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Tuberculosis

Drug resistance in Canada

2005

Reported susceptibility results of the Canadian Tuberculosis Laboratory Surveillance System

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For more information, copies of this report or other reports, please contact:

Tuberculosis Prevention and Control
Community Acquired Infections Division
Centre for Infectious Disease Prevention and Control
Public Health Agency of Canada
100 Eglantine Driveway, Health Canada Building
A.L. 0603B, Tunney's Pasture
Ottawa, ON K1A 0K9

Internal Postal Address: 0603B
Telephone: (613) 941-0238
Facsimile: (613) 946-3902

This report can also be accessed on the internet at:

http://www.phac-aspc.gc.ca/tbpc-latb/surv_e.html

The following text, figures and tables were prepared by:

Edward Ellis, MD, MPH, FRCPC
Manager
Tuberculosis Prevention and Control

Derek Scholten, MSc
Senior Epidemiologist
Tuberculosis Prevention and Control

Victor Gallant, MA
Tuberculosis Database Manager
Tuberculosis Prevention and Control

Mindy Miron
Surveillance Officer
Tuberculosis Prevention and Control

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Cat. HP37-4/2005
ISBN 0-662-49315-X

Cat. HP37-4/2005E-PDF
ISBN 0-662-43627-X

This publication can be made available in alternative formats.

▶ ACKNOWLEDGEMENT

Tuberculosis Prevention and Control would like to acknowledge the members of the Canadian Tuberculosis Laboratory Technical Network and their teams for their contribution to and their participation in the Canadian Tuberculosis Laboratory Surveillance System (CTBLSS).

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INTRODUCTION

Tuberculosis Prevention and Control (TBPC) at the Centre for Infectious Disease Prevention and Control, Public Health Agency of Canada, in collaboration with the Canadian Tuberculosis Laboratory Technical Network and participating laboratories (representing all provinces and territories) in the Canadian Tuberculosis Laboratory Surveillance System (CTBLSS) (Appendix 1), established a laboratory-based national surveillance system in 1998 to monitor tuberculosis (TB) drug resistance patterns in Canada.

Laboratories report annually to TBPC the results of anti-tuberculosis drug susceptibility testing for every patient for whom a specimen or an isolate is received within the calendar year. TBPC subsequently produces this annual report.

METHODS

TBPC maintains a database containing drug susceptibility test results of *Mycobacterium tuberculosis* (MTB) and other tuberculosis species as well as MTB complex (MTBC) isolates as laboratories report identification of isolates either at the complex level (MTBC) or at the species level. Isolates identified as *Mycobacterium bovis* BCG are included in the CTBLSS but are excluded from this report. *M. bovis* (BCG) is intrinsically resistant to pyrazinamide (PZA) and the identity of the majority of isolates of *M. bovis* (BCG) can be inferred from the history of recent vaccination. Results of susceptibility testing for second-line anti-tuberculosis drugs were not uniformly reported from the provinces/territories and are not included in this report. Streptomycin was reclassified in 2005 as a second line TB drug in Canada; however it will continue to appear in the report to maintain historical continuity.

Data are collected either through manual completion of a standard reporting form (Appendix 2) or by electronic transmission. Information collected includes sex, year of birth, province/territory from which the specimen originated, province/territory where the tests were performed, and susceptibility results. TBPC, in collaboration with the provinces/territories makes every effort to eliminate duplicate specimens. Only the most recent susceptibility results for a given patient in the current reporting year are included for analysis.

Some provinces perform drug testing for other provinces/territories. British Columbia tests British Columbia and Yukon isolates; Alberta tests Alberta and Northwest Territories isolates; and Nova Scotia tests isolates for Nova Scotia and Prince Edward Island. Both Ontario and Alberta test isolates for Nunavut. Cross validation with both Ontario and Alberta is performed to ensure that the results for the Nunavut isolates are not being reported twice.

Laboratories perform routine susceptibility testing of MTB or MTBC to first-line anti-tuberculous drugs using either the radiometric proportion method Bactec® 460 or MGIT® 960. New Brunswick, Nova Scotia and Saskatchewan used MGIT® 960; Newfoundland and Labrador used a combination of both. All other provinces/territories used Bactec® 460. Table A lists the first-line anti-tuberculosis drugs and the critical concentrations in mg/L used by the participating laboratories.

As not all isolates were tested for resistance to all drugs, the proportion of isolates showing monoresistance is expressed as the number of isolates resistant to the drug over the total number of isolates tested for sensitivity to that particular drug. An adjustment based on this method has been made to all data starting from 1998. These proportions for 1998 through 2005 are reported in Table 1, and Tables 5-17.

Table A: Critical concentrations for routine testing of anti-tuberculosis drugs			
	Critical Concentrations* (mg/L)		
Anti-TB drugs	Bactec 460	MGIT 960	Comments
Isoniazid (INH)	0.1	0.1	When resistance to INH is found at the critical concentration, tests are repeated with INH 0.4 mg/L to determine the level of resistance.
Rifampin (RMP)	2.0	1.0	
Ethambutol (EMB)	2.5	5.0	British Columbia uses a CC of 4.0 mg/L.
Pyrazinamide (PZA)	100.0	100.0	Routine testing is not performed for isolates from British Columbia, Saskatchewan and the Yukon Territory.
Streptomycin (SM)	2.0	1.0	Routine testing is not performed for isolates from New Brunswick, Nova Scotia, Prince Edward Island and Quebec.

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

As noted in Table A, the number and specific anti-tuberculous drugs that are subject to routine susceptibility testing differ among the provinces and territories. Accordingly, the number of isolates drugs included in the descriptive analyses varies.

In 2005, a total of 10 laboratories participated in the proficiency for anti-microbial susceptibility testing of *M. tuberculosis* to isoniazid (INH), rifampin (RMP), ethambutol (EMB), pyrazinamide (PZA) and streptomycin (SM) conducted by the National Reference Centre for Mycobacteriology, National Microbiology Laboratory in Winnipeg. Participant results are presented in Appendix 3.

This report presents drug susceptibility data for TB isolates tested in 2005 and adjusted results for 2004 isolates (to reflect duplicate removal and late reporting) across Canada as of May 2006.

▶ RESULTS

Of the 1,308 isolates in 2005 included for analysis, 163 (12.5%) were resistant to at least one of the antituberculosis drugs: INH, RMP, EMB, PZA or SM. For Canada as a whole, INH resistance was 8.3%. Twenty-one isolates (1.6%) were multidrug-resistant (MDR- TB) strains (defined as resistance to at least INH and RMP). Twelve isolates demonstrated resistance to more than three of the five anti-tuberculous drugs tested. MDR-TB isolates were reported from Alberta, British Columbia, Ontario and Quebec. Of the 1,062 isolates tested for resistance to SM, 77 (7.3%) were resistant.

The Northwest Territories, Nunavut, Prince Edward Island and Yukon Territory reported that all isolates tested were susceptible to all the anti-tuberculous drugs.

Demographic information on the individual patients from whom the isolates originated is limited in this laboratory-based surveillance system. Of the 1,296 isolates for which the age at time of testing and/or sex reporting was complete, 37% were between the ages 25 and 44 and males accounted for 55% of all the isolates and 57% of the drug resistant isolates.

DISCUSSION

The number of reported TB isolates in 2005 was slightly lower than for the previous year (1,381 isolates in 2004 compared to 1,308 in 2005). The percentage of isolates demonstrating any type of drug resistance was 12.5%, equal to the value reported in 2004. The proportion of isolates classified as MDR-TB increased from 0.9% in 2004 to 1.6% in 2005. Although the reported increase in MDR-TB from 2004 is of some concern it is comparable to the average reported over the past 5 years (1.2%).

Seventy-three percent of the reported laboratory TB isolates in Canada in 2005 originated from three provinces. British Columbia, Ontario and Quebec have consistently reported the majority of isolates and MDR-TB in the eight years of data collection. Since the initiation of this laboratory-based surveillance system the Atlantic Provinces, the Northwest Territories, Saskatchewan, and the Yukon have not reported any MDR-TB isolates.

The results observed to date in this surveillance system are consistent with international data. In the latest report of the global TB drug resistance surveillance project jointly conducted by the World Health Organization (WHO) and the International Union Against Tuberculosis and Lung Disease (IUATLD)[1], the median prevalence of TB drug resistance among the participating countries was 10.5 (Range 0.0 – 57.1%) for new cases and 22.7% (Range 0.0 – 82.1%) for previously treated cases (as compared with 12.5% overall in Canada)*. The median prevalence of MDR-TB was 1.2% (Range 0.0 – 14.2%) for new cases and 7.6% (Range 0.0 – 58.3%) for previously treated cases (as compared with 1.6% overall in Canada)*.[1]

"Extensively drug-resistant TB" (XDR-TB) refers to TB isolates resistant to INH and RMP and at least three of the six main classes of second-line drugs (aminoglycosides, polypeptides, fluoroquinolones, thioamides, cycloserine, and *para*-aminosalicylic acid). XDR-TB carries a worse prognosis than MDR-TB and accordingly, the *Morbidity and Mortality Weekly Report* for March 24, 2006 stated that XDR-TB is emerging as a worldwide threat to public health and TB control, raising concerns of a future epidemic of virtually untreatable TB.[2]

For 2005, only reports of resistance testing for first-line TB drugs along with streptomycin were routinely reported to the Public Health Agency of Canada. Discussions are underway with the provincial/territorial laboratories regarding second line drug resistance reporting to begin with the *Tuberculosis Drug Resistance in Canada 2006* report.

LIMITATIONS

Sensitivity testing for first-line anti-TB drugs is not uniform across the country. Therefore, there are limitations in interpreting the data, particularly the percentage of isolates that are resistant to SM and PZA.

More epidemiological information on the TB cases from which the isolates were submitted would be desirable to examine more critically drug resistance patterns in Canada. However, this information is difficult to collect as isolates are often submitted to the laboratories with only the sex and year of birth of the case. As well, no differentiation can be made between primary and secondary/acquired drug resistance from the data. The annual Tuberculosis in Canada report (http://www.phac-aspc.gc.ca/tbpc-latb/surv_e.html) includes additional drug resistance data for each reported TB case.

* Unlike IULTD that provides the prevalence of TB drug resistance for both new and retreated cases, TBPC only reports prevalence overall as isolates are not separated into new and retreated.

CONCLUSIONS

With growing worldwide concern regarding TB drug resistance, this surveillance system is vital in providing the necessary data in a timely fashion to monitor trends in TB drug resistance in Canada. The surveillance data collected to date indicate that the presence of TB drug resistance in this country is similar to the global average.

REFERENCES

1. The WHO/IUATLD Global Project on Anti-tuberculosis Drug Resistance Surveillance. *Anti-TB drug resistance in the world History, Coverage, Issues, Future.* Joint Working Group Meeting. France 16, October 2005.
2. Emergence of Mycobacterium tuberculosis with Extensive Resistance to Second-Line Drugs — Worldwide, 2000—2004. *Morbidity and Mortality Weekly*. 2006; 55 (10): 301-305.

Figure 1
Reported TB drug resistance in Canada by province/territory – 2005

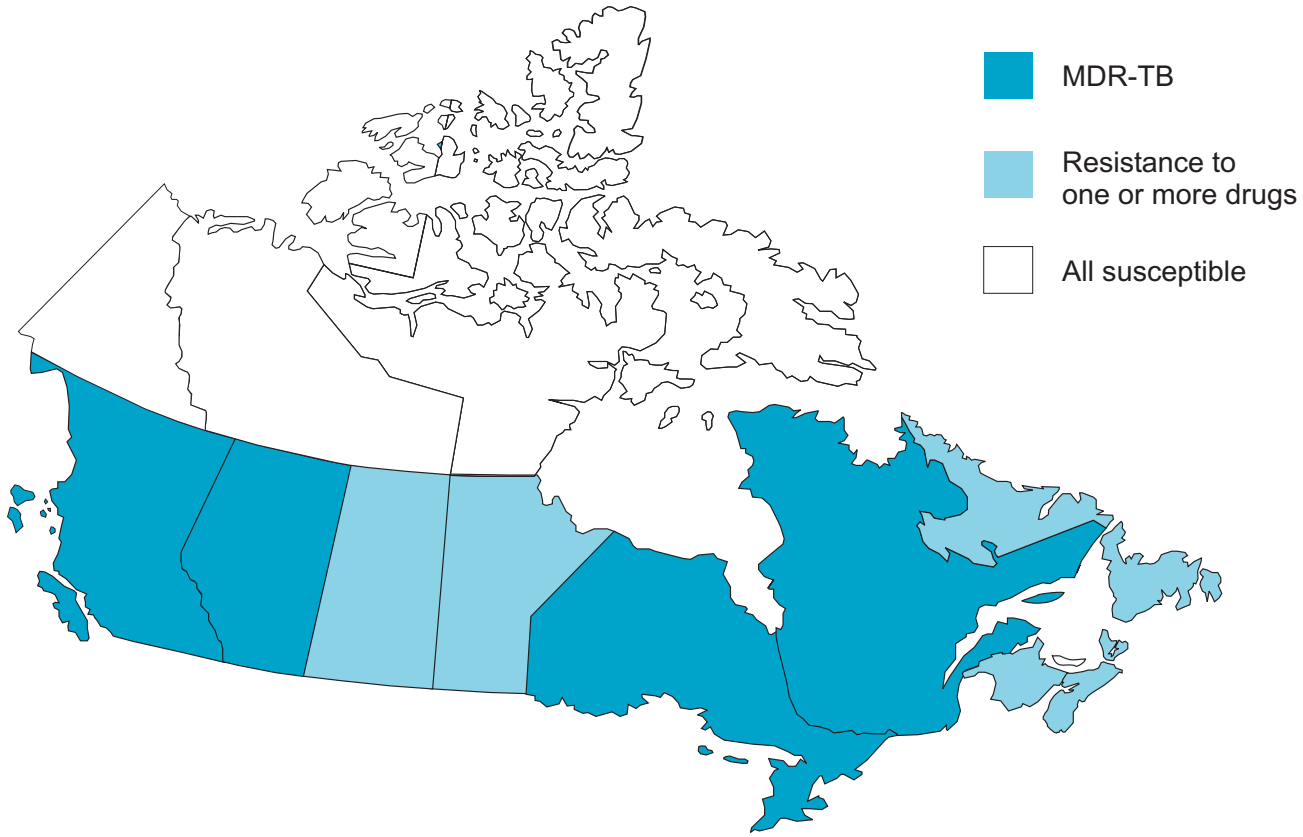


Figure 2
Reported *Mycobacterium tuberculosis* isolates in Canada by province/territory– 2005

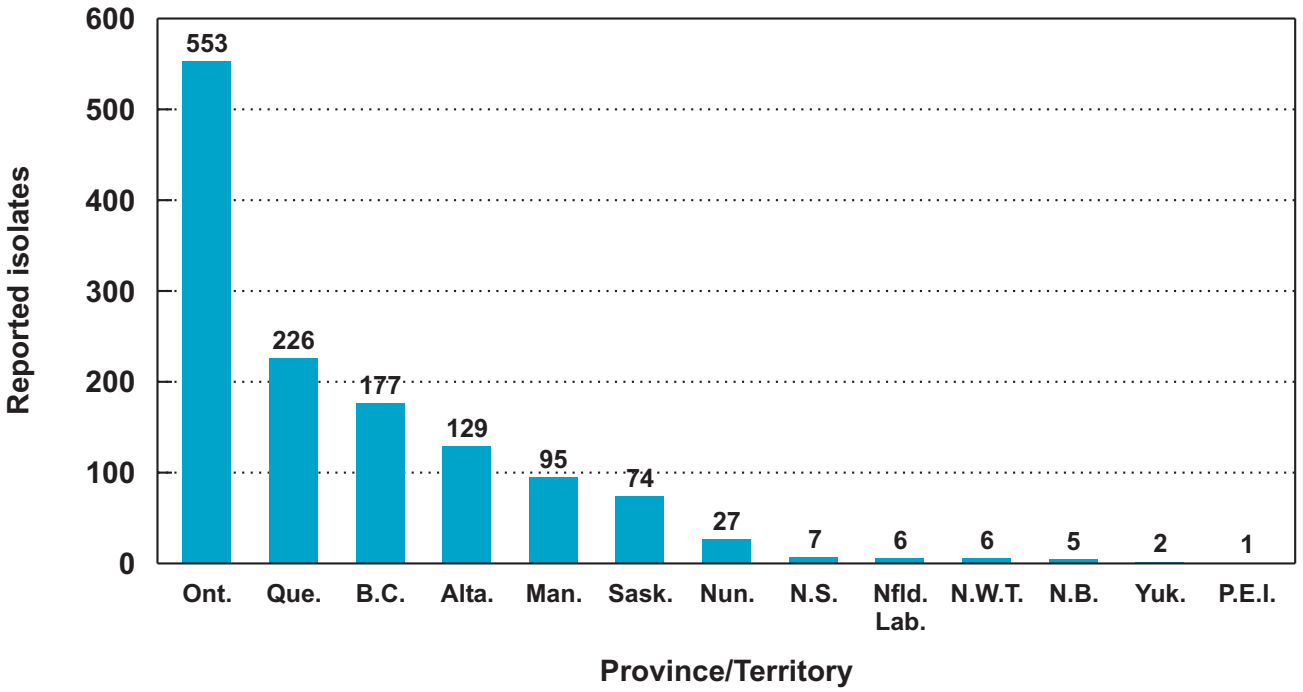
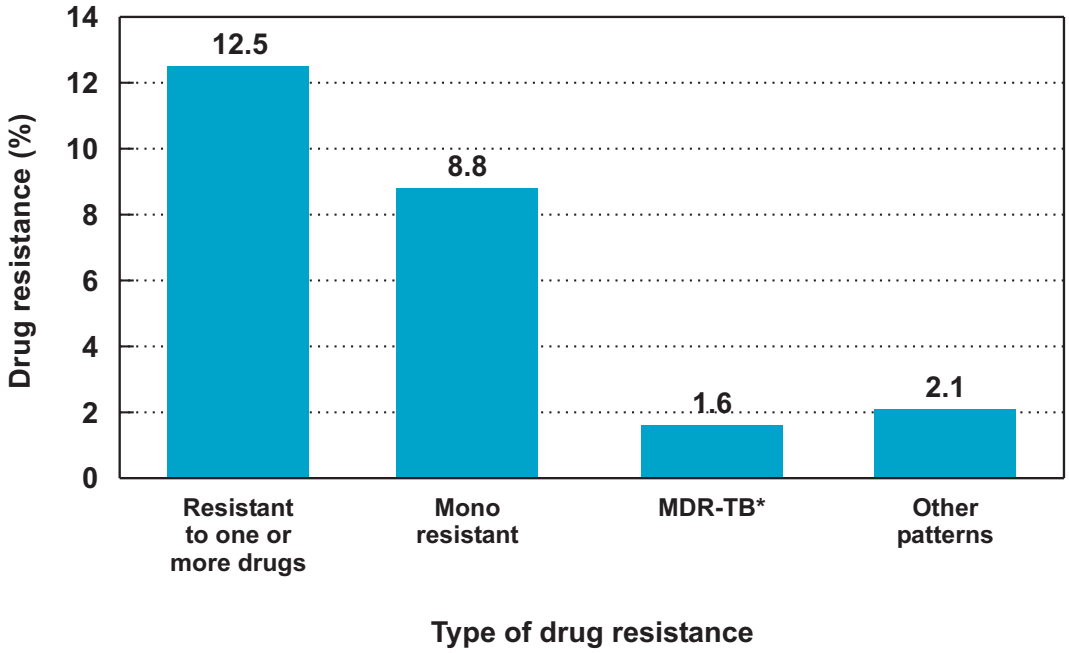
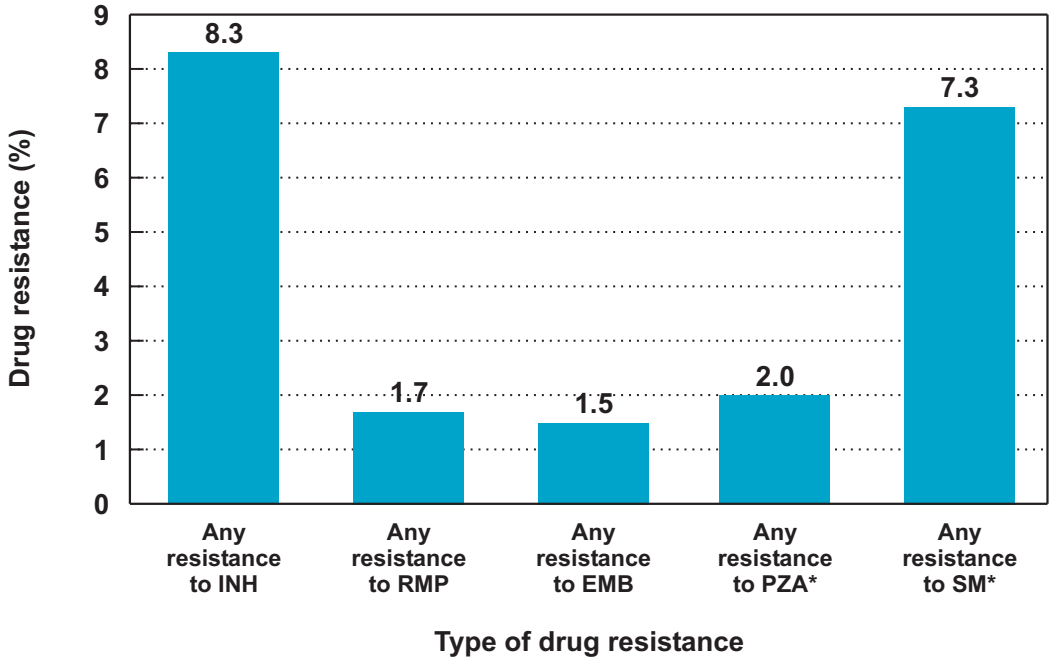


Figure 3
Overall pattern of reported TB drug resistance in Canada – 2005



* Multi-drug resistant TB (MDR-TB) is resistance to at least isoniazid and rifampin.

Figure 4
Reported TB drug resistance in Canada by type of drug – 2005



* SM and PZA are not part of routine first line drug testing in some provinces/territories.

Figure 5
Any resistance by type of drug in Canada – 1998-2005

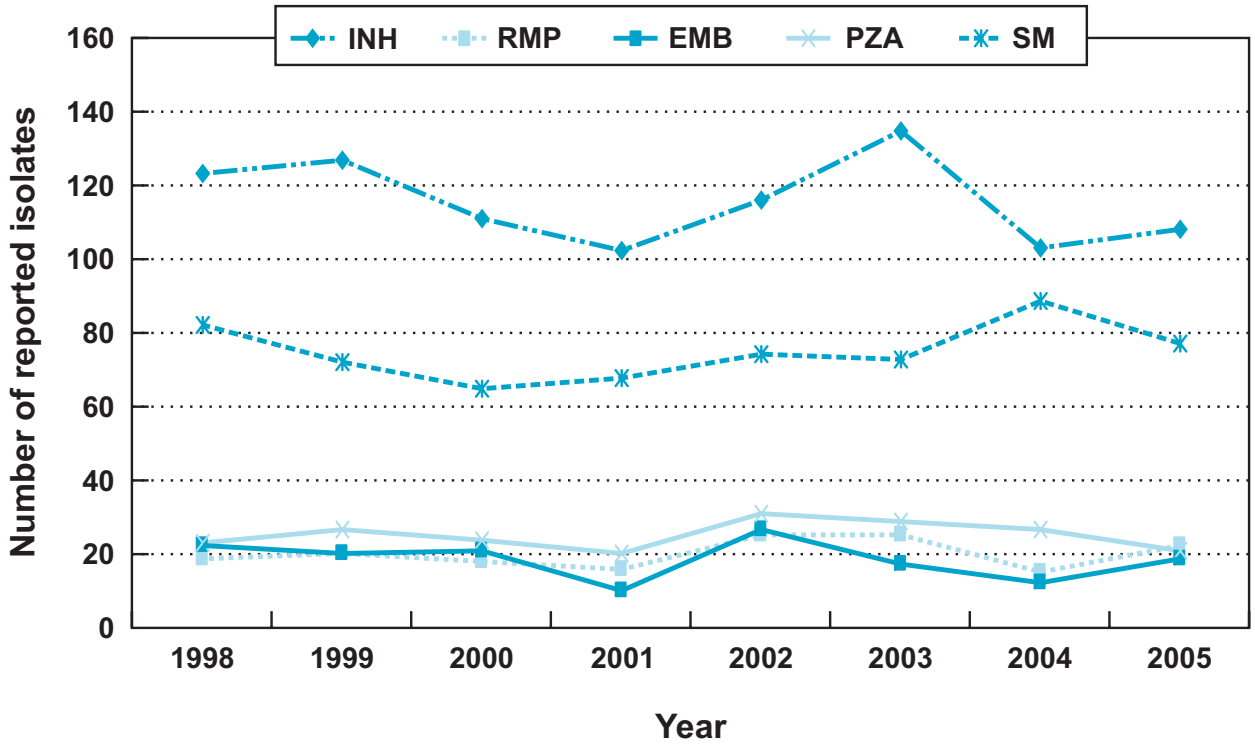


Figure 6
Any resistance by type of drug in Canada as a proportion of the number of isolates tested – 1998-2005

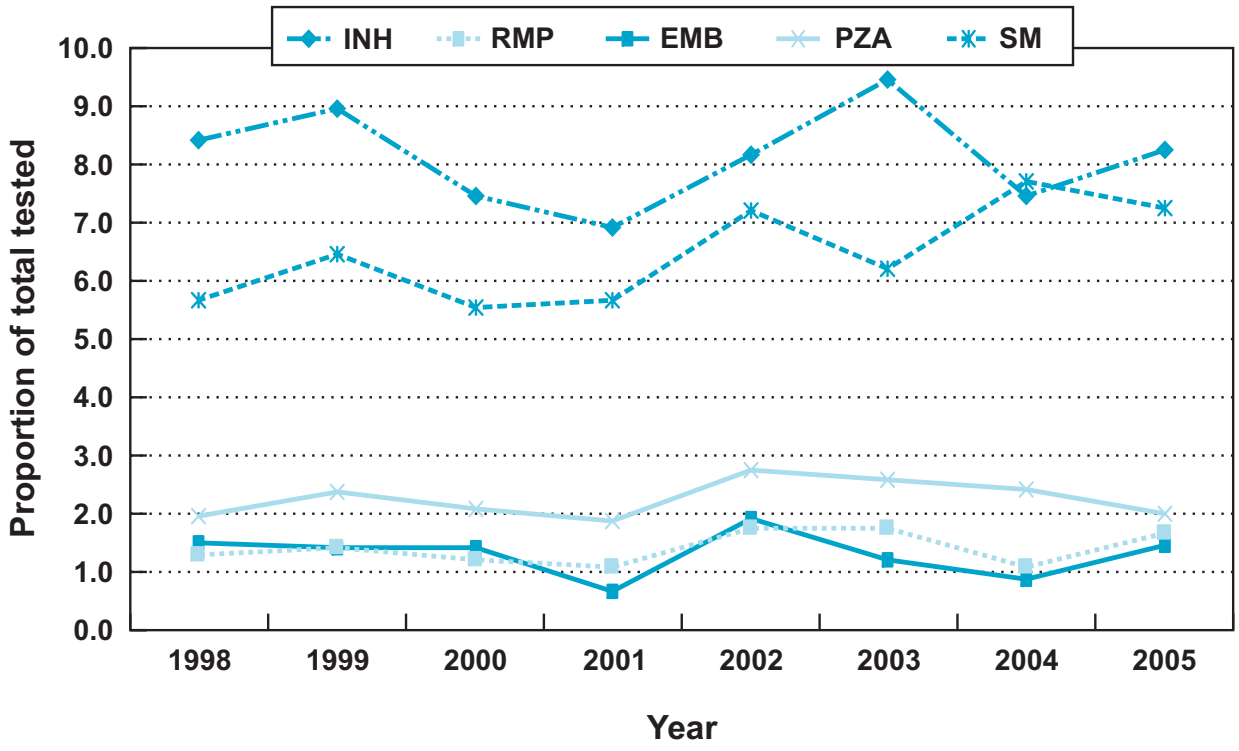


Figure 7
Overall pattern of reported TB drug resistance in Canada – 1998-2005

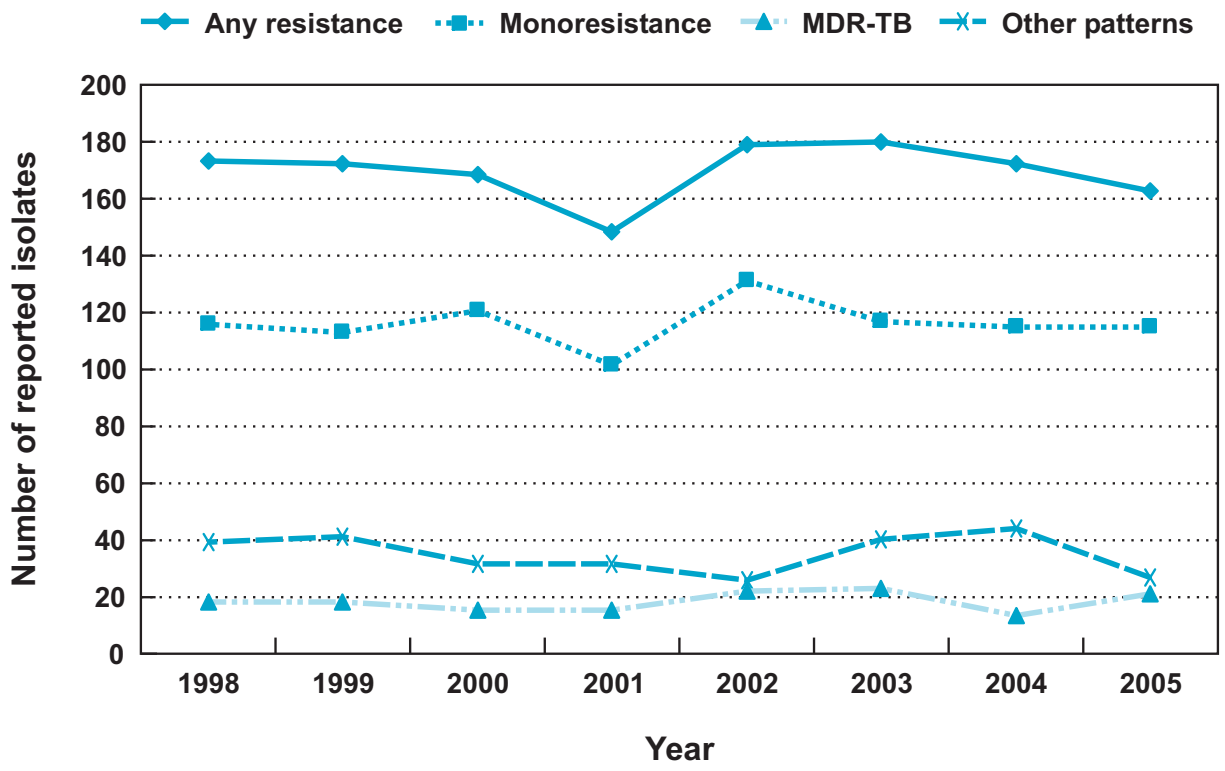


Figure 8
Overall pattern of reported TB drug resistance in Canada as a proportion of isolates tested – 1998-2005

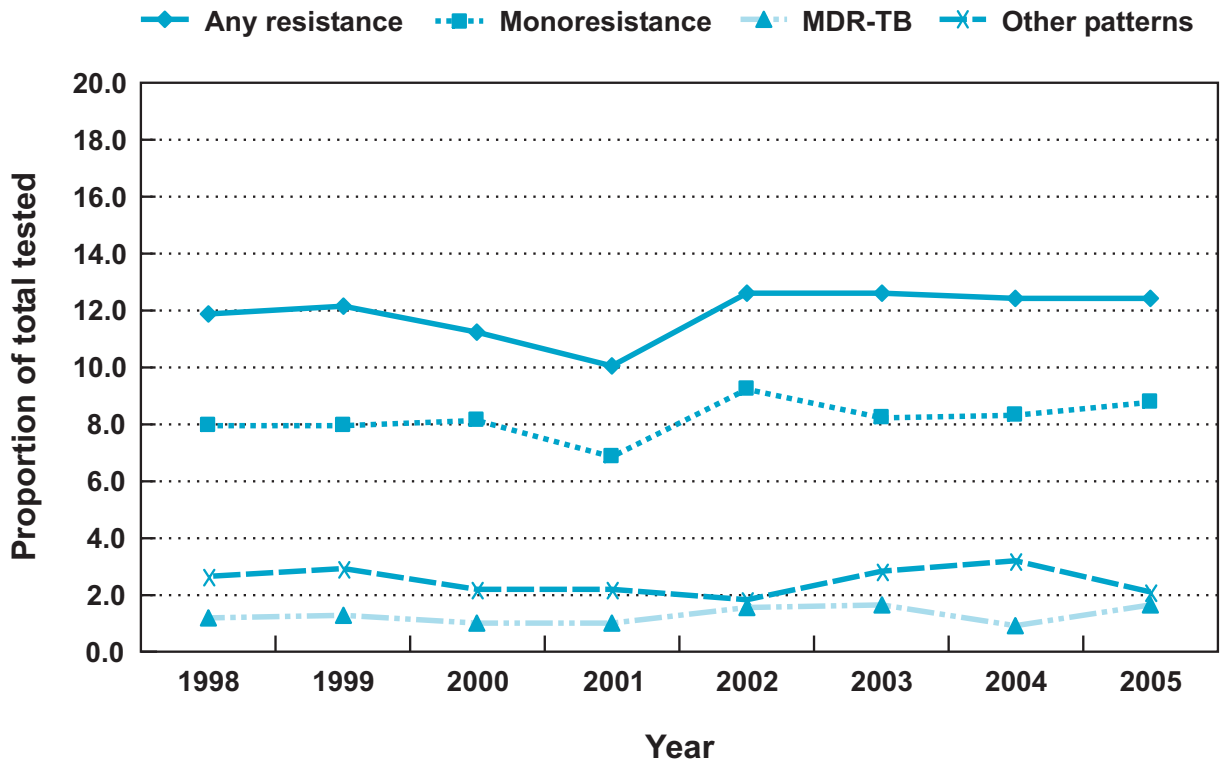


Table 1. Overall pattern of reported TB drug resistance in Canada – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested	**1,461 (100.0)**	**1,415 (100.0)**	**1,491 (100.0)**	**1,475 (100.0)**	**1,420 (100.0)**	**1,428 (100.0)**	**1,381 (100.0)**	**1,308 (100.0)**
Isolates susceptible	1,288 (88.2)	1,243 (87.8)	1,323 (88.7)	1,327 (90.0)	1,241 (87.4)	1,248 (87.4)	1,209 (87.5)	1,145 (87.5)
Any resistance*								
INH	123 (8.4)	127 (9.0)	111 (7.4)	102 (6.9)	116 (8.2)	135 (9.5)	103 (7.5)	108 (8.3)
RMP	19 (1.3)	20 (1.4)	18 (1.2)	16 (1.1)	25 (1.8)	25 (1.8)	15 (1.1)	22 (1.7)
EMB	22 (1.5)	20 (1.4)	21 (1.4)	10 (0.7)	27 (1.9)	17 (1.2)	12 (0.9)	19 (1.5)
PZA	23 (2.0)	27 (2.4)	24 (2.1)	20 (1.9)	31 (2.7)	29 (2.6)	27 (2.5)	21 (2.0)
SM	82 (5.7)	72 (6.5)	65 (5.6)	68 (5.7)	74 (7.2)	73 (6.2)	89 (7.7)	77 (7.3)
Resistance to one or more drugs	173 (11.8)	172 (12.2)	168 (11.3)	148 (10.0)	179 (12.6)	180 (12.6)	172 (12.5)	163 (12.5)
Monoresistance	116 (7.9)	113 (8.0)	121 (8.1)	101 (6.8)	131 (9.2)	117 (8.2)	115 (8.3)	115 (8.8)
MDR-TB	18 (1.2)	18 (1.3)	15 (1.0)	15 (1.0)	22 (1.5)	23 (1.6)	13 (0.9)	21 (1.6)
Other patterns	39 (2.7)	41 (2.9)	32 (2.1)	32 (2.2)	26 (1.8)	40 (2.8)	44 (3.2)	27 (2.1)

* Not all isolates were tested for resistance to all drugs; percentage reflects the total number of isolates actually tested.

Table 2. Reported *Mycobacterium tuberculosis* isolates by "reporting" and "originating" province/territory, Canada – 2005

Reporting Province	CANADA	Originating Province/Territory												
		Nfld. Lab.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Nun.
Number of isolates	**1,308**	**6**	**1**	**7**	**5**	**226**	**553**	**95**	**74**	**129**	**177**	**2**	**6**	**27**
Nfld. Lab.	**6**	6	0	0	0	0	0	0	0	0	0	0	0	0
N.S.	**8**	0	1	7	0	0	0	0	0	0	0	0	0	0
N.B.	**5**	0	0	0	5	0	0	0	0	0	0	0	0	0
Que.	**226**	0	0	0	0	226	0	0	0	0	0	0	0	0
Ont.	**555**	0	0	0	0	0	553	0	0	0	0	0	0	2
Man.	**95**	0	0	0	0	0	0	95	0	0	0	0	0	0
Sask.	**72**	0	0	0	0	0	0	0	72	0	0	0	0	0
Alta.	**164**	0	0	0	0	0	0	0	2	129	2	0	6	25
B.C.	**177**	0	0	0	0	0	0	0	0	0	175	2	0	0

Table 3. Reported MDR-TB isolates by province/territory, Canada – 2005

	CANADA	Originating Province/Territory												
		Nfld. Lab.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.	Nun.
Total number of isolates tested	**1,308**	**6**	**1**	**7**	**5**	**226**	**553**	**95**	**74**	**129**	**177**	**2**	**6**	**27**
Total number of MDR-TB isolates*	**21**	**0**	**0**	**0**	**0**	**1**	**13**	**0**	**0**	**4**	**3**	**0**	**0**	**0**
INH & RMP	**3**	0	0	0	0	0	3	0	0	0	0	0	0	0
INH, RMP & SM	**3**	0	0	0	0	0	2	0	0	1	0	0	0	0
INH, RMP & EMB	**1**	0	0	0	0	0	0	0	0	1	0	0	0	0
INH, RMP & PZA	**2**	0	0	0	0	1	1	0	0	0	0	0	0	0
INH, RMP, PZA & EMB	**1**	0	0	0	0	0	0	0	0	1	0	0	0	0
INH, RMP, EMB & SM	**6**	0	0	0	0	0	4	0	0	0	2	0	0	0
INH, RMP, PZA & SM	**1**	0	0	0	0	0	0	0	0	0	1	0	0	0
INH, RMP, EMB, PZA & SM	**4**	0	0	0	0	0	3	0	0	1	0	0	0	0

* MDR-TB is defined as resistance to at least INH and RMP.

Table 4. Reported TB drug resistance by gender and age group, Canada – 2005

Age Group		Isolates	Any Resistance	MDR-TB
		Number (%)	Number (%)	Number (%)
Total		**1,308 (100)**	**163 (100)**	**21 (100)**
0-4	Males	6 (0.5)	0 (0.0)	0 (0.0)
	Females	8 (0.6)	1 (0.6)	0 (0.0)
	Unknown	0 (0.0)	0 (0.0)	0 (0.0)
	Total	**14 (1.1)**	**1 (0.6)**	**0 (0.0)**
5-14	Males	12 (0.9)	0 (0.0)	0 (0.0)
	Females	12 (0.9)	4 (2.5)	0 (0.0)
	Unknown	0 (0.0)	0 (0.0)	0 (0.0)
	Total	**24 (1.8)**	**4 (2.5)**	**0 (0.0)**
15-24	Males	96 (7.3)	17 (10.4)	3 (14.3)
	Females	90 (6.9)	11 (6.7)	1 (4.8)
	Unknown	8 (0.6)	2 (1.2)	0 (0.0)
	Total	**194 (14.8)**	**30 (18.4)**	**4 (19.0)**
25-34	Males	120 (9.2)	14 (8.6)	1 (4.8)
	Females	110 (8.4)	10 (6.1)	4 (19.0)
	Unknown	14 (1.1)	3 (1.8)	0 (0.0)
	Total	**244 (18.7)**	**27 (16.6)**	**5 (23.8)**
35-44	Males	136 (10.4)	24 (14.7)	3 (14.3)
	Females	93 (7.1)	23 (14.1)	3 (14.3)
	Unknown	6 (0.5)	1 (0.6)	0 (0.0)
	Total	**235 (18.0)**	**48 (29.4)**	**6 (28.6)**
45-54	Males	93 (7.1)	10 (6.1)	0 (0.0)
	Females	60 (4.6)	5 (3.1)	0 (0.0)
	Unknown	7 (0.5)	2 (1.2)	0 (0.0)
	Total	**160 (12.2)**	**17 (10.4)**	**0 (0.0)**
55-64	Males	73 (5.6)	7 (4.3)	2 (9.5)
	Females	47 (3.6)	4 (2.5)	0 (0.0)
	Unknown	3 (0.2)	0 (0.0)	0 (0.0)
	Total	**123 (9.4)**	**11 (6.7)**	**2 (9.5)**
65-74	Males	84 (6.4)	7 (4.3)	3 (14.3)
	Females	53 (4.1)	5 (3.1)	0 (0.0)
	Unknown	5 (0.4)	0 (0.0)	0 (0.0)
	Total	**142 (10.9)**	**12 (7.4)**	**3 (14.3)**
75+	Males	98 (7.5)	8 (4.9)	1 (4.8)
	Females	58 (4.4)	3 (1.8)	0 (0.0)
	Unknown	4 (0.3)	0 (0.0)	0 (0.0)
	Total	**160 (12.2)**	**11 (6.7)**	**1 (4.8)**
Unknown	Males	4 (0.3)	0 (0.0)	0 (0.0)
	Females	3 (0.2)	0 (0.0)	0 (0.0)
	Unknown	5 (0.4)	2 (1.2)	0 (0.0)
	Total	**12 (0.9)**	**2 (1.2)**	**0 (0.0)**
Total	**Males**	**722 (55.2)**	**87 (53.4)**	**13 (61.9)**
	Females	**534 (40.8)**	**66 (40.5)**	**8 (38.1)**
	Unknown	**52 (4.0)**	**10 (6.1)**	**0 (0.0)**

Table 5. Reported results for routine drug susceptibility testing *of Mycobacterium tuberculosis* isolates, Alberta – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, SM, EMB and PZA	**119 (100.0)**	**117 (100.0)**	**104 (100.0)**	**91 (100.0)**	**108 (100.0)**	**106 (100.0)**	**98 (100.0)**	**129 (100.0)**
Isolates susceptible	**107 (89.9)**	**110 (94.0)**	**92 (88.5)**	**79 (86.8)**	**94 (87)**	**87 (82.1)**	**83 (84.7)**	**104 (80.6)**
Isolates resistant to one or more drugs	**12 (10.1)**	**7 (6.0)**	**12 (11.5)**	**12 (13.2)**	**14 (13)**	**19 (17.9)**	**15 (15.3)**	**25 (19.4)**
Monoresistance	**9 (7.6)**	**6 (5.1)**	**7 (6.7)**	**8 (8.8)**	**12 (11.1)**	**12 (11.3)**	**8 (8.2)**	**14 (10.9)**
INH	4 (3.4)	2 (1.7)	2 (1.9)	5 (5.5)	6 (5.6)	6 (5.7)	4 (4.1)	3 (2.3)
RMP	–	–	–	–	–	–	–	–
EMB	–	–	1 (1)	–	–	–	–	–
PZA	–	–	1 (1)	–	–	2 (1.9)	3 (3.1)	–
SM	5 (4.2)	4 (3.4)	3 (2.9)	3 (3.3)	6 (5.6)	4 (3.8)	1 (1.0)	11 (8.5)
MDR–TB*	**1 (0.8)**	**–**	**–**	**–**	**–**	**1 (0.9)**	**3 (3.1)**	**4 (3.1)**
INH & RMP	–	–	–	–	–	1 (0.9)	–	–
INH & RMP & SM	–	–	–	–	–	–	–	1 (0.8)
INH & RMP & EMB	–	–	–	–	–	–	2 (2.0)	1 (0.8)
INH & RMP & EMB & PZA	–	–	–	–	–	–	–	1 (0.8)
INH & RMP & EMB & SM	–	–	–	–	–	–	1 (1.0)	–
INH & SM & EMB & RMP & PZA	1 (0.8)	–	–	–	–	–	–	1 (0.8)
Other Patterns	**2 (1.7)**	**1 (0.9)**	**5 (4.8)**	**4 (4.4)**	**2 (1.9)**	**6 (5.7)**	**4 (4.1)**	**7 (5.4)**
INH & SM	1 (0.8)	1 (0.9)	3 (2.9)	2 (2.2)	1 (0.9)	5 (4.7)	3 (3.1)	7 (5.4)
INH & SM & EMB	–	–	1 (1)	–	–	1 (0.9)	–	–
INH & SM & PZA	1 (0.8)	–	1 (1)	2 (2.2)	1 (0.9)	–	1 (1.0)	–

* MDR–TB is defined as resistance to at least INH and RMP.

Table 6. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, British Columbia – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, SM, EMB and PZA**	**237 (100.0)**	**244 (100.0)**	**277 (100.0)**	**332 (100.0)**	**259 (100.0)**	**293 (100.0)**	**263 (100.0)**	**177 (100.0)**
Isolates susceptible	**212 (89.5)**	**224 (91.8)**	**245 (88.4)**	**297 (89.5)**	**228 (88.0)**	**259 (88.4)**	**226 (85.9)**	**155 (87.6)**
Isolates resistant to one or more drugs	**25 (10.5)**	**20 (8.2)**	**32 (11.6)**	**35 (10.5)**	**31 (12.0)**	**34 (11.6)**	**37 (14.1)**	**22 (12.4)**
Monoresistance	**17 (7.2)**	**15 (6.1)**	**23 (8.3)**	**22 (6.6)**	**25 (9.7)**	**18 (6.1)**	**23 (8.7)**	**16 (9.0)**
INH	14 (5.9)	11 (4.5)	13 (4.7)	12 (3.6)	12 (4.6)	11 (3.8)	8 (3.0)	9 (5.1)
RMP	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.3)	2 (0.8)	–	–	1 (0.6)
EMB	–	1 (0.4)	1 (0.4)	–	2 (0.8)	1 (0.3)	1 (0.4)	4 (2.3)
PZA***	–	–	–	–	1 (3.8)^	–	3 (9.4)^	–
SM	2 (0.8)	2 (0.8)	8 (2.9)	9 (2.7)	8 (3.1)	5 (1.7)	11 (4.2)	2 (1.1)
MDR–TB*	**2 (0.8)**	**1 (0.4)**	**5 (1.8)**	**8 (2.4)**	**2 (0.8)**	**8 (2.7)**	**2 (0.8)**	**3 (1.7)**
INH & RMP	–	–	–	4 (1.2)	–	1 (0.3)	–	–
INH & RMP & EMB	–	–	1 (0.4)	–	–	–	1 (0.4)	–
INH & RMP & SM	1 (0.4)	–	2 (0.7)	2 (0.6)	–	3 (1.0)	–	–
INH & RMP & PZA	–	–	–	–	–	1 (0.3)	–	–
INH & RMP & EMB & PZA	–	–	–	–	1 (0.4)	1 (0.3)	1 (0.4)	–
INH & RMP & SM & EMB	1 (0.4)	1 (0.4)	2 (0.7)	1 (0.3)	–	–	–	2 (0.6)
INH & RMP & EMB & SM	–	–	–	–	–	–	–	1 (1.1)
INH & RMP & SM & EMB & PZA	–	–	–	1 (0.3)	1 (0.4)	2 (0.7)	–	–
Other Patterns	**6 (2.5)**	**4 (1.6)**	**4 (1.4)**	**5 (1.5)**	**4 (1.5)**	**8 (2.7)**	**12 (4.6)**	**3 (1.7)**
INH & EMB	1 (0.4)	1 (0.4)	–	–	–	–	1 (0.4)	–
INH & SM	5 (2.1)	2 (0.8)	2 (0.7)	5 (1.5)	3 (1.2)	7 (2.4)	5 (1.9)	2 (1.1)
INH & PZA	–	–	–	–	1 (0.4)	1 (0.3)	3 (1.1)	–
RMP & PZA	–	–	–	–	–	–	2 (0.8)	–
INH & SM & EMB	–	1 (0.4)	2 (0.7)	–	–	–	–	1 (0.6)
INH & SM & PZA	–	–	–	–	–	–	1 (0.4)	–

* MDR-TB is defined as resistance to at least INH and RMP.

** Routine testing for PZA not conducted.

*** Includes 1 *M. bovis* isolate for 2002 and 1 *M. bovis* isolate for 2003.

^ Not all isolates were tested for resistance to all drugs; percentage reflects the total number of isolates actually tested.

Table 7. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Manitoba – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA**	**106 (100.0)**	**100 (100.0)**	**102 (100.0)**	**110 (100.0)**	**114 (100.0)*****	**122 (100.0)**	**123 (100.0)**	**95 (100.0)**
Isolates susceptible	**98 (92.5)**	**89 (89.0)**	**94 (92.2)**	**101 (91.8)**	**106 (93)**	**114 (93.4)**	**121 (98.4)**	**90 (94.7)**
Isolates resistant to one or more drugs	**8 (7.5)**	**11 (11.0)**	**8 (7.8)**	**9 (8.2)**	**8 (7)**	**8 (6.6)**	**2 (1.6)**	**5 (5.3)**
Monoresistance	**4 (3.8)**	**6 (6.0)**	**6 (5.9)**	**6 (5.5)**	**4 (3.5)**	**7 (5.7)**	**2 (1.6)**	**5 (5.3)**
INH	2 (1.9)	3 (3.0)	6 (5.9)	2 (1.8)	3 (2.6)	3 (2.5)	–	2 (2.1)
PZA***	–	–	–	–	1 (0.9)	1 (0.8)	1 (0.8)	–
SM	2 (1.9)	3 (3.0)	–	4 (3.8)^	–	3 (2.6)^	1 (0.8)	3 (3.2)
MDR–TB*	**2 (1.9)**	**2 (2.0)**	**–**	**2 (1.8)**	**3 (2.6)**	**1 (0.8)**	**–**	**–**
INH & RMP	–	1 (1.0)	–	1 (0.9)	1 (0.9)	1 (0.8)	–	–
INH & EMB & RMP & PZA	–	–	–	–	1 (0.9)	–	–	–
INH & EMB & RMP	1 (0.9)	–	–	–	–	–	–	–
INH & SM & EMB & RMP & PZA	1 (0.9)	–	–	1 (0.9)	1 (0.9)	–	–	–
INH & SM & RMP & PZA	–	1 (1.0)	–	–	–	–	–	–
Other Patterns	**2 (1.9)**	**3 (3.0)**	**2 (2)**	**1 (0.9)**	**1 (0.9)**	**–**	**–**	**–**
INH & PZA	–	–	–	–	1 (0.9)	–	–	–
INH & SM	2 (1.9)	1 (1.0)	2 (2)	1 (0.9)	–	–	–	–
INH & SM & EMB	–	1 (1.0)	–	–	–	–	–	–
INH & SM & PZA	–	1 (1.0)	–	–	–	–	–	–

* MDR-TB is defined as resistance to at least INH and RMP.

** Routine testing for SM not conducted for 2002.

*** Includes 1 *M. bovis* isolate for 2002.

^ Not all isolates were tested for resistance to all drugs; percentage reflects the total number of isolates actually tested.

Table 8. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, New Brunswick – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**10 (100.0)**	**12 (100.0)**	**9 (100.0)**	**10 (100.0)**	**10 (100.0)**	**14 (100.0)**	**11 (100.0)**	**5 (100.0)**
Isolates susceptible	**9 (90.0)**	**12 (100.0)**	**9 (100.0)**	**10 (100.0)**	**9 (90.0)**	**13 (92.9)**	**10 (90.9)**	**4 (80.0)**
Isolates resistant to one or more drugs	**1 (10.0)**	**–**	**–**	**–**	**1 (10.0)**	**1 (7.1)**	**1 (9.1)**	**1 (20.0)**
Monoresistance	**1 (10.0)**	**–**	**–**	**–**	**1 (10.0)**	**1 (7.1)**	**1 (9.1)**	**1 (20.0)**
INH	1 (10.0)	–	–	–	1 (10.0)	1 (7.1)	1 (9.1)	–
PZA	–	–	–	–	–	–	–	1 (20.0)

* Routine testing for SM not conducted.

Table 9. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Newfoundland and Labrador – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA	**8 (100.0)**	**9 (100.0)**	**11 (100.0)**	**9 (100.0)**	**4 (100.0)**	**6 (100.0)**	**8 (100.0)**	**6 (100.0)**
Isolates susceptible	**8 (100.0)**	**9 (100.0)**	**11 (100.0)**	**9 (100.0)**	**4 (100.0)**	**4 (66.7)**	**8 (100.0)**	**5 (83.3)**
Isolates resistant to one or more drugs	**–**	**–**	**–**	**–**	**–**	**2 (33.3)**	**–**	**1 (16.7)**
Monoresistance	**–**	**–**	**–**	**–**	**–**	**2 (33.3)**	**–**	**1 (16.7)**
INH	–	–	–	–	–	1 (16.7)	–	1 (16.7)
RMP	–	–	–	–	–	1 (16.7)	–	–

Table 10. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Northwest Territories – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA	**27 (100.0)**	**11 (100.0)**	**8 (100.0)**	**6 (100.0)**	**3 (100.0)**	**18 (100.0)**	**10 (100.0)**	**6 (100.0)**
Isolates susceptible	**27 (100.0)**	**11 (100.0)**	**8 (100.0)**	**6 (100.0)**	**3 (100.0)**	**18 (100.0)**	**10 (100.0)**	**6 (100.0)**

Table 11. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Nova Scotia – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**9 (100.0)**	**8 (100.0)**	**4 (100.0)**	**7 (100.0)**	**10 (100.0)**	**6 (100.0)**	**9 (100.0)**	**7 (100.0)**
Isolates susceptible	**8 (88.9)**	**7 (87.5)**	**4 (100.0)**	**7 (100.0)**	**9 (90.0)**	**6 (100.0)**	**9 (100.0)**	**6 (85.7)**
Isolates resistant to one or more drugs	**1 (11.1)**	**1 (12.5)**	**–**	**–**	**1 (10.0)**	**–**	**–**	**1 (14.3)**
Monoresistance	**1 (11.1)**	**1 (12.5)**	**–**	**–**	**1 (10.0)**	**–**	**–**	**1 (14.3)**
INH	1	1 (12.5)	–	–	–	–	–	–
PZA	–	–	–	–	1 (10.0)	–	–	1 (14.3)

* Routine testing for SM not conducted.

Table 12. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Nunavut* – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, SM, EMB and PZA**	**N/A**	**15 (100.0)**	**29 (100.0)**	**31 (100.0)**	**22 (100.0)**	**4 (100.0)**	**16 (100.0)**	**27 (100.0)**
Isolates susceptible	**N/A**	**15 (100.0)**	**28 (96.6)**	**30 (96.8)**	**22 (100.0)**	**4 (100.0)**	**16 (100.0)**	**27 (100.0)**
Isolates resistant to one or more drugs	**N/A**	**–**	**1 (3.4)**	**1 (3.2)**	**–**	**–**	**–**	**–**
Monoresistance	**N/A**	**–**	**1 (3.4)**	**–**	**–**	**–**	**–**	**–**
INH		–	1 (3.4)	–	–	–	–	–
MDR-TB	**N/A**	**–**	**–**	**1 (3.2)**	**–**	**–**	**–**	**–**
INH & RMP		–	–	1 (3.2)	–	–	–	–

* Note: Nunavut began reporting in 1999.

** Routine testing for SM not conducted when isolate tested by Quebec (n=13 for 1999, n=28 for 2000 and n=30 for 2001, n=11 for 2002).

Table 13. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Ontario – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA**	**629 (100.0)**	**589 (100.0)**	**599 (100.0)**	**589 (100.0)**	**586 (100.0)**	**591 (100.0)**	**598 (100.0)**	**553 (100.0)**
Isolates susceptible	**538 (85.5)**	**489 (83)**	**519 (86.6)**	**521 (88.5)**	**492 (84)**	**508 (86.0)**	**501 (83.8)**	**466 (84.3)**
Isolates resistant to one or more drugs	**91 (14.5)**	**100 (17)**	**80 (13.4)**	**68 (11.5)**	**94 (16)**	**83 (14.0)**	**97 (16.2)**	**87 (15.7)**
Monoresistance	**55 (8.7)**	**57 (9.7)**	**52 (8.7)**	**44 (7.5)**	**61 (10.4)**	**45 (7.6)**	**63 (10.5)**	**57 (10.3)**
INH	34 (5.4)	34 (5.8)	23 (3.8)	20 (3.4)	30 (5.1)	24 (4.1)	23 (3.8)	29 (5.2)
RMP	–	–	–	–	–	1 (0.2)	–	–
EMB	4 (0.6)	–	1 (0.2)	1 (0.2)	1 (0.2)	–	–	–
PZA	6 (1)	4 (0.7)	12 (2)	7 (1.2)	5 (0.9)	3 (0.5)	3 (0.5)	7(1.3)
SM	11 (1.7)	19 (3.2)	16 (2.7)	16 (2.7)	25 (4.3)	17 (2.9)	37 (6.2)	21 (3.8)
MDR-TB*	**11 (1.7)**	**13 (2.2)**	**9 (1.5)**	**3 (0.5)**	**16 (2.7)**	**12 (2.0)**	**7 (1.2)**	**13 (2.4)**
INH & RMP	2 (0.3)	3 (0.5)	1 (0.2)	–	2 (0.3)	3 (0.5)	4 (0.7)	3 (0.5)
INH & RMP & EMB	–	1 (0.2)	2 (0.3)	1 (0.2)	1 (0.2)	1 (0.2)	–	–
INH & RMP & SM	1 (0.2)	3 (0.5)	3 (0.5)	–	2 (0.3)	1 (0.2)	–	2 (0.4)
INH & RMP & PZA	–	1 (0.2)	–	–	–	2 (0.3)	1 (0.2)	1 (0.2)
INH & RMP & EMB & PZA	–	–	–	1 (0.2)	1 (0.2)	1 (0.2)	–	–
INH & RMP & SM & EMB	2 (0.3)	–	2 (0.3)	–	5 (0.9)	–	–	4 (0.7)
INH & RMP & SM & PZA	–	–	1 (0.2)	–	–	–	1 (0.2)	–
INH & RMP & SM & EMB & PZA	6 (1)	5 (0.8)	–	1 (0.2)	5 (0.9)	4 (0.7)	1 (0.2)	3 (0.5)
Other Patterns	**25 (4)**	**30 (5.1)**	**19 (3.2)**	**21 (3.6)**	**17 (2.9)**	**26 (4.4)**	**27 (4.5)**	**17 (3.1)**
INH & EMB	2 (0.3)	4 (0.7)	2 (0.3)	–	1 (0.2)	2 (0.3)	1 (0.2)	1 (0.2)
INH & PZA**	–	–	–	2 (0.3)	–	–	1 (0.2)	–
INH & SM	20 (3.2)	20 (3.4)	14 (2.3)	16 (2.7)	13 (2.2)	18 (3.1)	23 (3.8)	15 (2.7)
SM & PZA	–	–	–	–	–	1 (0.2)	–	–
EMB & RMP	–	–	2 (0.3)	–	–	–	–	–
INH & SM & EMB	2 (0.3)	4 (0.7)	1 (0.2)	3 (0.5)	2 (0.3)	3 (0.5)	2 (0.3)	1 (0.2)
INH & SM & PZA	1 (0.2)	2 (0.3)	–	–	–	1 (0.2)	–	–
INH & EMB & PZA	–	–	–	–	–	1 (0.2)	–	–
INH & SM & EMB & PZA	–	–	–	–	1 (0.2)	–	–	–

* MDR-TB is defined as resistance to at least INH and RMP.

** Includes 1 *M. Bovis* isolate for 1999, 2 *M. Bovis* isolates for 2000, 2 *M. Bovis* isolates for 2001, 1 *M. Bovis* isolate for 2002 and 1 *M. Bovis* isolate for each 2003, 2004 and 2005.

Table 14. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Prince Edward Island – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**2 (100.0)**	**2 (100.0)**	**3 (100.0)**	**2 (100.0)**	**1 (100.0)**	**2 (100.0)**	**1 (100.0)**	**1 (100.0)**
Isolates susceptible	**2 (100.0)**	**2 (100.0)**	**3 (100.0)**	**1 (50)**	**1 (100.0)**	**2 (100.0)**	**1 (100.0)**	**1 (100.0)**
Isolates resistant to one or more drugs	**–**	**–**	**–**	**1 (50)**	**–**	**–**	**–**	**–**
Monoresistance	**–**	**–**	**–**	**1 (50)**	**–**	**–**	**–**	**–**
PZA**	–	–	–	1 (50)	–	–	–	–

* Routine testing for SM not conducted.

** Includes 1 *M. bovis* isolate for 2001.

Table 15. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Quebec – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**264 (100.0)**	**268 (100.0)**	**278 (100.0)**	**221 (100.0)**	**247 (100.0)**	**219 (100.0)**	**207 (100.0)**	**226 (100.0)**
Isolates susceptible	**231 (87.5)**	**236 (88.1)**	**249 (89.6)**	**202 (91.4)**	**222 (89.9)**	**187 (85.4)**	**190 (91.8)**	**207 (91.6)**
Isolates resistant to one or more drugs	**33 (12.5)**	**32 (11.9)**	**29 (10.4)**	**19 (8.6)**	**25 (10.1)**	**32 (14.6)**	**17 (8.2)**	**19 (8.4)**
Monoresistance	**28 (10.6)**	**28 (10.4)**	**28 (10.1)**	**18 (8.1)**	**23 (9.3)**	**31 (14.2)**	**15 (7.2)**	**18 (8.0)**
INH	9 (3.4)	17 (6.3)	19 (6.8)	14 (6.3)	13 (5.3)	25 (11.4)	11 (5.3)	14 (6.2)
RMP	–	1 (0.4)	–	–	1 (0.4)	–	–	–
PZA**	6 (2.3)	10 (3.7)	9 (3.2)	4 (1.8)	9 (3.6)	6 (2.7)	4 (1.9)	4 (1.8)
SM	13 (4.9)	–	–	–	–	–	–	–
MDR-TB	**2 (0.8)**	**2 (0.7)**	**1 (0.4)**	**1 (0.5)**	**1 (0.4)**	**1 (0.5)**	**1 (0.5)**	**1 (0.4)**
INH & RMP	–	1 (0.4)	–	1 (0.5)	–	1 (0.5)	1 (0.5)	–
INH & RMP & EMB	1 (0.4)	–	1 (0.4)	–	1 (0.4)	–	–	–
INH & RMP & SM	1 (0.4)	–	–	–	–	–	–	–
INH & RMP & EMB & PZA	–	1 (0.4)	–	–	–	–	–	1 (0.4)
Other Patterns	**3 (1.1)**	**2 (0.7)**	**–**	**–**	**1 (0.4)**	**–**	**1 (0.5)**	**–**
INH & SM	2 (0.8)	–	–	–	–	–	–	–
INH & EMB	–	–	–	–	1 (0.4)	–	1 (0.5)	–
INH & PZA	1 (0.4)	2 (0.7)	–	–	–	–	–	–

* Routine testing for SM not conducted in Quebec effective January 1, 1999.

** Includes *M. bovis* isolates: 1 in 1998, 1 in 1999, 2 in 2000, 1 in 2001, 1 in 2002, 1 in 2003, and 2 in 2004; *M. caprae*: 1 in 2002; *M. africanum*: 1 in 2003 and 1 in 2005.

Table 16. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Saskatchewan – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**49 (100.0)**	**40 (100.0)**	**64 (100.0)**	**68 (100.0)**	**56 (100.0)**	**46 (100.0)**	**34 (100.0)**	**74 (100.0)**
Isolates susceptible	**47 (95.9)**	**39 (97.5)**	**58 (90.6)**	**65 (95.6)**	**51 (91.1)**	**45 (97.8)**	**31 (91.2)**	**72 (97.3)**
Isolates resistant to one or more drugs	**2 (4.1)**	**1 (2.5)**	**6 (9.4)**	**3 (4.4)**	**5 (8.9)**	**1 (2.2)**	**3 (8.8)**	**2 (2.7)**
Monoresistance	**1 (2)**	**–**	**4 (6.3)**	**2 (2.9)**	**4 (7.1)**	**1 (2.2)**	**3 (8.8)**	**2 (2.7)**
INH	1 (2)	–	2 (3.1)	2 (2.9)	3 (5.4)	1 (2.2)	2 (5.9)	2 (2.7)
EMB	–	–	1 (1.6)	–	1 (1.8)	–	–	–
SM	–	–	1 (1.6)	–	–	–	1 (2.9)	–
Other Patterns	**1 (2.0)**	**1 (2.5)**	**2 (3.1)**	**1 (1.5)**	**1 (1.8)**	**–**	**–**	**–**
INH & EMB	–	–	1 (1.6)	–	1 (1.8)	–	–	–
INH & SM	1 (2.0)	1 (2.5)	1 (1.6)	1 (1.5)	–	–	–	–

* Routine testing for PZA not conducted.

Table 17. Reported results for routine drug susceptibility testing of *Mycobacterium tuberculosis* isolates, Yukon Territory – 1998-2005

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)	2003 Total (%)	2004 Total (%)	2005 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA*	**1 (100.0)**	**–**	**3 (100.0)**	**1 (100.0)**	**–**	**1 (100.0)**	**3 (100.0)**	**2 (100.0)**
Isolates susceptible	**1 (100.0)**	**–**	**3 (100.0)**	**1 (100.0)**	**–**	**1 (100.0)**	**3 (100.0)**	**2 (100.0)**

* Routine testing for PZA not conducted.

Appendix 1

Participating Laboratories of the Canadian Tuberculosis Laboratory Surveillance System (CTBLSS)

Alberta **(Alberta and Northwest Territories)**	Cary Shandro Mycobacteriology Provincial Laboratory of Public Health Dr. Greg Tyrrell Medical Microbiologist Provincial Laboratory of Public Health Dr. Jutta Preiksaitis Director Provincial Laboratory of Public Health
British Columbia **(British Columbia and Yukon Territory)**	Dr. Mabel Rodrigues, Ph.D. Section Supervisor TB B.C. Centre for Disease Control Dr. Judy L. Isaac-Renton Director, Provincial Laboratory B.C. Centre for Disease Control
Manitoba	Assunta Rendina Charge Technologist, Mycobacteriology
New Brunswick	Hope MacKenzie Microbiology Laboratory Dept. of Laboratory Medicine Dr. Glenna Hardy Medical Microbiologist Dept. of Laboratory Medicine Dr. Anne O'Brien Clinical Head Dept. of Laboratory Medicine Saint John Regional Hospital
Newfoundland and Labrador	Sandra B. March, MSc ART Clinical Microbiologist Newfoundland Public Health Laboratory Dr. Sam Ratnam Director Newfoundland Public Health Labs L.A. Miller Centre for Health Sciences

Northwest Territories **(see also Alberta)**	Norine M. Fraley, MLT Supervisor, Bacteriology Stanton Territorial Hospital Mr. Robin Greig Manager Therapeutic & Diagnostic Services
Nova Scotia **(Nova Scotia and Prince Edward Island)**	Carol Pelton, Tech II, MLT Division of Medical Microbiology Dept. of Pathology & Laboratory Medicine Dr David Haldane Director of Special Pathogens and Microbiology Dr. Kevin Forward Director Department of Public Health Pathology & Laboratory Medicine
Ontario **(Ontario and Nunavut)**	Pamela Chedore, MLT Head, Mycobacteriology Laboratories Branch: Ministry of Health and Longterm Care, Ontario Dr. Frances Jamieson Medical Microbiologist Clinical & Environmental Microbiology Laboratories Branch: Ministry of Health and Longterm Care, Ontario Mr. Nicholas Paul Manager, Direct Services Laboratories Branch: Ministry of Health and Longterm Care, Ontario
Quebec	Louise Thibert, MSc Head, Mycobacteriology and Aerobic Actinomycetes Laboratoire de sante publique du Quebec Institut national de santé publique du Québec Dr. Anne-Marie Bourgeault Director Laboratoire de santé publique du Québec Institut national de santé publique du Québec

Saskatchewan	*North:*	Colleen Foster, MLT Supervisor Microbiology/Mycobacteriology Royal University Hospital
		Dr. J Blondeau Department Head Microbiology/Mycobacteriology Royal University Hospital
	South:	Evelyn Nagle, MLT Clinical Services/Microbiology Saskatchewan Health
		Dr. Paul Levett Microbiologist Provincial Laboratory
		Dr. Greg Horsman Director, Saskatchewan Health Laboratory and Disease Control
Federal		Dr. Edward Ellis Manager Tuberculosis Prevention and Control Section Centre for Infectious Disease Prevention and Control Public Health Agency of Canada
		Joyce Wolfe, ART Head, Mycobacteriology National Reference Centre for Mycobacteriology Canadian Science Centre for Human and Animal Control

Appendix 2

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

Serial No. - N° de série

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

FOR INTERNAL USE ONLY - POUR USAGE INTERNE SEULEMENT

Date Rec'd at TBPC: / Date de réception au LATB: (Y / A, M, D / J)

TBPC Number: / Numéro du LATB:

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)

Specie: / Espèce : ☐ M. tuberculosis (may include M. africanum or M. microti / peut inclure M. africanum et M. microti) ☐ M. bovis ☐ M. BCG bovis ☐ MTB Complex (species unknown) / Complexe MTB (espèce inconnu)

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 UNE SEULE SOUCHE 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 originated: / 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 = NFLD / TN	46 = MAN
11 = PEI / IPÉ	47 = SASK
12 = NS / NÉ	48 = ALTA / ALB
13 = NB	59 = BC / BC
24 = QUÉ / Qc	60 = YUK
35 = ONT	61 = NWT / TNO
	62 = NUN

5. **LABORATORY RESULTS / RÉSULTATS DE LABORATOIRE**

Antituberculous Drugs / Agents Antituberculeux	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)
SM (Streptomycin / Streptomycine)	mg / L	☐	☐	
INH (Isoniazid / Isoniazide)	mg / L	☐	☐	
RMP (Rifampin / Rifampicine)	mg / L	☐	☐	
EMB (Ethambutol)	mg / L	☐	☐	
PZA (Pyrazinamide)	mg / L	☐	☐	

2nd line drugs (specify) / Antibiotiques de 2e ligne (préciser)	Concentration	Sensitive / Sensible	Resistant / Résistant	Other (specify) / Autre (préciser)
1.	mg / L	☐	☐	
2.	mg / L	☐	☐	
3.	mg / L	☐	☐	
4.	mg / L	☐	☐	
5.	mg / L	☐	☐	
6.	mg / L	☐	☐	

6. **Comments - Commentaires**

HC/SC 9061 (07-2000)

Copy 1 (White) - Reporting Laboratory
Copie 1 (Blanche) - Laboratoire déclarant

Copy 2 (Yellow) - Tuberculosis Prevention and Control (TBPC)
Copie 2 (Jaune) - Lutte anti-tuberculeuse (LATB)

Appendix 3

Proficiency panel results for antimicrobial susceptibility testing of *M. tuberculosis* 2005

	Strain A	Strain B	Strain C	Strain D	Strain E	Strain F
SM 2.0 µg/ml	Resistant 7/7 (100%)	Sensitive 6/6 (100%)	Sensitive 6/6 (100%)	Resistant 7/7 (100%)	Sensitive 6/7 (85.7%)	Sensitive 6/6 (100%)
INH 0.1 µg/ml	Resistant 10/10 (100%)	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)	Resistant 10/10 (100%)	Resistant 9/10 (90%)	Sensitive 10/10 (100%)
RMP 2.0 µg/ml	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)	Sensitive 10/10 (100%)
EMB 2.5 µg/ml	Resistant 10/10 (100%)	Sensitive 9/10 (90%)	Sensitive 10/10 (100%)	Resistant 9/10 (90%)	Sensitive 10/10 (100%)	Resistant 9/10 (90%)
PZA 100 µg/ml	Sensitive 8/8 (100%)	Sensitive 6/8 (75%)	Sensitive 6/8 (75%)	Sensitive 8/8 (100%)	Resistant 7/8 (87.5%)	Sensitive 8/8 (100%)

A total of 10 laboratories participated in susceptibility testing of six *M. tuberculosis* complex isolates. Percentages indicate consensus values.

Six laboratories are using the Bactec® 460 radiometric technology and 4 laboratories are using the Bactec® 960 (MGIT) continuous monitoring technology in performing susceptibility testing. All laboratories are testing appropriate concentrations of antimicrobials in accordance with the parameters of the testing systems.

Streptomycin: Current CSLI (Clinical Laboratory Standards Institute) (formerly NCCLS) approved guidelines consider streptomycin as a second line drug and suggest the laboratory director should consult with pulmonary/ infectious disease specialist and TB control officer to decide if streptomycin should be routinely tested based on the following:

1. Availability and timelines of testing if resistance or intolerance is encountered
2. Patient population
3. Prevalence of drug resistance
4. Use in community

Note: As of 2005, streptomycin is no longer considered a first line tuberculosis drug in Canada.