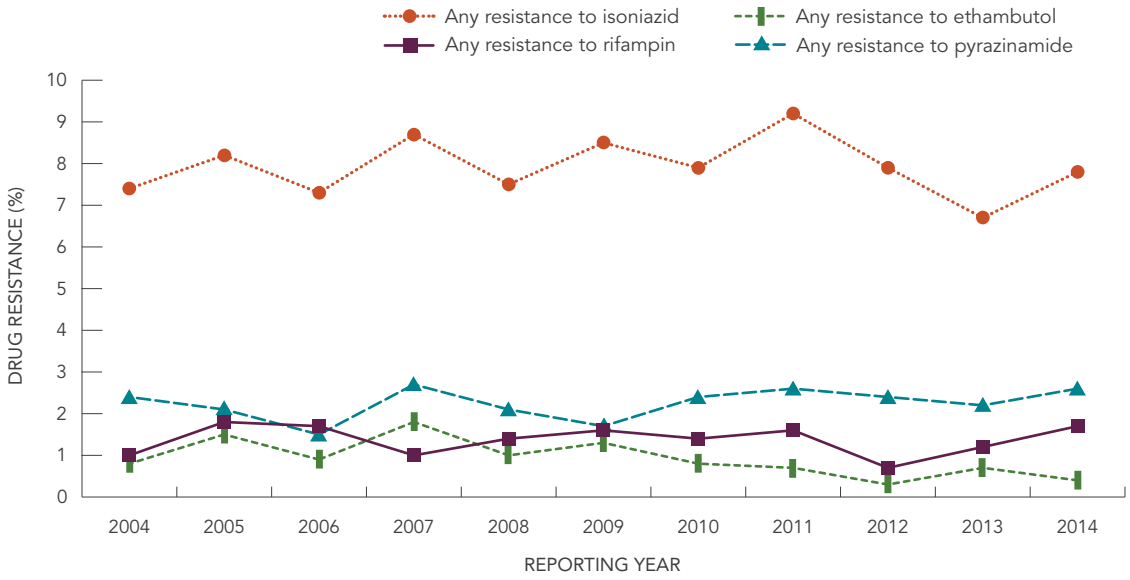


Figure 3 shows the changes over time in the percentage of isolates resistant to each of the first-line drugs for the period 2004 to 2014. There has been very little change in the percentage of tested isolates showing any resistance. For the period 2004 to 2014, 7.9% (range: 6.7% to 9.2%) of all isolates tested were resistant to isoniazid (**Table 4**). Ethambutol, rifampin and pyrazinamide resistance have remained below 3%.

FIGURE 3: Percentage of isolates tested with any resistance to isoniazid, pyrazinamide, rifampin and ethambutol, 2004 to 2014



MONORESISTANCE

Overall, in 2014, 131 TB isolates (9.5% of all isolates tested) were reported to be resistant to at least one of the four first-line drugs (**Table 4**). The majority (108, 82.4%) were monoresistant. Of these 84 (77.8%) were isoniazid monoresistant, 19 (17.6%) were pyrazinamide monoresistant and five (4.6%) were rifampin monoresistant. No isolates were identified as ethambutol monoresistant (**Table 5** to **Table 17**). For the period 2004 to 2014, 7.7% of all isolates tested were monoresistant, ranging from a high of 9.0% in 2011 to a low of 6.7% in 2013 (**Table 4**).

For the period 2004 to 2014, 28 isolates (0.2% of all isolates tested) were identified as rifampin monoresistant. Of these, 15 (53.6%) originated from British Columbia; six (21.4%) from Ontario, two (7.1%) each from Alberta and Quebec, and one (3.6%) each from Saskatchewan, Northwest Territories and Nunavut. With the exception of 2004 and 2010 in which there were no reports of rifampin monoresistant isolates, one to three rifampin monoresistant isolates were reported each year from 2005 to 2014. In 2006, eight (0.6%) rifampin monoresistant isolates were reported, representing an atypically high number for a one-year period (**Table 5** to **Table 17**).

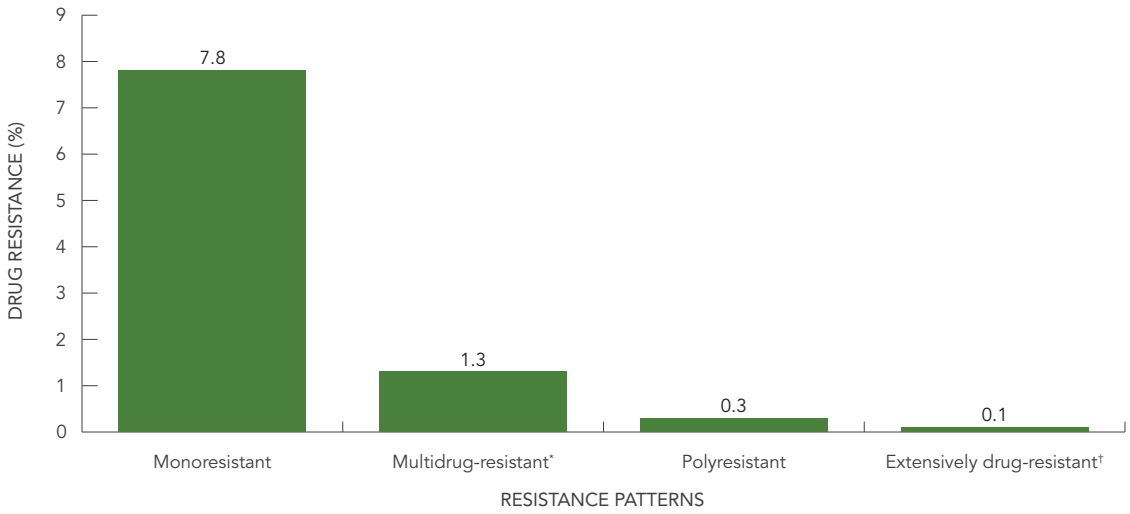
POLYRESISTANCE, MULTIDRUG-RESISTANT AND EXTENSIVELY DRUG-RESISTANT TB

In 2014, four isolates (0.3%) were resistant to two or more of the first-line drugs excluding the isoniazid and rifampin combination (**Table 4**). All four were resistant to both isoniazid and pyrazinamide and susceptible to rifampin and ethambutol. Between 2004 and 2014 there were 64 (0.4%) isolates identified as polyresistant. Of these, 29 (45.3%) were resistant to isoniazid and ethambutol and 26 (40.6 %) were resistant to isoniazid and pyrazinamide. Of the remaining nine isolates, six were resistant to isoniazid, ethambutol, and pyrazinamide, two were resistant to rifampin and pyrazinamide, and one was resistant to ethambutol and pyrazinamide (**Table 5** to **Table 17**).

In 2014, 19 (1.4%) of all isolates tested were resistant to both isoniazid and rifampin (identifying them as at least MDR-TB). Of these 19 isolates, ten (52.6%) were resistant only to isoniazid and rifampin, three (15.8%) were also resistant to ethambutol, two (10.5%) were also resistant to pyrazinamide and four (21.0%) were also resistant to pyrazinamide and ethambutol (**Table 18**).

To rule out XDR-TB, all 19 isolates found to be resistant to both isoniazid and rifampin were subsequently tested for resistance to select second-line drugs. Of these, 16 (84.2%) isolates were susceptible to both the injectable agents and the fluoroquinolones, one (5.2%) was resistant to an injectable agent but susceptible to the flouroquinolones and one (5.2%) was resistant to a fluoroquinolone but susceptible to the injectable agents (data not shown). The remaining isolate was resistant to at least one of the injectable agents and to a fluoroquinolone. Therefore, in 2014, 18 isolates were identified as MDR-TB and one was identified as XDR-TB. **Figure 4** presents patterns of TB drug resistance as a percentage of all isolates tested in 2014.

FIGURE 4: Tuberculosis drug resistance patterns as a percentage of isolates tested, 2014



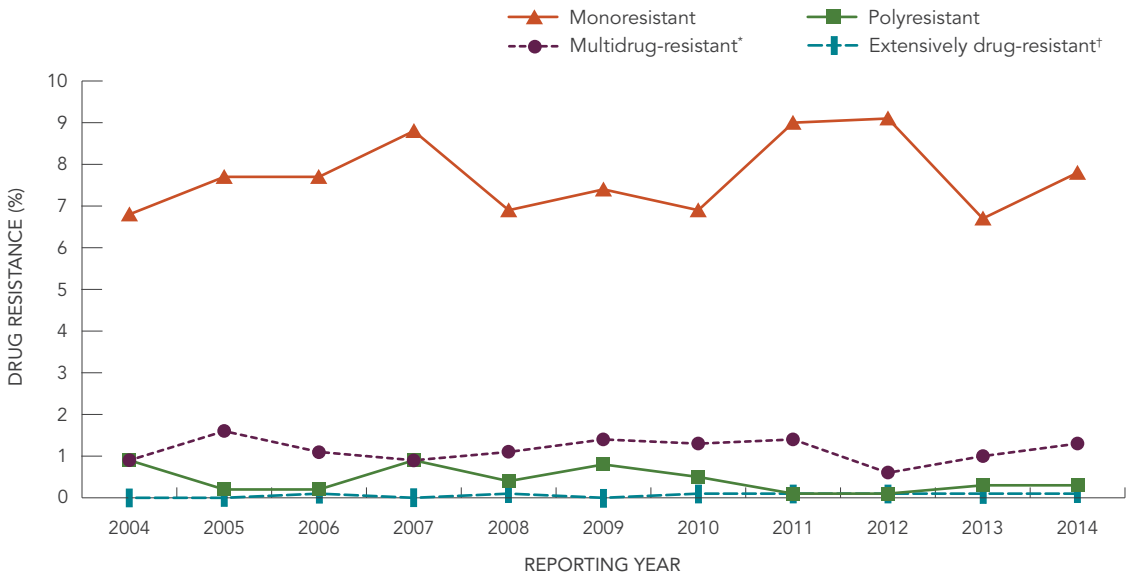
* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin but does not meet the definition of extensively drug-resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second-line drugs (amikacin, capreomycin and kanamycin).

For the period 2004 to 2014, 168 isolates were classified as MDR-TB, representing 1.1% of isolates tested over this time (**Table 4**). Seven isolates were classified as XDR-TB, representing an annual average of less than 0.1% of the total number of isolates tested for this period. An average of 15 MDR-TB isolates were reported each year, ranging from a low of eight in 2012 (0.6% of all isolates) to a high of 22 in 2005 (1.6% of all isolates tested).

Figure 5 shows the overall pattern of reported TB drug resistance as a percentage of isolates tested for the period 2004 to 2014. While there were small fluctuations in the percentage of isolates showing various resistance patterns, there was no notable trend over time.

FIGURE 5: Tuberculosis drug resistance patterns as a percentage of isolates tested, 2004 to 2014



* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second-line drugs (amikacin, capreomycin and kanamycin).

GEOGRAPHICAL DISTRIBUTION

Overall, the total number of isolates tested and reported in 2014 (1,376) was similar to the number reported in 2013 (1,381) (**Table 2**). In 2014, the majority of reported isolates originated from five provinces: Ontario (33.2%), British Columbia (19.6%), Quebec (13.5%), Alberta (13.2%), and Manitoba (9.1%). Saskatchewan accounted for fewer than 5% of reported isolates while the territories (Northwest Territories, Nunavut and Yukon) and the Atlantic provinces (New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island) together accounted for fewer than 7% of reported isolates in 2014.

All isolates from Northwest Territories, Nunavut, Yukon, New Brunswick, Newfoundland and Labrador, and Prince Edward Island were fully susceptible to all first-line drugs tested. Of the 19 isolates resistant to both isoniazid and rifampin in 2014, four originated from Alberta, six from British Columbia, seven from Ontario and two from Quebec (**Table 18**).

For the period 2004 to 2014, all 168 MDR-TB isolates originated from six provinces: Alberta, British Columbia, Manitoba, Ontario, Quebec and Saskatchewan (**Table 19**). Of the seven isolates identified as XDR-TB, five originated from Ontario, one from Manitoba and one from Quebec.

Tables 5 through **17** present results of routine drug susceptibility testing of MTBC isolates to anti-tuberculosis drugs for the period 2004 to 2014, by province and territory.

DEMOGRAPHIC INFORMATION

In 2014, age or date of birth was reported for all but one of the 1,376 individuals from whom reported isolates were obtained (**Table 20**). Of the 131 isolates with drug resistance, 22.9% were from individuals 25 to 34 years of age and 20.6% were from individuals 35 to 44 years of age. 1.6% of isolates were from individuals under 15 years of age (**Table 20**). The XDR-TB isolate was from an individual 25 to 34 years of age.

In 2014, sex was known for individuals from whom 1,374 (99.9%) of the 1,376 isolates were obtained (**Table 20**). Males accounted for 56.6% of reported isolates in 2014 (**Table 20**). Of isolates with any resistance, females accounted for 51.9%, and one half were isolates with resistance to both isoniazid and rifampin. The XDR-TB isolate was from a female.

DISCUSSION

In many parts of the world, drug resistance is a major challenge to preventing and controlling TB. Eastern Europe and Central Asia continue to have the world's highest proportion of MDR-TB cases.[6]

Organisms resistant to both isoniazid and rifampin pose a considerable challenge to treatment and prevention efforts because effective anti-tuberculosis drugs are limited. Data published by the World Health Organization show that globally in 2012, about 3.6% (95% CI: 2.1%–5.1%) of new TB cases and 20.2% (95% CI: 13.3%–27.2%) of previously treated TB cases were MDR-TB.[6] Although the data captured through the CTBLSS do not distinguish between isolates from new versus previously treated cases of TB, the fact that only 1.3 % of isolates tested in 2014 were MDR-TB is a considerably lower finding than global estimates. In addition, the identification of seven XDR-TB cases over the period 2004 to 2014 indicates that XDR-TB in Canada is still a relatively rare event.

Overall, there was no notable change in the percentage of isolates with resistance to first-line medications in Canada from 2004 to 2014; however, geographic distribution changed. The percentage of isolates originating from Ontario decreased whereas the percentage originating from Alberta and British Columbia increased relative to the number of reports received in previous years. This may indicate a change in the overall distribution of TB disease in Canada, and requires further monitoring.

STRENGTHS AND LIMITATIONS

The CTBLSS is the result of successful collaboration between federal, provincial and territorial governments and the CTLTN. The primary objective of the CTBLSS is to monitor emerging trends and patterns in anti-tuberculosis drug resistance in Canada. This report presents detailed data on the extent of first- and second-line TB drug resistance in Canada, disaggregated by province/territory and, where feasible, by sex and age. As the primary source of national data on TB drug resistance in Canada, the data within this report provide timely information for public health action, as well as policy and program development and assessment.

Prior to analysis and report preparation, all data were reviewed for errors, inconsistencies and completeness. Submitting laboratories were provided with a summary report of their data for review. Following validation by the reporting laboratories, the data were integrated into the CTBLSS database. Nevertheless, like most surveillance data, the data in this report are subject to possible coding, reporting and processing errors.

Previously published data are subject to updates resulting from late reporting or when revisions are received from participating laboratories. Any revisions to previously reported data are reflected in subsequent reports. Therefore, the data presented in this report are considered the most up-to-date and replace those previously published in this report series.

Although efforts are made to ensure that multiple records for any one individual in a given year are removed, given the minimal identifying information available for each isolate (age and sex), it is possible that multiple records from one individual may be included in the database. This bias is likely minimal given the validation process with the data providers.

Demographic and clinical data collected through the CTBLSS are limited. No data are collected on ethnic origin, diagnostic/clinical information, or treatment outcome. Additional demographic and clinical information on individuals from whom the TB isolates were obtained would facilitate a more in-depth epidemiological assessment of drug resistance patterns in Canada. Additionally, differentiation between primary and acquired drug resistance and differing resistance pattern among new cases in comparison to re-treatment cases is not possible based on data collected through this surveillance system. However, the *Tuberculosis in Canada* report, which provides an overview of the overall number of reported active TB cases and corresponding incidence rates in Canada by select demographic and clinical characteristics, presents case-based (vs. isolate-based) data on primary and acquired drug resistance in Canada that are not presented here. Together, these two reports provide a comprehensive overview of TB case and drug resistance surveillance data from a national perspective.

Typically, only isolates with MDR-TB or other extensive resistance patterns will undergo drug sensitivity testing to select second-line drugs. Although the Clinical and Laboratory Standards Institute (CLSI) recommends that isoniazid-monoresistant isolates, as well as other polyresistant, non-MDR isolates be tested for second-line drug resistance, this is not universally reported in Canada. Other isolates which are not MDR-TB may be resistant to fluoroquinolones because of the widespread use of these antibiotics for other respiratory infections. To some extent, this limits our understanding of the emergence of second-line drug resistance within Canada.

CONCLUSION

Data collected through the CTBLSS indicate that the presence of TB drug resistance in Canada is currently below the global average and has remained relatively stable since reporting began. However, the CTBLSS remains vital to the monitoring of TB drug resistance in Canada in order to respond to growing worldwide concern about resistance and the emergence of XDR-TB.

APPENDIX I: PARTICIPATING LABORATORIES OF THE CANADIAN TUBERCULOSIS LABORATORY TECHNICAL NETWORK (CTLTN)

ALBERTA Provincial Laboratory of Public Health Calgary	Cary Shandro Technologist Mycobacteriology Dr. Greg Tyrrell Clinical Microbiologist Graham Tipples Medical/Scientific Director
BRITISH COLUMBIA British Columbia Centre for Disease Control Public Health Microbiology and Reference Laboratory Vancouver	Dr. Mabel Rodrigues Mycobacteriology/TB Laboratory, Section Head Dr. Patrick Tang Medical Microbiologist Dr. Judy L. Isaac-Renton Director, Laboratory Services
MANITOBA Diagnostics Services Manitoba Health Sciences Centre Winnipeg	Assunta Rendina Charge Technologist, Mycobacteriology Doug Swidinsky Senior Technologist
NEW BRUNSWICK Department of Laboratory Medicine Saint John Regional Hospital Saint John	Hope MacKenzie MLT3-Supervisor CL3 Lab Dr. Duncan Webster Medical Microbiologist/Infectious Disease Dr. Marek Godlewski Laboratory Director
NEWFOUNDLAND AND LABRADOR Newfoundland and Labrador Public Health Laboratory St. John's	Audrey Martin Tech II Lourens Robberts Director & Clinical Microbiologist
NORTHWEST TERRITORIES Stanton Territorial Hospital Yellowknife	Sherrill Webber Tech II, Microbiology Carolyn Russell Laboratory Supervisor Cheryl Case Manager, Therapeutic & Diagnostic Services

NOVA SCOTIA Department of Pathology & Laboratory Medicine Queen Elizabeth II Health Sciences Centre Halifax	Sherry Maston Division of Medical Microbiology Dr. David Haldane Director, Provincial Public Health Laboratory Network and Special Pathogens Dr. Todd Hatchette Director, Pathology and Laboratory Medicine
NUNAVUT Qikiqtani General Hospital Iqaluit	Sonia Marchand Laboratory Health
ONTARIO Central Public Health Laboratory Ontario Agency for Health Protection and Promotion Toronto	Kevin May Operational Lead, Mycobacteriology Dr. Frances Jamieson Medical Microbiologist -TB and Mycobacteriology Alex Marchand-Austin Manager, Laboratory Surveillance and Data Management
QUEBEC Laboratoire de santé publique du Québec Institut national de santé publique du Québec Sainte-Anne-de-Bellevue	Hafid Soualhine Head, Mycobacteriology & Aerobic Actinomycetes Dr. Cécile Tremblay Director
SASKATCHEWAN Saskatchewan Disease Control Laboratory Regina	Rita Thomas Technologist, TB/Bacteriology Dr. Christine Turenne Microbiologist Dr. Paul Levett Microbiologist Dr. David Alexander Microbiologist Dr. Greg Horsman Director, Saskatchewan Health
FEDERAL National Microbiology Laboratory Public Health Agency of Canada Winnipeg	Joyce Wolfe Program Manager, Mycobacteriology

APPENDIX II: *M. TUBERCULOSIS* COMPLEX ANTIMICROBIAL SUSCEPTIBILITY REPORTING FORM

Public Health Agency of Canada / Agence de la santé publique du Canada

The Canadian Tuberculosis Laboratory Surveillance System
M. TUBERCULOSIS COMPLEX ANTIMICROBIAL SUSCEPTIBILITY REPORTING FORM

Système de surveillance des laboratoires de tuberculose au Canada
RAPPORT SUR LA SENSIBILITÉ DES SOUCHES DU COMPLEXE M. TUBERCULOSIS AUX ANTIMICROBIENS

Unique Source Laboratory ID No.:
Identificateur unique du laboratoire déclarant:

Date specimen / culture received at laboratory:
Date de réception échantillon / culture au laboratoire: Y / A | M | D / J

Species: / **Espèce :**
☐ M. tuberculosis complex (species known)* / Complexe M. tuberculosis (espèce connue)* ☐ M. bovis ☐ M. bovis BCG ☐ MTB Complex (species unknown) / Complexe MTB (espèce inconnue)

Have susceptibility test results been previously reported for this patient? - Des résultats d'antibiogramme ont-ils déjà été fournis pour ce patient?

☐ No / Non ☐ Yes / Oui → What is the **previous** Unique Source Laboratory ID No.? / Identificateur **antérieur**?

→ What is the **previous** Form No.? (If known) / N° de formulaire **antérieur**? (Si connu)

Note: Only DRUG TESTING RESULTS OF ONE ISOLATE are to be reported. No subsequent drug testing results for the same patient are to be reported unless the sensitivity pattern changes.

Note: Ne fournir que les RÉSULTATS POUR UN SEUL ISOLAT par patient à moins d'un changement du profil de sensibilité.

1	Province / territory from which this report originates: / Province / territoire qui soumet ce rapport :	(see code list) / (voir liste de codes)
2	Province / territory from which specimen originates: / Province / territoire d'où provient l'échantillon :	(see code list) / (voir liste de codes)
3	Patient's date of birth: / Date de naissance du patient : Y / A | M | D / J	(CCYY/MM/DD) / (SSAA/MM/JJ) ☐ Unknown / Inconnu
4	Patient's gender: / Sexe du patient :	☐ Male / Masculin ☐ Female / Féminin ☐ Unknown / Inconnu

PROV / TERR CODES PROV / TERR

10 = N.L. / T.N.-L.	46 = Man.
11 = P.E.I. / Î.-P.-É.	47 = Sask.
12 = N.S. / N.-É.	48 = Alta. / Alb.
13 = N.B. / N.-B.	59 = B.C. / C.-B.
24 = Que. / Qc	60 = Y.T. / Yn
35 = Ont.	61 = N.W.T. / T.N.-O.
	62 = Nvt. / Nt

5

LABORATORY RESULTS / RÉSULTATS DE LABORATOIRE	**Concentration** (if different from on file) / **Concentration** (si autre que spécifiée)	**Results** (check appropriate box for every drug) / **Résultats** (cocher la case pertinente pour chaque antibiotique)		
		Sensitive / Sensible	Resistant / Résistant	Other (specify) / Autre (préciser)
Antituberculous Drugs/Antituberculeux				
INH (Isoniazid/Isoniazide)	mg / L	☐	☐	
RMP (Rifampin/Rifampicine)	mg / L	☐	☐	
EMB (Ethambultol/Éthambutol)	mg / L	☐	☐	
PZA (Pyrazinamide)	mg / L	☐	☐	
2nd line drugs/Antituberculeux mineurs				
AK (Amikacin/Amikacine)	mg / L	☐	☐	
CM (Capreomycin/Capréomycine)	mg / L	☐	☐	
CIPRO (Ciprofloxacin/Ciprofloxacine)	mg / L	☐	☐	
CF (Clofazamine)	mg / L	☐	☐	
CS (Cycloserine/Cyclosérine)	mg / L	☐	☐	
ETH (Ethinoamide/Éthionamide)	mg / L	☐	☐	
KM (Kanamycin/Kanamycine)	mg / L	☐	☐	
LEV (Levofloxacin/Lévofloxacine)	mg / L	☐	☐	
MOX (Moxifloxacin/Moxifloxacine	mg / L	☐	☐	
OFL (Ofloxacin/Ofloxacine)	mg / L	☐	☐	
PAS (Para-Aminosalicylic Acid/Acide Para-aminosalicylique)	mg / L	☐	☐	
RBT (Rifabutin/Rifabutine)	mg / L	☐	☐	
SM (Streptomycin/Streptomycine)	mg / L	☐	☐	
Other/Autre (specify/préciser)				
1.	mg / L	☐	☐	
2.	mg / L	☐	☐	
3.	mg / L	☐	☐	
4.	mg / L	☐	☐	
5.	mg / L	☐	☐	

6 **Comments - Commentaires**

* include/inclus: M. tuberculosis, M. africanum, M. canetti, M. caprae, M. microti, M. pinnipedii.

PHAC/ASPC 9061
(01-2010)

APPENDIX III: DATA TABLES

TABLE 1: Critical concentrations for routine testing of anti-tuberculosis drugs

	ANTI-TUBERCULOSIS DRUGS	CRITICAL CONCENTRATIONS* (mg/L) BACTEC® 960	COMMENTS
FIRST-LINE	Isoniazid (INH)	0.1	When resistance to INH is 0.1 mg/L, tests are repeated with INH 0.4 mg/L to determine the level of resistance. Nevertheless, the isolate is reported as resistant using the 0.1 mg/L cut-off level.
	Rifampin (RMP)	1.0	
	Ethambutol (EMB)	5.0	
	Pyrazinamide (PZA)	100.0	Routine testing is not performed for isolates from British Columbia.
SECOND-LINE	Amikacin (AK)	1.0	
	Capreomycin (CM)	2.5	
	Ethionamide (ETH)	5.0	
	Kanamycin (KM)	2.5	
	Linezolid (LIN)	1.0	
	Moxifloxacin (MOX)	0.3	
	Ofloxacin (OFL)	2.0	
	Para-amino salicylic acid (PAS)	4.0	
	Rifabutin (RBT)	0.5	
	Streptomycin (SM)	1.0	

* Critical concentrations: the lowest concentration of drug that will inhibit 95% of wild strains of *Mycobacterium tuberculosis* that have never been exposed to drugs while at the same time not inhibiting strains of *Mycobacterium tuberculosis* that have been isolated from patients who are not responding to therapy and that are considered resistant.

TABLE 2: Total number of *Mycobacterium tuberculosis* complex isolates by reporting and originating province/territory, 2014

REPORTING PROVINCE	CANADA	ORIGINATING PROVINCE												
		N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.
N.L.	6	6	0	0	0	0	0	0	0	0	0	0	0	0
N.S.	10	0	2	8	0	0	0	0	0	0	0	0	0	0
N.B.	6	0	0	0	6	0	0	0	0	0	0	0	0	0
Que.	183	0	0	0	0	183	0	0	0	0	0	0	0	0
Ont.	523	0	0	0	0	3	457	0	0	0	2	0	0	61
Man.	125	0	0	0	0	0	0	125	0	0	0	0	0	0
Sask.	63	0	0	0	0	0	0	0	63	0	0	0	0	0
Alta.	188	0	0	0	0	0	0	0	0	180	1	0	2	5
B.C.	272	0	0	0	0	0	0	0	0	1	267	4	0	0
TOTAL	1,376	6	2	8	6	186	457	125	63	181	270	4	2	66

ABBREVIATIONS: Alta.=Alberta; B.C.=British Columbia; Man.=Manitoba; N.B.=New Brunswick; N.L.=Newfoundland and Labrador; N.S.=Nova Scotia; Nvt.=Nunavut; N.W.T.=Northwest Territories; Ont.=Ontario; P.E.I.=Prince Edward Island; Que.=Quebec; Sask.=Saskatchewan; Y.T.=Yukon Territory.

TABLE 3: Total number of *Mycobacterium tuberculosis* complex isolates and number and percentage identified with any resistance, as multidrug and as extensively drug resistant in Canada, 2004 to 2014

REPORTING YEAR	TOTAL NUMBER OF REPORTED MTBC ISOLATES	RESISTANT TO ONE OR MORE FIRST LINE DRUGS		MULTIDRUG-RESISTANT TB*		EXTENSIVELY DRUG-RESISTANT TB†	
		NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)
2004	1,376	119	8.6	12	0.9	0	0.0
2005	1,335	128	9.6	22	1.6	0	0.0
2006	1,389	126	9.1	15	1.1	1	0.1
2007	1,267	133	10.5	11	0.9	0	0.0
2008	1,356	116	8.6	15	1.1	1	0.1
2009	1,331	127	9.5	18	1.4	0	0.0
2010	1,279	112	8.8	17	1.3	1	0.1
2011	1,319	139	10.5	18	1.4	1	0.1
2012	1,404	139	9.9	8	0.6	1	0.1
2013	1,381	112	8.1	14	1.0	1	0.1
2014	1,376	131	9.5	18	1.3	1	0.1
TOTAL	14,813	1,382	9.3	168	1.1	7	<0.1

ABBREVIATIONS: MTBC=*Mycobacterium tuberculosis* complex

* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second-line drugs (amikacin, capreomycin and kanamycin).

TABLE 4: Overall pattern of reported tuberculosis drug resistance in Canada, 2004 to 2014

	REPORTING YEAR																							
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		TOTAL	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total number of isolates tested	1,376	100.0	1,335	100.0	1,389	100.0	1,267	100.0	1,356	100.0	1,331	100.0	1,279	100.0	1,319	100.0	1,404	100.0	1,381	100.0	1,376	100.0	14,813	100.0
Isolates tested that were susceptible	1,257	91.4	1,207	90.4	1,263	90.9	1,134	89.5	1,240	91.4	1,204	90.5	1,167	91.2	1,180	89.5	1,265	90.1	1,269	91.9	1,245	90.5	13,431	90.7
Isolates showing any resistance to first-line drugs																								
Any resistance to isoniazid	102	7.4	109	8.2	101	7.3	110	8.7	102	7.5	113	8.5	101	7.9	122	9.2	111	7.9	93	6.7	107	7.8	1,171	7.9
Any resistance to rifampin	14	1.0	24	1.8	24	1.7	13	1.0	19	1.4	21	1.6	18	1.4	21	1.6	10	0.7	17	1.2	24	1.7	205	1.4
Any resistance to ethambutol	11	0.8	20	1.5	12	0.9	23	1.8	13	1.0	17	1.3	10	0.8	9	0.7	4	0.3	10	0.7	6	0.4	135	0.9
Any resistance to pyrazinamide*	26	2.4	22	2.1	16	1.5	27	2.7	22	1.7	18	2.4	25	2.6	28	2.4	33	2.4	26	2.2	30	2.6	273	2.6
Isolates resistant to one or more first-line TB drugs	119	8.6	128	9.6	126	9.1	133	10.5	116	8.6	127	9.5	112	8.8	139	10.5	139	9.9	112	8.1	131	9.5	1,382	9.3
Monoresistant	94	6.8	103	7.7	107	7.7	111	8.8	94	6.9	98	7.4	88	6.9	119	9.0	128	9.1	93	6.7	108	7.8	1,143	7.7
Multidrug resistant†	12	0.9	22	1.6	15	1.1	11	0.9	15	1.1	18	1.4	17	1.3	18	1.4	8	0.6	14	1.0	18	1.3	168	1.1
Polyresistant	13	0.9	3	0.2	3	0.2	11	0.9	6	0.4	11	0.8	6	0.5	1	0.1	2	0.1	4	0.3	4	0.3	64	0.4
Extensively drug resistant‡	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1	0	0.0	1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	7	<0.1

* Not all isolates were tested for resistance to pyrazinamide. The percentage shown with any resistance is based on the number tested by year: 2004=1,105; 2005=1,063; 2006=1,080; 2007=991; 2008=1,048; 2009=1,042; 2010=1,042; 2011=1,197; 2012=1,175; 2013=1,187; 2014=1,143.

† Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

‡ Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

TABLE 5: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Alberta, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	94	100.0	129	100.0	104	100.0	98	100.0	134	100.0	159	100.0	107	100.0	156	100.0	163	100.0	154	100.0	181	100.0
Isolates susceptible to all first-line TB drugs	82	87.2	115	89.1	95	91.3	92	93.9	123	91.8	145	91.2	96	89.7	133	85.3	148	90.8	140	90.9	165	91.2
Resistant to one or more first line drugs	12	12.8	14	10.9	9	8.7	6	6.1	11	8.2	14	8.8	11	10.3	23	14.7	15	9.2	14	9.1	16	8.8
Monoresistant TB	9	9.6	10	7.8	8	7.7	6	6.1	8	6.0	12	7.5	6	5.6	16	10.3	13	8.0	13	8.4	12	6.6
INH	7	7.4	10	7.8	7	6.7	5	5.1	8	6.0	8	5.0	6	5.6	14	9.0	10	6.1	9	5.8	11	6.1
RMP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
EMB	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	0	0.0	0	0.0
PZA	2	2.1	0	0.0	1	1.0	1	1.0	0	0.0	3	1.9	0	0.0	2	1.3	3	1.8	4	2.6	0	0.0
Polyresistant	1	1.1	0	0.0	0	0.0	0	0.0	1	0.7	2	1.3	2	1.9	0	0.0	1	0.6	1	0.6	0	0.0
INH & PZA	1	1.1	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	1	0.9	0	0.0	1	0.6	0	0.0	0	0.0
INH & EMB	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & EMB & PZA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	1	0.6	0	0.0
Multidrug-resistant TB†	2	2.1	4	3.1	1	1.0	0	0.0	2	1.5	0	0.0	3	2.8	7	4.5	1	0.6	0	0.0	4	2.2
INH & RMP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
INH & RMP & EMB	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	0	0.0	0	0.0
INH & RMP & EMB & AK & KM & RBT	1	1.1	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	0	0.0
INH & RMP & EMB & PZA	0	0.0	1	0.8	0	0.0	0	0.0	1	0.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & RBT	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	0	0.0	1	0.6
INH & RMP & EMB & PZA & SM	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	0	0.0	0	0.0

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & EMB & PZA & SM & OFL & MOX & ETH & RBT	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	0	0.0	1	0.6
INH & RMP & EMB & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	1	0.7	0	0.0	1	0.9	1	0.6	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM	0	0.0	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & OFL	1	1.1	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	0	0.0
INH & RMP & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.3	0	0.0	0	0.0	1	0.6
INH & RMP & PZA & SM & ETH	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & SM & OFL & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	1	0.6	0	0.0	0	0.0	0	0.0
INH & RMP & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
INH & RMP & SM	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	0	0.0	0	0.0
INH & RMP & SM & ETH & RBT	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	0	0.0	1	0.6
INH & RMP & SM & RBT	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	0.6	0	0.0	0	0.0

ABBREVIATIONS: AK=amikacin; EMB=ethambutol; ETH=ethionamide; INH=isoniazid; KM=kanamycin; MOX=moxifloxacin; OFL=ofloxacin; PAS=*para*-aminosalicylic acid; PZA=pyrazinamide; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Includes *Mycobacterium africanum* isolate: 1 in 2011, 2013 and 2014, 2 in 2007 and 2009, and 3 in 2010; *Mycobacterium bovis*: 1 in 2012, 2 in 2009, 2011 and 2013.

† Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

TABLE 6: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for British Columbia, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB[*†]	263	100.0	204	100.0	275	100.0	231	100.0	254	100.0	239	100.0	204	100.0	194	100.0	254	100.0	223	100.0	270	100.0
Isolates susceptible to all first-line TB drugs	237	90.1	182	89.2	257	93.5	210	90.9	230	90.6	215	90.0	185	90.7	170	87.6	231	90.9	204	91.5	235	87.0
Resistant to one or more first line drugs	26	9.9	22	10.8	18	6.5	21	9.1	24	9.4	24	10.0	19	9.3	24	12.4	23	9.1	19	8.5	35	13.0
Monoresistant TB	17	6.5	17	8.3	16	5.8	17	7.4	21	8.3	23	9.6	18	8.8	22	11.3	21	8.3	19	8.5	27	10.0
INH	13	4.9	11	5.4	7	2.5	13	5.6	18	7.1	22	9.2	16	7.8	21	10.8	21	8.3	19	8.5	25	9.3
RMP	0	0.0	2	1.0	6	2.2	0	0.0	3	1.2	1	0.4	0	0.0	1	0.5	0	0.0	0	0.0	2	0.7
EMB	1	0.4	4	2.0	3	1.1	4	1.7	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
PZA	3	1.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Polyresistant	7	2.7	1	0.5	0	0.0	2	0.9	0	0.0	1	0.4	0	0.0	1	0.5	0	0.0	0	0.0	2	0.7
RMP & PZA	2	0.8	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	0	0.0
INH & PZA	4	1.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	2	0.7
INH & EMB	1	0.4	1	0.5	0	0.0	2	0.9	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Multidrug-resistant TB[‡]	2	0.8	4	2.0	2	0.7	2	0.9	3	1.2	0	0.0	1	0.5	1	0.5	2	0.8	0	0.0	6	2.2
INH & RMP	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & ETH & RBT	1	0.4	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	0	0.0
INH & RMP & EMB & PZA & KM & CM & ETH & RBT	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & PAS	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & RBT	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & EMB & PZA & SM & ETH & RBT & PAS	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & KM & RBT	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	0.4	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & OFL & ETH & RBT & PAS	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & RBT	0	0.0	1	0.5	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
INH & RMP & EMB & RBT	1	0.4	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	0	0.0
INH & RMP & EMB & SM & ETH & RBT	0	0.0	1	0.5	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	0.4
INH & RMP & EMB & SM & ETH & RBT & PAS	0	0.0	1	0.5	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
INH & RMP & ETH & RBT	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	0	0.0	1	0.4
INH & RMP & PZA & RBT	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	0	0.0	1	0.4
INH & RMP & PZA & SM & RBT	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.4	0	0.0	0	0.0
INH & RMP & PZA & SM & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
INH & RMP & RBT	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.7
INH & RMP & SM & RBT	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	0	0.0	1	0.4

ABBREVIATIONS: CM=capreomycin; EMB=ethambutol; ETH=ethionamide; INH=isoniazid; KM=kanamycin; MOX=moxifloxacin; OFL=ofloxacin; PAS=para-aminosalicylic acid; PZA=pyrazinamide; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Includes *Mycobacterium bovis* isolates: 1 in 2006 and 2007; *Mycobacterium africanum*: 1 in 2008, 2009 and 2014; 5 in 2012 and 2013.

† Routine testing for PZA not conducted in British Columbia.

‡ Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

TABLE 7: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Manitoba, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	122	100.0	94	100.0	119	100.0	84	100.0	116	100.0	106	100.0	113	100.0	97	100.0	123	100.0	148	100.0	125	100.0
Isolates susceptible to all first-line TB drugs	121	99.2	92	97.9	113	95.0	75	89.3	111	95.7	99	93.4	99	87.6	90	92.8	113	91.9	144	97.3	120	96.0
Resistant to one or more first line drugs	1	0.8	2	2.1	6	5.0	9	10.7	5	4.3	7	6.6	14	12.4	7	7.2	10	8.1	4	2.7	5	4.0
Monoresistant TB	1	0.8	2	2.1	6	5.0	8	9.5	4	3.4	5	4.7	11	9.7	5	5.2	10	8.1	4	2.7	5	4.0
INH	0	0.0	2	2.1	6	5.0	7	8.3	4	3.4	4	3.8	10	8.8	5	5.2	10	8.1	4	2.7	5	4.0
RMP	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	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	1	0.8	0	0.0	0	0.0	1	1.2	0	0.0	1	0.9	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
Polyresistant	0	0.0	0	0.0	0	0.0	1	1.2	0	0.0	2	1.9	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & PZA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & EMB	0	0.0	0	0.0	0	0.0	1	1.2	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Multidrug-resistant TB†	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	1	0.9	2	2.1	0	0.0	0	0.0	0	0.0
INH & RMP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & AK & KM & CM & ETH & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	0	0.0	0	0.0
Extensively drug-resistance‡	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & KM & OFL & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	0	0.0	0	0.0	0	0.0

ABBREVIATIONS: AK=amikacin; CM=capreomycin; EMB=ethambutol; ETH=ethionamide; INH=isoniazid; KM=kanamycin; MOX=moxifloxacin; OFL=ofloxacin; PAS=para-aminosalicylic acid; PZA=pyrazinamide; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Includes *Mycobacterium bovis* isolates: 1 in 2006 and 2007; *Mycobacterium africanum*: 1 in 2008.

† Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

‡ Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

TABLE 8: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for New Brunswick, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	11	100.0	5	100.0	3	100.0	5	100.0	3	100.0	10	100.0	9	100.0	5	100.0	4	100.0	3	100.0	6	100.0
Isolates susceptible to all first-line TB drugs	10	90.9	4	80.0	3	100.0	5	100.0	3	100.0	10	100.0	7	77.8	5	100.0	3	75.0	2	66.7	6	100.0
Resistant to one or more first line drugs	1	9.1	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	2	22.2	0	0.0	1	25.0	1	33.3	0	0.0
Monoresistant TB	1	9.1	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	2	22.2	0	0.0	1	25.0	1	33.3	0	0.0
INH	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	22.2	0	0.0	0	0.0	1	33.3	0	0.0
RMP	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	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	1	9.1	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

* Includes 1 *Mycobacterium africanum* isolate for 2007.

TABLE 9: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Newfoundland and Labrador, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA	8	100.0	6	100.0	11	100.0	5	100.0	5	100.0	10	100.0	9	100.0	5	100.0	5	100.0	11	100.0	6	100.0
Isolates susceptible to all first-line TB drugs	8	100.0	5	83.3	11	100.0	5	100.0	5	100.0	10	100.0	9	100.0	5	100.0	5	100.0	11	100.0	6	100.0
Resistant to one or more first line drugs	0	0.0	1	16.7	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
Monoresistant TB	0	0.0	1	16.7	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
INH	0	0.0	1	16.7	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
RMP	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	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	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	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

TABLE 10: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Northwest Territories, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA	9	100.0	6	100.0	4	100.0	14	100.0	13	100.0	10	100.0	5	100.0	8	100.0	6	100.0	3	100.0	2	100.0
Isolates susceptible to all first-line TB drugs	9	100.0	6	100.0	3	75.0	14	100.0	13	100.0	9	90.0	4	80.0	8	100.0	6	100.0	3	100.0	2	100.0
Resistant to one or more first line drugs	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0	1	10.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0
Monoresistant TB	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0	1	10.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0
INH	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0
RMP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	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	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

TABLE 11: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Nova Scotia, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	9	100.0	7	100.0	8	100.0	5	100.0	3	100.0	7	100.0	8	100.0	7	100.0	9	100.0	9	100.0	8	100.0
Isolates susceptible to all first-line TB drugs	9	100.0	6	85.7	8	100.0	5	100.0	3	100.0	7	100.0	5	62.5	7	100.0	9	100.0	8	88.9	5	62.5
Resistant to one or more first line drugs	0	0.0	1	14.3	0	0.0	0	0.0	0	0.0	0	0.0	3	37.5	0	0.0	0	0.0	1	11.1	3	37.5
Monoresistant TB	0	0.0	1	14.3	0	0.0	0	0.0	0	0.0	0	0.0	2	25.0	0	0.0	0	0.0	1	11.1	3	37.5
INH	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	0	0.0	0	0.0	1	11.1	3	37.5
RMP	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	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	0	0.0	1	14.3	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	0	0.0
Polyresistant	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	0	0.0
INH & PZA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

* Includes 1 *Mycobacterium bovis* isolate for 2010.

TABLE 12: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Nunavut, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA	16	100.0	28	100.0	37	100.0	25	100.0	51	100.0	50	100.0	71	100.0	64	100.0	65	100.0	42	100.0	66	100.0
Isolates susceptible to all first-line TB drugs	16	100.0	28	100.0	37	100.0	24	96.0	51	100.0	49	98.0	70	98.6	62	96.9	65	100.0	42	100.0	66	100.0
Resistant to one or more first line drugs	0	0.0	0	0.0	0	0.0	1	4.0	0	0.0	1	2.0	1	1.4	2	3.1	0	0.0	0	0.0	0	0.0
Monoresistant TB	0	0.0	0	0.0	0	0.0	1	4.0	0	0.0	1	2.0	1	1.4	2	3.1	0	0.0	0	0.0	0	0.0
INH	0	0.0	0	0.0	0	0.0	1	4.0	0	0.0	1	2.0	1	1.4	1	1.6	0	0.0	0	0.0	0	0.0
RMP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.6	0	0.0	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	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	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

TABLE 13: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Ontario, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	599	100.0	553	100.0	567	100.0	538	100.0	479	100.0	488	100.0	496	100.0	507	100.0	493	100.0	511	100.0	457	100.0
Isolates susceptible to all first-line TB drugs	539	90.0	487	88.1	504	88.9	466	86.6	427	89.1	428	87.7	456	91.9	454	89.5	429	87.0	458	89.6	407	89.1
Resistant to one or more first line drugs	60	10.0	66	11.9	63	11.1	72	13.4	52	10.9	60	12.3	40	8.1	53	10.5	64	13.0	53	10.4	50	10.9
Monoresistant TB	49	8.2	51	9.2	49	8.6	61	11.3	40	8.4	44	9.0	29	5.8	45	8.9	57	11.6	37	7.2	42	9.2
INH	46	7.7	44	8.0	39	6.9	50	9.3	33	6.9	39	8.0	27	5.4	39	7.7	45	9.1	27	5.3	30	6.6
RMP	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	2	0.4	1	0.2
EMB	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	1	0.2	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0
PZA	3	0.5	7	1.3	9	1.6	9	1.7	6	1.3	4	0.8	2	0.4	6	1.2	10	2.0	8	1.6	11	2.4
Polyresistant	4	0.7	2	0.4	3	0.5	4	0.7	4	0.8	5	1.0	1	0.2	0	0.0	1	0.2	3	0.6	1	0.2
EMB & PZA	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & EMB	3	0.5	2	0.4	3	0.5	1	0.2	2	0.4	3	0.6	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
INH & PZA	1	0.2	0	0.0	0	0.0	2	0.4	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	2	0.4	1	0.2
INH & EMB & PZA	0	0.0	0	0.0	0	0.0	0	0.0	2	0.4	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Multidrug-resistant TB†	7	1.2	13	2.4	10	1.8	7	1.3	7	1.5	11	2.3	10	2.0	7	1.4	5	1.0	13	2.5	6	1.3
INH & RMP	1	0.2	0	0.0	2	0.4	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & AK & CM & RBT	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & CM & ETH & RBT	1	0.2	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	0	0.0
INH & RMP & CM & RBT	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & ETH & RBT	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	0.2	0	0.0

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & EMB & PZA & AK & CM & ETH & RBT	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & CM & RBT	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	0.2	0	0.0	0	0.0
INH & RMP & EMB & PZA & ETH & RBT	0	0.0	0	0.0	0	0.0	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & RBT	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
INH & RMP & EMB & PZA & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & ETH & RBT	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	1	0.2	0	0.0
INH & RMP & EMB & PZA & SM & ETH & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & OFL & ETH & RBT	1	0.2	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	0	0.0
INH & RMP & EMB & PZA & SM & OFL & MOX & ETH & RBT	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	0.2	0	0.0
INH & RMP & EMB & PZA & SM & OFL & RBT	0	0.0	1	0.2	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
INH & RMP & EMB & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	1	0.2	0	0.0	1	0.2	0	0.0	1	0.2	0	0.0
INH & RMP & EMB & RBT	0	0.0	0	0.0	2	0.4	1	0.2	1	0.2	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & AK & CM	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & ETH & RBT	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & ETH & RBT & PAS	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	0.2	0	0.0

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & EMB & SM & KM & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & OFL & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & OFL & MOX & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & SM & OFL & RBT	0	0.0	1	0.2	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
INH & RMP & EMB & SM & RBT	0	0.0	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2
INH & RMP & ETH & RBT	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
INH & RMP & ETH & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & OFL & ETH & RBT	2	0.3	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	0	0.0
INH & RMP & OFL & ETH & RBT & PAS	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & ETH & RBT	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & RBT	1	0.2	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	0	0.0
INH & RMP & PZA & SM	1	0.2	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	0	0.0
INH & RMP & PZA & SM & ETH & RBT	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & SM & OFL & MOX & RBT	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	0.2	0	0.0	0	0.0
INH & RMP & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	1	0.2
INH & RMP & RBT	0	0.0	3	0.5	1	0.2	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	2	0.4	0	0.0
INH & RMP & SM	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	0.2	1	0.2	0	0.0
INH & RMP & SM & CM & RBT	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	0	0.0	1	0.2
INH & RMP & SM & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & SM & ETH & RBT & PAS	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	0	0.0	1	0.2

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & SM & KM & ETH & RBT	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	0.2	0	0.0	0	0.0
INH & RMP & SM & OFL & ETH & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & SM & RBT	0	0.0	2	0.4	0	0.0	0	0.0	3	0.6	1	0.2	1	0.2	1	0.2	1	0.2	2	0.4	1	0.2
Extensively drug-resistant TB‡	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	1	0.2
INH & RMP & AK & CM & OFL & ETH & RBT	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & CM & OFL & ETH & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & KM & OFL & MOX & ETH & RBT	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	0.2	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & KM & OFL & MOX & ETH & RBT & PAS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & KM & OFL & MOX & RBT & ETA & PAS	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	0	0.0	1	0.2

ABBREVIATIONS: AK=amikacin; CM=capreomycin; EMB=ethambutol; ETH=ethionamide; INH=isoniazid; KM=kanamycin; MOX=moxifloxacin; OFL=ofloxacin; PAS=*para*-aminosalicylic acid; PZA=pyrazinamide; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Includes *Mycobacterium bovis* isolates: 1 isolate for 2004 and 2014; 2 for 2009, 2005 and 2010; 3 for 2011, and 4 for 2006.

† Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

‡ Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

TABLE 14: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Prince Edward Island, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	1	100.0	1	100.0	0	0	0	0	0	0	1	100.0	1	100.0	3	100.0	0	0	0	0	2	100.0
Isolates susceptible to all first-line TB drugs	1	100.0	1	100.0	0	0	0	0	0	0	1	100.0	1	100.0	2	66.7	0	0	0	0	2	100.0
Resistant to one or more first line drugs	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	33.3	0	0	0	0	0	0.0
Monoresistant TB	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	33.3	0	0	0	0	0	0.0
INH	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	0.0
RMP	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	0.0
EMB	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	0.0
PZA	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	33.3	0	0	0	0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

TABLE 15: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Quebec, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA*	207	100.0	226	100.0	201	100.0	200	100.0	210	100.0	171	100.0	197	100.0	205	100.0	209	100.0	205	100.0	186	100.0
Isolates susceptible to all first-line TB drugs	190	91.8	207	91.6	173	86.1	177	88.5	188	89.5	156	91.2	179	90.9	180	87.8	187	89.5	187	91.2	167	89.8
Resistant to one or more first line drugs	17	8.2	19	8.4	28	13.9	23	11.5	22	10.5	15	8.8	18	9.1	25	12.2	22	10.5	18	8.8	19	10.2
Monoresistant TB	15	7.2	18	8.0	26	12.9	17	8.5	19	9.0	9	5.3	16	8.1	24	11.7	22	10.5	16	7.8	17	9.1
INH	11	5.3	14	6.2	21	10.4	12	6.0	15	7.1	7	4.1	11	5.6	18	8.8	13	6.2	12	5.9	10	5.4
RMP	0	0.0	0	0.0	1	0.5	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
EMB	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	0	0.0	0	0.0
PZA	4	1.9	4	1.8	4	2.0	4	2.0	4	1.9	2	1.2	5	2.5	6	2.9	9	4.3	4	2.0	7	3.8
Polyresistant	1	0.5	0	0.0	0	0.0	4	2.0	1	0.5	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
INH & PZA	0	0.0	0	0.0	0	0.0	1	0.5	1	0.5	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
INH & EMB	1	0.5	0	0.0	0	0.0	3	1.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Multidrug-resistant TB†	1	0.5	1	0.4	2	1.0	2	1.0	2	1.0	6	3.5	1	0.5	1	0.5	0	0.0	1	0.5	2	1.1
INH & RMP & EMB & ETH & RBT	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & ETH	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & PZA & SM & KM & ETH & RBT & PAS	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	0.5	0	0.0
INH & RMP & EMB & PZA & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0
INH & RMP & EMB & RBT	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
INH & RMP & EMB & SM & RBT	0	0.0	0	0.0	1	0.5	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & ETH & RBT	0	0.0	1	0.4	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
INH & RMP & PZA & RBT	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	0	0.0	1	0.5
INH & RMP & PZA & SM & AK & KM & CM	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & PZA & SM & KM & CM & ETH	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & RBT	1	0.5	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & SM & RBT	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	2	1.2	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Extensively drug-resistant TB‡	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	0.5	0	0.0
INH & RMP & EMB & PZA & SM & AK & KM & CM & OFL & MOX & ETH & RBT	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	0.5	0	0.0

ABBREVIATIONS: AK=amikacin; CM=capreomycin; ETH=ethionamide; KM=kanamycin; MOX=moxifloxacin; OFL=ofloxacin; PAS=*para*-aminosalicylic acid; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Includes *Mycobacterium bovis* isolates: 1 in 2007, 2009, 2013 and 2014; 2 in 2004, 2006, and 2010; 3 in 2011; 4 in 2012; *Mycobacterium caprae*: 1 in 2006; *Mycobacterium africanum*: 1 in 2005, 2006, 2008, and 2014; 2 in 2007, 2012, and 2013; 3 in 2009 and 2011; and 4 in 2010.

† Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

‡ Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

TABLE 16: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Saskatchewan, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP, EMB & PZA	34	100.0	74	100.0	58	100.0	60	100.0	81	100.0	77	100.0	54	100.0	66	100.0	72	100.0	71	100.0	63	100.0
Isolates susceptible to all first-line TB drugs	32	94.1	72	97.3	57	98.3	59	98.3	79	97.5	72	93.5	51	94.4	62	93.9	68	94.4	69	97.2	60	95.2
Resistant to one or more first line drugs	2	5.9	2	2.7	1	1.7	1	1.7	2	2.5	5	6.5	3	5.6	4	6.1	4	5.6	2	2.8	3	4.8
Monoresistant TB	2	5.9	2	2.7	1	1.7	1	1.7	2	2.5	3	3.9	2	3.7	4	6.1	4	5.6	2	2.8	2	3.2
INH	2	5.9	2	2.7	1	1.7	1	1.7	2	2.5	3	3.9	2	3.7	4	6.1	1	1.4	1	1.4	0	0.0
RMP	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	0	0.0	1	1.6
EMB	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	0	0.0	0	0.0
PZA	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	4.2	1	1.4	1	1.6
Polyresistant	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	0	0.0	0	0.0	0	0.0	0	0.0	1	1.6
INH & PZA	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	0	0.0	1	1.6
INH & EMB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Multidrug-resistant TB*	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	1	1.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & RBT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.9	0	0.0	0	0.0	0	0.0	0	0.0
INH & RMP & SM	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RBT=rifabutin; RMP=rifampin; SM=streptomycin.

* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

TABLE 17: Results for routine drug susceptibility testing of *Mycobacterium tuberculosis* complex isolates to anti-tuberculosis drugs for Yukon, 2004 to 2014

	REPORTING YEAR																					
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Isolates tested for resistance to INH, RMP & EMB*	3	100.0	2	100.0	2	100.0	2	100.0	7	100.0	3	100.0	5	100.0	2	100.0	1	100.0	1	100.0	4	100.0
Isolates susceptible to all first-line TB drugs	3	100.0	2	100.0	2	100.0	2	100.0	7	100.0	3	100.0	5	100.0	2	100.0	1	100.0	1	100.0	4	100.0

ABBREVIATIONS: EMB=ethambutol; INH=isoniazid; PZA=pyrazinamide; RMP=rifampin.

* Routine testing for PZA not conducted for Yukon.

TABLE 18: Multidrug-resistant tuberculosis and extensively drug-resistant tuberculosis isolates by province/territory of origin, 2014

		ORIGINATING PROVINCE												
	CANADA	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.
Total number of MTBC isolates tested	1,376	6	2	8	6	186	457	125	63	181	270	4	2	66
Multidrug-resistant TB*	18	0	0	0	0	2	6	0	0	4	6	0	0	0
Isoniazid & rifampin	10	0	0	0	0	1	3	0	0	2	4	0	0	0
Isoniazid & rifampin & ethambutol	3	0	0	0	0	0	1	0	0	0	2	0	0	0
Isoniazid & rifampin & pyrazinamide	2	0	0	0	0	1	1	0	0	0	0	0	0	0
Isoniazid & rifampin & pyrazinamide & ethambutol	3	0	0	0	0	0	1	0	0	2	0	0	0	0
Extensively drug-resistant TB†	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Isoniazid & rifampin & pyrazinamide & ethambutol & streptomycin & kanamycin & ofloxacin & moxifloxacin & rifabutin	1	0	0	0	0	0	1	0	0	0	0	0	0	0

ABBREVIATIONS: Alta.=Alberta; B.C.=British Columbia; Man.=Manitoba; N.B.=New Brunswick; N.L.=Newfoundland and Labrador; N.S.=Nova Scotia; Nvt.=Nunavut; N.W.T.=Northwest Territories; Ont.=Ontario; P.E.I.=Prince Edward Island; Que.=Quebec; Sask.=Saskatchewan; Y.T.=Yukon.

* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second-line drugs (amikacin, capreomycin and kanamycin).

TABLE 19: Provincial/territorial breakdown by any resistance, multidrug-resistant tuberculosis and extensively drug-resistant tuberculosis in Canada, 2004 to 2014

ORIGINATING PROVINCE	TOTAL NUMBER OF REPORTED MTBC ISOLATES	RESISTANT TO ONE OR MORE FIRST LINE DRUGS		MULTIDRUG-RESISTANT TB*		EXTENSIVELY DRUG-RESISTANT TB†	
		NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)
Ontario	5,688	633	11.1	96	1.7	5	0.1
British Columbia	2,611	255	9.8	23	0.9	0	0.0
Quebec	2,217	226	10.2	19	0.9	1	0.0
Alberta	1,479	145	9.8	24	1.6	0	0.0
Manitoba	1,247	70	5.6	4	0.3	1	0.1
Saskatchewan	710	29	4.1	2	0.3	0	0.0
Nunavut	515	5	1.0	0	0.0	0	0.0
Newfoundland and Labrador	81	1	1.2	0	0.0	0	0.0
Nova Scotia	80	8	10.0	0	0.0	0	0.0
Northwest Territories	80	3	3.8	0	0.0	0	0.0
New Brunswick	64	6	9.4	0	0.0	0	0.0
Yukon	32	0	0.0	0	0.0	0	0.0
Prince Edward Island	9	1	11.1	0	0.0	0	0.0
CANADA	14,813	1,382	9.3	168	1.1	7	<0.1

* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

TABLE 20: Tuberculosis drug resistance by sex and age group in Canada, 2014

AGE GROUP AND SEX		ISOLATES REPORTED		RESISTANT TO ONE OR MORE FIRST LINE DRUGS		MULTIDRUG RESISTANT*		EXTENSIVELY DRUG RESISTANT†	
		NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)
0 to 4	Males	8	0.6	0	0.0	0	0.0	0	0.0
	Females	4	0.3	1	0.8	1	5.6	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	12	0.9	1	0.8	1	5.6	0	0.0
5 to 14	Males	12	0.9	1	0.8	0	0.0	0	0.0
	Females	10	0.7	0	0.0	0	0.0	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	22	1.6	1	0.8	0	0.0	0	0.0
15 to 24	Males	93	6.8	4	3.1	1	5.6	0	0.0
	Females	81	5.9	9	6.9	1	5.6	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	174	12.6	13	9.9	2	11.1	0	0.0
25 to 34	Males	116	8.4	9	6.9	3	16.7	0	0.0
	Females	134	9.7	21	16.0	2	11.1	1	100.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	250	18.2	30	22.9	5	27.8	1	100.0
35 to 44	Males	103	7.5	11	8.4	0	0.0	0	0.0
	Females	113	8.2	16	12.2	3	16.7	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	216	15.7	27	20.6	3	16.7	0	0.0
45 to 54	Males	120	8.7	9	6.9	2	11.1	0	0.0
	Females	70	5.1	7	5.3	1	5.6	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	190	13.8	16	12.2	3	16.7	0	0.0

AGE GROUP AND SEX		ISOLATES REPORTED		RESISTANT TO ONE OR MORE FIRST LINE DRUGS		MULTIDRUG RESISTANT*		EXTENSIVELY DRUG RESISTANT†	
		NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)	NUMBER	PERCENT (%)
55 to 64	Males	110	8.0	12	9.2	1	5.6	0	0.0
	Females	49	3.6	5	3.8	0	0.0	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	159	11.6	17	13.0	1	5.6	0	0.0
65 to 74	Males	90	6.5	12	9.2	1	5.6	0	0.0
	Females	50	3.6	4	3.1	0	0.0	0	0.0
	Unknown	1	0.1	0	0.0	0	0.0	0	0.0
	Total	141	10.2	16	12.2	1	5.6	0	0.0
75+	Males	127	9.2	5	3.8	1	5.6	0	0.0
	Females	83	6.0	5	3.8	1	5.6	0	0.0
	Unknown	1	0.1	0	0.0	0	0.0	0	0.0
	Total	211	15.3	10	7.6	2	11.1	0	0.0
Unknown	Males	0	0.0	0	0.0	0	0.0	0	0.0
	Females	1	0.1	0	0.0	0	0.0	0	0.0
	Unknown	0	0.0	0	0.0	0	0.0	0	0.0
	Total	1	0.1	0	0.0	0	0.0	0	0.0
Total	Males	779	56.6	63	48.1	9	50.0	0	0.0
	Females	595	43.2	68	51.9	9	50.0	1	100.0
	Unknown	2	0.1	0	0.0	0	0.0	0	0.0
TOTAL		**1,376**	**100.0**	**131**	**100.0**	**18**	**100.0**	**1**	**100.0**

* Multidrug-resistant TB is TB that is resistant to isoniazid and rifampin, but does not meet the definition of extensively drug-resistant TB.

† Extensively drug-resistant TB is TB that is resistant to isoniazid and rifampin, any fluoroquinolone and at least one of three injectable second–line drugs (amikacin, capreomycin and kanamycin).

REFERENCES

1 Christianson S, Jamieson F, Sharma M, Wolfe J. Appendix D: Tuberculosis and mycobacteriology laboratory standards. In: Menzies R and Wong T. (eds). 2013. Canadian Tuberculosis Standards, 7th Edition. Canadian Thoracic Society, Canadian Lung Association, Public Health Agency of Canada.

2 World Health Organization. Definitions and reporting framework for tuberculosis—2013 revision. Geneva: WHO Press; 2013 Available from: http://apps.who.int/iris/bitstream/10665/79199/1/9789241505345_eng.pdf.

3 Woods GL, Brown-Elliott BA, Conville PS, et al. Susceptibility testing of mycobacteria, nocardiae, and other aerobic actinomycetes; Approved standard. 2nd ed. Wayne, PA: Clinical and Laboratory Standards Institute; 2011.

4 Sharma M, Thibert L, Chedore P, et al. Canadian multicentre laboratory study for standardized second-line antimicrobial susceptibility testing of mycobacterium tuberculosis. J Clin Microbiol. 2011;49(12):4112–6.

5 Public Health Agency of Canada. Directive for the collection, use and dissemination of information relating to public health. Unpublished document. Ottawa, ON: 2013.

6 World Health Organization. Global tuberculosis report 2013. Geneva: WHO Press; 2013. Available from: http://apps.who.int/iris/bitstream/10665/91355/1/9789241564656_eng.pdf.