

December 12, 2001

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

Subject: Analyses of Participant Laboratory Results for the June 2001 Shipment

Dear Participant:

Enclosed are analyses of laboratory test results reported to the Centers for Disease Control and Prevention (CDC) by participant laboratories for the strains of *Mycobacterium tuberculosis*-complex (*M. tuberculosis*) and *M. avium*-complex shipped in June 2001. Participant laboratories received either four *M. tuberculosis*-complex strains only or four *M. tuberculosis* strains and a non-tuberculous mycobacteria (NTM) culture. Testing results were received and analyzed from 134 of 155 (86%) laboratories participating in this shipment. Results from eight laboratories were not included in this data for the following reasons: results submitted well after the deadline (4); personnel shortage (2); reagent shortage (1); and missing samples and slow growth of strains upon receipt (1). An additional three laboratories submitted forms that were blank or invalid due to data entry errors for susceptibility results. Twenty-two laboratories are located in countries other than the United States.

The enclosed aggregate report is prepared in a format that will allow laboratories to compare their results with results obtained by other participants for the same strain using the same method, drug, and concentration. The first 3 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 interpretation for *M. tuberculosis* and NTM.

The NTM strain in each performance evaluation is intended to provide an assessment of the various methods, drugs, and interpretations that are reported by laboratories that perform drug susceptibility testing for these different strains. The test results for the NTM strain also provide information on inter-laboratory 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 NCCLS tentative 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 us at (770) 488-8133.

Sincerely yours,

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Enclosures

Analyses of the June 2001 Performance Evaluation Results for *M. tuberculosis* complex and Non-tuberculous Mycobacteria Drug Susceptibility Testing Reported to the Centers for Disease Control and Prevention 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 a fifth strain which included a non-tuberculous mycobacteria, *M. avium*-complex shipped in June 2001. Testing results were received and analyzed from 134 of 155 (86%) laboratories participating in this shipment. Eight laboratories reported results beyond the deadline for analysis for various reasons. Two of the 137 result forms were reported blank and a third form was invalidated based on data entry errors for susceptibility results.

Descriptive Information on Participant Laboratories

Figure 1 shows the laboratory classification reported by 134 of the participants. Participants consisted of 47 hospitals, 72 health departments, 8 independents, and 7 "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 2000.

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 all test methods used. Some methods, such as the proportion method with Lowenstein-Jensen (L-J) media, may reflect procedures used by international participants. The three 'other' methods listed were the E-test, micro dilution MIC, and L-J resistance ratio methods. Figure 5 provides a breakdown of the test procedures used by the participating laboratories for *M. avium*-complex.

***M. tuberculosis* test results:**

The aggregate test results provided in separate tables, representing strains P, Q, R, and S facilitate comparison among laboratories. Table 1 for the *M. tuberculosis*-complex strains P, Q, R and S are constructed to include the results for the radiometric (BACTEC), agar proportion, Lowenstein Jensen (L-J) proportion, and other methods at each concentration of drug. The results for 3 "other" methods are grouped together and include the E-test, L-J resistance ratio, and micro dilution MIC. The test results are listed in the appropriate ([S] susceptible or [R] 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 (ethionamide, kanamycin, capreomycin, cycloserine, p-amino-salicylic acid) antituberculosis drugs are highlighted for the conventional and radiometric methods. Participants should note that the new NCCLS tentative standard (Susceptibility Testing of Mycobacteria, Nocardia, and Other Aerobic Actinomycetes; Tentative Standard-Second Edition, NCCLS document M24-T2 [ISBN 1-56238-423-6] NCCLS, 940 West

Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898, USA, 2000) recommends testing streptomycin as a secondary drug and also adds ofloxacin and rifabutin to the list of recommended secondary drugs. Participants should 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 concentration is the critical concentration that should always be included to determine whether the *M. tuberculosis* isolate is resistant.

Strains P, Q, R and S are cultures of *M. tuberculosis*.

Strain P was susceptible to the critical concentration of INH (0.1 µg/ml) by 100% (107) laboratories performing the BACTEC method as well by all 38 laboratories performing INH (0.2 µg/ml) by the agar proportion method. One percent of laboratories reported resistance to ethambutol (2.5 µg/ml) by BACTEC; however, 3% (1/34) reported resistance by AP. Eighty percent (86/107) of laboratories found the isolate resistant to rifampin by BACTEC at 2.0 µg/ml, while 76% (31/41) of the laboratories found the isolate resistant by AP at 1.0 µg/ml. Ninety-eight percent (88/90) of laboratories found strain P to be susceptible to PZA at 100 µg/ml by the BACTEC method.

For **Strain Q**, 99% (106/107) of laboratories reported susceptibility to INH (0.1 µg/ml) by BACTEC and 100% (38) susceptibility to INH (0.2 µg/ml) by AP. For BACTEC, 99% (107/108) of laboratories reported rifampin 2.0 µg/ml as susceptible. The strain was reported as 100% susceptible by laboratories testing rifampin at 1.0 µg/ml by the AP method. Ninety-three percent (94/101) of laboratories reported resistance to ethambutol (2.5 µg/ml) by BACTEC, while only 69% percent of laboratories reported resistance to the equivalent concentration of 5.0 µg/ml by AP. Although rare, monoresistance to ethambutol should be repeated or confirmed by another method (7). Strain Q appears to have a subpopulation of resistant organisms detected by the majority of laboratories performing BACTEC but not AP. The reason for the differences in detection of resistance between the two methods for Strain Q is unclear. Six percent (5/88) of laboratories detected resistance to PZA 100 µg/ml.

Ninety-eight percent (104/106) of laboratories testing **Strain R** reported resistance to isoniazid 0.1 µg/ml by BACTEC, while 98% (39/40) also reported resistance to 0.2 µg/ml of INH. There was complete consensus among all labs reporting susceptibility to ethambutol 5.0 µg/ml by AP, while only 1% reported resistance using the BACTEC method at 2.5 µg/ml. There was complete agreement between laboratories performing BACTEC (107) and AP (41) on the susceptibility of Strain R to the critical concentrations of rifampin. One hundred percent (89) of laboratories reported susceptible results to PZA for this strain.

Strain S was 95% (36/38) susceptible to INH (0.2 µg/ml) by the AP method. Approximately 98% (105/107) of laboratories reported susceptible results with this strain using the BACTEC method. For ethambutol 2.5 µg/ml, 2% (2/101) of laboratories reported resistance for the BACTEC method, and 100% (32/32) of laboratories reported susceptibility by AP at 5.0 µg/ml. There was complete consensus on susceptibility of strain S to the critical concentrations of rifampin by laboratories using BACTEC (108) and AP (39). In addition all laboratories (90) reported susceptible results for PZA 100 µg/ml for strain S.

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 *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 the consultation of physicians having expertise in treating multi-drug resistant tuberculosis. Laboratories may contact their local TB control program for appropriate referrals.

Nontuberculous Mycobacteria test results:

The aggregate test results are provided in Table 2 for strain T to facilitate comparison among laboratories. Table 2 represents either single or multiple drug concentrations with “breakpoint” susceptibility test results.

In Table 3, the participant laboratories reported an MIC interpretation of susceptibility, resistance, or other for each drug concentration that was reported. The results on the drugs tested varied among laboratories.

The recommended method for susceptibility testing of *M. avium*-complex is a broth based method either macrodilution or microtiter dilution (7). For **Strain T**, *M. avium*-complex, 9 of 12 laboratories reported resistant minimum inhibitory concentrations using broth-based methods for clarithromycin and azithromycin. Three laboratories reported MICs at >32 µg/ml and three at ≥64 µg/ml using BACTEC. With the microtiter method, one laboratory reported resistance at >64 µg/ml and another at >128µg/ml. Azithromycin was reported as resistant by one laboratory at >256 µg/ml. Some laboratories reported MIC results on drugs such as ethambutol, rifabutin, and rifampin, a retrospective analysis with these drugs in one study revealed no correlation between susceptibility test results and patient clinical outcome (7).

The macrolides are the only antimicrobial agents that have demonstrated a correlation between the *in-vitro* susceptibility tests and clinical response. The class drug to be tested is clarithromycin either by BACTEC or by microtiter. Azithromycin may have solubility problems at the higher concentrations of the drug. Please refer to the NCCLS guidelines for further information on the methods for testing *M. avium*- complex against the macrolides (7,8).

Many laboratories perform drug susceptibility testing for NTM in the absence of clinical studies demonstrating the efficacy of particular drugs and/or drug concentrations and methods (6). 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.

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Figure 1. Primary Classification of Participating Laboratories

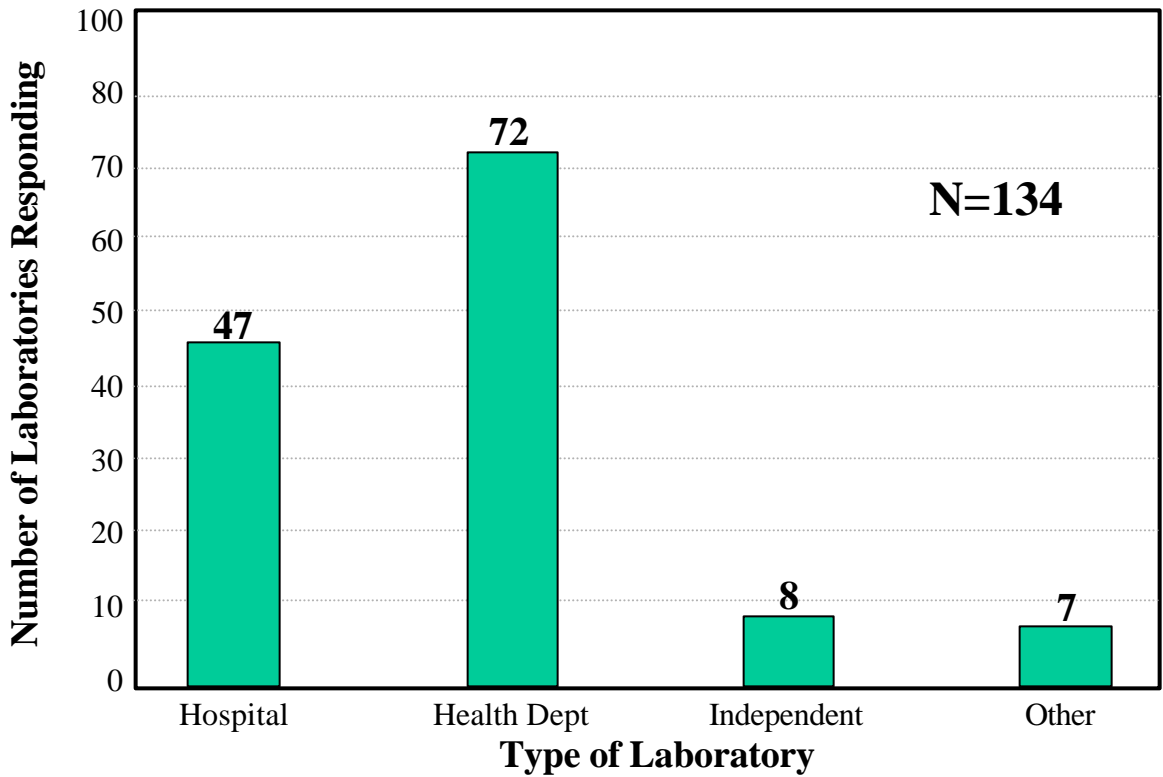
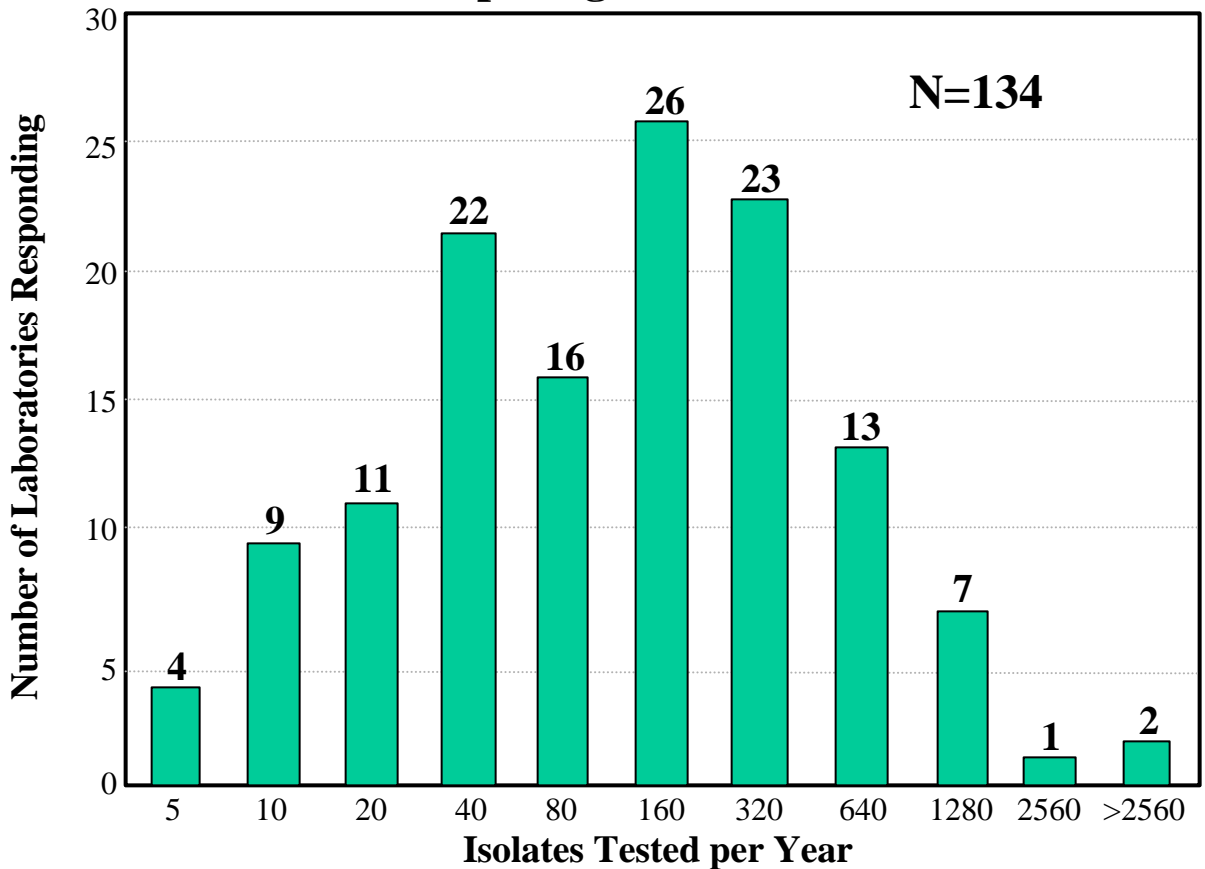
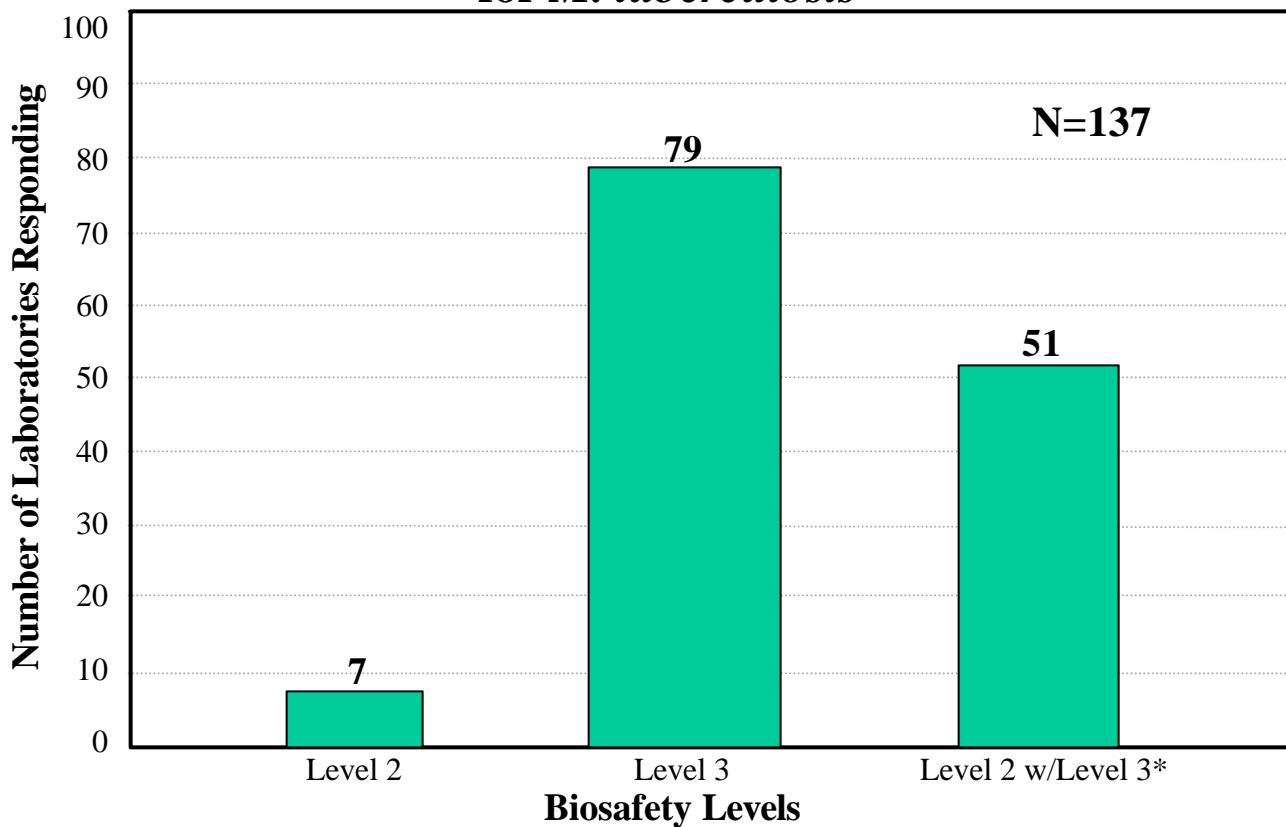


Figure 2. 2000 Annual Volume of *M. tuberculosis* Isolates for Participating Laboratories



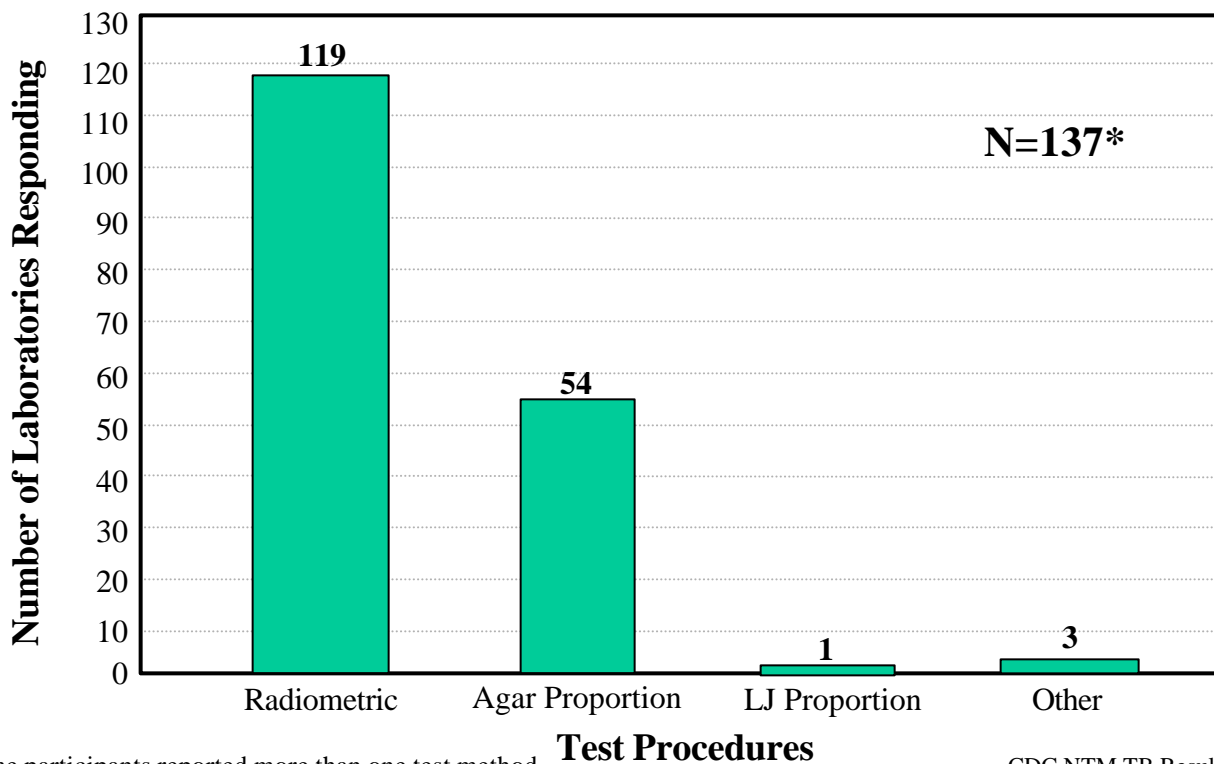
Group labels indicate upper limit of the group.

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



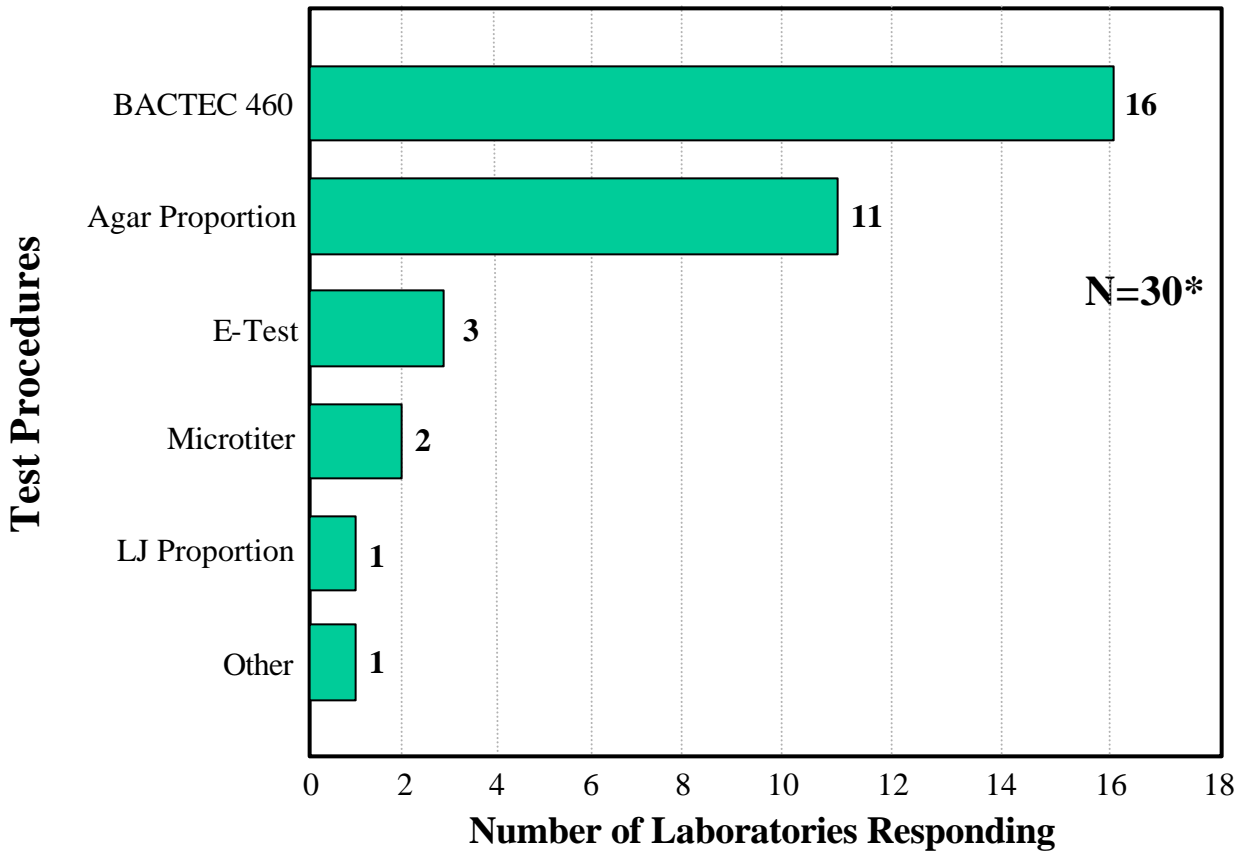
* Biosafety level 2 for facilities with level 3 containment equipment

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 T - *M. avium*-Complex



* Some participants reported more than one test method

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

DRUG	Conc.	Test Method												
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Isoniazid	0.05											1		1
Isoniazid	0.10				107		107					2		2
Isoniazid	0.12	1		1										
Isoniazid	0.20	38		38	5		5	1		1		1		1
Isoniazid	0.40				22		22					1		1
Isoniazid	1.00	37		37	7		7							
Isoniazid	5.00	4		4										
Rifampin	0.50					2	2							
Rifampin	1.00	10	31	41		9	9					1		1
Rifampin	2.00				21	86	107							
Rifampin	5.00	3	2	5										
Rifampin	10.00				1		1							
Rifampin	14.00												1	1
Rifampin	28.00												1	1
Rifampin	40.00							1		1				
Rifampin	56.00												1	1
Pyrazinamide	50.00				2		2							
Pyrazinamide	64.00											1		1
Pyrazinamide	99.00				1		1							
Pyrazinamide	100.00				88	2	90					1		1
Pyrazinamide	300.00				1		1						1	1
Ethambutol	1.60											1		1
Ethambutol	2.00							1		1				
Ethambutol	2.50				100	1	101							
Ethambutol	3.20											1		1
Ethambutol	3.75				3		3							
Ethambutol	4.00				1		1							
Ethambutol	5.00	33	1	34	10		10					1		1
Ethambutol	6.40											1		1
Ethambutol	7.50	6	1	7	14		14							
Ethambutol	8.00											1		1
Ethambutol	10.00	9		9										
Ethambutol	25.00	1		1										
Streptomycin	2.00	41		41	104		104							
Streptomycin	4.00				1		1	1		1				
Streptomycin	6.00				18		18							
Streptomycin	7.50											1		1
Streptomycin	10.00	28		28										
Streptomycin	15.00											1		1
Streptomycin	30.00											1		1
Streptomycin	50.00	1		1										

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

DRUG	Conc.	Test Method											
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.25				1	1	2						
Ethionamide	2.50				1		1						
Ethionamide	5.00	28	1	29	7		7						
Ethionamide	10.00	3		3								1	1
Ethionamide	20.00										1		1
Ethionamide	40.00										1		1
Kanamycin	2.50				1		1						
Kanamycin	5.00	12		12	6		6						
Kanamycin	6.00	20		20									
Capreomycin	2.50				1		1						
Capreomycin	5.00	2		2	7		7						
Capreomycin	10.00	21		21									
Capreomycin	12.50											1	1
Capreomycin	50.00										1		1
Cycloserine	12.00	1		1							1		1
Cycloserine	24.00										1		1
Cycloserine	25.00	2		2									
Cycloserine	30.00	13		13									
Cycloserine	48.00										1		1
Cycloserine	50.00	1		1	1		1						
Cycloserine	60.00	1		1									
p-Aminosalicylic acid	0.50							1		1			
p-Aminosalicylic acid	2.00	16		16									
p-Aminosalicylic acid	4.00				1	1	2						
p-Aminosalicylic acid	8.00	2		2									
p-Aminosalicylic acid	10.00	2		2									
Amikacin	0.60	1		1									
Amikacin	1.00	1		1	1		1						
Amikacin	2.00	1		1	1		1						
Amikacin	2.50				1		1						
Amikacin	4.00	2		2									
Amikacin	5.00				1		1						
Amikacin	6.00	6		6									
Amikacin	12.00	1		1									
Ofloxacin	1.00	1	3	4		1	1						
Ofloxacin	1.25											1	1
Ofloxacin	2.00		4	4		7	7						
Ofloxacin	2.50											1	1
Ofloxacin	4.00		2	2									
Ofloxacin	5.00					1	1					1	1
Ofloxacin	8.00					2	2						

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

DRUG	Conc.	Test Method											
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ciprofloxacin	1.00		1	1		2	2						
Ciprofloxacin	1.60											1	1
Ciprofloxacin	2.00	3	7	10		1	1						
Ciprofloxacin	2.50					1	1						
Ciprofloxacin	3.20											1	1
Ciprofloxacin	4.00					2	2						
Ciprofloxacin	6.40											1	1
Levofloxacin	1.00		1	1									
Levofloxacin	2.00					1	1						
Levofloxacin	8.00					1	1						
Rifabutin	0.50	1	1	2	1	2	3						
Rifabutin	1.00	2		2	1		1						
Rifabutin	2.00	3	1	4									
Clofazimine	0.06				1		1						
Clofazimine	0.50				1		1						
Clofazimine	1.00	1		1									
Clofazimine	15.00											1	1
Clofazimine	30.00											1	1
Clofazimine	60.00										1		1
Azithromycin	3.00		1	1									
Clarithromycin	3.00		1	1									
Clarithromycin	6.00											1	1
Clarithromycin	24.00										1		1

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

DRUG	Conc.	Test Method								
		Agar Prop. Results			BACTEC Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.05							1		1
Isoniazid	0.10				106	1	107	2		2
Isoniazid	0.12	1		1						
Isoniazid	0.20	38		38	5		5	1		1
Isoniazid	0.40				21	1	22	1		1
Isoniazid	1.00	37		37	7		7			
Isoniazid	2.00				1		1			
Isoniazid	5.00	4		4	1		1			
Rifampin	0.50				2		2			
Rifampin	1.00	41		41	9		9	1		1
Rifampin	2.00				107	1	108			
Rifampin	5.00	5		5	1		1			
Rifampin	14.00							1		1
Rifampin	28.00							1		1
Rifampin	56.00							1		1
Pyrazinamide	50.00				2		2			
Pyrazinamide	64.00							1		1
Pyrazinamide	99.00					1	1			
Pyrazinamide	100.00				83	5	88	1		1
Pyrazinamide	300.00				1		1	1		1
Ethambutol	1.60								1	1
Ethambutol	2.50				7	94	101			
Ethambutol	3.20							1		1
Ethambutol	3.75				1	2	3			
Ethambutol	4.00					1	1			
Ethambutol	5.00	11	25	36	1	10	11		1	1
Ethambutol	6.40							1		1
Ethambutol	7.50	3	4	7	14	4	18			
Ethambutol	8.00							1		1
Ethambutol	10.00	9		9		1	1			
Ethambutol	25.00		1	1						
Streptomycin	2.00	40		40	104		104			
Streptomycin	4.00				1		1			
Streptomycin	6.00				18		18			
Streptomycin	7.50							1		1
Streptomycin	10.00	27		27						
Streptomycin	15.00							1		1
Streptomycin	30.00							1		1
Streptomycin	50.00	1		1						
Ethionamide	1.25				1		1			
Ethionamide	2.00	1		1						
Ethionamide	2.50				2		2			
Ethionamide	5.00	27		27	7		7			
Ethionamide	10.00	2		2				1		1
Ethionamide	20.00							1		1
Ethionamide	40.00							1		1
Kanamycin	5.00	12		12	6		6			
Kanamycin	6.00	19		19						
Capreomycin	2.50				1		1			
Capreomycin	5.00	2		2	7		7			
Capreomycin	10.00	21		21						
Capreomycin	12.50							1		1
Capreomycin	25.00							1		1
Capreomycin	50.00							1		1

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

DRUG	Conc.	Test Method									
		Agar Prop. Results			BACTEC Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	
Cycloserine	12.00	1		1					1		1
Cycloserine	24.00								1		1
Cycloserine	25.00	2		2							
Cycloserine	30.00	13		13							
Cycloserine	48.00								1		1
Cycloserine	50.00	1		1		1	1				
Cycloserine	60.00	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							
Amikacin	0.60	1		1							
Amikacin	1.00	1		1	1		1				
Amikacin	2.00	1		1	1		1				
Amikacin	2.50				1		1				
Amikacin	4.00	3		3							
Amikacin	5.00				1		1				
Amikacin	6.00	5		5							
Amikacin	12.00	1		1							
Ofloxacin	1.00	5		5	1		1				
Ofloxacin	1.25							1			1
Ofloxacin	2.00	5		5	7		7				
Ofloxacin	2.50							1			1
Ofloxacin	4.00	1		1							
Ofloxacin	5.00							1			1
Ofloxacin	8.00				1		1				
Ciprofloxacin	1.00	1		1	2		2				
Ciprofloxacin	1.60							1			1
Ciprofloxacin	2.00	11		11	1		1				
Ciprofloxacin	2.50				1		1				
Ciprofloxacin	3.20							1			1
Ciprofloxacin	4.00				1		1				
Ciprofloxacin	6.40							1			1
Levofloxacin	0.30	1		1							
Levofloxacin	1.00	1		1							
Levofloxacin	2.00				1		1				
Levofloxacin	8.00				1		1				
Rifabutin	0.50	2		2	1		1				
Rifabutin	1.00	2		2	1		1				
Rifabutin	2.00	4		4							
Clofazimine	0.06				1		1				
Clofazimine	0.50				1		1				
Clofazimine	1.00	1		1							
Clofazimine	15.00							1			1
Clofazimine	30.00							1			1
Clofazimine	60.00							1			1
Clarithromycin	6.00							1			1
Clarithromycin	12.00							1			1
Clarithromycin	24.00							1			1

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

DRUG	Conc.	Test Method												
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Isoniazid	0.05												1	1
Isoniazid	0.10				2	104	106						2	2
Isoniazid	0.20	1	39	40		5	5		1	1			1	1
Isoniazid	0.40				25	1	26					1		1
Isoniazid	1.00	32	7	39	8		8							
Isoniazid	2.00				1		1							
Isoniazid	5.00	5		5	2		2							
Rifampin	0.50				2		2							
Rifampin	1.00	41		41	8	1	9					1		1
Rifampin	2.00				107		107							
Rifampin	5.00	5		5										
Rifampin	14.00											1		1
Rifampin	28.00											1		1
Rifampin	40.00							1		1				
Rifampin	56.00											1		1
Pyrazinamide	50.00				2		2							
Pyrazinamide	64.00											1		1
Pyrazinamide	99.00				1		1							
Pyrazinamide	100.00				89		89					1		1
Pyrazinamide	300.00				1		1					1		1
Ethambutol	1.60											1		1
Ethambutol	2.00							1		1				
Ethambutol	2.50				100	1	101							
Ethambutol	3.20											1		1
Ethambutol	3.75				3		3							
Ethambutol	4.00				1		1							
Ethambutol	5.00	35		35	10		10					1		1
Ethambutol	6.40											1		1
Ethambutol	7.50	6		6	14		14							
Ethambutol	8.00											1		1
Ethambutol	10.00	10		10										
Ethambutol	25.00	1		1										
Streptomycin	2.00	5	36	41	13	87	100							
Streptomycin	4.00				1	1	2		1	1				
Streptomycin	6.00				16	5	21							
Streptomycin	7.50												1	1
Streptomycin	10.00	29	2	31										
Streptomycin	15.00												1	1
Streptomycin	30.00												1	1
Streptomycin	50.00	1		1										
Ethionamide	1.25					3	3							
Ethionamide	2.50					1	1							
Ethionamide	5.00	17	14	31	4	3	7							
Ethionamide	10.00	3		3									1	1
Ethionamide	20.00												1	1
Ethionamide	40.00												1	1
Kanamycin	2.50				1		1							
Kanamycin	5.00	12		12	7		7							
Kanamycin	6.00	21		21										
Capreomycin	1.25				1		1							
Capreomycin	2.50				1		1							
Capreomycin	5.00	2		2	7		7							
Capreomycin	10.00	21		21										
Capreomycin	12.50												1	1
Capreomycin	25.00												1	1
Capreomycin	50.00											1		1

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

DRUG	Conc.	Test Method												
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Cycloserine	12.00	1		1								1		1
Cycloserine	24.00											1		1
Cycloserine	25.00	2		2										
Cycloserine	30.00	14		14										
Cycloserine	48.00											1		1
Cycloserine	50.00	1		1		1	1							
Cycloserine	60.00	1		1										
p-Aminosalicylic acid	0.50							1		1				
p-Aminosalicylic acid	2.00	17		17										
p-Aminosalicylic acid	4.00				2		2							
p-Aminosalicylic acid	8.00	2		2										
p-Aminosalicylic acid	10.00	2		2										
Amikacin	1.00	1		1	1		1							
Amikacin	2.00	1		1	1		1							
Amikacin	2.50				1		1							
Amikacin	4.00	3		3										
Amikacin	5.00				1		1							
Amikacin	6.00	6		6										
Amikacin	12.00	1		1										
Ofloxacin	1.00	5		5	1		1							
Ofloxacin	1.25											1		1
Ofloxacin	2.00	5		5	8		8							
Ofloxacin	2.50											1		1
Ofloxacin	4.00	2		2										
Ofloxacin	5.00											1		1
Ofloxacin	8.00				1		1							
Ciprofloxacin	1.00	1		1	2		2							
Ciprofloxacin	1.60											1		1
Ciprofloxacin	2.00	12		12	1		1							
Ciprofloxacin	3.20											1		1
Ciprofloxacin	4.00				1		1							
Ciprofloxacin	6.40											1		1
Levofloxacin	0.30	1		1										
Levofloxacin	1.00	1		1										
Levofloxacin	2.00				1		1							
Levofloxacin	8.00				1		1							
Rifabutin	0.50	2		2	2		2							
Rifabutin	1.00	2		2	1		1							
Rifabutin	2.00	4		4										
Clofazimine	0.06				1		1							
Clofazimine	0.50				2		2							
Clofazimine	1.00	1		1										
Clofazimine	15.00												1	1
Clofazimine	30.00											1		1
Clofazimine	60.00											1		1
Clarithromycin	6.00											1		1
Clarithromycin	12.00											1		1
Clarithromycin	24.00											1		1

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

DRUG	Conc.	Test Method												
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results			
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	
Isoniazid	0.05											1		1
Isoniazid	0.10				105	2	107					2		2
Isoniazid	0.12	1		1										
Isoniazid	0.20	36	2	38	5		5	1		1		1		1
Isoniazid	0.40				22		22					1		1
Isoniazid	1.00	36		36	7		7							
Isoniazid	5.00	4		4										
Rifampin	0.50				2		2							
Rifampin	1.00	39		39	9		9					1		1
Rifampin	2.00				108		108							
Rifampin	5.00	5		5										
Rifampin	14.00											1		1
Rifampin	28.00											1		1
Rifampin	40.00							1		1				
Rifampin	56.00											1		1
Pyrazinamide	50.00				2		2							
Pyrazinamide	64.00											1		1
Pyrazinamide	99.00				1		1							
Pyrazinamide	100.00				90		90					1		1
Pyrazinamide	300.00				1		1					1		1
Ethambutol	1.60												1	1
Ethambutol	2.00							1		1				
Ethambutol	2.50				99	2	101							
Ethambutol	3.20											1		1
Ethambutol	3.75				3		3							
Ethambutol	4.00				1		1							
Ethambutol	5.00	32		32	10		10					1		1
Ethambutol	6.40											1		1
Ethambutol	7.50	7		7	14		14							
Ethambutol	8.00											1		1
Ethambutol	10.00	8		8										
Ethambutol	25.00	1		1										
Streptomycin	2.00	37	1	38	102	1	103							
Streptomycin	4.00				1		1	1		1				
Streptomycin	6.00				18		18							
Streptomycin	7.50											1		1
Streptomycin	10.00	26		26										
Streptomycin	15.00											1		1
Streptomycin	30.00											1		1
Streptomycin	50.00	1		1										
Ethionamide	1.25				2		2							
Ethionamide	5.00	25		25	7		7							
Ethionamide	10.00	3		3									1	1
Ethionamide	20.00											1		1
Ethionamide	40.00											1		1
Kanamycin	5.00	10		10	6		6							
Kanamycin	6.00	19		19										

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

DRUG	Conc.	Test Method											
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			Other Tests Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Capreomycin	5.00	2		2	6		6						
Capreomycin	10.00	18		18									
Capreomycin	12.50											1	1
Capreomycin	25.00											1	1
Capreomycin	50.00											1	1
Cycloserine	12.00	1		1								1	1
Cycloserine	24.00											1	1
Cycloserine	25.00	2		2									
Cycloserine	30.00	10		10									
Cycloserine	48.00											1	1
Cycloserine	50.00	1		1		1	1						
Cycloserine	60.00	1		1									
p-Aminosalicylic acid	0.50							1		1			
p-Aminosalicylic acid	2.00	13		13									
p-Aminosalicylic acid	4.00				1	1	2						
p-Aminosalicylic acid	8.00	2		2									
p-Aminosalicylic acid	10.00	1		1									
Amikacin	1.00				1		1						
Amikacin	4.00	2		2									
Amikacin	5.00				1		1						
Amikacin	6.00	5		5									
Amikacin	12.00	1		1									
Ofloxacin	1.00	4		4									
Ofloxacin	1.25											1	1
Ofloxacin	2.00	4		4	7		7						
Ofloxacin	2.50											1	1
Ofloxacin	4.00	2		2									
Ofloxacin	5.00											1	1
Ciprofloxacin	1.00	1		1	1		1						
Ciprofloxacin	1.60											1	1
Ciprofloxacin	2.00	10		10	1		1						
Ciprofloxacin	3.20											1	1
Ciprofloxacin	4.00				1		1						
Ciprofloxacin	6.40											1	1
Levofloxacin	1.00	1		1									
Levofloxacin	2.00				1		1						
Levofloxacin	8.00				1		1						
Rifabutin	0.50	2		2	1		1						
Rifabutin	1.00	2		2	1		1						
Rifabutin	2.00	3		3									
Clofazimine	1.00	1		1									
Clofazimine	15.00											1	1
Clofazimine	30.00											1	1
Clofazimine	60.00										1		1
Clarithromycin	6.00											1	1
Clarithromycin	12.00											1	1
Clarithromycin	24.00										1		1

Table 2. Participant Results for Culture T, *M. avium*-Complex

DRUG	Conc.	Test Method														
		Agar Prop. Results			BACTEC Results			LJ Proportion Results			Other Test Results			E-Test Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Amikacin	2.00					1	1									
Amikacin	6.00	1	1	2												
Amikacin	8.00				2		2									
Amikacin	12.00	2		2												
Amikacin	20.00	1		1												
Azithromycin	3.00		1	1												
Azithromycin	8.00					1	1									
Clofazimine	0.06					1	1									
Clofazimine	0.25					1	1									
Clofazimine	0.50	1	2	3												
Clofazimine	1.00	2		2												
Clarithromycin	1.00							1	1							
Clarithromycin	2.00				1	1	2									
Clarithromycin	3.00		3	3												
Clarithromycin	4.00					2	2									
Clarithromycin	6.00		1	1								1	1			
Clarithromycin	9.00		2	2												
Clarithromycin	12.00											1	1			
Clarithromycin	16.00					1	1									
Clarithromycin	24.00											1	1			
Clarithromycin	32.00		1	1		1	1									
Clarithromycin	64.00		1	1		1	1									
Clarithromycin	256.00														1	1
Capreomycin	2.50					1	1									
Capreomycin	5.00					1	1									
Capreomycin	10.00	2	3	5	1		1									
Capreomycin	12.50											1	1			
Capreomycin	25.00											1	1			
Ciprofloxacin	1.00	1		1	1		1									
Ciprofloxacin	1.25				1		1									
Ciprofloxacin	1.60											1	1			
Ciprofloxacin	2.00	3		3												
Ciprofloxacin	2.50	1		1												
Ciprofloxacin	3.20											1	1			
Ciprofloxacin	6.40											1	1			
Ciprofloxacin	8.00				1		1									
Cycloserine	12.00											1		1		
Cycloserine	24.00											1		1		
Cycloserine	30.00	2		2												
Cycloserine	48.00											1		1		
Cycloserine	50.00				1		1									
Cefoxitin	30.00		1	1												
Ethambutol	2.00					1	1		1	1						
Ethambutol	2.50					4	4									
Ethambutol	5.00		4	4												
Ethambutol	7.50		1	1		1	1									
Ethambutol	8.00				1	1	2									
Ethambutol	10.00		2	2												

Table 2. Participant Results for Culture T, *M. avium*-Complex

DRUG	Conc.	Test Method														
		Agar Prop. Results			BACTEC Results			LJ Proportion Results			Other Test Results			E-Test Results		
		S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.10					4	4									
Isoniazid	0.20		3	3					1	1						
Isoniazid	0.40					1	1									
Isoniazid	1.00		4	4												
Isoniazid	2.00		1	1												
Isoniazid	5.00					1	1									
Kanamycin	2.50					1	1									
Kanamycin	5.00				2		2									
Kanamycin	6.00	1	2	3												
Ofloxacin	1.25	1		1								1	1			
Ofloxacin	2.00		1	1												
Ofloxacin	4.00	1		1												
Ofloxacin	5.00					1	1				1		1			
p-Aminosalicylic acid	2.00	1	1	2												
p-Aminosalicylic acid	8.00		1	1												
Rifabutin	0.05					1	1									
Rifabutin	0.12					1	1									
Rifabutin	0.25				1		1									
Rifabutin	1.00	1		1	1		1									
Rifabutin	2.00	3		3	1		1									
Rifabutin	40.00							1		1						
Rifampin	1.00	2	5	7												
Rifampin	2.00				2	2	4									
Rifampin	40.00							1		1						
Streptomycin	2.00		4	4	2	2	4									
Streptomycin	4.00								1	1						
Streptomycin	5.00	1		1												
Streptomycin	6.00				1		1									
Streptomycin	10.00	4	1	5												
Ethionamide	5.00		4	4		1	1									
Ethionamide	8.00											1	1			
Ethionamide	10.00		2	2												
Ethionamide	16.00											1	1			
Ethionamide	32.00											1	1			

Table 3. Minimum Inhibitory Concentrations for Culture T, *M. avium*-Complex

DRUG	Test Method	MIC	S	R	Other	Sum
Amikacin	BACTEC 460	≤4.00	1		2	3
Amikacin	E-test	0.80	1			1
Amikacin	Microtiter	8.00			1	1
Azithromycin	Microtiter	>256.00		1		1
Cefoxitin	E-test	24.00		1		1
Ciprofloxacin	BACTEC 460	≤2.00	1		1	2
Ciprofloxacin	E-test	0.50	1			1
Ciprofloxacin	E-test	8.00		1		1
Ciprofloxacin	Microtiter	1.00	1			1
Clarithromycin	BACTEC 460	>16.00		1		1
Clarithromycin	BACTEC 460	>32.00		3		3
Clarithromycin	BACTEC 460	≥64.00		3		3
Clarithromycin	E-test	>256.00		3		3
Clarithromycin	Microtiter	>64.00		1		1
Clarithromycin	Microtiter	>128.00		1		1
Clofazimine	BACTEC 460	<0.06	1			1
Ethambutol	BACTEC 460	>8.00		1		1
Ethambutol	E-test	48.00		1		1
Ethambutol	Microtiter	8.00			1	1
Minocycline	E-test	0.50	1			1
Ofloxacin	BACTEC 460	8.00		1		1
Rifabutin	BACTEC 460	0.25			1	1
Rifabutin	BACTEC 460	<0.50	1			1
Rifabutin	Microtiter	2.00			1	1
Rifampin	BACTEC 460	<1.00	1			1
Rifampin	BACTEC 460	2.00			2	2
Rifampin	E-test	12.00		1		1
Rifampin	Microtiter	4.00			1	1
Streptomycin	BACTEC 460	<2.00	1			1
Trimethoprim-Sulfamethoxazole	E-test	>32.00		1		1