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# **Tuberculosis**

## **Drug resistance in Canada**

**2002**

**Reported susceptibility results of the  
Canadian Tuberculosis Laboratory  
Surveillance System**

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## ► 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).

Published by authority of the Minister of Health

© Her Majesty the Queen in Right of Canada, represented by the Minister of Public Works and Government Services Canada, 2003.

Cat. H49-110/2002  
ISBN 0-662-67307-7

This publication can be made available in alternative formats.



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## ► INTRODUCTION

Tuberculosis Prevention and Control (TBPC) at the Centre for Infectious Disease Prevention and Control, Health 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 their results on anti-tuberculous drug susceptibility testing to TBPC for every patient that they receive a specimen or an isolate from each calendar year. TBPC subsequently produces an annual report. This report presents 2002 and adjusted 2001, 2000 and 1999 (to reflect duplicate removal and late reporting) drug susceptibility data for TB isolates across Canada as of February 28, 2003.

## ► METHODOLOGY

TBPC maintains a computerized database containing drug susceptibility test results of *Mycobacterium tuberculosis* (MTB) and MTB complex (MTBC) isolates. Isolates identified as *M. bovis* BCG are included in the CTBLSS but are excluded from this report. 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 report originates, province/territory from which the specimen originates and susceptibility results. TBPC 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.

Newfoundland identifies the species and tests all isolates for drug resistance in Newfoundland. Some provinces identify the species and test their own isolates and those of other provinces/territories (British Columbia: British Columbia and Yukon Territory isolates; Alberta: Alberta, Northwest Territories and some Nunavut isolates; Quebec: Quebec, New Brunswick, Northwest Territories and some Nunavut isolates; Ontario: Ontario and some Nunavut isolates; Nova Scotia: Nova Scotia and Prince Edward Island isolates). Saskatchewan tests for drug resistance on all MTBC isolates. Other provinces and territories report results at the species level.

Laboratories generally perform routine susceptibility testing of MTB or MTBC to first-line anti-tuberculous drugs using the radiometric proportion method (Bactec<sup>®</sup>). Saskatchewan uses Bactec<sup>®</sup> 960 and all others use Bactec<sup>®</sup> 460. Table A lists the first-line anti-tuberculosis drugs and the concentrations in mg/L used by the participating laboratories. Results of susceptibility testing for second-line anti-tuberculous drugs are not included in this report.

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

**Table A: Minimal inhibitory concentrations for routine testing of first-line anti-tuberculosis drugs**

Anti-TB drugs	MIC (mg/L)	Comments
Isoniazid (INH)	0.1	
Rifampin (RMP)	2.0	
Ethambutol (EMB)	2.5	British Columbia uses an MIC of 4.0 mg/L.
Streptomycin (SM)	2.0	Routine testing is not performed for isolates from Quebec, Nova Scotia, New Brunswick, Prince Edward Island and Nunavut isolates tested in Quebec.
Pyrazinamide (PZA)	100.0	Routine testing is not performed for isolates from British Columbia, Saskatchewan and the Yukon Territory.

In 2002, a total of nine laboratories participated in the proficiency for anti-microbial susceptibility testing of *M. tuberculosis* to anti-tuberculous first line drugs conducted by the National Reference Centre for Mycobacteriology. Three strains of *M. tuberculosis* were submitted for testing. Participant results are presented in Table B.

**Table B: Proficiency panel results for anti-microbial susceptibility testing of *M. tuberculosis* to first-line drugs<sup>1</sup>**

Antibiotic	Strain D (201-221)	Strain K (237-260)	Strain M (266-284)
SM 2 µg/mL	Sensitive 6/6 (100% consensus)	Sensitive 6/6 (100% consensus)	Sensitive 6/6 (100% consensus)
INH 0.1 µg/mL	Sensitive 9/9 (100% consensus)	Sensitive 9/9 (100% consensus)	Sensitive 9/9 (100% consensus)
RMP 2.0 µg/mL	Sensitive 9/9 (100% consensus)	Sensitive 9/9 (100% consensus)	Sensitive 9/9 (100% consensus)
EMB 2.5 µg/mL	Sensitive 9/9 (100% consensus)	Resistant 9/9 (100% consensus)	Sensitive 9/9 (100% consensus)
PZA 100 µg/mL	Sensitive 6/7 (85.7% consensus)	Sensitive 7/7 (100% consensus)	Resistant 8/8 (100% consensus)

<sup>1</sup> Eight laboratories used the BACTEC® TB 460 as their test method. One laboratory used the MGIT 960 as its test method.

- *SM*: Six laboratories included results for streptomycin. Current National Committee for Clinical Laboratory Standards (NCCLS) guidelines no longer recommend that streptomycin be tested as a first-line anti-tuberculous agent.
- *INH*: No resistant strain was included in the 2002 panel. Current NCCLS guidelines recommend testing a higher concentration of INH for strains resistant to the critical concentration of INH.
- *EMB*: All laboratories using the BACTEC® TB 460 tested EMB at 2.5 µg/mL. The laboratory using the MGIT 960 tested EMB at 5.0 µg/mL, the manufacturer's recommended critical concentration. Two laboratories also tested EMB at the higher concentration of 7.5 µg/mL. The 2002 panel included a rare strain showing mono-resistance to EMB. Madison et al. reported that EMB resistance was coupled with INH resistance in 96.6% of strains and recommend that EMB mono-resistance based on BACTEC® 460TB results be confirmed with another NCCLS method (Madison et al. *J Clin Microbiol* 2000;40:3976-3979). Current NCCLS guidelines recommend confirmation of resistance by agar proportion or repeat testing following the manufacturer's instructions concerning EMB testing.
- *PZA*: All laboratories correctly identified PZA resistance. One laboratory reported a sensitive strain as showing low level resistance and indicated that the strain would be referred to the reference laboratory.



## ► RESULTS

Of the 1,352 isolates in 2002 included for analysis, 172 (12.7%) were resistant to one or more first-line anti-tuberculous drug(s). Resistance to INH was the most common type of drug resistance (8.1%). Twenty-two isolates (1.6%) were multi-drug resistant tuberculosis (MDR-TB) strains (defined as resistance to at least INH and RMP), of which 15 isolates demonstrated resistance to four or five first-line anti-tuberculous drugs tested. Reporting of these isolates was from Ontario, Manitoba and British Columbia. In addition, Alberta, British Columbia, Manitoba, Ontario and Quebec reported isolates with other patterns of multi-drug resistance. Five provinces and territories (Nunavut, Northwest Territories, Yukon, Newfoundland and Labrador and Prince Edward Island) reported that all isolates tested were susceptible to all the first-line anti-tuberculous drugs.

Demographic information on the individual patients from whom the isolates originated is limited in this laboratory-based surveillance system. Of the 1,320 isolates for which the year of birth reporting was complete, 40% were between the ages 25 and 44. Males accounted for 53% of all the isolates and 49% of the drug resistant isolates.

## ► DISCUSSION

The number of reported TB isolates in 2002 decreased by 3.6% from the previous year (1,475 to 1,352 isolates). However, the percentage of isolates demonstrating any type of drug resistance increased from 10% in 2001 to 12.7% in 2002 and the proportion of isolates classified as MDR-TB increased slightly from 1.0% in 2001 to 1.6% in 2002.

Over 90% of the reported laboratory TB isolates in Canada in 2002 originated from five provinces. The three largest provinces (Ontario, Quebec and British Columbia) have consistently reported the majority of isolates and MDR-TB in the five years of data collection. Since the initiation of this laboratory-based surveillance system, which began January 1, 1998, Saskatchewan, the Atlantic Provinces, the Yukon and Northwest Territories 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), the median prevalence of overall TB drug resistance among the participating countries was 11.1 % (as compared with 12.7 % for Canada) and the median prevalence of MDR-TB was 1.8%<sup>1</sup> (as compared with 1.6% for Canada).

## ► 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 critically examine drug resistance patterns in Canada. Demographic information is sparse; only sex and year of birth are routinely reported in this surveillance system. As well, no differentiation can be made between primary and secondary/acquired drug resistance from the data.

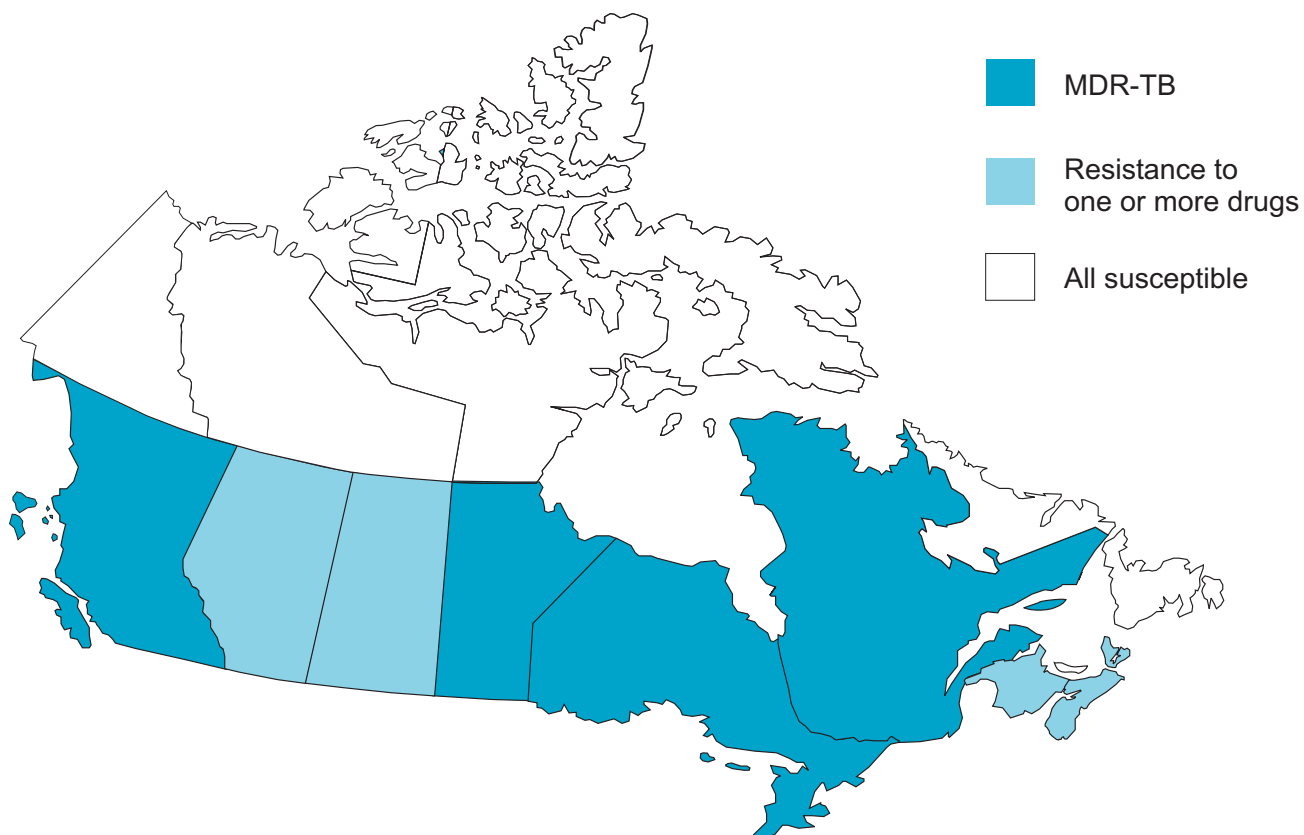
## ► CONCLUSIONS

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 prevalence of TB drug resistance in this country is similar to that in the overall global situation. Analysis reveals a slight increase in the reporting of MDR-TB for the latest reporting year; however, several more years of data will be required to determine whether this is a trend.

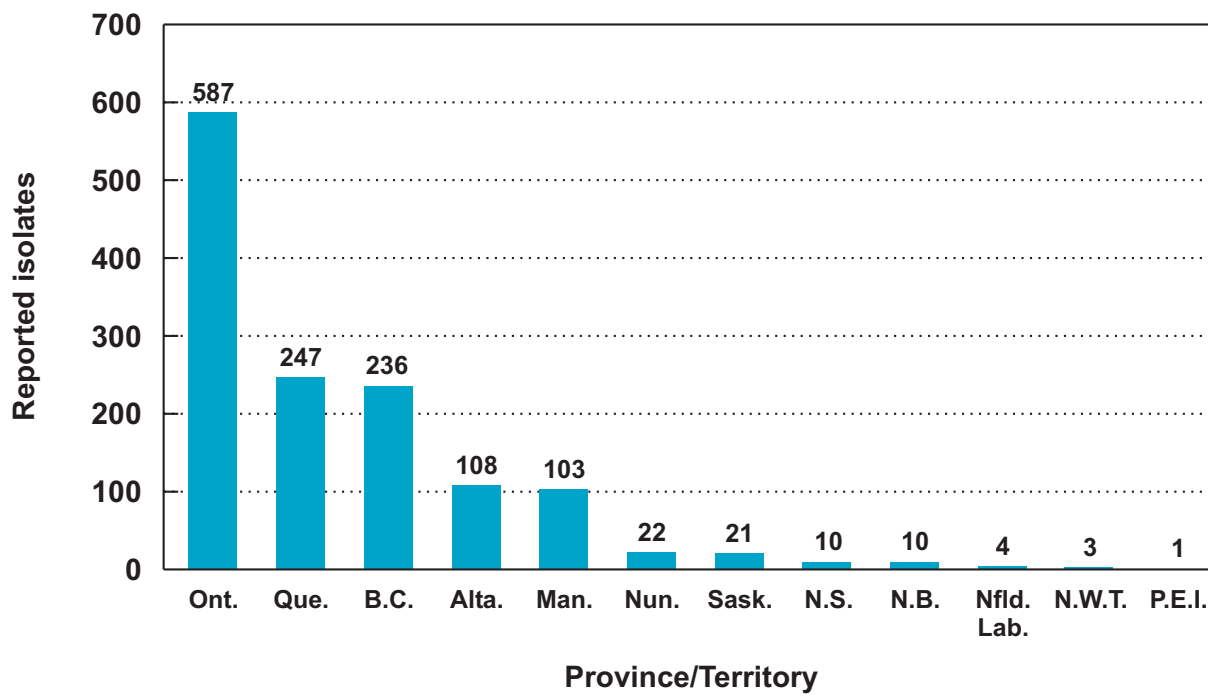
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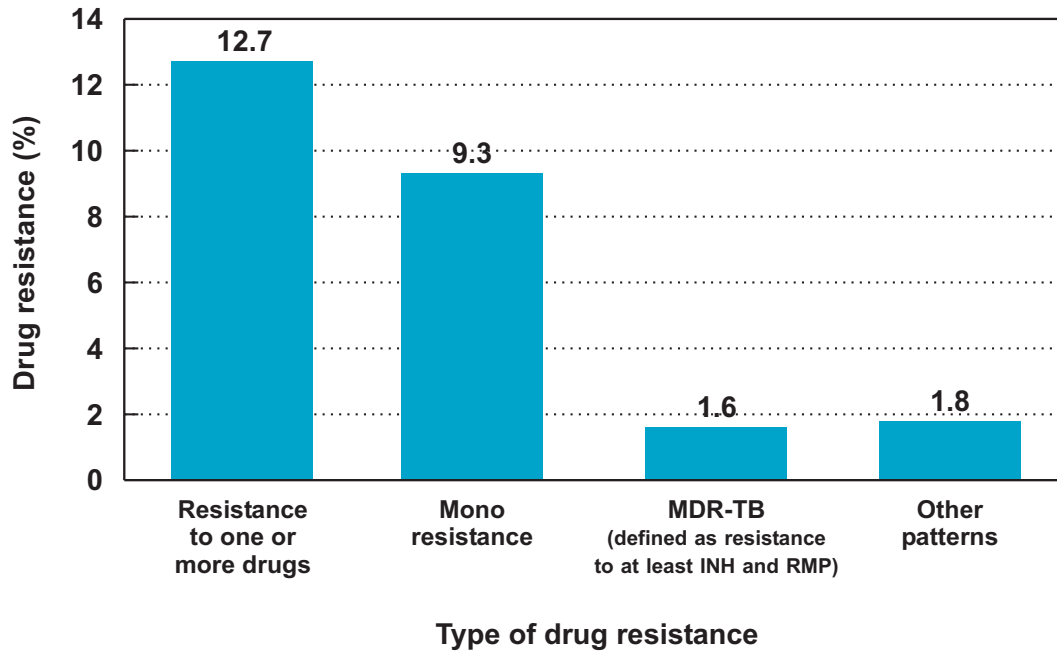
► **Figure 1**  
Reported TB drug resistance in Canada by province/territory – 2002



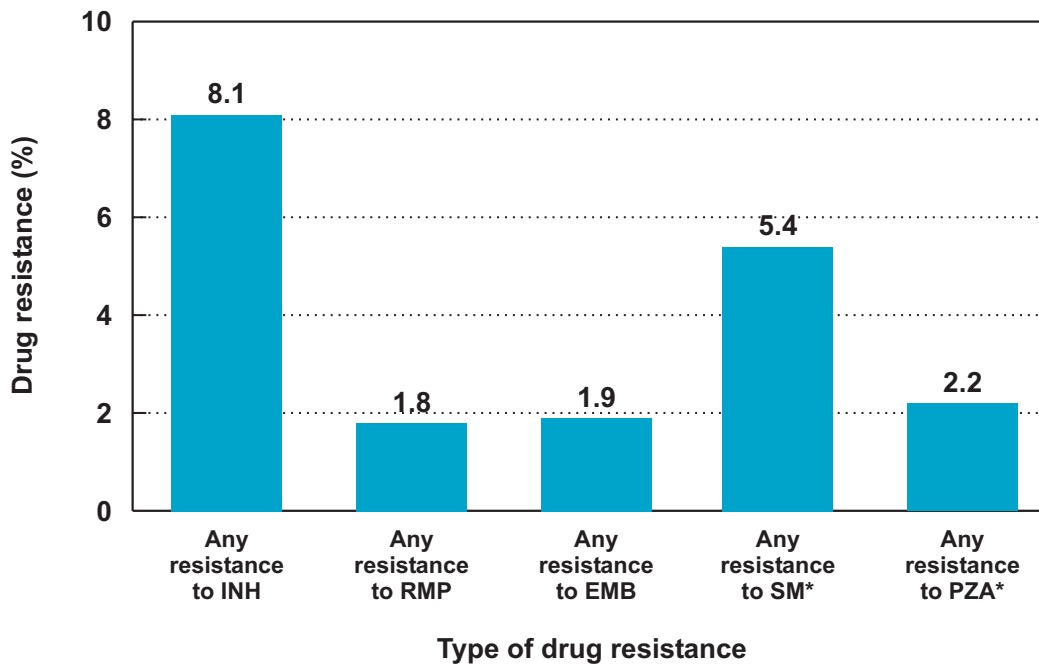
► **Figure 2**  
Reported MTB isolates in Canada by province/territory – 2002



► **Figure 3**  
Overall pattern of reported TB drug resistance in Canada – 2002

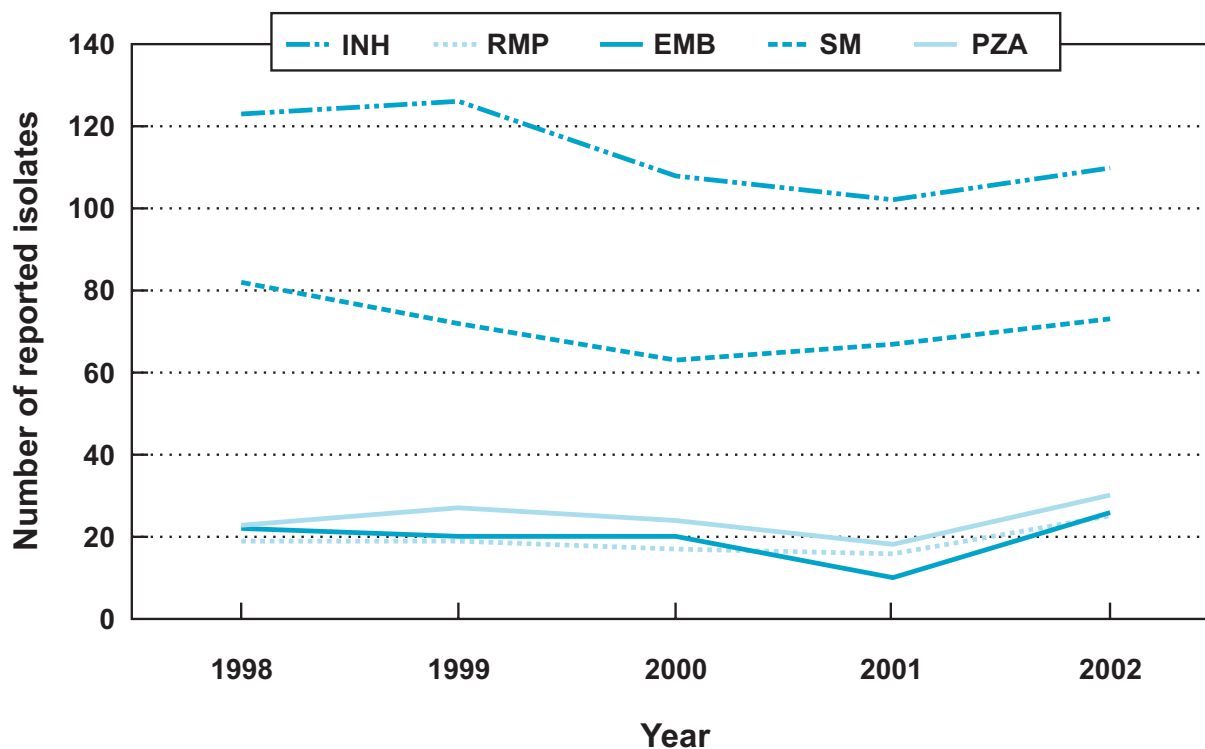


► **Figure 4**  
Reported TB drug resistance in Canada by type of drug – 2002

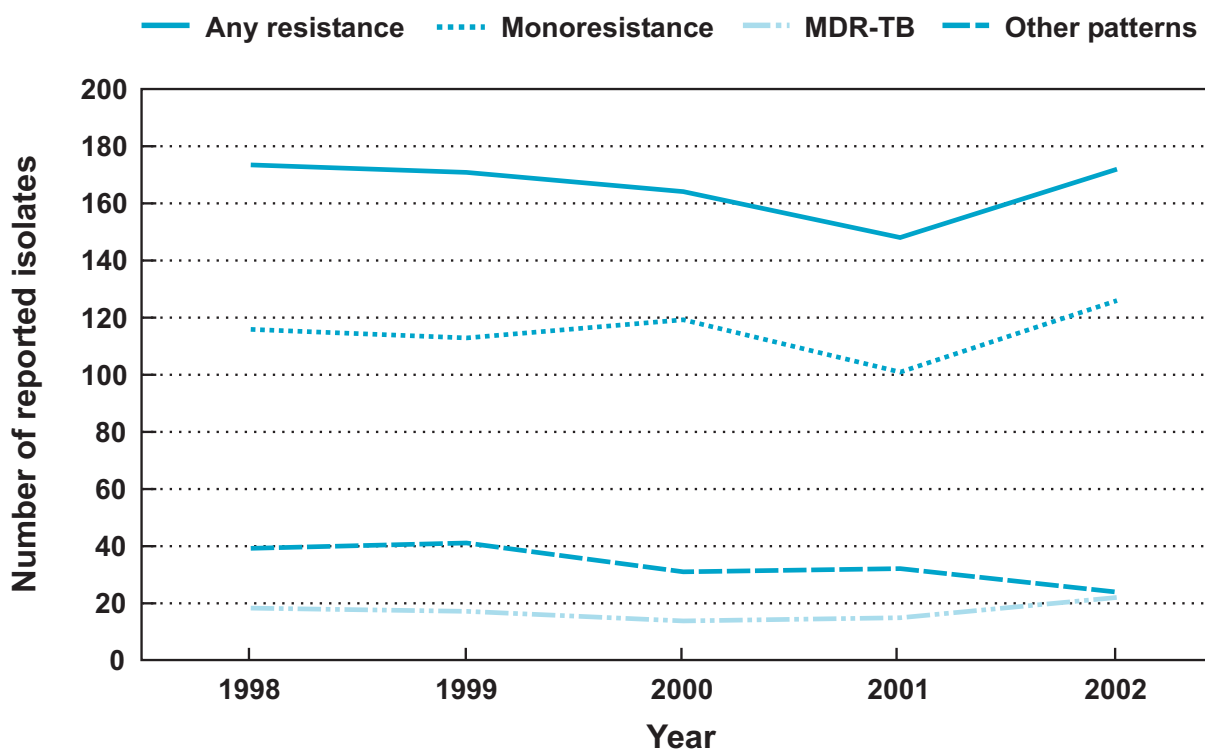


\* SM and PZA are not part of routine first-line drug testing in some provinces/territories.

► **Figure 5**  
Any resistance to first-line anti-TB drugs in Canada – 1998-2002



► **Figure 6**  
Overall pattern of reported TB drug resistance in Canada – 1998-2002



**Table 1. Overall pattern of reported TB drug resistance in Canada – 1998-2002**

	<b>1998 Total (%)</b>	<b>1999 Total (%)</b>	<b>2000 Total (%)</b>	<b>2001 Total (%)</b>	<b>2002 Total (%)</b>
<b>Total number of isolates tested</b>	<b>1,461 (100.0)</b>	<b>1,415 (100.0)</b>	<b>1,491 (100.0)</b>	<b>1,475 (100.0)</b>	<b>1,352 (100.0)</b>
<b>Isolates susceptible</b>	1,288 (88.2)	1,243 (87.8)	1,323 (88.7)	1,327 (90)	1,180 (87.3)
<b>Any resistance to INH</b>	123 (8.4)	127 (9)	111 (7.4)	102 (6.9)	110 (8.1)
<b>Any resistance to RMP</b>	19 (1.3)	20 (1.4)	18 (1.2)	16 (1.1)	25 (1.8)
<b>Any resistance to EMB</b>	22 (1.5)	20 (1.4)	21 (1.4)	10 (0.7)	26 (1.9)
<b>Any resistance to SM</b>	82 (5.6)	72 (5.1)	65 (4.4)	68 (4.6)	73 (5.4)
<b>Any resistance to PZA</b>	23 (1.6)	27 (1.9)	24 (1.6)	20 (1.4)	30 (2.2)
<b>Resistance to one or more drugs</b>	173 (11.8)	172 (12.2)	168 (11.3)	148 (10)	172 (12.7)
<b>Monoresistance</b>	116 (7.9)	113 (8)	121 (8.1)	101 (6.8)	126 (9.3)
<b>MDR-TB*</b>	18 (1.2)	18 (1.3)	15 (1)	15 (1)	22 (1.6)
<b>Other patterns</b>	39 (2.7)	41 (2.9)	32 (2.1)	32 (2.2)	24 (1.8)

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

**Table 2. Reported MTB isolates by “reporting” and “originating” province/territory, Canada – 2002**

Reporting Province	CANADA	Originating Province/Territory											
		Alta.	B.C.	Man.	N.B.	Nfld. Lab.	N.S.	Nun.	N.W.T.	Ont.	P.E.I.	Que.	Sask.
Number of isolates	1,352	108	236	103	10	4	10	22	3	587	1	247	21
Alta.	114	108	-	-	-	-	-	3	3	-	-	-	-
B.C.	236	-	236	-	-	-	-	-	-	-	-	-	-
Man.	103	-	-	103	-	-	-	-	-	-	-	-	-
N.B.	10	-	-	-	10	-	-	-	-	-	-	-	-
Nfld.Lab.	4	-	-	-	-	4	-	-	-	-	-	-	-
N.S.	11	-	-	-	-	-	10	-	-	-	1	-	-
Ont.	595	-	-	-	-	-	-	8	-	587	-	-	-
Que.	258	-	-	-	-	-	-	11	-	-	-	247	-
Sask.	21	-	-	-	-	-	-	-	-	-	-	-	21

**Table 3. Reported MDR-TB\* isolates by province/territory, Canada – 2002**

	CANADA	Originating Province/Territory											
		Alta.	B.C.	Man.	N.B.	Nfld. Lab.	N.S.	Nun.	N.W.T.	Ont.	P.E.I.	Que.	Sask.
<b>Total number of isolates tested</b>	1,352	108	236	103	10	4	10	22	3	587	1	247	21
<b>Total number of MDR-TB* isolates</b>	22	-	2	3	-	-	-	-	-	16	-	1	-
<b>INH &amp; RMP</b>	3	-	-	1	-	-	-	-	-	2	-	-	-
<b>INH, RMP &amp; SM</b>	2	-	-	-	-	-	-	-	-	2	-	-	-
<b>INH, RMP &amp; EMB</b>	2	-	-	-	-	-	-	-	-	1	-	1	-
<b>INH, RMP, SM &amp; EMB</b>	5	-	-	-	-	-	-	-	-	5	-	-	-
<b>INH, RMP, EMB &amp; PZA</b>	3	-	1	1	-	-	-	-	-	1	-	-	-
<b>INH, RMP, SM, EMB &amp; PZA</b>	7	-	1	1	-	-	-	-	-	5	-	-	-

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



**Table 4. Reported TB drug resistance by gender and age group, Canada – 2002**

Age Group		Number of Isolates	Any Resistance	MDR-TB*
		No. (%)	No. (%)	No. (%)
<b>Total</b>		1352 (100)	172 (100)	22 (100)
0-4	Males	6 (0.4)	- (0.0)	- (0.0)
	Females	6 (0.4)	1 (0.6)	- (0.0)
	Unknown	1 (0.1)	- (0.0)	- (0.0)
	<b>Total</b>	<b>13 (1)</b>	<b>1 (0.6)</b>	<b>- (0.0)</b>
5-14	Males	5 (0.4)	- (0.0)	- (0.0)
	Females	17 (1.3)	4 (2.3)	- (0.0)
	Unknown	2 (0.1)	- (0.0)	- (0.0)
	<b>Total</b>	<b>24 (1.8)</b>	<b>5 (2.9)</b>	<b>- (0.0)</b>
15-24	Males	75 (5.5)	15 (8.7)	1 (4.5)
	Females	78 (5.8)	14 (8.1)	1 (4.5)
	Unknown	8 (0.6)	1 (0.6)	1 (4.5)
	<b>Total</b>	<b>161 (11.9)</b>	<b>30 (17.4)</b>	<b>3 (13.6)</b>
25-34	Males	131 (9.7)	22 (12.8)	3 (13.6)
	Females	102 (7.5)	14 (8.1)	4 (18.2)
	Unknown	12 (0.9)	3 (1.7)	1 (4.5)
	<b>Total</b>	<b>245 (18.1)</b>	<b>39 (22.7)</b>	<b>8 (36.4)</b>
35-44	Males	128 (9.5)	15 (8.7)	4 (18.2)
	Females	86 (6.4)	16 (9.3)	- (0.0)
	Unknown	5 (0.4)	1 (0.6)	- (0.0)
	<b>Total</b>	<b>219 (16.2)</b>	<b>32 (18.6)</b>	<b>4 (18.2)</b>
45-54	Males	89 (6.6)	5 (2.9)	- (0.0)
	Females	74 (5.5)	6 (3.5)	1 (4.5)
	Unknown	11 (0.8)	1 (0.6)	- (0.0)
	<b>Total</b>	<b>174 (12.9)</b>	<b>12 (7)</b>	<b>1 (4.5)</b>
55-64	Males	70 (5.2)	13 (7.6)	- (0.0)
	Females	52 (3.8)	8 (4.7)	2 (9.1)
	Unknown	3 (0.2)	1 (0.6)	- (0.0)
	<b>Total</b>	<b>125 (9.2)</b>	<b>22 (12.8)</b>	<b>2 (9.1)</b>
65-74	Males	98 (7.2)	4 (2.3)	- (0.0)
	Females	63 (4.7)	6 (3.5)	2 (9.1)
	Unknown	1 (0.1)	- (0.0)	- (0.0)
	<b>Total</b>	<b>162 (12)</b>	<b>10 (5.8)</b>	<b>2 (9.1)</b>
75+	Males	104 (7.7)	8 (4.7)	1 (4.5)
	Females	87 (6.4)	8 (4.7)	1 (4.5)
	Unknown	5 (0.4)	- (0.0)	- (0.0)
	<b>Total</b>	<b>196 (14.5)</b>	<b>16 (9.3)</b>	<b>2 (9.1)</b>
Unknown	Males	11 (0.8)	2 (1.2)	- (0.0)
	Females	9 (0.7)	- (0.0)	- (0.0)
	Unknown	13 (1)	3 (1.7)	- (0.0)
	<b>Total</b>	<b>33 (2.4)</b>	<b>5 (2.9)</b>	<b>- (0.0)</b>
<b>Total</b>	<b>Males</b>	<b>717 (53)</b>	<b>84 (48.8)</b>	<b>9 (40.9)</b>
	<b>Females</b>	<b>574 (42.5)</b>	<b>77 (44.8)</b>	<b>11 (50)</b>
	<b>Unknown</b>	<b>61 (4.5)</b>	<b>11 (6.4)</b>	<b>2 (9.1)</b>

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

**Table 5. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Alberta – 1998-2002**

	<b>1998 Total (%)</b>	<b>1999 Total (%)</b>	<b>2000 Total (%)</b>	<b>2001 Total (%)</b>	<b>2002 Total (%)</b>
<b>Total number of isolates tested for INH, RMP, SM, EMB and PZA</b>	<b>119 (100.0)</b>	<b>118 (100.0)</b>	<b>104 (100.0)</b>	<b>91 (100.0)</b>	<b>108 (100.0)</b>
<b>Isolates susceptible</b>	<b>107 (89.9)</b>	<b>111 (94.1)</b>	<b>92 (88.5)</b>	<b>79 (86.8)</b>	<b>94 (87.0)</b>
<b>Isolates resistant to one or more drugs</b>	<b>12 (10.1)</b>	<b>7 (5.9)</b>	<b>12 (11.5)</b>	<b>12 (13.2)</b>	<b>14 (13.0)</b>
<b>Monoresistance</b>	<b>9 (7.6)</b>	<b>6 (5.1)</b>	<b>7 (6.7)</b>	<b>8 (8.8)</b>	<b>12 (11.1)</b>
INH	4 (3.4)	2 (1.7)	2 (1.9)	5 (5.5)	6 (5.6)
EMB	- (0.0)	- (0.0)	1 (1.0)	- (0.0)	- (0.0)
SM	5 (4.2)	4 (3.4)	3 (2.9)	3 (3.3)	6 (5.6)
PZA	- (0.0)	- (0.0)	1 (1.0)	- (0.0)	- (0.0)
<b>MDR-TB*</b>	<b>1 (0.8)</b>	<b>- (0.0)</b>	<b>- (0.0)</b>	<b>- (0.0)</b>	<b>- (0.0)</b>
INH & SM & EMB & RMP & PZA	1 (0.8)	- (0.0)	- (0.0)	- (0.0)	- (0.0)
<b>Other Patterns</b>	<b>2 (1.7)</b>	<b>1 (0.8)</b>	<b>5 (4.8)</b>	<b>4 (4.4)</b>	<b>2 (1.9)</b>
INH & SM	1 (0.8)	1 (0.8)	3 (2.9)	2 (2.2)	1 (0.9)
INH & SM & EMB	- (0.0)	- (0.0)	1 (1.0)	- (0.0)	- (0.0)
INH & SM & PZA	1 (0.8)	- (0.0)	1 (1.0)	2 (2.2)	1 (0.9)

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

**Table 6. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, British Columbia – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, SM and EMB**</b>	<b>237 (100.0)</b>	<b>244 (100.0)</b>	<b>277 (100.0)</b>	<b>331 (100.0)</b>	<b>236 (100.0)</b>
<b>Isolates susceptible</b>	<b>212 (89.5)</b>	<b>224 (91.8)</b>	<b>245 (88.4)</b>	<b>296 (89.4)</b>	<b>208 (88.1)</b>
<b>Isolates resistant to one or more drugs</b>	<b>25 (10.5)</b>	<b>20 (8.2)</b>	<b>32 (11.6)</b>	<b>35 (10.6)</b>	<b>28 (11.9)</b>
<b>Monoresistance</b>	<b>17 (7.2)</b>	<b>15 (6.1)</b>	<b>23 (8.3)</b>	<b>22 (6.6)</b>	<b>23 (9.7)</b>
INH	14 (5.9)	11 (4.5)	13 (4.7)	12 (3.6)	11 (4.7)
EMB	- (0.0)	1 (0.4)	1 (0.4)	- (0.0)	2 (0.8)
RMP	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.3)	2 (0.8)
SM	2 (0.8)	2 (0.8)	8 (2.9)	9 (2.7)	7 (3.0)
PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (0.4)
<b>MDR-TB*</b>	<b>2 (0.8)</b>	<b>1 (0.4)</b>	<b>5 (1.8)</b>	<b>8 (2.4)</b>	<b>2 (0.8)</b>
INH & RMP	- (0.0)	- (0.0)	- (0.0)	4 (1.2)	- (0.0)
INH & RMP & EMB	- (0.0)	- (0.0)	1 (0.4)	- (0.0)	- (0.0)
INH & RMP & SM	1 (0.4)	- (0.0)	2 (0.7)	2 (0.6)	- (0.0)
INH & RMP & EMB & PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (0.4)
INH & RMP & SM & EMB	1 (0.4)	1 (0.4)	2 (0.7)	1 (0.3)	- (0.0)
INH & RMP & SM & EMB & PZA	- (0.0)	- (0.0)	- (0.0)	1 (0.3)	1 (0.4)
<b>Other Patterns</b>	<b>6 (2.5)</b>	<b>4 (1.6)</b>	<b>4 (1.4)</b>	<b>5 (1.5)</b>	<b>3 (1.3)</b>
INH & EMB	1 (0.4)	1 (0.4)	- (0.0)	- (0.0)	- (0.0)
INH & SM	5 (2.1)	2 (0.8)	2 (0.7)	5 (1.5)	3 (1.3)
INH & SM & EMB	- (0.0)	1 (0.4)	2 (0.7)	- (0.0)	- (0.0)

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

\*\* Routine testing for PZA not conducted

**Table 7. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Manitoba – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, EMB, SM and PZA**</b>	106 (100.0)	100 (100.0)	102 (100.0)	110 (100.0)	103 (100.0)
<b>Isolates susceptible</b>	98 (92.5)	89 (89.0)	94 (92.2)	101 (91.8)	95 (92.2)
<b>Isolates resistant to one or more drugs</b>	8 (7.5)	11 (11.0)	8 (7.8)	9 (8.2)	8 (7.8)
<b>Monoresistance</b>	4 (3.8)	6 (6.0)	6 (5.9)	6 (5.5)	4 (3.9)
INH	2 (1.9)	3 (3.0)	6 (5.9)	2 (1.8)	3 (2.9)
SM**	2 (1.9)	3 (3.0)	- (0.0)	4 (3.6)	- (0.0)
PZA***	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (1.0)
<b>MDR-TB*</b>	2 (1.9)	2 (2.0)	- (0.0)	2 (1.8)	3 (2.9)
INH & RMP	- (0.0)	1 (1.0)	- (0.0)	1 (0.9)	1 (1.0)
INH & EMB & RMP & PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (1.0)
INH & EMB & RMP	1 (0.9)	- (0.0)	- (0.0)	- (0.0)	- (0.0)
INH & SM & EMB & RMP & PZA	1 (0.9)	- (0.0)	- (0.0)	1 (0.9)	1 (1.0)
INH & SM & RMP & PZA	- (0.0)	1 (1.0)	- (0.0)	- (0.0)	- (0.0)
<b>Other Patterns</b>	2 (1.9)	3 (3.0)	2 (2.0)	1 (0.9)	1 (1.0)
INH & PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (1.0)
INH & SM	2 (1.9)	1 (1.0)	2 (2.0)	1 (0.9)	- (0.0)
INH & SM & EMB	- (0.0)	1 (1.0)	- (0.0)	- (0.0)	- (0.0)
INH & SM & PZA	- (0.0)	1 (1.0)	- (0.0)	- (0.0)	- (0.0)

\* MDR-TB is defined as resistance to at least INH and RMP  
\*\* Routine testing for SM not conducted for 2002.  
\*\*\* Includes *M. bovis* isolates: 1 for 2002

**Table 8. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, New Brunswick – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, EMB and PZA*</b>	10 (100.0)	12 (100.0)	9 (100.0)	10 (100.0)	10 (100.0)
<b>Isolates susceptible</b>	9 (90.0)	12 (100.0)	9 (100.0)	10 (100.0)	9 (90.0)
<b>Isolates resistant to one or more drugs</b>	1 (10.0)	- (0.0)	- (0.0)	- (0.0)	1 (10.0)
<b>Monoresistance</b>	1 (10.0)	- (0.0)	- (0.0)	- (0.0)	1 (10.0)
INH	1 (10.0)	- (0.0)	- (0.0)	- (0.0)	1 (10.0)

\* Routine testing for SM not conducted.

**Table 9. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Newfoundland and Labrador – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 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)
Isolates susceptible	8 (100.0)	9 (100.0)	11 (100.0)	9 (100.0)	4 (100.0)

**Table 10. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Northwest Territories – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 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)
Isolates susceptible	27 (100.0)	11 (100.0)	8 (100.0)	6 (100.0)	3 (100.0)

**Table 11. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Nova Scotia – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
Total number of isolates tested for INH, RMP, EMB and PZA*	9 (100.0)	8 (100.0)	4 (100.0)	7 (100.0)	10 (100.0)
Isolates susceptible	8 (88.9)	7 (87.5)	4 (100.0)	7 (100.0)	9 (90.0)
Isolates resistant to one or more drugs	1 (11.1)	1 (12.5)	- (0.0)	- (0.0)	1 (10.0)
<b>Monoresistance</b>					
INH	1 (11.1)	1 (12.5)	- (0.0)	- (0.0)	- (0.0)
PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (10.0)

\* Routine testing for SM not conducted.

**Table 12. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Nunavut\* – 1998-2002**

	<b>1998 Total (%)</b>	<b>1999 Total (%)</b>	<b>2000 Total (%)</b>	<b>2001 Total (%)</b>	<b>2002 Total (%)</b>
<b>Total number of isolates tested for INH, RMP, SM***, EMB and PZA</b>	N/A	15 (100.0)	29 (100.0)	31 (100.0)	22 (100.0)
<b>Isolates susceptible</b>	N/A	15 (100.0)	28 (96.6)	30 (96.8)	22 (100.0)
<b>Isolates resistant to one or more drugs</b>	N/A	- (0.0)	1 (3.4)	1 (3.2)	- (0.0)
<b>Monoresistance</b>	N/A	- (0.0)	1 (3.4)	- (0.0)	- (0.0)
INH		- (0.0)	1 (3.4)	- (0.0)	- (0.0)
<b>MDR-TB**</b>	N/A	- (0.0)	- (0.0)	1 (3.2)	- (0.0)
INH&RMP		- (0.0)	- (0.0)	1 (3.2)	- (0.0)

\* Note: Nunavut began reporting in 1999.

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

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

**Table 13. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Ontario – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, EMB, SM and PZA</b>	<b>629 (100.0)</b>	<b>589 (100.0)</b>	<b>599 (100.0)</b>	<b>589 (100.0)</b>	<b>587 (100.0)</b>
<b>Isolates susceptible</b>	<b>538 (85.5)</b>	<b>489 (83.0)</b>	<b>519 (86.6)</b>	<b>521 (88.5)</b>	<b>493 (84.0)</b>
<b>Isolates resistant to one or more drugs</b>	<b>91 (14.5)</b>	<b>100 (17.0)</b>	<b>80 (13.4)</b>	<b>68 (11.5)</b>	<b>94 (16.0)</b>
<b>Monoresistance</b>	<b>55 (8.7)</b>	<b>57 (9.7)</b>	<b>52 (8.7)</b>	<b>44 (7.5)</b>	<b>61 (10.4)</b>
INH	34 (5.4)	34 (5.8)	23 (3.8)	20 (3.4)	30 (5.1)
EMB	4 (0.6)	- (0.0)	1 (0.2)	1 (0.2)	1 (0.2)
SM	11 (1.7)	19 (3.2)	16 (2.7)	16 (2.7)	25 (4.3)
PZA**	6 (1.0)	4 (0.7)	12 (2.0)	7 (1.2)	5 (0.9)
<b>MDR-TB*</b>	<b>11 (1.7)</b>	<b>13 (2.2)</b>	<b>9 (1.5)</b>	<b>3 (0.5)</b>	<b>16 (2.7)</b>
INH & RMP	2 (0.3)	3 (0.5)	1 (0.2)	- (0.0)	2 (0.3)
INH & RMP & EMB	- (0.0)	1 (0.2)	2 (0.3)	1 (0.2)	1 (0.2)
INH & RMP & SM	1 (0.2)	3 (0.5)	3 (0.5)	- (0.0)	2 (0.3)
INH & RMP & PZA	- (0.0)	1 (0.2)	- (0.0)	- (0.0)	- (0.0)
INH & RMP & EMB & PZA	- (0.0)	- (0.0)	- (0.0)	1 (0.2)	1 (0.2)
INH & RMP & SM & EMB	2 (0.3)	- (0.0)	2 (0.3)	- (0.0)	5 (0.9)
INH & RMP & SM & PZA	- (0.0)	- (0.0)	1 (0.2)	- (0.0)	- (0.0)
INH & RMP & SM & EMB & PZA	6 (1.0)	5 (0.8)	- (0.0)	1 (0.2)	5 (0.9)
<b>Other Patterns</b>	<b>25 (4.0)</b>	<b>30 (5.1)</b>	<b>19 (3.2)</b>	<b>21 (3.6)</b>	<b>17 (2.9)</b>
INH & EMB	<b>2 (0.3)</b>	<b>4 (0.7)</b>	<b>2 (0.3)</b>	<b>- (0.0)</b>	<b>1 (0.2)</b>
INH & PZA**	- (0.0)	- (0.0)	- (0.0)	2 (0.3)	- (0.0)
INH & SM	20 (3.2)	20 (3.4)	14 (2.3)	16 (2.7)	13 (2.2)
EMB & RMP	- (0.0)	- (0.0)	2 (0.3)	- (0.0)	- (0.0)
INH & SM & EMB	2 (0.3)	4 (0.7)	1 (0.2)	3 (0.5)	2 (0.3)
INH & SM & PZA	1 (0.2)	2 (0.3)	- (0.0)	- (0.0)	- (0.0)
INH & SM & EMB & PZA	- (0.0)	- (0.0)	- (0.0)	- (0.0)	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 and 1 *M. Bovis* isolate for 2002

**Table 14. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Prince Edward Island – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, EMB and PZA*</b>	2 (100.0)	2 (100.0)	3 (100.0)	2 (100.0)	1 (100.0)
<b>Isolates susceptible</b>	2 (100.0)	2 (100.0)	3 (100.0)	1 (50.0)	1 (100.0)
<b>Isolates resistant to one or more drugs</b>	- (0.0)	- (0.0)	- (0.0)	1 (50.0)	- (0.0)
<b>Monoresistance</b>	- (0.0)	- (0.0)	- (0.0)	1 (50.0)	- (0.0)
PZA**	- (0.0)	- (0.0)	- (0.0)	1 (50.0)	- (0.0)

\* Routine testing for SM not conducted.  
\*\* Includes *M. bovis* isolates: 1 for 2001

**Table 15. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Québec – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, EMB and PZA</b>	264 (100.0)	268 (100.0)	278 (100.0)	221 (100.0)	247 (100.0)
<b>Isolates susceptible</b>	231 (87.5)	236 (88.1)	249 (89.6)	202 (91.4)	222 (89.9)
<b>Isolates resistant to one or more drugs</b>	33 (12.5)	32 (11.9)	29 (10.4)	19 (8.6)	25 (10.1)
<b>Monoresistance</b>	28 (10.6)	28 (10.4)	28 (10.1)	18 (8.1)	23 (9.3)
INH	9 (3.4)	17 (6.3)	19 (6.8)	14 (6.3)	13 (5.3)
RMP	- (0.0)	1 (0.4)	- (0.0)	- (0.0)	1 (0.4)
SM**	13 (4.9)	NT**	NT**	NT**	NT**
PZA***	6 (2.3)	10 (3.7)	9 (3.2)	4 (1.8)	9 (3.6)
<b>MDR-TB*</b>	2 (0.8)	2 (0.7)	1 (0.4)	1 (0.5)	1 (0.4)
INH & RMP	- (0.0)	1 (0.4)	- (0.0)	1 (0.5)	- (0.0)
INH & RMP & EMB	1 (0.4)	- (0.0)	1 (0.4)	- (0.0)	1 (0.4)
INH & RMP & SM	1 (0.4)	NT**	NT**	NT**	NT**
INH & RMP & EMB & PZA	- (0.0)	1 (0.4)	- (0.0)	- (0.0)	- (0.0)
<b>Other Patterns</b>	3 (1.1)	2 (0.7)	- (0.0)	- (0.0)	1 (0.4)
INH & SM	2 (0.8)	NT**	NT**	NT**	NT**
INH & EMB	- (0.0)	- (0.0)	- (0.0)	- (0.0)	1 (0.4)
INH & PZA	1 (0.4)	2 (0.7)	- (0.0)	- (0.0)	- (0.0)

\* MDR-TB is defined as resistance to at least INH and RMP  
\*\* Routine testing for SM not conducted in Quebec effective January 1, 1999 (NT = not tested)  
\*\*\* Includes *M. bovis* isolates: 1 for 1999, 2 for 2000, 1 for 2001 and 1 for 2002



**Table 16. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Saskatchewan – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, SM and EMB*</b>	<b>49 (100.0)</b>	<b>40 (100.0)</b>	<b>64 (100.0)</b>	<b>68 (100.0)</b>	<b>21 (100.0)</b>
<b>Isolates susceptible</b>	<b>47 (95.9)</b>	<b>39 (97.5)</b>	<b>58 (90.6)</b>	<b>65 (95.6)</b>	<b>19 (90.5)</b>
<b>Isolates resistant to one or more drugs</b>	<b>2 (4.1)</b>	<b>1 (2.5)</b>	<b>6 (9.4)</b>	<b>3 (4.4)</b>	<b>2 (9.5)</b>
<b>Monoresistance</b>	<b>1 (2.0)</b>	<b>- (0.0)</b>	<b>4 (6.3)</b>	<b>2 (2.9)</b>	<b>2 (9.5)</b>
INH	1 (2.0)	- (0.0)	2 (3.1)	2 (2.9)	1 (4.8)
EMB	- (0.0)	- (0.0)	1 (1.6)	- (0.0)	1 (4.8)
SM	- (0.0)	- (0.0)	1 (1.6)	- (0.0)	- (0.0)
<b>Other Patterns</b>	<b>1 (2.0)</b>	<b>1 (2.5)</b>	<b>2 (3.1)</b>	<b>1 (1.5)</b>	<b>- (0.0)</b>
INH & EMB	- (0.0)	- (0.0)	1 (1.6)	- (0.0)	- (0.0)
INH & SM	1 (2.0)	1 (2.5)	1 (1.6)	1 (1.5)	- (0.0)

\* Routine testing for PZA not conducted.

**Table 17. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Yukon Territory – 1998-2002**

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)	2002 Total (%)
<b>Total number of isolates tested for INH, RMP, SM and EMB*</b>	<b>1 (100.0)</b>	<b>- (0.0)</b>	<b>3 (100.0)</b>	<b>1 (100.0)</b>	<b>- (0.0)</b>
<b>Isolates susceptible</b>	<b>1 (100.0)</b>	<b>- (0.0)</b>	<b>3 (100.0)</b>	<b>1 (100.0)</b>	<b>- (0.0)</b>

\* Routine testing for PZA not conducted.

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## ► Appendix 1

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

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and Nunavut)

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<b>Northwest Territories</b> (see also Alberta and Quebec)	Norine Fraley Supervisor – Bacteriology Stanton Territorial Health Authority
<b>Nova Scotia</b> (Nova Scotia and Prince Edward Island)	Carol Pelton - Chair Lab Tech II Microbiology Queen Elizabeth II Health Sciences Centre
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<b>Québec</b> (Quebec, New Brunswick, Northwest Territories and Nunavut)	Louise Thibert Head Mycobacteriology Laboratoire de santé publique du Québec – INSPQ

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**Saskatchewan**

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## Appendix 2



Health Canada Santé 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		Unique Source Laboratory ID No. - Identificateur unique du laboratoire déclarant:	
Date Rec'd at TBPC: Date de réception au LATB: Y / A M / J		Date specimen / culture received at laboratory: Date de réception échantillon / culture au laboratoire: Y / A M / J	
TBPC Number: Numéro du LATB:			
Specie: Espèce: <input type="checkbox"/> M. tuberculosis (may include M. africanum or M. microti) (peut inclure M. africanum et M. microti)		<input type="checkbox"/> M. bovis <input type="checkbox"/> M. BCG bovis <input type="checkbox"/> 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?			
<input type="checkbox"/> No / Non <input type="checkbox"/> 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:	<input type="text"/>	(see code list) (voir liste de codes)
2	Province / territory from which specimen originated: Province / territoire d'où provient l'échantillon:	<input type="text"/>	(see code list) (voir liste de codes)
3	Patient's date of birth: Date de naissance du patient:	Y / A M / J	(CCYYMMDD) (SSAA/MM/JJ) <input type="checkbox"/> Unknown / Inconnu
4	Patient's gender: Sexe du patient:	<input type="checkbox"/> Male / Masculin <input type="checkbox"/> Female / Féminin <input type="checkbox"/> Unknown / Inconnu	
PROV / TERR CODES PROV / TERR			
10 = NFLD / TN 46 = MAN			
11 = PEI / IPÉ 47 = SASK			
12 = NS / NE 48 = ALTA / ALB			
13 = NB 59 = BC / BC			
24 = QUÉ / Qc 60 = YUK			
35 = ONT 61 = NWT / TND			
62 = NUN			
<b>LABORATORY RESULTS</b> <b>RÉSULTATS DE LABORATOIRE</b>		<b>Concentration</b> (if different from on file) <b>Concentration</b> (si autre que spécifiée)	
<b>Antituberculous Drugs</b> <b>Agents Antituberculeux</b>		<b>Results</b> (check appropriate box for every drug) <b>Résultats</b> (cocher la case pertinente pour chaque antibiotique)	
<b>SM</b> (Streptomycin) (Streptomycine)	mg / L	Sensitive / Sensible <input type="checkbox"/>	Resistant / Résistant <input type="checkbox"/>
<b>INH</b> (Isoniazid) (Isoniazide)	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
<b>RMP</b> (Rifampin) (Rifampicine)	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
<b>EMB</b> (Ethambutol)	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
<b>PZA</b> (Pyrazinamide)	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
<b>2nd line drugs (specify)</b> <b>Antibiotiques de 2<sup>e</sup> ligne (préciser)</b>	<b>Concentration</b>	Sensitive / Sensible	Resistant / Résistant
1.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
2.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
3.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
4.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
5.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
6.	mg / L	<input type="checkbox"/>	<input type="checkbox"/>
<b>6</b> <b>Comments - Commentaires</b>			

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)