

June 24, 2005

Participant
Centers for Disease Control and Prevention (CDC)
Drug Susceptibility Testing of *Mycobacterium tuberculosis* and Nontuberculous Mycobacteria
Performance Evaluation Program

Subject: Analyses of Participant Laboratory Results for the January 2005 Shipment

Dear Participant:

Enclosed are analyses of laboratory test results reported to the Centers for Disease Control and Prevention (CDC) by participant laboratories for strains of *Mycobacterium tuberculosis* complex and the nontuberculous mycobacteria (NTM), *M. avium*, shipped in January 2005. Participant laboratories (155) received either four *M. tuberculosis* complex strains only or four *M. tuberculosis* strains and one NTM culture. Testing results were received and analyzed from 143 of 155 (92%) laboratories participating in this shipment. Of the laboratories submitting results, 64 reported them via the online data entry system.

The enclosed aggregate report is prepared in a format that will allow laboratories to compare their results with those obtained by other participants for the same strain using the same method, drug, and concentration. The first three pages contain descriptive information about the participant laboratories. We encourage you to circulate this report to personnel who are involved with drug susceptibility testing, reporting, or interpreting for *M. tuberculosis* and NTM.

The NTM strain in this performance evaluation is intended to provide an assessment of the various methods, drugs, and interpretations that are reported by laboratories performing drug susceptibility testing for these different strains. The test results for the NTM strain also provide information on interlaboratory agreement with different test methods and will assist with efforts to develop standard methods for NTM drug susceptibility testing. By reporting these practices and test results, CDC is neither recommending nor endorsing these testing practices. Some of the test results reported by participants may, in fact, provide inappropriate or misleading information to the clinician. A consensus report by the American Thoracic Society and the National Committee for Clinical Laboratory Standards (NCCLS) approved standard are referenced to provide participants with recommendations for NTM test methods and drugs that have clinical relevance.

If you have any comments or suggestions on the results in this report or have questions regarding the changes in this program, you may call me at (770) 488-8133.

Sincerely yours,

Bereneice M. Madison, Ph.D.
Division of Public Health Partnerships – Laboratory Systems

Enclosures

Analyses of January 2005 *M. tuberculosis* and nontuberculous mycobacteria drug susceptibility test results reported by participating laboratories

This report is an analysis of laboratory test results reported to the Centers for Disease Control and Prevention (CDC) by participant laboratories for the four *Mycobacterium tuberculosis* complex and one *M. avium* strain shipped in January 2005. Participant laboratories received either four *M. tuberculosis* complex strains only or four *M. tuberculosis* complex strains and one NTM strain. Testing results were received and analyzed from 143 of 155 (92%) laboratories participating in this shipment. Of the laboratories submitting results, 64 reported them via the online data entry system.

Descriptive Information on Participant Laboratories

Figure 1 shows the laboratory classification reported by 142 of the participants. Participants consisted of 83 health departments, 43 hospitals, 12 independent laboratories, and 4 "other" type of laboratories.

Figure 2 provides the distribution of the annual volume of *M. tuberculosis* isolates tested for drug susceptibilities by participating laboratories in calendar year 2004. It is noted that some laboratories perform less than one drug susceptibility test per month based on the annual volume of testing reported. Laboratories performing these low testing volumes may want to consider referring drug susceptibility tests to other facilities.

Figure 3 lists the biosafety levels reported by participant laboratories for *M. tuberculosis*. All laboratories are strongly encouraged to consult the CDC/NIH manual, Biosafety in Microbiological and Biomedical Laboratories (4th edition), for recommendations and to determine their correct biosafety level.

Figure 4 provides a breakdown of the test procedures used by the participating laboratories for *M. tuberculosis* drug susceptibility testing. Participants were asked to check test methods used. Some methods, such as the proportion method with Lowenstein-Jensen (L-J) media, may reflect procedures used by international participants. The 'other' methods listed were microtiter, BacT/ALERT, TREK ESP and Colorimetric method for determining MICs.

Figure 5 provides information on the test procedures used by the participating laboratories testing *M. avium*.

M. tuberculosis Complex Strains Test Results:

The aggregate test results are provided in separate tables, representing strains K, L, M, and N to facilitate comparison among laboratories. Table 1 for the *M. tuberculosis* complex strains K, L, M, and N are constructed to include the results for the radiometric (BACTEC), agar proportion (AP), Lowenstein-Jensen (L-J) proportion, MGIT and other methods at each concentration of drug. The test results are listed in the appropriate (susceptible or resistant) columns with a corresponding total number of tests (Sum) column provided as a denominator for determining the level of consensus. This report contains all results reported by participating laboratories, including many drug concentrations with only one result.

In Table 1 the concentrations recommended by CDC and the NCCLS for the primary (isoniazid, rifampin, pyrazinamide, and ethambutol) and secondary (streptomycin, ethionamide, kanamycin, capreomycin, and p-amino-salicylic acid) antituberculosis drugs are highlighted for the conventional and radiometric methods. Participants should note that the Clinical and Laboratory Standards Institute (previously known as NCCLS-approved standard "Susceptibility Testing of Mycobacteria, Nocardiae, and Other Aerobic Actinomycetes", M24-A [ISBN 1-56238-500-3] NCCLS, 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898,

USA, 2003) recommends testing streptomycin as a secondary drug and also adds ofloxacin and rifabutin to the list of recommended secondary drugs.

Note that these recommended combinations reflect the critical concentrations of antituberculosis drugs in 7H10 agar and those concentrations for the BACTEC method that directly correlate with the critical concentrations in the conventional method (1-4). When two concentrations are highlighted, such as for isoniazid and ethambutol, the lower value is the critical concentration to always be included for determining whether the *M. tuberculosis* isolate is resistant. Included for participants information is the following table showing recommended drug concentrations to be used for susceptibility testing of *M. tuberculosis*.

Recommended drug concentrations for susceptibility testing (11)

Drug	Broth-based systems					
	Proportion method		Radiometric (BACTEC)	ESP Myco	MGIT	BacT/ALERT MB [†]
	7H10 Agar	7H11 Agar				
First-line drugs						
Isoniazid	0.2 [‡]	0.2 [‡]	0.1 [‡]	0.1 [‡]	0.1	0.09
Isoniazid (high)	1.0	1.0	0.4	0.4	0.4	0.4
Rifampicin	1.0 [‡]	1.0	2.0 [‡]	1.0 [‡]	1.0	0.9
Ethambutol	5.0 [‡]	7.5	2.5 [‡]	5.0 [‡]	5.0	2.3
Pyrazinamide	NR	NR	100.0 [‡]	—	100.0	200.0
Second-line drugs						
Streptomycin	2.0 [‡]	2.0	2.0 [‡]	—	1.0	0.9
Streptomycin (high)	10.0	10.0	6.0	—	4.0	—
Ethambutol (high) [¶]	10.0	10.0	7.5	—	7.5	—
Capreomycin	10.0	10.0				
Ethionamide	5.0	10.0				
Kanamycin [#]	5.0	6.0				
Ofloxacin	2.0	2.0				
p-Aminosalicylic acid	2.0	8.0				
Rifabutin ^{**}	0.5	0.5				

Abbreviations: ESP Myco = ESP (Extra Sensing Power) Culture System II; BacT/ALERT MB = BacT/ALERT MB susceptibility kit; MGIT = mycobacterial growth indicator tube; NR = not recommended.

Woods GL. 2000. Susceptibility testing for mycobacteria. Clin Infect Dis. 31: 1209–1215

* Concentration in micrograms per milliliter. [‡] BacT/ALERT MB is not currently FDA approved for susceptibility tests. [§] [¶] Critical concentration of the drug in this medium. Rifampin is the class agent for rifapentine. Isolates of *M. tuberculosis* that are resistant to rifampin or resistant to any two primary drugs should be tested for susceptibility to the secondary drugs.

[#] In addition, the NCCLS recommends a higher concentration of ethambutol (i.e., 10 mg/ml in both 7H10 and 7H11 agar) should be tested.

Kanamycin is the class agent for amikacin.

^{**} Some investigators also test a higher concentration (usually 1.0 or 2.0 mg/ml) of rifabutin.

Strain K is resistant to streptomycin 2.0 µg/ml. Of laboratories performing drug susceptibility testing using the agar proportion (AP) method 77.4% (24/31) reported resistance; 70.7% (46/65) detected resistance with BACTEC 460TB while 88% (32/36) of laboratories performing MGIT detected resistance to 1.0 µg/ml. All (6) laboratories submitting results by the L-J proportion method detected resistance to streptomycin at 6.0 µg/ml. Streptomycin is a secondary drug and is not tested routinely by most laboratories in the U.S. A high degree of interlaboratory disagreement is not uncommon among agar and automated methods of susceptibility testing. This may be due in part to the nature of the drug, problems related to adjustment for potency, distinct patterns of resistance due to different point mutations (8) and as well as technical factors which seem have more pronounced effects at the lower concentrations of the drug as demonstrated in this report. This was demonstrated by susceptibility of this strain to higher concentrations of streptomycin with different methods; 100% (23/23) by AP with 10 µg/ml; 93.3% (14/15) with streptomycin 6.0 µg/ml with the BACTEC 460TB and 100% (8/8) with streptomycin 4.0 µg/ml for the MGIT method.

Strain L is susceptible to all of the primary drugs except ethambutol. The resistance detected was variable based on the method used. Resistance was detected to ethambutol 5.0 µg/ml by 55.5% (15/27) of laboratories performing AP, while 38.3% (23/60) of laboratories performing testing ethambutol 2.5 µg/ml with BACTEC 460TB detected resistance and only 17.7% (8/45) testing ethambutol 5.0 µg/ml with the MGIT reported resistance.

Ethambutol drug susceptibility test results historically have shown greater interlaboratory agreement with AP than with the BACTEC 460TB method. This does not suggest that AP is more accurate than BACTEC 460TB; however, finding ethambutol resistant *M. tuberculosis* isolates by AP which are BACTEC 460TB susceptible is less common than the reverse pattern. In a multicenter study, concentrations of ethambutol increased from 2.5 to 3.75 µl/ml in BACTEC 460TB was compared to AP (ethambutol 5.0 µg/ml) yielded more BACTEC susceptible results on paired isolates (9). Whether this could be an explanation for the increased number of susceptible MGIT results with the isolate in this panel is not known.

Strain M is resistant to rifampicin 1.0 µg/ml. This was detected by 100% (36/36) of laboratories testing by the AP method; 98.6% (75/76) of labs testing rifampicin 2.0 µg/ml by BACTEC 460TB and 97.7% (43/44) of laboratories testing rifampicin 1.0 µg/ml with MGIT. Only a few laboratories performed drug susceptibility testing on rifabutin. Two laboratories performed testing at the recommended critical concentration of rifabutin 0.5 µg/ml with 50% agreement. Interestingly, 4 laboratories performed testing at rifabutin at a higher concentration of 4.0 µg/ml with 100% agreement. However, there was agreement on resistance with the recommended critical concentration of rifabutin 0.5 µg/ml among all 4 laboratories performing BACTEC 460 TB method. There was 100% (6/6) agreement on resistance to rifampicin 40.0 µg/ml among laboratories performing L-J Proportion method. This strain was sequenced for the *rpob* region and a His 526>Asp mutation was noted which has not been determined to be a common mutation based on a previous study by Cooksey et al (8).

Strain N is a fully susceptible strain and laboratories were in complete agreement on susceptibility to all primary drugs reported by A-P and BACTEC 460TB methods. There was minor discordance among participants using MGIT for each of the primary drugs for this strain: INH 1.0 µg/ml reporting resistance 4.7% (2/42); 2.4% (1/43) for rifampicin 1.0 µg/ml; 2.7% (1/38) for pyrazinamide 100 µg/ml; and 2.2% (1/44) for ethambutol 5.0 µg/ml and 2.7% (1/36) for streptomycin 1.0 µg/ml.

Our providing test results for all drugs that are reported to CDC should not be construed as a recommendation or endorsement for testing particular drugs or concentrations with patient isolates of the *M. tuberculosis* complex. It is assumed that some of the drugs are being tested for research purposes or potential use in the few referral institutions that may treat patients with *M. tuberculosis* isolates resistant to almost all standard drugs. Laboratories should not add drugs to their testing regimen without consulting physicians having expertise in treating multi-drug resistant tuberculosis. Laboratories may contact their local TB control program for referrals of physicians with experience and expertise in treating multi-drug resistant tuberculosis.

Nontuberculous Mycobacteria Test Results:

Strain O is from a 35-year old male who abused both alcohol and intravenous drugs and was admitted for treatment of *Mycobacterium avium* complex (MAC) lung disease. Multiple sputum AFB smears revealed 4+ acid fast bacilli and cultures were positive in broth and on solid media for nontuberculous mycobacteria. Genetic probe assay was positive for MAC, specifically *M. avium*. The patient was reported as non-compliant on a standard regimen of clarithromycin, rifabutin, and ethambutol.

Strain O was reported as resistant to >128 µg/ml by microtiter and BACTEC 460TB to concentrations as high as 64 µg/ml. Antimicrobial agents recommended for testing *M. avium* are found in Table 5 in the Clinical and Laboratory Standards Institute (NCCLS) Guidelines (6). Some laboratories still continue to test the first line TB drugs which is contrary to the recommendations made by the American Thoracic Society (1997 document) and the soon to be released new document. Participants should review the Clinical and Laboratory Standards Institute Guidelines (CLSI) on pages 20-22 and appendix Section 4.2 when testing MAC.

Mycobacterium avium is a slow-growing, non-tuberculous mycobacterium that is commonly associated with patients infected with HIV. Prior to the availability of more potent antiretroviral medications, 30% of patients positive for HIV developed disseminated MAC. In a 1996 study, patients taking highly active antiretroviral therapy (HAART), including a protease inhibitor, had an incidence of only 2%. Prior to the availability of clarithromycin, the life expectancy of a patient with AIDS and disseminated MAC was 4 months. In a 1999 study, patients treated with rifabutin, ethambutol, and clarithromycin had a median survival time of 9 months. Life expectancy is longer now with the advent of HAART. The most common complication of disseminated MAC is anemia that may require transfusion (10). Unfortunately, there are no known publications on strategies for patients that have macrolide resistant MAC but it is suggested that such patients be referred to experts for treatment consultations.

The addition of NTM strains to this performance evaluation program should not be interpreted as a recommendation for laboratories to adopt NTM drug susceptibility testing, especially if the laboratory has limited experience with these tests and methods. We encourage laboratories that perform NTM drug susceptibility testing to consult recommendations, references, and physicians with expertise in infectious diseases when selecting test methods, drugs, and test interpretations.

Special thanks to the following persons for reviewing this report: Nancy G. Warren, Ph.D., Pennsylvania Department of Health; Richard Wallace, M.D., Ph.D., and Barbara Brown-Elliott, M.S., University of Texas at Tyler, TX; Beverly Metchock, Dr.PH, and Pamela H. Robinson, CDC; Wendy Gross, M.S., TB Reference Laboratory, West Haven, CT and Ed Desmond, Ph.D, Microbial Disease Laboratory, CA Dept Health Services Richmond, CA.

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11. <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5211a1.htm>

Figure 1. Primary Classification of Participating Laboratories

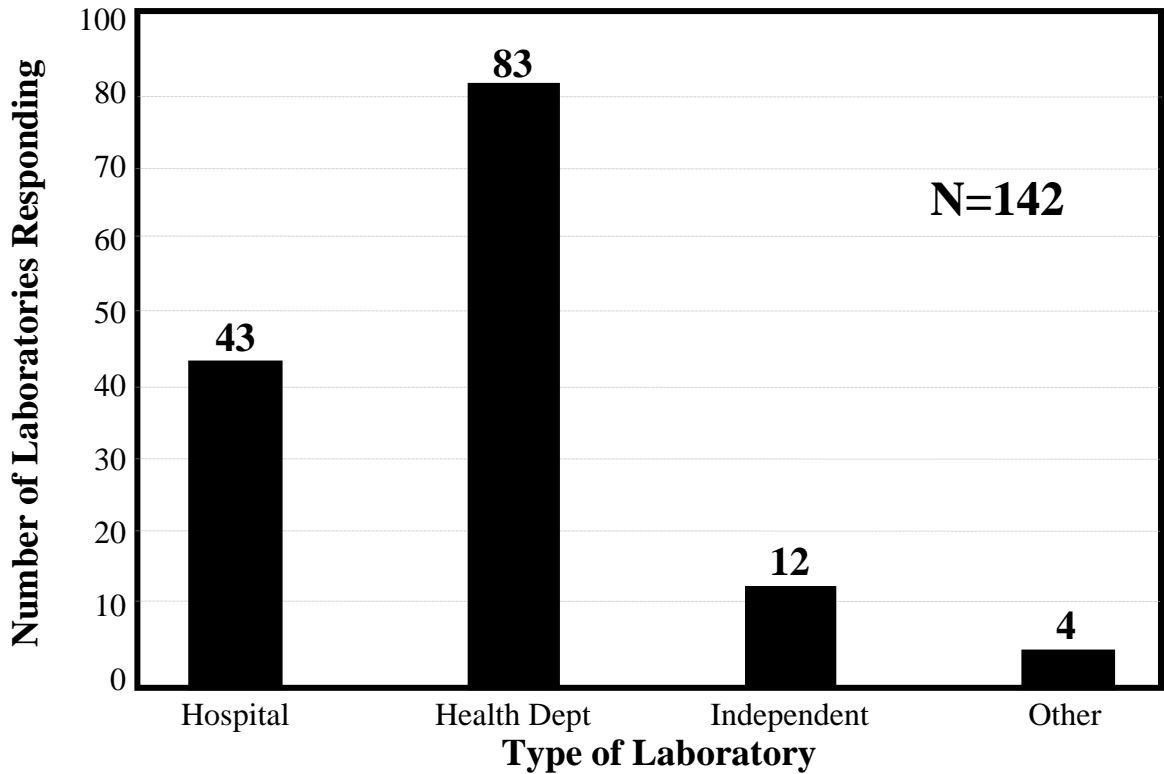
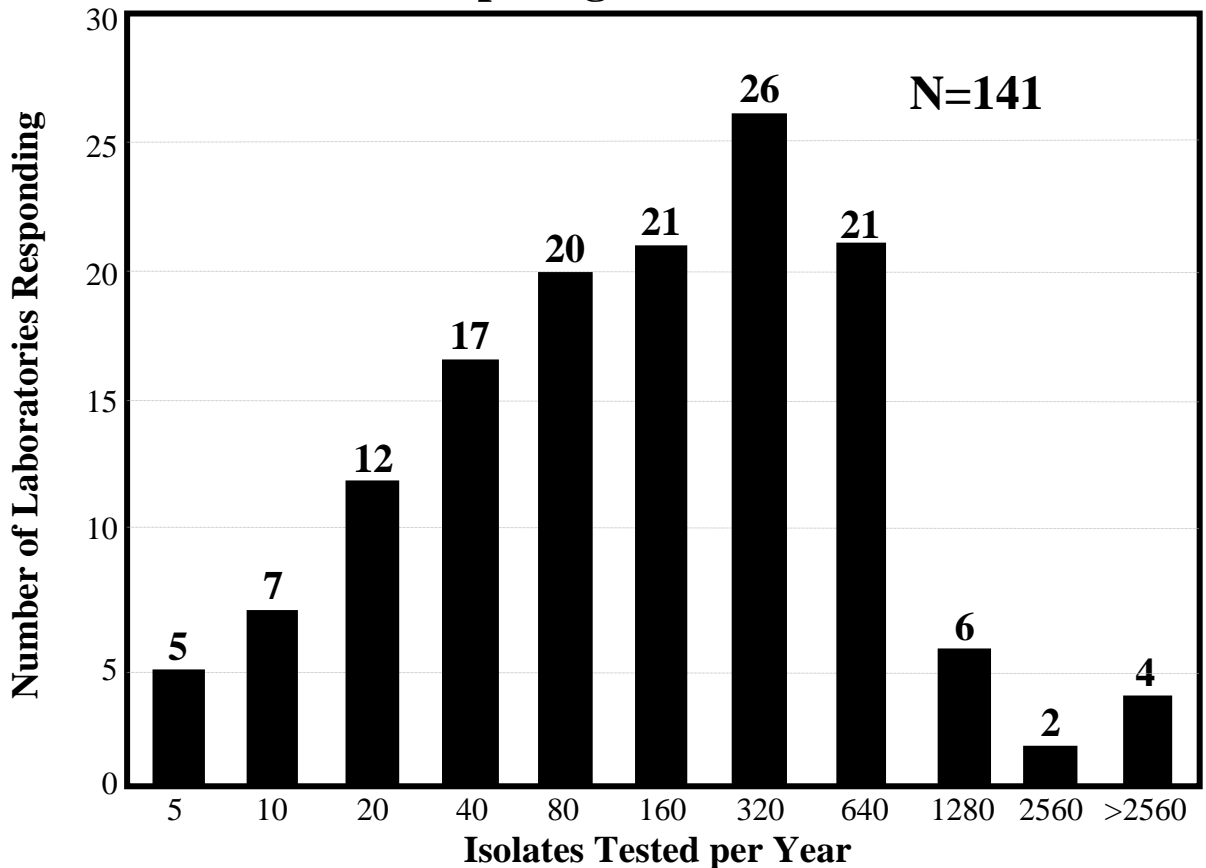
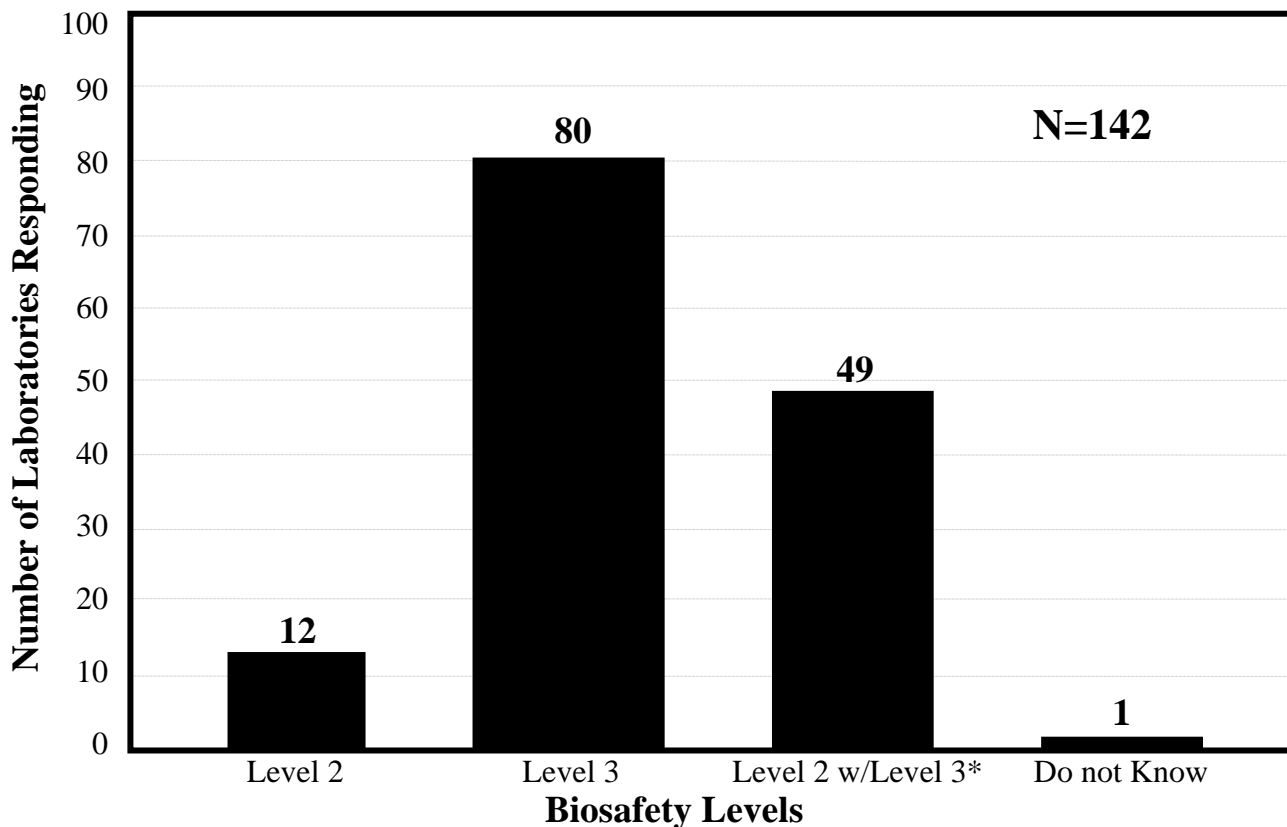


Figure 2. 2004 Annual Volume of *M. tuberculosis* Isolates for Participating Laboratories



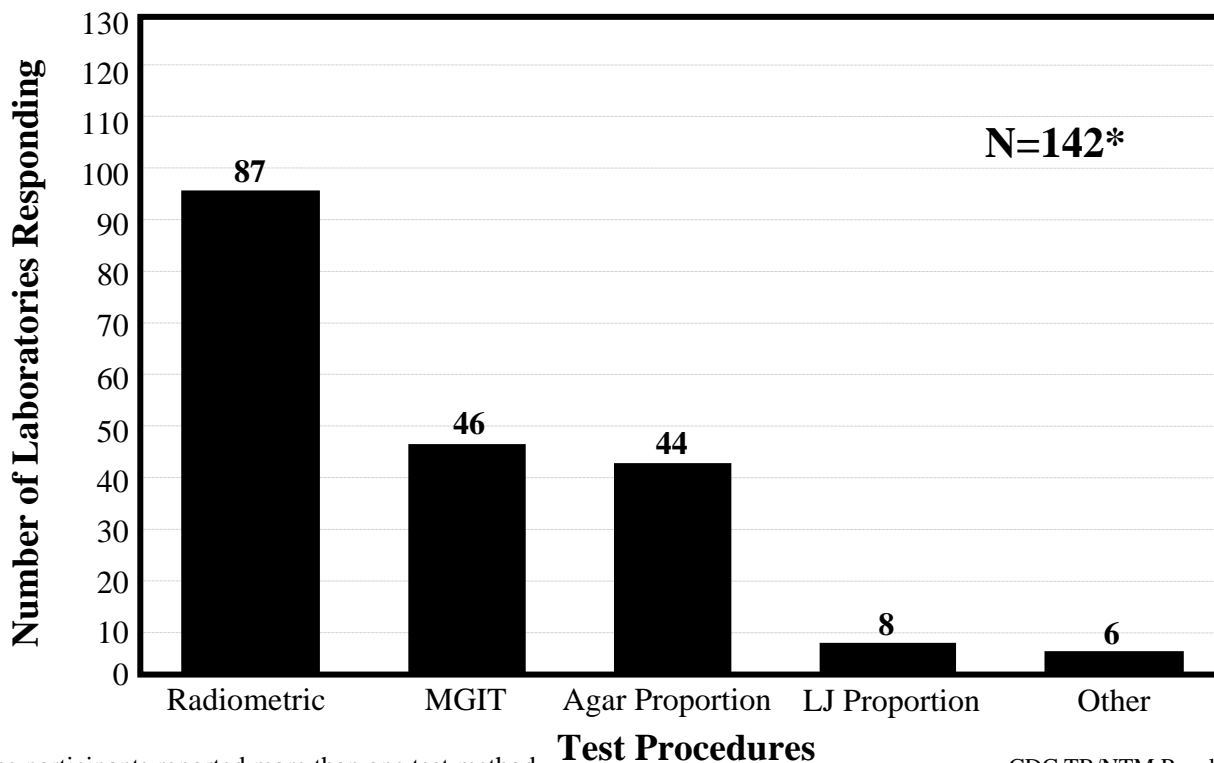
Group labels indicate upper limit of the group.

Figure 3. Biosafety Levels of Participating Laboratories for *M. tuberculosis*



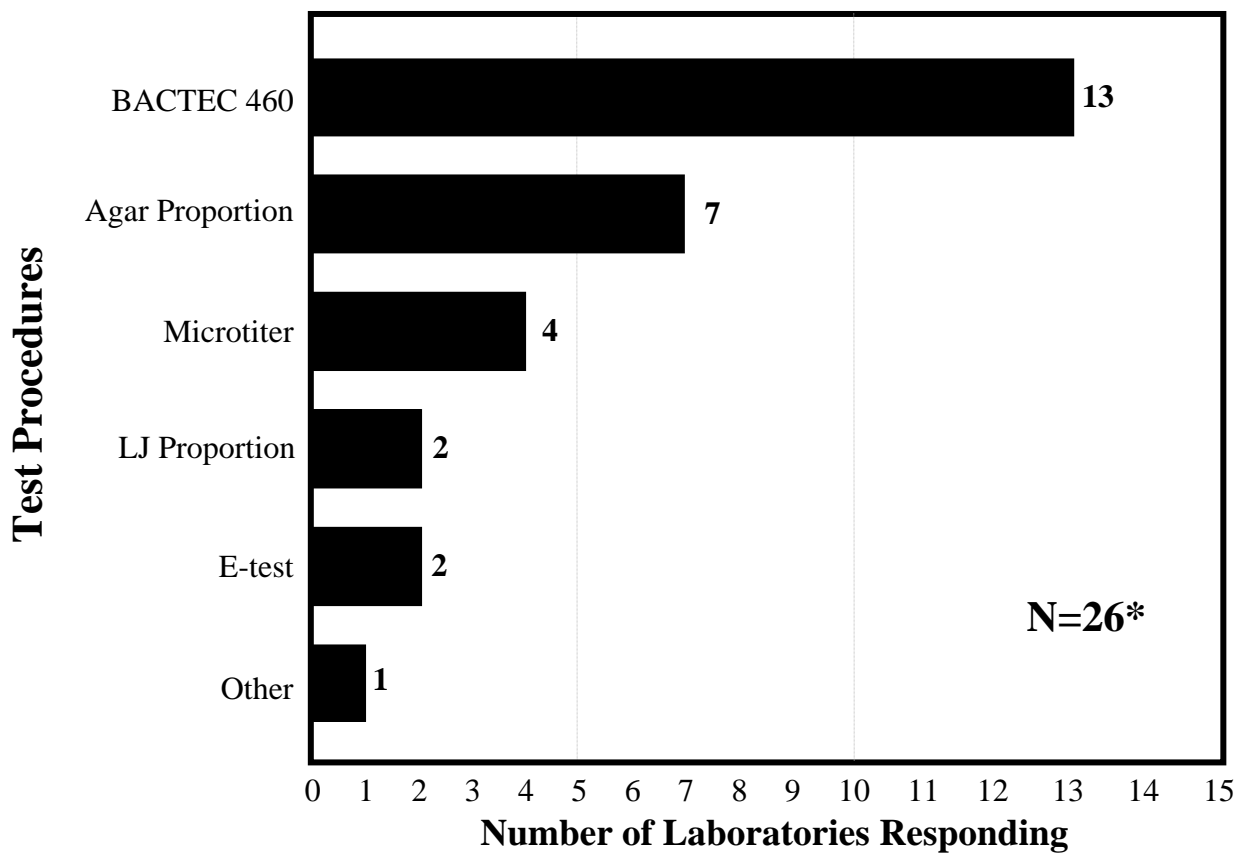
* Biosafety level 2 for facilities with level 3 containment equipment

Figure 4. Test Procedures used by Laboratories for *M. tuberculosis*



* Some participants reported more than one test method

Figure 5. Test Procedures used by Laboratories for Strain O - *M. avium*



* Some participants reported more than one test method

Table 1. Participant Results for Culture K, *M. tuberculosis*

DRUG	Conc.	Test Method															
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Isoniazid	0.05															1	1
Isoniazid	0.09															1	1
Isoniazid	0.10				76		76					42	1	43	1	1	
Isoniazid	0.20	31		31	3		3	7		7	1		1	2	2		
Isoniazid	0.40				21		21				11		11	1	1		
Isoniazid	0.50							1		1							
Isoniazid	1.00	29		29	3		3	4		4	1		1	1	1		
Isoniazid	5.00	2		2													
Isoniazid	10.00							2		2							
Isoniazid	100.00							1		1							
Rifampin	0.50				2		2										
Rifampin	1.00	31		31	7		7		1	1	44		44	1	1		
Rifampin	2.00	1		1	75		75										
Rifampin	5.00	4		4				1		1							
Rifampin	14.00													1	1		
Rifampin	20.00								1	1							
Rifampin	28.00													1	1		
Rifampin	40.00							6		6							
Rifampin	50.00							1		1							
Rifampin	56.00													1	1		
Pyrazinamide	64.00													1	1		
Pyrazinamide	99.00				1		1										
Pyrazinamide	100.00				65		65	1		1	38		38	2	2		
Pyrazinamide	200.00							1		1							
Pyrazinamide	400.00							1		1							
Ethambutol	1.00							1		1							
Ethambutol	1.60													1	1		
Ethambutol	1.80													1	1		
Ethambutol	2.00							6	1	7							
Ethambutol	2.50	1		1	64		64	1		1				1	1		
Ethambutol	3.20													1	1		
Ethambutol	3.75				2		2										
Ethambutol	4.00				2		2										
Ethambutol	5.00	27	1	28	6		6	2		2	45		45	1	1		
Ethambutol	6.40													1	1		
Ethambutol	7.50	2	1	3	13		13										
Ethambutol	10.00	8		8													
Streptomycin	1.00						1	1		1	1	4	32	36			
Streptomycin	2.00	7	24	31	19	46	65								1	1	
Streptomycin	4.00	1		1	2		2		6	6	8		8				
Streptomycin	5.00							1		1							
Streptomycin	6.00				14	1	15										
Streptomycin	7.50														1	1	
Streptomycin	8.00								1	1							
Streptomycin	10.00	23		23	1		1	1		1				1	1		
Streptomycin	15.00														1	1	
Streptomycin	30.00													1	1		

Table 1. Participant Results for Culture K, *M. tuberculosis*

DRUG	Conc.	Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.00				1		1									
Ethionamide	1.25				2		2									
Ethionamide	2.00				1		1									
Ethionamide	2.50				2		2									
Ethionamide	4.00				1		1									
Ethionamide	5.00	20		20	3		3									
Ethionamide	10.00	4		4										1		1
Ethionamide	20.00								1	1				1		1
Ethionamide	30.00								1		1					
Ethionamide	40.00								1		1			1		1
Kanamycin	4.00	1		1												
Kanamycin	5.00	9		9	3		3									
Kanamycin	6.00	12		12												
Kanamycin	10.00	1		1					1		1					
Kanamycin	20.00								1		1					
Kanamycin	40.00								1		1					
Capreomycin	0.50													1		1
Capreomycin	1.00													1		1
Capreomycin	1.25				2		2									
Capreomycin	5.00				5		5									
Capreomycin	10.00	15		15												
Capreomycin	12.50													1		1
Capreomycin	25.00													1		1
Capreomycin	40.00								1		1					
Capreomycin	50.00													1		1
Cycloserine	12.00													1		1
Cycloserine	20.00									1	1					
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	8		8					2		2					
Cycloserine	40.00								1		1					
Cycloserine	48.00													1		1
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50								2	1	3					
p-Aminosalicylic acid	1.00								2		2					
p-Aminosalicylic acid	2.00	15		15												
p-Aminosalicylic acid	4.00				2		2									
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	2		2												

Table 1. Participant Results for Culture K, *M. tuberculosis*

DRUG	Conc.	Test Method															
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Amikacin	0.50														1		1
Amikacin	1.00				2		2								1		1
Amikacin	2.00	1		1	2		2										
Amikacin	4.00	2		2	2		2										
Amikacin	5.00				1		1										
Amikacin	6.00	6		6													
Amikacin	7.50														1		1
Amikacin	8.00				2		2										
Amikacin	12.00	1		1													
Amikacin	15.00														1		1
Amikacin	30.00														1		1
Ofloxacin	0.50															1	1
Ofloxacin	1.00	3		3		1	1								1		1
Ofloxacin	1.25														1		1
Ofloxacin	2.00	10		10	6		6	1		1							
Ofloxacin	2.50														1		1
Ofloxacin	4.00	1		1	3		3								1		1
Ofloxacin	5.00														1		1
Ofloxacin	8.00				1		1										
Ciprofloxacin	0.50														1		1
Ciprofloxacin	1.00	1		1	3		3								1		1
Ciprofloxacin	1.60														1		1
Ciprofloxacin	2.00	7		7	4		4										
Ciprofloxacin	3.20														1		1
Ciprofloxacin	4.00				1		1										
Ciprofloxacin	6.40														1		1
Levofloxacin	1.00	1		1													
Levofloxacin	2.00				6		6										
Levofloxacin	4.00				1		1										
Levofloxacin	8.00				1		1										
Rifabutin	0.50	1		1													
Rifabutin	1.00	3		3													
Rifabutin	2.00	2		2													
Clofazimine	0.06				1		1										
Clofazimine	0.12				2		2										
Clofazimine	0.25				2		2										
Clofazimine	0.50				2		2								1		1
Clofazimine	1.00	3		3											1		1
Clofazimine	17.50														1		1
Clofazimine	35.00														1		1
Clofazimine	70.00														1		1
Clarithromycin	12.00														1		1

Table 1. Participant Results for Culture L, *M. tuberculosis*

DRUG	Conc.	Test Method															
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Isoniazid	0.05															1	1
Isoniazid	0.09															1	1
Isoniazid	0.10				75	1	76					41	1	42	1	1	
Isoniazid	0.20	30		30	3		3	8		8		1		1	2	2	
Isoniazid	0.40				21		21					11		11	1	1	
Isoniazid	0.50							1		1							
Isoniazid	1.00	28		28	3		3	4		4		1		1	1	1	
Isoniazid	5.00	2		2													
Isoniazid	10.00							2		2							
Isoniazid	100.00							1		1							
Rifampin	0.50				2		2										
Rifampin	0.90														1	1	
Rifampin	1.00	31		31	7		7		1	1		43		43	1	1	
Rifampin	2.00	1		1	75		75										
Rifampin	5.00	4		4				1		1							
Rifampin	14.00														1	1	
Rifampin	20.00							1		1							
Rifampin	28.00														1	1	
Rifampin	40.00							7		7							
Rifampin	50.00							1		1							
Rifampin	56.00														1	1	
Pyrazinamide	64.00														1	1	
Pyrazinamide	99.00						1	1									
Pyrazinamide	100.00				65		66	1		1		37		37	2	2	
Pyrazinamide	200.00							1		1							
Pyrazinamide	400.00							1		1							
Ethambutol	1.00						1	1	1		1						
Ethambutol	1.60														1	1	
Ethambutol	1.80														1	1	
Ethambutol	2.00						1	1	4	3	7						
Ethambutol	2.50		1	1	37	23	60	1		1							
Ethambutol	3.20														1	1	
Ethambutol	3.75				2		2										
Ethambutol	4.00				3		3										
Ethambutol	5.00	12	15	27	5	1	6	2		2		37	8	45		1	
Ethambutol	6.40														1	1	
Ethambutol	7.50	2	1	3	14		14										
Ethambutol	8.00				1		1										
Ethambutol	10.00	7		7													
Streptomycin	1.00				1		1	1		1		35	1	36			
Streptomycin	2.00	31		31	66		66								1	1	
Streptomycin	4.00	1		1	2		2	6		6		5		5			
Streptomycin	5.00							1		1							
Streptomycin	6.00				13		13										
Streptomycin	7.50														1	1	
Streptomycin	8.00							1	1	2							
Streptomycin	10.00	21		21	1		1	1		1					1	1	
Streptomycin	15.00														1	1	
Streptomycin	30.00														1	1	

Table 1. Participant Results for Culture L, *M. tuberculosis*

DRUG	Conc.	Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.00				1		1									
Ethionamide	1.25				2		2									
Ethionamide	2.00				1		1									
Ethionamide	2.50				3		3									
Ethionamide	4.00				1		1									
Ethionamide	5.00	20		20	4		4									
Ethionamide	10.00	4		4										1		1
Ethionamide	20.00							1		1				1		1
Ethionamide	30.00							1		1						
Ethionamide	40.00							1		1				1		1
Kanamycin	4.00	1		1												
Kanamycin	5.00	9		9	3		3									
Kanamycin	6.00	11		11												
Kanamycin	10.00	1		1				1		1						
Kanamycin	20.00							1		1						
Kanamycin	40.00							1		1						
Capreomycin	0.50													1		1
Capreomycin	1.00													1		1
Capreomycin	1.25				2		2									
Capreomycin	5.00				7		7									
Capreomycin	10.00	15		15												
Capreomycin	12.50													1		1
Capreomycin	25.00													1		1
Capreomycin	40.00							1		1						
Capreomycin	50.00													1		1
Cycloserine	12.00													1		1
Cycloserine	20.00								1	1						
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	7	1	8				2		2						
Cycloserine	40.00							1		1						
Cycloserine	48.00													1		1
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50							3		3						
p-Aminosalicylic acid	1.00							2		2						
p-Aminosalicylic acid	2.00	15		15												
p-Aminosalicylic acid	4.00				2		2									
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	2		2												

Table 1. Participant Results for Culture L, *M. tuberculosis*

DRUG	Conc.	Test Method															
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Amikacin	0.50														1		1
Amikacin	1.00				2		2								1		1
Amikacin	2.00	1		1	2		2										
Amikacin	2.50				1		1										
Amikacin	4.00	2		2	2		2										
Amikacin	5.00				1		1										
Amikacin	6.00	7		7													
Amikacin	7.50														1		1
Amikacin	8.00				2		2										
Amikacin	12.00	2		2													
Amikacin	15.00														1		1
Amikacin	30.00														1		1
Ofloxacin	0.50															1	1
Ofloxacin	1.00	3		3	2		2								1		1
Ofloxacin	1.25														1		1
Ofloxacin	2.00	10		10	7		7	1		1							
Ofloxacin	2.50														1		1
Ofloxacin	4.00	1		1	3		3								1		1
Ofloxacin	5.00														1		1
Ofloxacin	8.00				1		1										
Ciprofloxacin	0.50														1		1
Ciprofloxacin	1.00	1		1	4		4								1		1
Ciprofloxacin	1.60														1		1
Ciprofloxacin	2.00	7		7	4		4										
Ciprofloxacin	3.20														1		1
Ciprofloxacin	4.00				1		1										
Ciprofloxacin	6.40														1		1
Levofloxacin	1.00	1		1	1		1										
Levofloxacin	2.00				6		6										
Levofloxacin	4.00				1		1										
Levofloxacin	8.00				1		1										
Rifabutin	0.50	1		1													
Rifabutin	1.00	3		3	1		1										
Rifabutin	2.00	2		2													
Clofazimine	0.06				1		1										
Clofazimine	0.12				2		2										
Clofazimine	0.25				2		2										
Clofazimine	0.50				3		3								1		1
Clofazimine	1.00	3		3											1		1
Clofazimine	17.50														1		1
Clofazimine	35.00														1		1
Clofazimine	70.00														1		1
Clarithromycin	12.00														1		1