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Drug resistance in Canada

2001

Reported susceptibility results of the Canadian Tuberculosis Laboratory Surveillance System

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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-tuberculosis drug susceptibility testing to TBPC for every patient for whom a specimen or an isolate has been received for each calendar year. TBPC subsequently produces an annual report. This report presents 2001 and adjusted 2000 and 1999 (to reflect duplicate removal and late reporting) drug susceptibility data for TB isolates across Canada as of February 28, 2002.

METHODOLOGY

A computerized database containing drug susceptibility test results of *Mycobacterium tuberculosis* (MTB) and MTB complex (MTBC) isolates is maintained at TBPC at the Centre for Infectious Disease Prevention and Control. Isolates identified as *M.bovis* BCG are also reported to the CTBLSS but are excluded from analysis. Data are collected either through manual completion and mailing of a standard reporting form (Appendix 2) or by electronic transmission. Information collected includes gender, year of birth, province/territory from which the report originates, province/territory from which the specimen originates and susceptibility results. Every effort is made to eliminate duplicate specimens; only the most recent susceptibility results for a given patient in the current reporting year are included for analysis.

Manitoba, Ontario and Newfoundland identify the species and test all isolates for drug resistance in their respective provinces. 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 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.

Routine susceptibility testing of MTB or MTBC to first-line anti-tuberculosis drugs is generally performed using the radiometric proportion method (Bactec®). Saskatchewan uses Bactec® 960 and all others use Bactec® 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-tuberculosis drugs are not included in this report.

As noted in Table A, the number and specific first-line anti-tuberculosis drugs for which routine susceptibility testing is carried out differ among the provinces and territories. Accordingly, the number of isolates included in the descriptive analyses that were carried out vary. Analyses were performed using SAS version 8e.

All laboratories participate in collaborative proficiency testing which consists of identification and drug testing by the National Reference Centre for Mycobacteriology.

Table A: Concentrations for routine testing of first-line anti-tuberculosis drugs		
Anti-tuberculosis drugs	**mg/L**	**Comments**
Isoniazid (INH)	0.1	
Rifampin (RMP)	2.0	
Ethambutol (EMB)	2.5	British Columbia used a concentration of 4.0 mg/L until October 1, 2001.
Streptomycin (SM)	2.0	Routine testing is not performed for isolates from Quebec, Nova Scotia, New Brunswick, Prince Edward Island and for Nunavut isolates tested in Quebec.
Pyrazinamide (PZA)	100.0	Routine testing is not performed for isolates from British Columbia, Saskatchewan and the Yukon Territory.

RESULTS

In 2001, participating laboratories across Canada reported drug susceptibility results for 1,448 isolates of MTBC. Fifteen *M. bovis* isolates were reported: eleven isolates of *M. bovis* BCG and four isolates of *M. bovis* other than BCG. Only the four (0.3%) *M. bovis* other than BCG isolates (one each from Prince Edward Island and Quebec, and two from Ontario) are included in the analyses, leaving a total of 1,437 isolates. The majority of isolates originated from Ontario, Quebec, British Columbia, Alberta and Manitoba.

Of the 1,437 isolates in 2001 included for analysis, 145 (10.1%) were resistant to one or more first-line anti-tuberculosis drug(s). Resistance to INH was the most common type of drug resistance (7.0%). A total of 14 isolates (1.0%) were multi-drug resistant tuberculosis (MDR-TB) strains (defined as resistance to at least INH and RMP); of which four isolates demonstrated resistance to four or five first-line anti-tuberculosis drugs tested. These isolates were reported from Ontario, Manitoba and British Columbia. In addition, British Columbia, Alberta, Saskatchewan, Manitoba and Ontario reported isolates with other patterns of multi-drug resistance. Five provinces and territories (Northwest Territories, Yukon, Newfoundland and Labrador, Nova Scotia and New Brunswick) reported that all isolates tested were susceptibile to all the first-line anti-tuberculosis drugs.

Demographic information on the individual patients from whom the isolates originated is limited in this laboratory-based surveillance system. Of the 1,385 isolates for which the year of birth was known, 59.9% reported a year of birth between 1942 and 1981. Among the 136 drug resistant isolates for which year of birth was known, 71.3% reported a year of birth between 1942 and 1981. Males accounted for 51.8% of all the isolates and 46.9% of the drug resistant isolates for which gender was reported.

DISCUSSION

The number of reported TB isolates in 2001 decreased by 3.6% from the previous year (1,491 to 1,437 isolates). The percentage of isolates demonstrating any type of drug resistance decreased from 11.3% in 2000 to 10.1% in 2001 and the proportion of isolates classified as MDR-TB remained the same at 1.0% for 2000 and 2001.

Over 90% of the reported laboratory TB isolates in Canada in 2001 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 four years of data collection. Since the initiation of this laboratory-based surveillance system that 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 to 10.1% for Canada) and the median prevalence of MDR-TB was 1.8%[1] (as compared to 1.0% for Canada).

Figure 1
Reported TB drug resistance in Canada by province/territory – 2001 (n = 1,437)

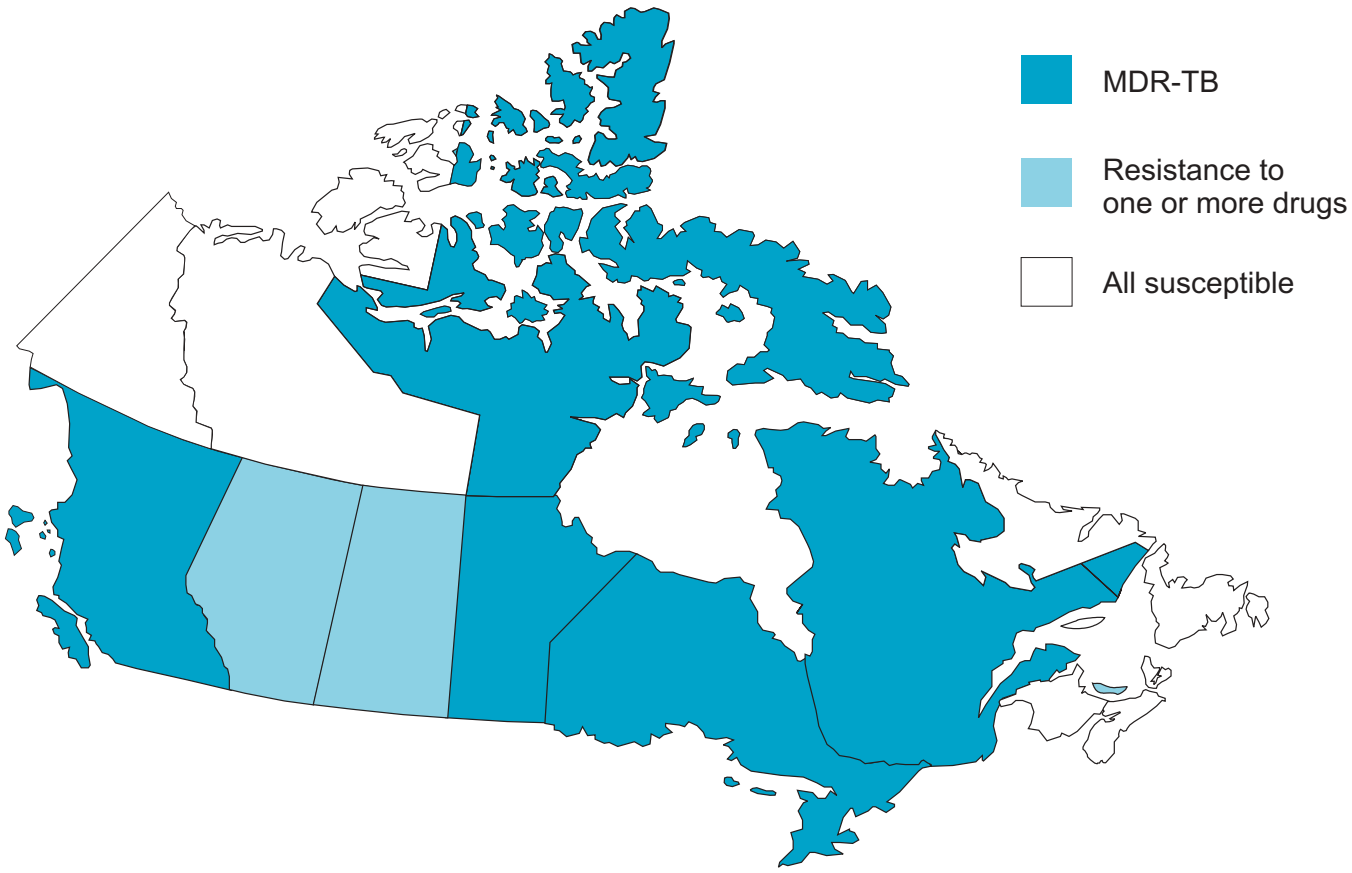


Figure 2
Reported MTB isolates in Canada by province/territory – 2001 (n = 1,437)

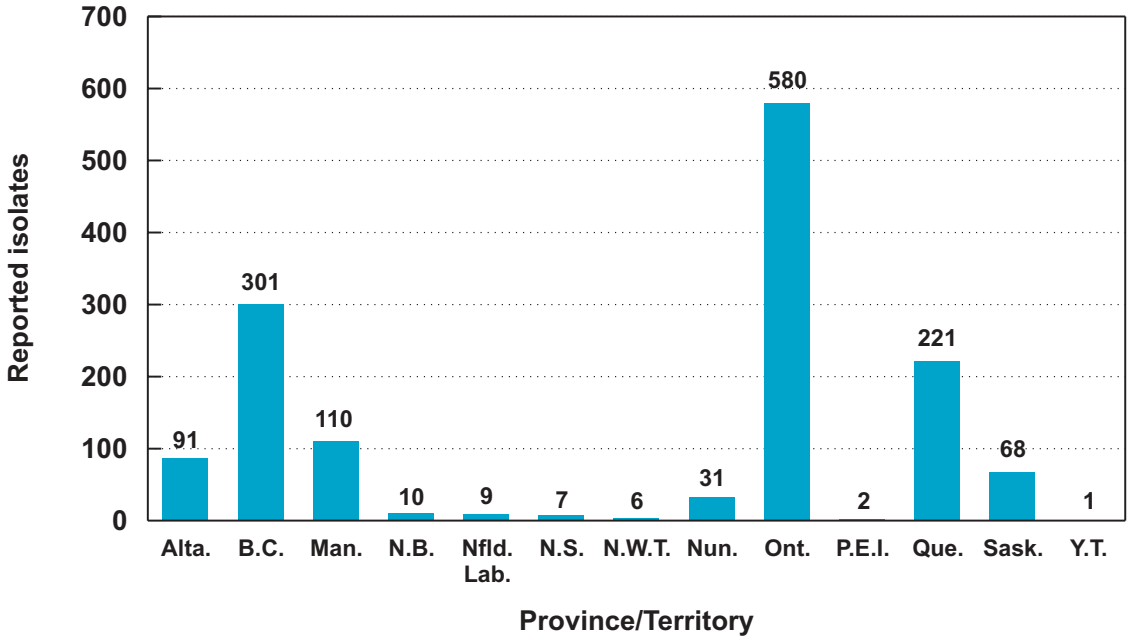


Figure 3
Overall pattern of reported TB drug resistance in Canada – 2001 (n = 145/1,437 total isolates)

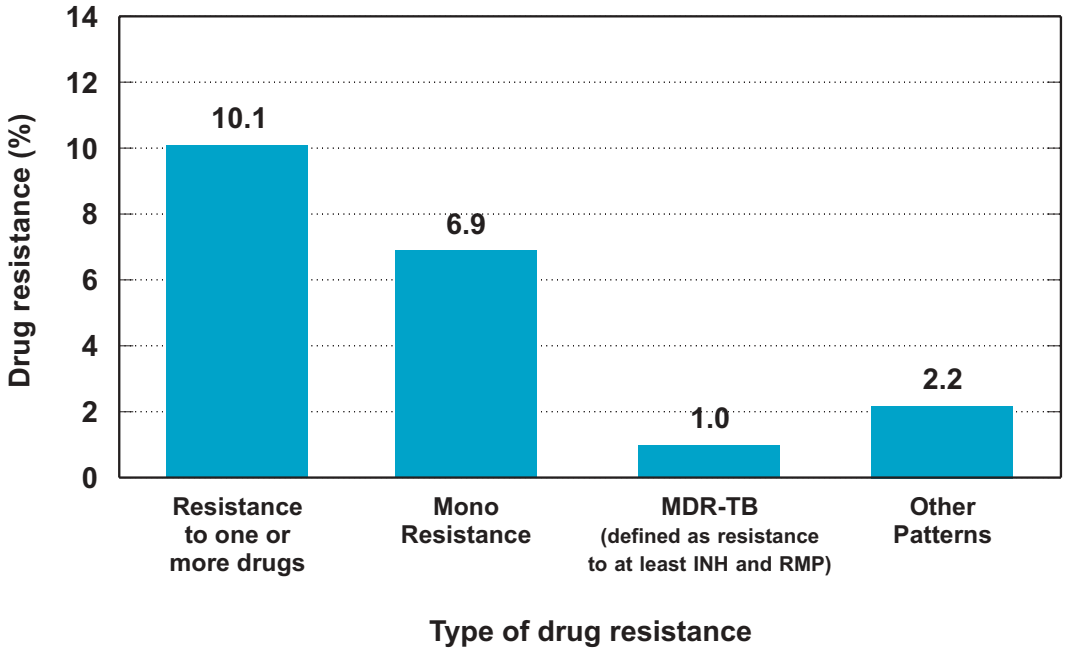
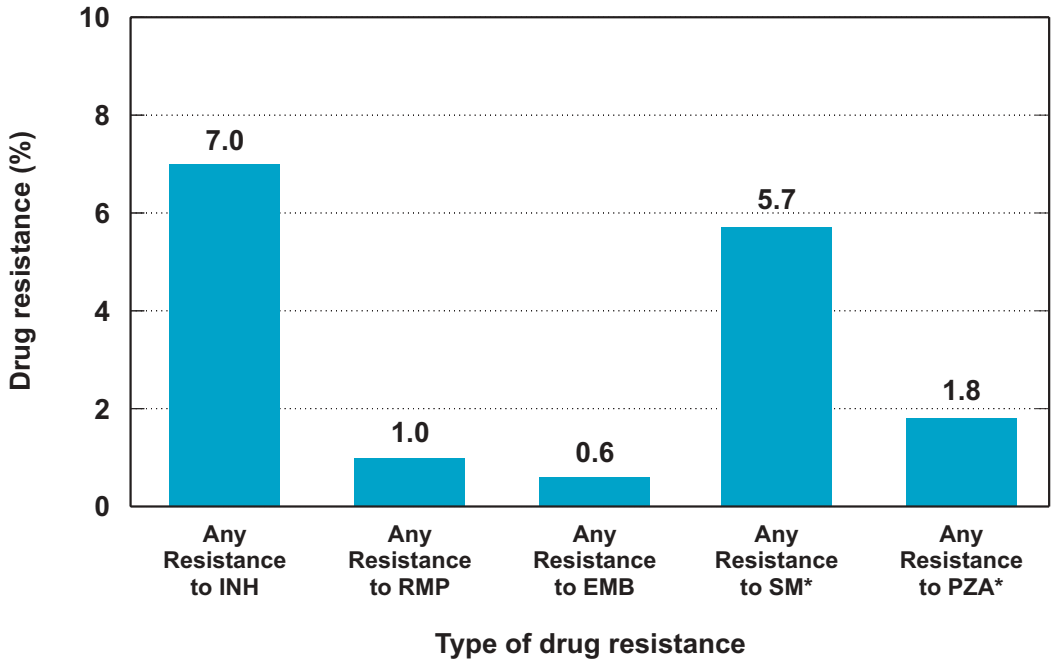


Figure 4

Reported TB drug resistance in Canada by type of drug – 2001 (n = 145/1,437 total isolates)



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

Figure 5

Reported TB drug resistance in Canada by gender and year of birth – 2001 (n = 145/1,437 total isolates)

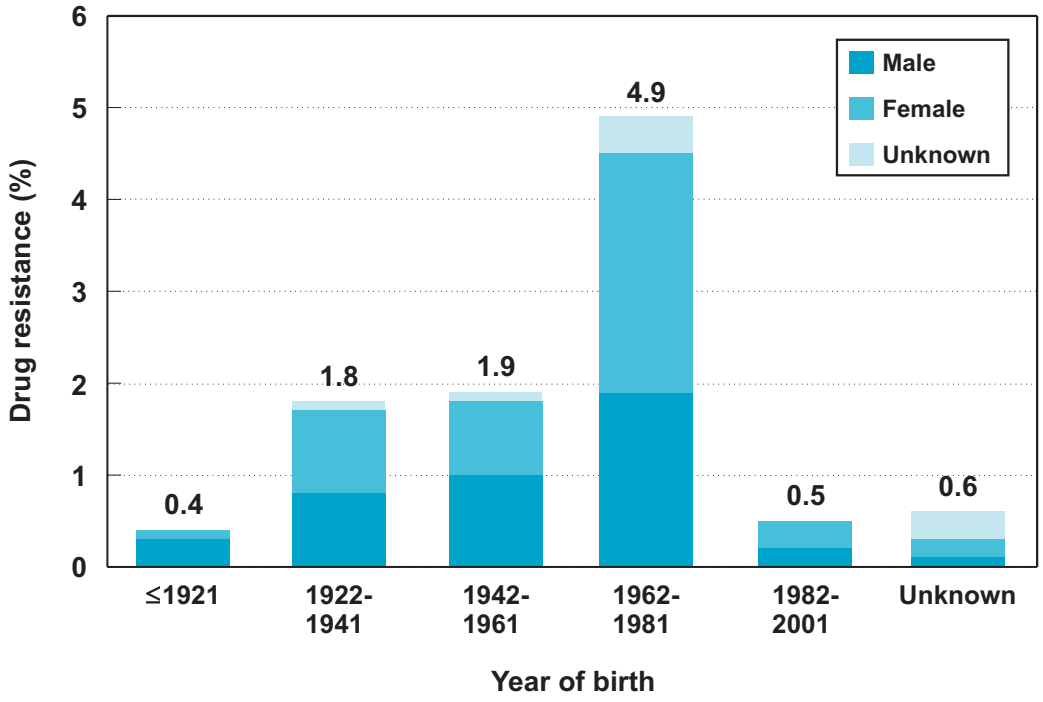


Table 1. Overall pattern of reported TB drug resistance in Canada – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested	**1,461 (100.0)**	**1,414 (100.0)**	**1,491 (100.0)**	**1,437 (100.0)**
Isolates susceptible	1,288 (88.2)	1,243 (87.9)	1,323 (88.7)	1,292 (89.9)
Any resistance to INH	123 (8.4)	126 (8.9)	111 (7.4)	100 (7.0)
Any resistance to RMP	19 (1.3)	19 (1.1)	18 (1.2)	15 (1.0)
Any resistance to EMB	22 (1.5)	20 (1.4)	21 (1.4)	9 (0.6)
Any resistance to SM**	82 (5.7)	72 (6.5)	65 (5.6)	66 (5.7)
Any resistance to PZA**	23 (2.0)	27 (2.4)***	24 (2.1)***	19 (1.8)***
Resistance to one or more drugs	173 (11.8)	171 (12.1)	168 (11.3)	145 (10.1)
Monoresistance**	116 (7.9)	113 (8.0)	121 (8.1)	99 (6.9)
MDR-TB*	18 (1.2)	17 (1.2)	15 (1.0)	14 (1.0)
Other patterns	39 (2.7)	41 (2.9)	32 (2.1)	32 (2.2)

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

** Because SM and PZA are not part of the routine first-line drugs in some provinces and territories, denominators for any resistance to these drugs have been modified to reflect this (1998: SM n = 1,450 and PZA n = 1,174) (1999: SM n = 1,110 and PZA n = 1,130) (2000: SM n = 1,169 and PZA n = 1,146) (2001: SM n = 1,167 and PZA n = 1,067).

*** Includes 2 *M. bovis* isolates for 1999, 4 *M. bovis* isolates for 2000 and 4 *M. bovis* isolates for 2001.

Table 2. Reported MTB isolates by "reporting" and "originating" province/territory, Canada – 2001

Reporting Province	CANADA	Originating Province/Territory												
		Alta.	B.C.	Man.	N.B.	Nfld. Lab.	N.S.	N.W.T.	Nun.	Ont.	P.E.I.	Que.	Sask.	Y.T.
Number of isolates	**1,437**	**91**	**301**	**110**	**10**	**9**	**7**	**6**	**31**	**580**	**2**	**221**	**68**	**1**
Alta.	98	91	-	-	-	-	-	6	1	-	-	-	-	-
B.C.	302	-	301	-	-	-	-	-	-	-	-	-	-	1
Man.	110	-	-	110	-	-	-	-	-	-	-	-	-	-
Nfld.Lab.	9	-	-	-	-	9	-	-	-	-	-	-	-	-
N.S.	9	-	-	-	-	-	7	-	-	-	2	-	-	-
Ont.	580	-	-	-	-	-	-	-	-	580	-	-	-	-
Que.	261	-	-	-	10	-	-	-	30	-	-	221	-	-
Sask.	68	-	-	-	-	-	-	-	-	-	-	-	68	-

Table 3. Reported MDR-TB* isolates by province/territory, Canada – 2001

	CANADA	Originating Province/Territory												
		Alta.	B.C.	Man.	N.B.	Nfld. Lab.	N.S.	N.W.T.	Nun.	Ont.	P.E.I.	Que.	Sask.	Y.T.
Total number of isolates tested	**1,437**	**91**	**301**	**110**	**10**	**9**	**7**	**6**	**31**	**580**	**2**	**221**	**68**	**1**
Total number of MDR-TB* isolates	14	-	7	2	-	-	-	-	1	3	-	1	-	-
INH & RMP	7	-	4	1	-	-	-	-	1	-	-	1	-	-
INH, RMP & EMB	1	-	-	-	-	-	-	-	-	1	-	-	-	-
INH, RMP & SM	2	-	2	-	-	-	-	-	-	-	-	-	-	-
INH, RMP, EMB & SM	1	-	1	-	-	-	-	-	-	-	-	-	-	-
INH, RMP, SM & PZA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
INH, RMP, EMB & PZA	1	-	-	-	-	-	-	-	-	1	-	-	-	-
INH, RMP, EMB, SM & PZA	2	-	-	1	-	-	-	-	-	1	-	-	-	-

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

Table 4. Reported TB drug resistance by gender and year of birth, Canada – 2001

Year of Birth		Number of isolates No.	(%)	Any type of resistance No.	(%)	MDR-TB* No.	(%)
Total Isolates		**1437**	**(100.0)**	**144**	**(10.1)**	**14**	**(1.0)**
≤ 1921	Males	75	(5.2)	4	(0.3)	-	(0.0)
	Females	54	(3.8)	2	(0.1)	-	(0.0)
	Unknown	6	(0.4)	-	(0.0)	-	(0.0)
	Total	**135**	**(9.4)**	**6**	**(0.4)**	**-**	**(0.0)**
1922-1941	Males	199	(13.8)	12	(0.8)	2	(0.1)
	Females	139	(9.7)	13	(0.9)	-	(0.0)
	Unknown	15	(1.0)	1	(0.1)	-	(0.0)
	Total	**353**	**(24.6)**	**26**	**(1.8)**	**2**	**(0.1)**
1942-1961	Males	192	(13.4)	15	(1.0)	1	(0.1)
	Females	142	(9.9)	11	(0.8)	-	(0.0)
	Unknown	9	(0.6)	1	(0.1)	-	(0.0)
	Total	**343**	**(23.9)**	**27**	**(1.9)**	**1**	**(0.1)**
1962-1981	Males	227	(15.8)	27	(1.9)	3	(0.2)
	Females	228	(15.9)	37	(2.6)	6	(0.4)
	Unknown	31	(2.2)	6	(0.4)	1	(0.1)
	Total	**486**	**(33.8)**	**70**	**(4.9)**	**10**	**(0.7)**
1982-2001	Males	36	(2.5)	3	(0.2)	-	(0.0)
	Females	31	(2.2)	4	(0.3)	-	(0.0)
	Unknown	1	(0.1)	-	(0.0)	-	(0.0)
	Total	**68**	**(4.7)**	**7**	**(0.5)**	**-**	**(0.0)**
Unknown	Males	16	(1.1)	1	(0.1)	-	(0.0)
	Females	21	(1.5)	3	(0.2)	-	(0.0)
	Unknown	15	(1.0)	5	(0.3)	1	(0.1)
	Total	**52**	**(3.5)**	**9**	**(0.6)**	**1**	**(0.1)**
Total	**Males**	**745**	**(51.8)**	**62**	**(4.3)**	**6**	**(0.4)**
	Females	**615**	**(42.8)**	**70**	**(4.9)**	**6**	**(0.4)**
	Unknown	**77**	**(5.4)**	**13**	**(0.9)**	**2**	**(0.1)**

* 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 – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA	**119 (100.0)**	**117 (100.0)**	**104 (100.0)**	**91 (100.0)**
Isolates susceptible	**107 (89.9)**	**110 (94.0)**	**92 (88.5)**	**79 (86.8)**
Isolates resistant to one or more drugs	**12 (10.1)**	**7 (6.0)**	**12 (11.5)**	**12 (13.2)**
Monoresistance	**9 (7.6)**	**6 (5.1)**	**7 (6.7)**	**8 (8.8)**
INH	4 (3.4)	2 (1.7)	2 (1.9)	5 (5.5)
SM	5 (4.2)	4 (3.4)	3 (2.9)	3 (3.3)
EMB	- (0.0)	- (0.0)	1 (1.0)	- (0.0)
PZA	- (0.0)	- (0.0)	1 (1.0)	- (0.0)
MDR-TB*	**1 (0.8)**	**0 (0.0)**	**0 (0.0)**	**0 (0.0)**
INH, RMP, EMB, SM & PZA	1 (0.8)	0 (0.0)	- (0.0)	- (0.0)
Other Patterns	**2 (1.7)**	**1 (0.9)**	**5 (4.8)**	**4 (4.4)**
INH & SM	1 (0.8)	1 (0.9)	3 (2.9)	2 (2.2)
INH, SM & EMB	- (0.0)	- (0.0)	1 (1.0)	- (0.0)
INH, SM & PZA	1 (0.8)	0 (0.0)	1 (1.0)	2 (2.2)

* 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 – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested for INH, RMP, EMB and SM**	**237 (100.0)**	**245 (100.0)**	**277 (100.0)**	**301 (100.0)**
Isolates susceptible***	**212 (89.5)**	**225 (91.8)**	**245 (88.5)**	**269 (89.4)**
Isolates resistant to one or more drugs	**25 (10.5)**	**20 (8.2)**	**32 (11.6)**	**32 (10.6)**
Monoresistance	**17 (7.2)**	**15 (6.1)**	**23 (8.3)**	**20 (6.6)**
INH	14 (5.9)	11 (4.5)	13 (4.7)	11 (3.7)
SM	2 (0.8)	2 (0.8)	8 (2.9)	8 (2.7)
RMP	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.3)
EMB	- (0.0)	1 (0.4)	1 (0.4)	- (0.0)
MDR-TB*	**2 (0.8)**	**1 (0.4)**	**5 (1.8)**	**7 (2.3)**
INH & RMP	- (0.0)	- (0.0)	- (0.0)	4 (1.3)
INH, RMP & SM	1 (0.4)	- (0.0)	2 (0.7)	2 (0.7)
INH, RMP & EMB	- (0.0)	- (0.0)	1 (0.4)	- (0.0)
INH, RMP, EMB & SM	1 (0.4)	1 (0.4)	2 (0.7)	1 (0.3)
Other Patterns	**6 (2.5)**	**4 (1.6)**	**4 (1.4)**	**5 (1.7)**
INH & SM	5 (2.1)	2 (0.8)	2 (0.7)	5 (1.7)
INH & EMB	1 (0.4)	1 (0.4)	- (0.0)	- (0.0)
INH, SM & EMB	- (0.0)	1 (0.4)	2 (0.7)	- (0.0)

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

** Routine testing for PZA not conducted in British Columbia.

*** Includes 1 *M. bovis* isolate (1999).

Table 7. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Manitoba – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 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)**
Isolates susceptible	**98 (92.5)**	**89 (89.0)**	**94 (92.2)**	**93 (91.8)**
Isolates resistant to one or more drugs	**8 (7.5)**	**11 (11.0)**	**8 (7.8)**	**9 (8.2)**
Monoresistance	**4 (3.8)**	**6 (6.0)**	**6 (5.9)**	**6 (5.5)**
INH	2 (1.9)	3 (3.0)	6 (5.9)	2 (1.8)
SM	2 (1.9)	3 (3.0)	- (0.0)	4 (3.6)
MDR-TB*	**2 (1.9)**	**2 (2.0)**	**- (0.0)**	**2 (1.8)**
INH & RMP	- (0.0)	1 (1.0)	- (0.0)	1 (0.9)
INH, RMP & EMB	1 (0.9)	- (0.0)	- (0.0)	- (0.0)
INH, RMP, SM & PZA	- (0.0)	1 (1.0)	- (0.0)	- (0.0)
INH, RMP, EMB, SM & PZA	1 (0.9)	- (0.0)	- (0.0)	1 (0.9)
Other Patterns	**2 (1.9)**	**3 (3.0)**	**2 (2.0)**	**1 (0.9)**
INH & SM	2 (1.9)	1 (1.0)	2 (2.0)	1 (0.9)
INH, SM & EMB	- (0.0)	1 (1.0)	- (0.0)	- (0.0)
INH, SM & PZA	- (0.0)	1 (1.0)	- (0.0)	- (0.0)

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

Table 8. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, New Brunswick – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested for INH, RMP, EMB and PZA*	**9 (100.0)**	**12 (100.0)**	**9 (100.0)**	**10 (100.0)**
Isolates susceptible	**8 (88.9)**	**12 (100.0)**	**9 (100.0)**	**10 (100.0)**
Isolates resistant to one or more drugs	**1 (1.1)**	**- (0.0)**	**- (0.0)**	**- (0.0)**
Monoresistance	**1 (1.1)**	**- (0.0)**	**- (0.0)**	**- (0.0)**
INH	1 (1.1)	- (0.0)	- (0.0)	- (0.0)

* Routine testing for SM not conducted in New Brunswick.

Table 9. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Newfoundland and Labrador – 1998-2001

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

Table 10. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Northwest Territories – 1998-2001

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

Table 11. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Nova Scotia – 1998-2001

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

* Routine testing for SM not conducted in Nova Scotia.

Table 12. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Nunavut* – 1998-2001

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

* Note: Nunavut began reporting in 1999.

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

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

Table 13. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Ontario – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested for INH, RMP, EMB, SM and PZA	**629 (100.0)**	**587 (100.0)**	**599 (100.0)**	**580 (100.0)**
Isolates susceptible	**538 (85.5)**	**488 (83.1)**	**519 (86.6)**	**512 (88.3)**
Isolates resistant to one or more drugs	**91 (14.5)**	**99 (16.9)**	**80 (13.3)**	**68 (11.7)**
Monoresistance	**55 (8.7)**	**57 (9.7)**	**52 (8.7)**	**44 (7.6)**
INH	34 (5.4)	34 (5.8)	23 (3.8)	20 (3.4)
SM	11 (1.7)	19 (3.2)	16 (2.7)	16 (2.8)
PZA**	6 (1.0)	4 (0.7)	12 (2.0)	7 (1.2)
EMB	4 (0.6)	- (0.0)	1 (0.2)	1 (0.2)
MDR-TB*	**11 (1.7)**	**12 (2.0)**	**9 (1.5)**	**3 (0.5)**
INH & RMP	2 (0.3)	2 (0.3)	1 (0.2)	- (0.0)
INH, RMP & SM	1 (0.2)	3 (0.5)	3 (0.5)	- (0.0)
INH, RMP & EMB	- (0.0)	1 (0.2)	2 (0.3)	1 (0.2)
INH, RMP & PZA	- (0.0)	1 (0.2)	- (0.0)	- (0.0)
INH, RMP, EMB & SM	2 (0.3)	- (0.0)	2 (0.3)	- (0.0)
INH, RMP, EMB & PZA	- (0.0)	- (0.0)	- (0.0)	1 (0.2)
INH, RMP, SM & PZA	- (0.0)	- (0.0)	1 (0.2)	- (0.0)
INH, RMP, EMB, SM & PZA	6 (1.0)	5 (0.9)	- (0.0)	1 (0.2)
Other Patterns	**25 (4.0)**	**30 (5.1)**	**19 (3.2)**	**21 (3.6)**
INH & EMB	2 (0.3)	4 (0.7)	2 (0.3)	- (0.0)
INH & SM	20 (3.2)	20 (3.4)	14 (2.3)	16 (2.8)
INH & PZA**	- (0.0)	- (0.0)	- (0.0)	2 (0.3)
EMB & RMP	- (0.0)	- (0.0)	2 (0.3)	- (0.0)
INH, SM & EMB	2 (0.3)	4 (0.7)	1 (0.2)	3 (0.5)
INH, SM & PZA	1 (0.2)	2 (0.3)	- (0.0)	- (0.0)

* 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 and 2 *M. bovis* isolates for 2001.

Table 14. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Prince Edward Island – 1998-2001

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

* Routine testing for SM not conducted in Prince Edward Island.

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

Table 15. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Québec – 1998-2001

	1998 Total (%)	1999 Total (%)	2000 Total (%)	2001 Total (%)
Total number of isolates tested for INH, RMP, EMB and PZA**	**264 (100.0)**	**268 (100.0)**	**278 (100.0)**	**221 (100.0)**
Isolates susceptible	**231 (87.5)**	**236 (88.1)**	**249 (89.6)**	**202 (91.4)**
Isolates resistant to one or more drugs	**33 (12.5)**	**32 (11.9)**	**29 (10.4)**	**19 (8.6)**
Monoresistance	**28 (10.6)**	**28 (10.4)**	**28 (10.1)**	**18 (8.1)**
INH	9 (3.4)	17 (6.3)	19 (6.8)	14 (6.3)
RMP	- (0.0)	1 (0.4)	- (0.0)	- (0.0)
SM	13 (4.9)	NT**	NT**	NT**
PZA***	6 (2.3)	10 (3.7)	9 (3.2)	4 (1.8)
MDR-TB*	**2 (0.8)**	**2 (0.7)**	**1 (0.4)**	**1 (0.5)**
INH & RMP	- (0.0)	1 (0.4)	- (0.0)	1 (0.5)
INH, RMP & SM	1 (0.4)	NT**	NT**	NT**
INH, RMP & EMB	1 (0.4)	- (0.0)	1 (0.4)	- (0.0)
INH, RMP, EMB & PZA	- (0.0)	1 (0.4)	- (0.0)	- (0.0)
Other Patterns	**3 (1.1)**	**2 (0.7)**	**- (0.0)**	**- (0.0)**
INH & SM	2 (0.8)	NT**	NT**	NT**
INH & PZA	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 SM not conducted in Québec effective January 1, 1999. (NT=not tested)

*** Includes 1 *M. bovis* isolate for 1999, 2 *M. bovis* isolates for 2000 and 1 *M. bovis* isolate for 2001.

Table 16. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Saskatchewan – 1998-2001

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

* Routine testing for PZA not conducted in Saskatchewan.

Table 17. Reported results for routine drug susceptibility testing of MTB isolates to first-line anti-tuberculosis drugs, Yukon Territory – 1998-2001

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

* Routine testing for PZA not conducted in Yukon Territory.

• No isolates were tested for Yukon Territory in 1999.

LIMITATIONS

Susceptibility testing for first-line anti-tuberculosis 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 epidemiologic 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 gender and year of birth are routinely reported to this surveillance system. As well, no differentiation can be made between primary and secondary/acquired drug resistance from the data in the system. The participating laboratories attempted to collect data on the country of origin in 1999. However, because of the difficulties in doing so, this variable has subsequently been dropped from the surveillance data set.

CONCLUSIONS

With growing worldwide concern regarding TB drug resistance, this laboratory-based 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. However, with data collected only for four years, any discussion of "trends" is premature at the present time. Several more years of collected data will be necessary in order to examine the unfolding pattern of TB drug resistance in Canada.

REFERENCE

1. The WHO/IUATLD Global Project on Anti-tuberculosis Drug Resistance Surveillance. Anti-tuberculosis drug resistance in the world; Report No. 2. (WHO/CDS/TB/2000.278). Geneva: World Health Organization, 2000.

Appendix 1

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

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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

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)