June 3, 2003

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 January 2003 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. marinum*, shipped in January 2003. Participant laboratories received either four *M. tuberculosis* complex strains only or four *M. tuberculosis* strains and one NTM culture. Testing results were received and analyzed from 147 of 155 (95%) laboratories participating in this shipment.

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 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 interpretation 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 that perform 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) 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 me at (770) 488-8133.

Sincerely yours,

Bereneice M. Madison, Ph.D.
Division of Laboratory Systems
Public Health Practice Program Office

Enclosures

Analyses of the January 2003 Performance Evaluation Results for *M. tuberculosis* complex and Nontuberculous 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 one *M. marinum* strains shipped in January 2003. Participant laboratories received either four *M. tuberculosis* strains only or four *M. tuberculosis* and one NTM strain. Testing results were received and analyzed from 147 of 155 (95%) laboratories participating in this shipment.

Descriptive Information on Participant laboratories

Figure 1 shows the laboratory classification reported by 147 of the participants. Participants consisted of 78 health departments, 52 hospitals, 12 independents, and 5 "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 2002.

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 (LJ) media, may reflect procedures used by international participants. The 'other' methods listed were microtiter and LJ resistance ratio method.

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

M. tuberculosis test results:

The aggregate test results are provided in separate tables, representing strains K, L, M, N and O to facilitate comparison among laboratories. Table 1 for the *M. tuberculosis* complex strains K, L, M, and N is constructed to include the results for the radiometric (BACTEC), agar proportion (AP), Lowenstein Jensen (LJ) 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 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.

Strain K was resistant to 0.1 µg/ml isoniazid (INH) by 99% (104/105) of participants and 65% (22/34) reported resistance to 0.4 µg/ml with the BACTEC 460TB method. Ninety-eight percent (40/41) of participants reported resistance to 0.2 µg/ml with agar proportion (AP) and 33% (13/40) reported resistance to the higher concentration of 1.0 µg/ml INH. Ninety-eight percent (95/97) of participants reported susceptible results to 2.5 µg/ml of ethambutol; 98% (94/96) also reported susceptible results to 2.0 µg/ml of streptomycin with BACTEC 460TB. Ninety-nine percent (91/92) of participants reported resistance to pyrazinamide (100 µg/ml) with the BACTEC 460TB method. There was complete consensus among participants in reporting resistance to 0.1 µg/ml INH and pyrazinamide100 µg/ml using BACTEC MGIT.

Strain L was fully susceptible to the primary drugs by all laboratories reporting results with BACTEC 460TB, BACTEC MGIT, AP and Lowenstein-Jensen proportion methods.

Strain M was susceptible to all primary drugs except pyrazinamide at 100 µg/ml; 97% (86/89) of participants reported resistance with BACTEC 460TB method and 6 of 7 (86%) participants reported resistance with BACTEC MGIT.

Strain N was susceptible to all primary drugs. It was reported as resistant by 97% (93/96) and 85% (17/20) of participants testing 2 µg/ml and 6 µg/ml streptomycin, respectively, in the BACTEC 460TB method; while 41/42 and19/29 participants reported resistance to 2 µg/ml and 10.0 µg/ml concentrations with AP. Resistance was reported by all 9 participants testing 1.0 µg/ml of streptomycin in MGIT.

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 referrals of physicians with experience and expertise in treating multi-drug resistant tuberculosis.

Nontuberculous Mycobacteria test results:

The aggregate test results are provided in Tables 2 and 3 for **Strain O**, *M. marinum,* to facilitate comparison among laboratories. Table 2 represents either single or multiple drug concentrations with "breakpoint" susceptibility test results. Table 3 provides quantitative MIC test results. The largest number of laboratories testing **Strain O**, tested for rifampin 1.0 µg/ml (17) and ethambutol 5.0 µg/ml (16) and found the isolate to be susceptible with the AP method. Sixty percent (3/5) participants reported resistance for doxycycline 6.0 µg/ml using the AP method. Of the 6 participants testing clarithromycin, 3.0 µg/ml was tested rather than the recommended 32 µg/ml recommended in Table 8 of (M24-T2 NCCLS) Susceptibility Testing of Mycobacteria, Nocardia, and other Aerobic Actinomycetes: Tentative Standard. The strain was susceptible to the recommended concentrations of antimycobacterial agents tested by MIC methods except for participant(s) testing sulfamethaxole at 64 and 128 µg/ml with the disk elution method. Two participants found the strain to be susceptible with lower concentrations of 16 and 32 µg/ml with disk elution. Some drugs such as ethionamide, cycloserine and PAS were

tested but are unlikely candidates for treatment of *M. marinum* infections. Anti-tuberculosis drugs to be tested for treatment of *M. marinum* infections are listed in Table 8. They include rifampin, ethambutol, doxycycline, clarithromycin, trimethoprim/sulfamethoxazole and amikacin.

Strain O was isolated from a 39-year old HIV positive patient who maintained a tropical fish aquarium and developed multiple cutaneous nodules on his hand and forearm. Sea water or water from fish tanks associated with trauma are a common source of infections with *M. marinum* (4,7). Because of the patient's anti-retroviral therapy, the physician did not wish to use a rifampin-containing regimen and asked for susceptibility testing to be performed on the isolate of *Mycobacterium marinum*. Some clinical strains of *M. marinum* may require isolation temperatures of 28-30 ºC (4,8); however, **Strain O** grew well at 37 (±1) ºC.

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 Public Health; Richard Wallace, M.D., Ph.D., and Barbara Brown-Elliott, M.S., University of Texas at Tyler, TX; Wendy Gross, M.S., TB Reference Laboratory, West Haven, CT.

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Figure 1. Primary Classification of Participating Laboratories

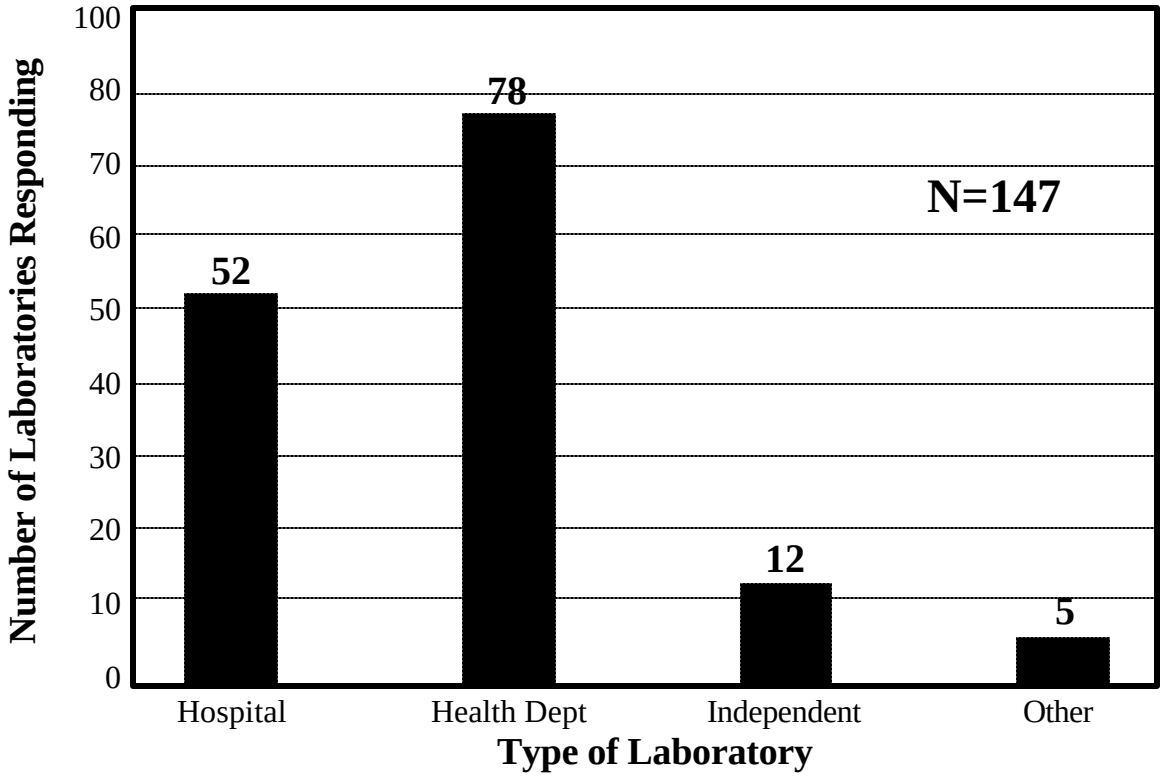
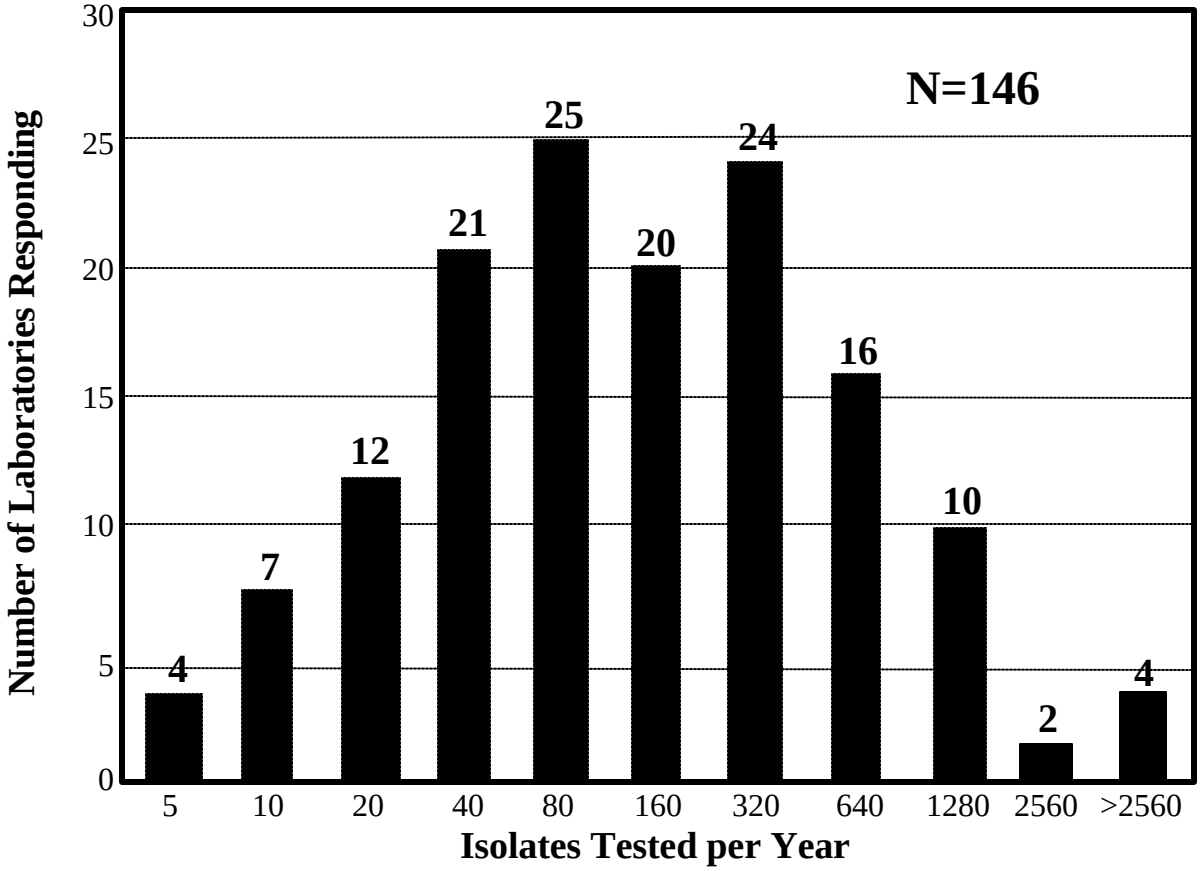
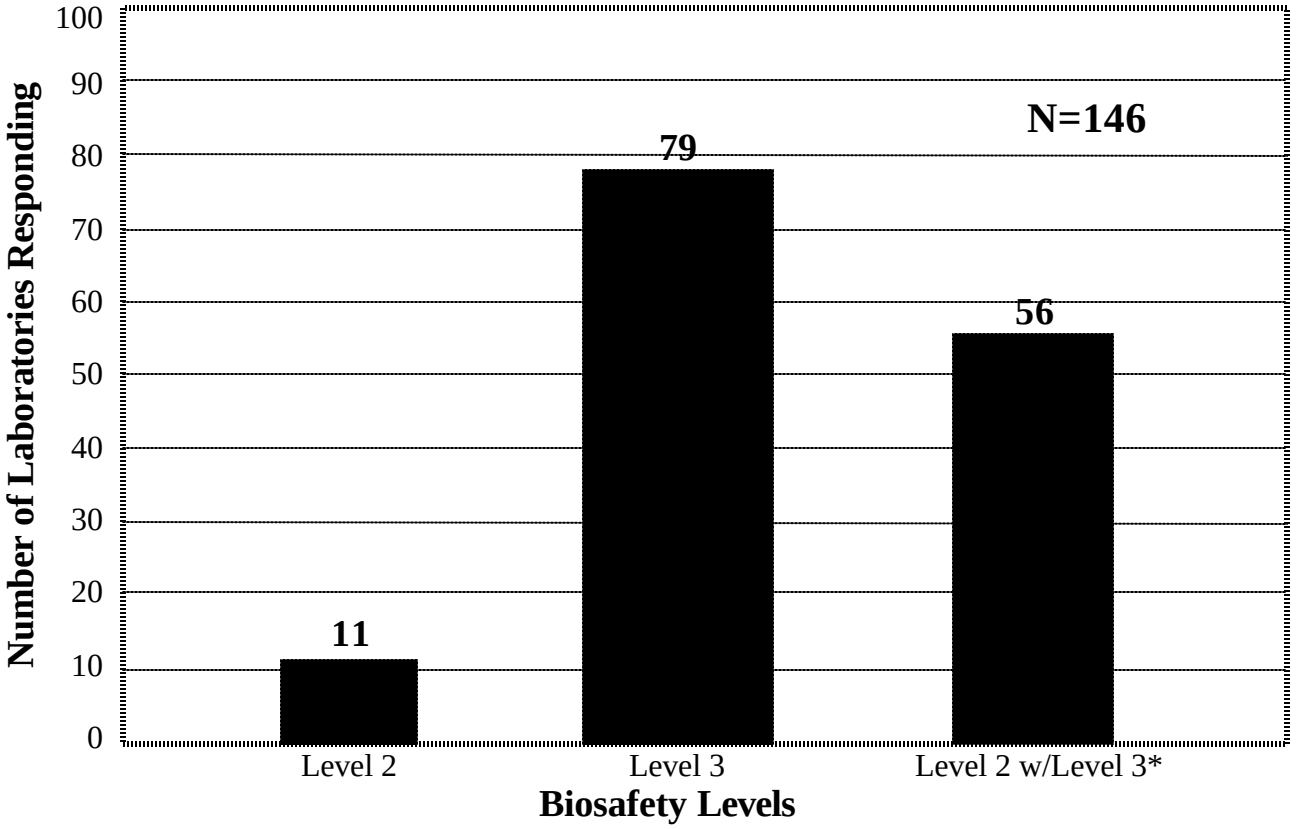


Figure 2. 2002 Annual Volume of *M. tuberculosis* Isolates for Participating Laboratories



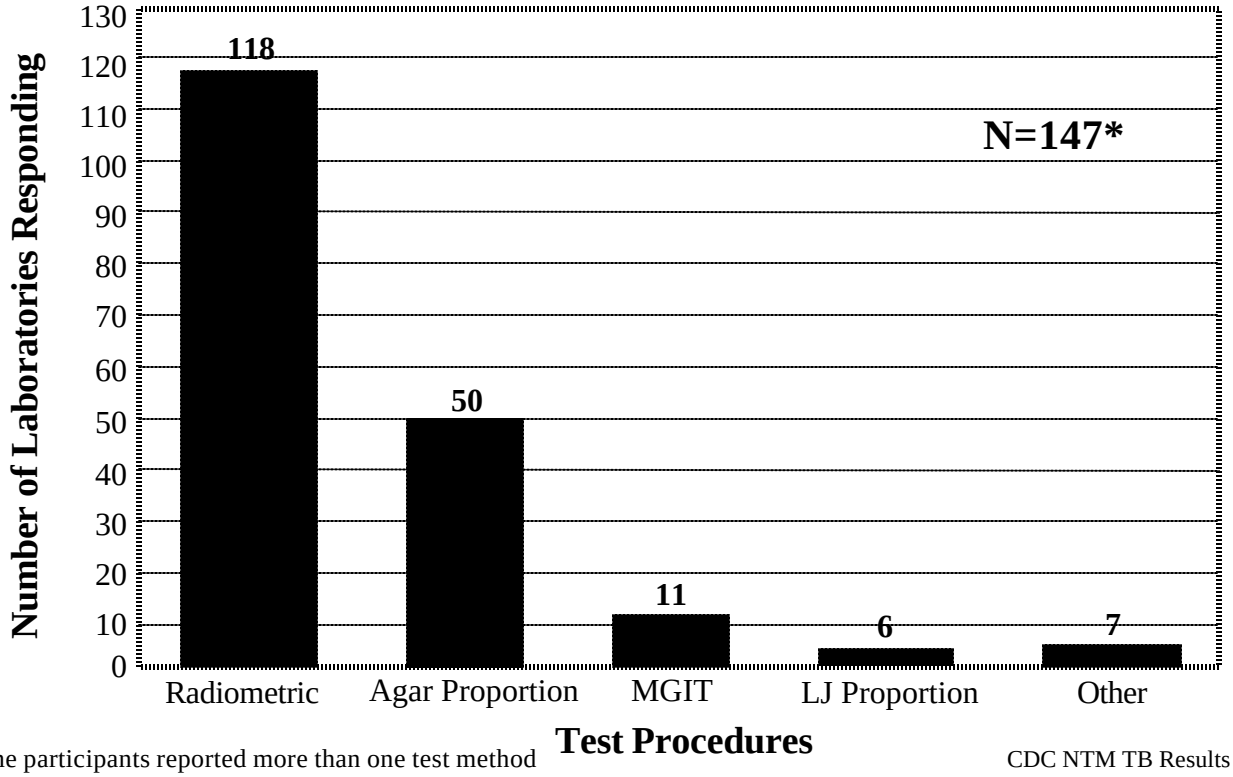
Group labels indicate upper limit of the group.

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. marinum*

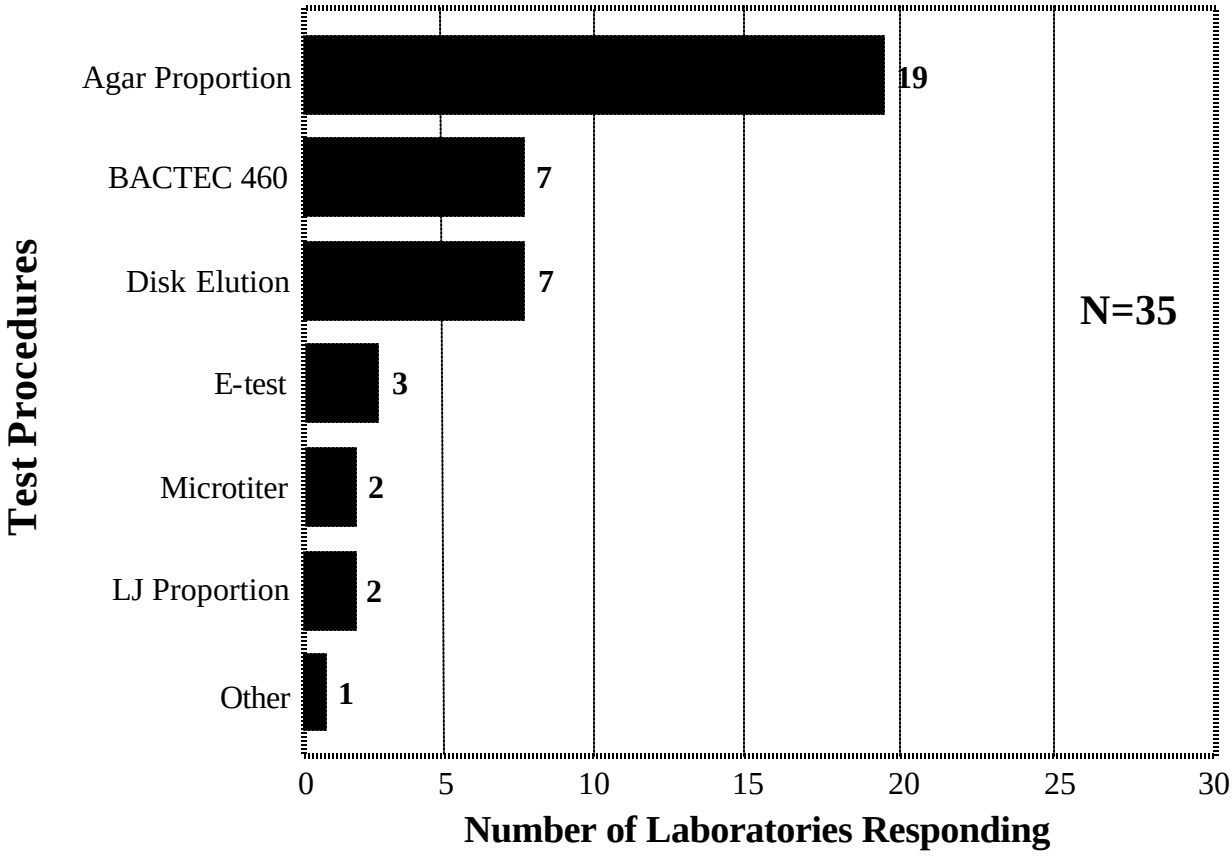


Table 1. Participant Results for Culture K, *M. tuberculosis*

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.05														1	1
Isoniazid	0.10				1	104	105	1		1		10	10		3	3
Isoniazid	0.20	1	40	41		5	5	2	3	5		1	1		2	2
Isoniazid	0.40				12	22	34					1	1	1	1	2
Isoniazid	1.00	27	13	40	2	2	4	2		2		1	1	1		1
Isoniazid	2.00				1		1									
Isoniazid	4.00					1	1									
Isoniazid	5.00	2	1	3	2		2							1		1
Isoniazid	10.00							1		1						
Isoniazid	100.00							1		1						
Rifampin	0.50				1		1									
Rifampin	1.00	45		45	7		7		1	1	11		11	3		3
Rifampin	2.00				105		105									
Rifampin	5.00	5		5	1		1	1		1						
Rifampin	14.00													1		1
Rifampin	20.00							1		1						
Rifampin	28.00													1		1
Rifampin	40.00							4		4						
Rifampin	50.00							1		1						
Rifampin	56.00													1		1
Rifampin	80.00				1		1									
Pyrazinamide	64.00														1	1
Pyrazinamide	100.00				1	91	92					8	8		2	2
Pyrazinamide	300.00					1	1									
Ethambutol	1.00							2		2						
Ethambutol	1.60													1		1
Ethambutol	2.00							5		5						
Ethambutol	2.50				95	2	97									
Ethambutol	3.20													1		1
Ethambutol	3.75				2		2									
Ethambutol	4.00				1		1									
Ethambutol	5.00	37	1	38	6	1	7	1		1	10	1	11	3		3
Ethambutol	6.00	1		1												
Ethambutol	6.40													1		1
Ethambutol	7.50	5		5	15		15									
Ethambutol	8.00													2		2
Ethambutol	10.00	13		13										1		1
Ethambutol	300.00				1		1									
Streptomycin	1.00							1		1	9		9			
Streptomycin	2.00	42		42	94	2	96							1		1
Streptomycin	3.00				1		1									
Streptomycin	4.00	1		1	1		1	4		4						
Streptomycin	5.00							1		1						
Streptomycin	6.00				18		18									
Streptomycin	7.50													1		1
Streptomycin	8.00							1		1						
Streptomycin	10.00	29		29				1		1				1		1
Streptomycin	15.00													1		1
Streptomycin	30.00													1		1
Streptomycin	240.00				1		1									

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.25				1	1	2									
Ethionamide	2.50				1	1	2									
Ethionamide	5.00	28		28	2		2							1		1
Ethionamide	10.00	4		4										1		1
Ethionamide	16.00							1		1						
Ethionamide	20.00								1	1				1		1
Ethionamide	40.00							2		2				1		1
Kanamycin	2.50				1		1									
Kanamycin	5.00	12		12	2		2									
Kanamycin	6.00	19		19										1		1
Kanamycin	10.00								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				1		1									
Capreomycin	2.50				2		2									
Capreomycin	5.00				3		3									
Capreomycin	10.00	20		20												
Capreomycin	12.50													1		1
Capreomycin	16.00							1		1						
Capreomycin	25.00													1		1
Capreomycin	40.00							1		1						
Capreomycin	50.00													1		1
Cycloserine	8.00	1		1												
Cycloserine	12.00													1		1
Cycloserine	16.00							1		1						
Cycloserine	20.00								1	1						
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	11		11				1		1						
Cycloserine	40.00							1		1						
Cycloserine	48.00													1		1
Cycloserine	50.00	1		1												
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50							2		2						
p-Aminosalicylic acid	1.00							2		2						
p-Aminosalicylic acid	2.00	18		18		1	1							1		1
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	4		4												
p-Aminosalicylic acid	60.00	1		1												

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Amikacin	0.50													1		1
Amikacin	1.00	1		1										1		1
Amikacin	2.00	2		2	2		2									
Amikacin	2.50	1		1	1		1									
Amikacin	4.00	2		2												
Amikacin	6.00	4		4										1		1
Amikacin	7.50													1		1
Amikacin	8.00				1		1									
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				1		1
Ofloxacin	1.25				1		1							1		1
Ofloxacin	2.00	9		9	6		6	1		1						
Ofloxacin	2.50													1		1
Ofloxacin	4.00	2		2	1		1									
Ofloxacin	5.00													1		1
Ofloxacin	8.00				2		2									
Ciprofloxacin	0.50													1		1
Ciprofloxacin	1.00	1		1	3		3							1		1
Ciprofloxacin	1.60													1		1
Ciprofloxacin	2.00	9		9	2		2							1		1
Ciprofloxacin	2.50				1		1									
Ciprofloxacin	3.20													1		1
Ciprofloxacin	4.00				2		2									
Ciprofloxacin	6.40													1		1
Levofloxacin	0.16	1		1												
Levofloxacin	1.00	1		1												
Levofloxacin	2.00				3		3									
Levofloxacin	8.00				1		1									
Rifabutin	0.50	3		3	1		1									
Rifabutin	1.00	2		2	2		2									
Rifabutin	2.00	6		6												
Clofazimine	0.06				1		1									
Clofazimine	0.12				1		1									
Clofazimine	0.25				1		1									
Clofazimine	0.50				1		1								1	1
Clofazimine	1.00	1		1										1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.05													1		1
Isoniazid	0.10				104		104	1		1	9	1	10	3		3
Isoniazid	0.12	1		1												
Isoniazid	0.20	37	1	38	4		4	5		5	1		1	1		1
Isoniazid	0.40				30		30							2		2
Isoniazid	1.00	36		36	3		3	2		2	1		1			
Isoniazid	4.00				1		1									
Isoniazid	5.00	4		4												
Isoniazid	10.00							1		1						
Isoniazid	100.00							1		1						
Rifampin	0.50				1		1									
Rifampin	1.00	40	1	41	7		7		1	1	11		11	2		2
Rifampin	2.00				105		105									
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							3	1	4						
Rifampin	50.00							1		1						
Rifampin	56.00													1		1
Rifampin	80.00				1		1									
Pyrazinamide	64.00													1		1
Pyrazinamide	100.00				91		91				7		7	2		2
Pyrazinamide	300.00				1		1									
Ethambutol	1.00							2		2						
Ethambutol	1.60													1		1
Ethambutol	2.00							5		5						
Ethambutol	2.50				98	1	99									
Ethambutol	3.20													1		1
Ethambutol	3.75				2		2									
Ethambutol	4.00				1		1									
Ethambutol	5.00	35		35	7		7	1		1	11		11	2		2
Ethambutol	6.00	1		1												
Ethambutol	6.40													1		1
Ethambutol	7.50	5		5	15		15									
Ethambutol	8.00													2		2
Ethambutol	10.00	11		11												
Ethambutol	300.00				1		1									
Streptomycin	1.00							1		1	9		9			
Streptomycin	2.00	39		39	95		95									
Streptomycin	3.00				1		1									
Streptomycin	4.00	1		1	1		1	4		4						
Streptomycin	5.00							1		1						
Streptomycin	6.00				18		18									
Streptomycin	7.50													1		1
Streptomycin	8.00							1		1						
Streptomycin	10.00	26		26				1		1						
Streptomycin	15.00													1		1
Streptomycin	30.00													1		1
Streptomycin	240.00				1		1									

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.25				2		2									
Ethionamide	5.00	24		24	3		3									
Ethionamide	10.00	4		4											1	1
Ethionamide	16.00							1		1						
Ethionamide	20.00								1	1				1		1
Ethionamide	40.00							2		2				1		1
Kanamycin	5.00	10		10	1		1									
Kanamycin	6.00	17		17												
Kanamycin	10.00								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				1		1									
Capreomycin	5.00				2		2									
Capreomycin	10.00	17		17												
Capreomycin	12.50													1		1
Capreomycin	16.00							1		1						
Capreomycin	25.00													1		1
Capreomycin	40.00							1		1						
Capreomycin	50.00													1		1
Cycloserine	12.00													1		1
Cycloserine	16.00							1		1						
Cycloserine	20.00								1	1						
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	10		10				1		1						
Cycloserine	40.00							1		1						
Cycloserine	48.00													1		1
Cycloserine	50.00	1		1												
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50							2		2						
p-Aminosalicylic acid	1.00							2		2						
p-Aminosalicylic acid	2.00	15		15												
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	3		3												
Amikacin	0.50													1		1
Amikacin	1.00													1		1
Amikacin	2.00	1		1	2		2									
Amikacin	4.00	2		2												
Amikacin	6.00	4		4												
Amikacin	7.50													1		1
Amikacin	8.00				1		1									
Amikacin	12.00	1		1												
Amikacin	15.00													1		1
Amikacin	30.00													1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ofloxacin	0.50														1	1
Ofloxacin	1.00	2		2				1		1				1		1
Ofloxacin	1.25													1		1
Ofloxacin	2.00	7		7	5		5	1		1						
Ofloxacin	2.50													1		1
Ofloxacin	4.00	2		2	1		1									
Ofloxacin	5.00													1		1
Ofloxacin	8.00				2		2									
Ciprofloxacin	0.50													1		1
Ciprofloxacin	1.00	1		1	2		2							1		1
Ciprofloxacin	1.60													1		1
Ciprofloxacin	2.00	9		9	2		2									
Ciprofloxacin	3.20													1		1
Ciprofloxacin	4.00				2		2									
Ciprofloxacin	6.40													1		1
Levofloxacin	1.00	1		1												
Levofloxacin	2.00				3		3									
Levofloxacin	8.00				1		1									
Rifabutin	0.50	2		2												
Rifabutin	1.00	1		1	1		1									
Rifabutin	2.00	4		4												
Clofazimine	0.06					1	1									
Clofazimine	0.12					1	1									
Clofazimine	0.25				1		1									
Clofazimine	0.50													1		1
Clofazimine	1.00	1		1										1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.05													1		1
Isoniazid	0.10				104		104	1		1	10		10	3		3
Isoniazid	0.12	1		1												
Isoniazid	0.20	36	2	38	4		4	5		5	1		1	1		1
Isoniazid	0.40				30		30							2		2
Isoniazid	1.00	36		36	3		3	2		2	1		1			
Isoniazid	4.00				1		1									
Isoniazid	5.00	4		4												
Isoniazid	10.00							1		1						
Isoniazid	100.00							1		1						
Rifampin	0.50				1		1									
Rifampin	1.00	41		41	7		7	1		1	11		11	2		2
Rifampin	2.00				106		106									
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							4		4						
Rifampin	50.00							1		1						
Rifampin	56.00													1		1
Rifampin	80.00				1		1									
Pyrazinamide	64.00													1		1
Pyrazinamide	100.00				3	86	89				1	6	7		2	2
Pyrazinamide	300.00					1	1									
Ethambutol	1.00							2		2						
Ethambutol	1.60													1		1
Ethambutol	2.00							5		5						
Ethambutol	2.50				100		100									
Ethambutol	3.20													1		1
Ethambutol	3.75				2		2									
Ethambutol	4.00				1		1									
Ethambutol	5.00	35		35	7		7	1		1	9	2	11	2		2
Ethambutol	6.00	1		1												
Ethambutol	6.40													1		1
Ethambutol	7.50	5		5	15		15									
Ethambutol	8.00													2		2
Ethambutol	10.00	11		11												
Ethambutol	300.00				1		1									
Streptomycin	1.00							1		1	9		9			
Streptomycin	2.00	38	1	39	94	1	95									
Streptomycin	3.00				1		1									
Streptomycin	4.00	1		1	1		1	4		4						
Streptomycin	5.00							1		1						
Streptomycin	6.00				18	1	19									
Streptomycin	7.50													1		1
Streptomycin	8.00							1		1						
Streptomycin	10.00	26		26				1		1						
Streptomycin	15.00													1		1
Streptomycin	30.00													1		1
Streptomycin	240.00				1		1									

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.25				1		1									
Ethionamide	5.00	25		25	3		3									
Ethionamide	10.00	4		4											1	1
Ethionamide	16.00							1		1						
Ethionamide	20.00								1	1					1	1
Ethionamide	40.00							2		2				1		1
Kanamycin	5.00	10		10	1		1									
Kanamycin	6.00	18		18												
Kanamycin	10.00								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				1		1									
Capreomycin	5.00				2		2									
Capreomycin	10.00	18		18												
Capreomycin	12.50														1	1
Capreomycin	16.00							1		1						
Capreomycin	25.00													1		1
Capreomycin	40.00							1		1						
Capreomycin	50.00													1		1
Cycloserine	12.00													1		1
Cycloserine	16.00							1		1						
Cycloserine	20.00								1	1						
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	10		10				1		1						
Cycloserine	40.00							1		1						
Cycloserine	48.00													1		1
Cycloserine	50.00	1		1												
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50							2		2						
p-Aminosalicylic acid	1.00							2		2						
p-Aminosalicylic acid	2.00	15		15												
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	3		3												
Amikacin	0.50													1		1
Amikacin	1.00													1		1
Amikacin	2.00	1		1	2		2									
Amikacin	4.00	2		2												
Amikacin	6.00	4		4												
Amikacin	7.50													1		1
Amikacin	8.00				1		1									
Amikacin	12.00	1		1												
Amikacin	15.00													1		1
Amikacin	30.00													1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ofloxacin	0.50													1		1
Ofloxacin	1.00	2		2				1		1				1		1
Ofloxacin	1.25													1		1
Ofloxacin	2.00	7		7	5		5	1		1						
Ofloxacin	2.50													1		1
Ofloxacin	4.00	2		2	1		1									
Ofloxacin	5.00													1		1
Ofloxacin	8.00				2		2									
Ciprofloxacin	0.50													1		1
Ciprofloxacin	1.00	1		1	2		2							1		1
Ciprofloxacin	1.60													1		1
Ciprofloxacin	2.00	9		9	2		2									
Ciprofloxacin	3.20													1		1
Ciprofloxacin	4.00				2		2									
Ciprofloxacin	6.40													1		1
Levofloxacin	1.00	1		1												
Levofloxacin	2.00				3		3									
Levofloxacin	8.00				1		1									
Rifabutin	0.50	2		2												
Rifabutin	1.00	1		1	1		1									
Rifabutin	2.00	4		4												
Clofazimine	0.06					1	1									
Clofazimine	0.12				1		1									
Clofazimine	0.25				1		1									
Clofazimine	0.50													1		1
Clofazimine	1.00	1		1										1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Isoniazid	0.05													1		1
Isoniazid	0.10				103		103	1		1	10		10	3		3
Isoniazid	0.12	1		1												
Isoniazid	0.20	40		40	4		4	5		5	1		1	1		1
Isoniazid	0.40				30		30							2		2
Isoniazid	1.00	38		38	3		3	2		2	1		1			
Isoniazid	4.00				1		1									
Isoniazid	5.00	3		3												
Isoniazid	10.00							1		1						
Isoniazid	100.00							1		1						
Rifampin	0.50				1		1									
Rifampin	1.00	43		43	7		7	1		1	11		11	2		2
Rifampin	2.00				105		105									
Rifampin	5.00	5		5				1		1						
Rifampin	14.00													1		1
Rifampin	20.00							1		1						
Rifampin	28.00													1		1
Rifampin	40.00							4		4						
Rifampin	50.00							1		1						
Rifampin	56.00													1		1
Rifampin	80.00				1		1									
Pyrazinamide	100.00				87	1	88				8		8	2		2
Pyrazinamide	300.00				1		1									
Ethambutol	1.00							2		2						
Ethambutol	1.60													1		1
Ethambutol	2.00							5		5						
Ethambutol	2.50				99		99									
Ethambutol	3.20													1		1
Ethambutol	3.75				2		2									
Ethambutol	4.00				1		1									
Ethambutol	5.00	37		37	7		7	1		1	11		11	1		1
Ethambutol	6.00	1		1												
Ethambutol	6.40													1		1
Ethambutol	7.50	5		5	15		15									
Ethambutol	8.00													2		2
Ethambutol	10.00	12		12												
Ethambutol	300.00				1		1									
Streptomycin	1.00								1	1		9	9			
Streptomycin	2.00	1	41	42	3	93	96									
Streptomycin	3.00					1	1									
Streptomycin	4.00		1	1		2	2	1	3	4						
Streptomycin	5.00							1		1						
Streptomycin	6.00				3	17	20									
Streptomycin	7.50														1	1
Streptomycin	8.00							1		1						
Streptomycin	10.00	10	19	29	1		1	1		1						
Streptomycin	15.00														1	1
Streptomycin	30.00														1	1
Streptomycin	240.00					1	1									

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ethionamide	1.25				2		2									
Ethionamide	5.00	24		24	2		2									
Ethionamide	10.00	4		4											1	1
Ethionamide	16.00							1		1						
Ethionamide	20.00							1		1				1		1
Ethionamide	40.00							2		2				1		1
Kanamycin	5.00	10		10	1		1									
Kanamycin	6.00	18		18												
Kanamycin	10.00								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				1		1									
Capreomycin	5.00				2		2									
Capreomycin	10.00	18		18												
Capreomycin	12.50													1		1
Capreomycin	16.00							1		1						
Capreomycin	25.00													1		1
Capreomycin	40.00							1		1						
Capreomycin	50.00													1		1
Cycloserine	12.00													1		1
Cycloserine	16.00							1		1						
Cycloserine	20.00								1	1						
Cycloserine	24.00													1		1
Cycloserine	25.00	1		1												
Cycloserine	30.00	11		11				1		1						
Cycloserine	40.00							1		1						
Cycloserine	48.00													1		1
Cycloserine	50.00	1		1												
Cycloserine	60.00	1		1												
p-Aminosalicylic acid	0.50							2		2						
p-Aminosalicylic acid	1.00							2		2						
p-Aminosalicylic acid	2.00	17		17												
p-Aminosalicylic acid	8.00	3		3												
p-Aminosalicylic acid	10.00	4		4												
Amikacin	0.50													1		1
Amikacin	1.00	1		1										1		1
Amikacin	2.00	2		2	2		2									
Amikacin	4.00	2		2												
Amikacin	6.00	4		4												
Amikacin	7.50													1		1
Amikacin	8.00				1		1									
Amikacin	12.00	1		1												
Amikacin	15.00													1		1
Amikacin	30.00													1		1

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

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Prop. Results			MGIT Results			Other Tests Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ofloxacin	0.50														1	1
Ofloxacin	1.00		3	3					1	1					1	1
Ofloxacin	1.25														1	1
Ofloxacin	2.00	1	7	8		5	5		1	1						
Ofloxacin	2.50														1	1
Ofloxacin	4.00		2	2	1		1									
Ofloxacin	5.00														1	1
Ofloxacin	8.00					2	2									
Ciprofloxacin	0.50														1	1
Ciprofloxacin	1.00		1	1		2	2								1	1
Ciprofloxacin	1.60														1	1
Ciprofloxacin	2.00	1	8	9	1	1	2									
Ciprofloxacin	3.20														1	1
Ciprofloxacin	4.00					2	2									
Ciprofloxacin	6.40														1	1
Levofloxacin	1.00		1	1												
Levofloxacin	2.00					3	3									
Levofloxacin	8.00					1	1									
Rifabutin	0.50	3		3												
Rifabutin	1.00	2		2	1		1									
Rifabutin	2.00	5		5												
Clofazimine	0.06					1	1									
Clofazimine	0.12				1		1									
Clofazimine	0.25				1		1									
Clofazimine	0.50													1		1
Clofazimine	1.00	1		1										1		1

Table 2. Participant Results for Culture O, *M. marinum*

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Proportion Results			Other Test Results			E-Test Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Amikacin	2.00				1		1									
Amikacin	6.00	2		2				1		1						
Amikacin	7.50											1	1			
Amikacin	12.00	1		1	1		1									
Amikacin	15.00											1	1			
Amikacin	30.00										1		1			
Amikacin	32.00				1		1									
Azithromycin	3.00		1	1												
Clofazimine	1.00	1		1												
Clofazimine	4.00														1	1
Clarithromycin	0.60	1		1												
Clarithromycin	2.00				1		1									
Clarithromycin	3.00	6		6				1		1						
Clarithromycin	4.00	1		1												
Clarithromycin	5.00				1		1									
Clarithromycin	6.00										1		1			
Clarithromycin	12.00										1		1			
Clarithromycin	24.00										1		1			
Clarithromycin	32.00				1		1									
Capreomycin	10.00	2		2												
Ciprofloxacin	1.00	1		1												
Ciprofloxacin	1.60											1	1			
Ciprofloxacin	2.00	1		1	1		1	2		2						
Ciprofloxacin	3.20											1	1			
Ciprofloxacin	6.40										1		1			
Cycloserine	20.00													1		1
Cycloserine	30.00	2		2												
Doxycycline	6.00	2	3	5				1		1						
Doxycycline	8.00				1		1									
Ethambutol	1.00													1		1
Ethambutol	1.60										1		1			
Ethambutol	2.00													1	1	2
Ethambutol	2.50				3		3									
Ethambutol	5.00	16		16				1		1						
Ethambutol	7.50				1		1									
Ethambutol	10.00	5		5				1		1						
Erythromycin	5.00		1	1												
Isoniazid	0.05											1	1			
Isoniazid	0.10					2	2					1	1			
Isoniazid	0.20		4	4					1	1		1	1		1	1
Isoniazid	0.25														1	1
Isoniazid	0.40					1	1									
Isoniazid	1.00		7	7					1	1					1	1
Isoniazid	5.00		1	1					1	1						
Kanamycin	5.00	1		1												
Kanamycin	6.00	1		1				1		1						
Kanamycin	20.00														1	1
Minocycline	6.00	3	1	4				1		1						

Table 2. Participant Results for Culture O, *M. marinum*

		Test Method														
		Agar Prop. Results			BACTEC Results			LJ Proportion Results			Other Test Results			E-Test Results		
DRUG	Conc.	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum	S	R	Sum
Ofloxacin	1.00													1		1
Ofloxacin	1.25											1	1			
Ofloxacin	2.00	1	1	2												
Ofloxacin	2.50											1	1			
Ofloxacin	5.00										1		1			
p-Aminosalicylic acid	0.50														1	1
p-Aminosalicylic acid	2.00	1		1					1	1						
p-Aminosalicylic acid	8.00		1	1												
Rifabutin	0.50	1		1												
Rifabutin	1.00	1		1												
Rifabutin	40.00														1	1
Rifampin	1.00	17		17	1		1	1		1					1	1
Rifampin	2.00				4		4									
Rifampin	5.00	1		1											1	1
Rifampin	14.00											1	1			
Rifampin	28.00											1	1			
Rifampin	32.00													1		1
Rifampin	40.00														1	1
Rifampin	56.00											1	1			
Streptomycin	2.00	3	5	8	2	1	3		1	1						
Streptomycin	4.00														2	2
Streptomycin	7.50											1	1			
Streptomycin	10.00	5		5				1		1					1	1
Tetracycline	6.00		1	1												
Ethionamide	5.00	2		2				1		1						
Ethionamide	10.00	1		1												
Ethionamide	40.00													1		1
Trimethoprim-Sulfame	0.25	1		1												
Trimethoprim-Sulfame	0.50	1		1												
Trimethoprim-Sulfame	0.60	1		1												
Trimethoprim-Sulfame	1.00	1		1												
Trimethoprim-Sulfame	10.00	1		1												
Trimethoprim-Sulfame	12.00							1		1						
Trimethoprim-Sulfame	30.00	2		2												
Trimethoprim-Sulfame	32.00	1		1												

Table 3. Minimum Inhibitory Concentrations for Culture O, *M. marinum*

DRUG	Test Method	MIC	S	R	Other	Sum
Amikacin	Disk elution	0.50	1			1
Amikacin	Disk elution	<0.63	1			1
Amikacin	Disk elution	1.00	3			3
Amikacin	Disk elution	2.00	2			2
Amikacin	Microtiter	1.00	2			2
Augmentin	Disk elution	16.00			1	1
Azithromycin	Disk elution	>0.50		1		1
Azithromycin	Disk elution	1.00	1			1
Azithromycin	Disk elution	16.00	1			1
Cefoxitin	Disk elution	32.00	1			1
Cefoxitin	Disk elution	>64.00		1		1
Cefoxitin	Disk elution	128.00		1		1
Cefoxitin	Microtiter	48.00		1		1
Ciprofloxacin	Disk elution	1.00	3			3
Ciprofloxacin	Disk elution	4.00		3		3
Clarithromycin	Disk elution	<0.25	1			1
Clarithromycin	Disk elution	>0.25		1		1
Clarithromycin	Disk elution	0.50	3			3
Clarithromycin	Disk elution	1.00	1			1
Clarithromycin	Disk elution	2.00	1			1
Clarithromycin	Disk elution	8.00	1			1
Clarithromycin	Microtiter	0.19	1			1
Clarithromycin	Microtiter	0.25	1			1
Doxycycline	Disk elution	4.00	1			1
Doxycycline	Microtiter	3.00	1			1
Doxycycline	Microtiter	4.00	1			1
Erythromycin	Disk elution	16.00		1		1
Ethambutol	Disk elution	0.25	1			1
Ethambutol	Disk elution	0.63	1			1
Ethambutol	Disk elution	2.00	1			1
Ethambutol	Microtiter	0.06	1			1
Gentamicin	Disk elution	8.00			1	1
Imipenem	Disk elution	0.50	1			1
Imipenem	Disk elution	1.00	1			1
Imipenem	Disk elution	2.00	1			1
Isoniazid	Disk elution	4.00			1	1
Kanamycin	Disk elution	4.00	1			1
Levofloxacin	Disk elution	4.00	1			1
Levofloxacin	Microtiter	>32.00		1		1
Minocycline	Disk elution	1.00	1			1
Minocycline	Disk elution	2.00	3		1	4
Minocycline	Microtiter	3.00	1			1
Ofloxacin	Disk elution	>4.00		1		1
Ofloxacin	Disk elution	8.00	1			1
Rifabutin	Disk elution	<0.12	1			1
Rifabutin	Disk elution	0.25	1			1
Rifabutin	Disk elution	>2.00		1		1
Rifabutin	Disk elution	4.00	1			1

Table 3. Minimum Inhibitory Concentrations for Culture O, *M. marinum*

DRUG	Test Method	MIC	S	R	Other	Sum
Rifampin	Disk elution	0.50	3			3
Rifampin	Disk elution	1.00	2			2
Rifampin	Microtiter	0.25	1			1
Rifampin	Microtiter	0.60	1			1
Sulfamethoxazole	Disk elution	16.00	1			1
Sulfamethoxazole	Disk elution	32.00	1			1
Sulfamethoxazole	Disk elution	64.00		1		1
Sulfamethoxazole	Disk elution	128.00		1		1
Tetracycline	Disk elution	4.00	1			1
Tobramycin	Disk elution	8.00	1		1	2
Trimethoprim-Sulfamethoxazo	Microtiter	0.25	1			1
Trimethoprim-Sulfamethoxazo	Disk elution	0.50	1			1
Trimethoprim-Sulfamethoxazo	Disk elution	1.00	1			1