www.uthct.edu/microbiology 11-15-23

INTRODUCTION. Susceptibility testing, identification by DNA gene sequencing and DNA fingerprinting of the rapidly growing mycobacteria and other nontuberculous mycobacteria (NTM) and related aerobic actinomycetes are performed at the UTHSCT Mycobacteria/Nocardia Laboratory. The laboratory is College of American Pathologists (CAP) accredited and holds a CLIA license. We also have a Pennsylvania and California license.

The Mycobacteria/Nocardia Laboratory has been in operation for approximately 40 years and accepts pure culture isolates (not gross specimens) of the above groups of organisms for susceptibility, identification, and DNA fingerprinting. **Please note there will be an additional charge and increased turn-around time for any isolates that are not pure.** If desired, gross specimens should be submitted to the UTHSCT Pathology Laboratory (See Mycobacterium/Mycology Referral; call **903-877-5745** for details. Additional charges will apply).

Please note that if a mixed culture (e.g., more than one colony morphology), unless otherwise specified on the requisition, we will only work up the predominant organism type. If ID/MICs are requested on all colony types, please check/initial the box on the requisition.

SUSCEPTIBILITY TESTING. Susceptibility testing is performed using the CLSI recommended broth microdilution MIC method for the NTM, Nocardia, and other related aerobic actinomycetes. For rapidly growing mycobacteria (RGM), the routine panel of drugs* includes clarithromycin, amikacin, imipenem, linezolid, tigecycline, tobramycin (for *M. chelonae/immunogenum* complex), cefoxitin, moxifloxacin, ciprofloxacin, trimethoprim-sulfamethoxazole, and doxycycline and/or minocycline. Incubation time is 3-5 days at 30°C except for clarithromycin which is held up to 14 days to check for inducible *in vitro* resistance (*erm* gene). However, if isolates of the *Mycobacterium abscessus* subspecies*, M. chelonae, M. immunogenum* and *M. mucogenicum* complex are sequenced in our laboratory, extended incubation will not be necessary and the clarithromycin MICs will be reported after 3-4 days incubation as susceptible or resistant based on sequencing of the *erm* gene, *rpoB* sequence identification, and/or exclusion of a 23S rRNA gene mutation.

Due to recent findings of a new plasmid-mediated *erm* gene [erm (55)], we have now extended clarithromycin incubation for up to 2 weeks for most RGM (Brown-Elliott, et al., J. Clin. Microbiol. 2023).

In isolates with resistant clarithromycin MICs, macrolide mutational resistance can be confirmed by ordering macrolide mutational sequencing 23S rRNA (Test Code 13). Additionally, confirmation of amikacin mutational resistance can be performed in isolates with high level amikacin MICs by ordering 16S rRNA mutational sequencing (Test Code 13).

For Nocardia and other related aerobic actinomycetes, the panel of drugs* includes amoxicillin/clavulanic acid, linezolid, clarithromycin, trimethoprim-sulfamethoxazole, ciprofloxacin, moxifloxacin, ceftriaxone, imipenem, tobramycin, amikacin, doxycycline and/or minocycline. Incubation time is 3-5 days at 35°C for most species. Slowly growing NTM (other than *M. avium* complex and *M. kansasii*) are tested against clarithromycin, amikacin, trimethoprim-sulfamethoxazole, rifabutin, ciprofloxacin, moxifloxacin, minocycline, linezolid, and rifampin.

Current recommendations by the ATS and the CLSI M24, 3rd ed., 2018 advise testing only clarithromycin and amikacin against isolates of *Mycobacterium avium* complex (MAC) as these are the only agents which have been shown to have *in vitro* correlation of MICs with clinical response. Clarithromycin is used as a "class drug" in susceptibility testing of azithromycin and other related macrolides. Thus, isolates of MAC are tested only for susceptibility to clarithromycin and amikacin. Resistance to clarithromycin confers resistance to azithromycin and vice versa. It may be reasonable to test agents such as moxifloxacin and linezolid and these may, in some cases, provide useful adjunctive treatment options. They should not, however, be used as treatment substitutions for any of the standard treatment agents (macrolide, ethambutol, rifampin, rifabutin) and their efficacy for treatment remains unproven. First line TB agents (ethambutol, rifampin, and isoniazid) are not reported with isolates of MAC in accordance with CLSI and ATS recommendations. Recently CLSI recommended breakpoints for amikacin MICs ≥64 µg/mL (IV treatment) and >64 µg/mL (inhaled treatment) as resistant so that resistance would be defined as ≥64 µg/mL depending upon the method of administration of amikacin. Mutational resistance can be confirmed for clarithromycin and/or amikacin by ordering Test Code 13 and specifying amikacin, clarithromycin or both.

In accordance with the American Thoracic Society (ATS) and CLSI recommendations, isolates of *M. kansasii* are reported with rifampin and clarithromycin susceptibility only, if they are rifampin susceptible. Additional agents can be included with special physician requests. Rifampin resistant *M. kansasii* will include a panel of drugs (same as noted for slowly growing NTM other than MAC). Incubation time is 7-14 days at 35°C. Please note that CLSI (M24, 3rd ed., 2018) no longer recommends *in vitro* MIC testing of ethambutol due to technical problems in testing this antimicrobial.

The methods and breakpoints for susceptibility testing of RGM and aerobic actinomycetes have been published by the CLSI. Recommendations for breakpoints for these organisms using the broth microdilution MIC method with nine drugs (amikacin, tobramycin, trimethoprim-sulfamethoxazole (TMP-SMX), cefoxitin, imipenem, linezolid, doxycycline/minocycline, clarithromycin and ciprofloxacin) are shown in Tables 1, 2, and 4. Breakpoints for tigecycline have not been addressed by the CLSI yet for NTM or other aerobic actinomycetes. However, our laboratory will report MICs to tigecycline for RGM without interpretation as has recently been recommended by the CLSI (M24, 3rd ed., 2018; M24S, 2023).

Generally, turn-around-time (T-A-T) for susceptibility testing is approximately **14-30 working days** for RGM (includes macrolide induction testing if sequencing is not 3 ordered), **7–14 working days** for Nocardia and related aerobic actinomycetes, and **21-35 working days** for the slowly growing NTM and some other aerobic actinomycetes.

Please note, if isolates are identified in our laboratory as containing a functional erm gene (i.e., most *M. abscessus* subsp*. abscessus*, *M. abscessus* subsp. *bolletii)*, these isolates will be reported as macrolide resistant and 14d clarithromycin induction will not be required. T-A-T for susceptibility will be reduced to approximately 7-10 working days, provided the culture submitted is a pure culture isolate and no problems occur with growth (Nash, et al., AAC 2006;50:3476; Nash, et al., JAC 2005:55:170; Brown-Elliott et al., 2015;53:1211).

If the isolate is identified in our laboratory as *M. senegalense, M. peregrinum, M. chelonae, M. abscessus* subsp*. massiliense, M. immunogenum, M. mucogenicum* complex or a sequence variant of *M. abscessus* which does not harbor a functional *erm* gene, it will be reported as macrolide susceptible without 14d induction (Brown-Elliott et al., JCM 2015;53:875). Again, T-A-T will be reduced to approximately 7-10 working days with the same provisions as described above. Other RGM species currently will require extended incubation to phenotypically describe macrolide susceptibility.

Isolates of *Mycobacterium haemophilum* are tested using the CLSI recommended agar disk elution method with hemin supplementation (CLSI, 2011). These isolates require longer incubation with an average T-A-T of approximately 6 weeks. The susceptibility panel includes amikacin, ciprofloxacin, clarithromycin, doxycycline and/or minocycline, linezolid, rifampin, and TMP-SMX.

The T-A-Ts given assume receipt of a viable pure culture isolate. Results are sent by FAX and mail. **FOR SUSCEPTIBILITY RESULTS OR TO CHECK RECEIPT OF ISOLATES PLEASE CALL (903) 877-7978.**

Recent studies have shown that previously treated isolates of *M. abscessus* may be difficult to grow adequately for susceptibility testing in broth, probably due to antibiotic pressure and stress on the isolates. Extended incubation, which may be deleterious to some antimicrobials may be required and if so, this will be noted on the report. If the organism does not grow within 5 days, the report will state that susceptibility testing is unable to be performed within the acceptable time period. Molecular sequencing of the 16S rRNA gene and *erm* gene are recommended to determine amikacin and clarithromycin susceptibility/resistance respectively. (Amikacin and clarithromycin are two important agents used for treatment of *M. abscessus*.) Clinical consultation for treatment recommendations and interpretation of these results should be considered.

If the 14-day clarithromycin MIC result is 4 µg/mL (intermediate), the submitter should consider ordering *erm* gene sequencing to more accurately and rapidly determine susceptibility/resistance of the isolate.

More studies are needed to assess the utility of sequencing of the *erm* gene among isolates of the *M. fortuitum* complex except for isolates of *M. senegalense* and *M. peregrinum* which do not contain functional *erm* genes. Until such evaluations are performed, extended (up to 14 days) incubation of isolates to assess macrolide susceptibility/resistance will be required unless the isolate has an initial (3-5 day) MIC of ≥8 µg/mL (suggesting mutational resistance which can be confirmed by ordering Test code 13, for clarithromycin gene mutation).

IDENTIFICATION. The application of molecular techniques for the identification of mycobacteria and nocardia has become the “gold standard” among methods of identification for these species.

The Mycobacteria/Nocardia Laboratory primarily uses *rpoB* sequencing along with *erm* gene sequence for identification of most clinically significant nonpigmented rapidly growing mycobacteria (Adekambi 2003; Steingrube 1995, 1997; Nash 2009). However, for slowly growing mycobacteria, Nocardia and other aerobic actinomycetes, sequence analysis of 500 bp segment of the 16S rRNA gene is also often used. Sequencing of the entire 16S rRNA gene (approximately 1500 bp) is not a practical method for routine test identification and thus sequencing of other target genes may be necessary. If species identification is not possible using the 16S rRNA, our laboratory, in some cases, will perform full 16S rRNA gene sequencing upon request. The interpretation of gene sequences follows the recommendations of the CLSI published in the MM18, 2nd ed. (CLSI, 2018). Isolates which give indeterminate results may be submitted for additional testing which may include full 16S rRNA sequence and/or multi-gene sequence analysis if required.

Recent studies have shown interspecies gene transfer among species and subspecies of RGM especially within the *M. abscessus* subspecies, *M. chelonae* and *M. fortuitum* complexes. This new finding necessitates the use of multiple gene sequences in order to determine definitive identification of species level. This additional step adds a significant amount of work to the identification process, and we will be re-assessing our T-A-Ts (based on working days) as time to finalize test results will be longer. Preliminary test results should, however, be available in approximately 72 hours. Please call us if you have an urgent need for identification of an isolate and we will attempt to identify as soon as possible.

FOR SEQUENCING OR DNA STRAIN TYPING RESULTS, PLEASE CALL (903) 877-5947 or (903) 877-7683.

DNA FINGERPRINTING. Isolates of NTM or other aerobic actinomycetes may also be submitted for DNA fingerprinting. The isolates will first be subcultured to check for purity and then sequenced to determine if strain typing is appropriate. If they are not the same species/subspecies, strain typing is not required. Techniques used for strain typing in cases of outbreaks, pseudo-outbreaks, or epidemics include pulsed-field gel electrophoresis (PFGE). Variable number tandem repeat (VNTR) is also available for

strain typing of *Mycobacterium avium* and *M. intracellulare* (Iakhiaeva et al., 2013; Iakhiaeva et al., 2016). Before sending isolates for restriction fragment length polymorphism (RFLP) analysis, please call for consultation. T-A-T for PFGE is approximately 6-8 weeks and 1-2 weeks for VNTR from receipt of the isolate depending on the type and number of organisms submitted for testing. (See Fees for Laboratory Services)

The PFGE instrumentation is no longer being manufactured. However, we have been working to obtain a used instrument. Please call (903) 877-7685 for availability/status.

FOR TECHNICAL CONSULTATION CALL BARBARA BROWN-ELLIOTT AT (903) 877-7685.

***Subject to Change (See Table 3 for expanded current panels available)**

Table 1. Suggested broth microdilution breakpoints for rapidly growing mycobacteria[a].

	Minimal Inhibitory Concentration (µg/mL) for Category		
Antimicrobial Agent	**Susceptible**	**Intermediate**	**Resistant**
Amikacin[b]	≤16	32	≥64
Cefoxitin	≤16	32-64	≥128
Ciprofloxacin	≤1	2	≥4
Clarithromycin	≤2	4	≥8
Doxycycline/Minocycline	≤1	2-4	≥8
Imipenem/Meropenem	≤4	8-16	≥32
Linezolid	≤8	16	≥32
Moxifloxacin	≤1	2	≥4
Tigecycline[c]	-	-	-
Tobramycin[d]	2	4	≥8
Trimethoprim-Sulfamethoxazole	≤2/38	-	≥4/76

[a] Breakpoints from the CLSI M24S, 2023.

[b] Amikacin resistance ≥64 µg/mL applies to IV treatment; >64 µg/mL is considered resistant for inhaled treatment. (Amikacin resistance can also be confirmed by sequencing the 16S rRNA gene for the mutation, Test Code 13).

[c] There are no interpretive criteria for tigecycline established with nontuberculous mycobacteria currently. MICs for tigecycline are given without interpretation of values.

[d] Tobramycin MIC is only reported for *M. chelonae* complex.

Table 2. CLSI Suggestions for susceptibility testing of the *M. abscessus* subspecies, *M. chelonae*, and the *M. fortuitum* complexes by broth microdilution[a].

Drug	Comment
Tobramycin	If the initial MIC is >4 µg/mL, the test should be repeated. If the repeat result is >4 µg/mL, the MIC should be reported with a comment.[b]
Sulfonamides	MIC is read at 80% inhibition of growth.
Doxycycline	Breakpoints are 8 µg/mL (resistant).
Cefoxitin	Breakpoints are 128 µg/mL (resistant).
Imipenem	If MIC for *M. fortuitum* complex, *M. smegmatis* complex, or *M. mucogenicum* complex is >8 µg/mL, test should be repeated with incubation period of no more than 3 days. If the repeat result is >8 µg/mL, the MIC should be reported with comment.[b]
Amikacin	Isolates of *M. abscessus* for which MIC is >64 µg/mL should be retested. If the repeat result is >64 µg/mL, the MIC should be reported with a comment.[b]
Clarithromycin	Isolates of *M. fortuitum* complex with a trailing endpoint should be considered resistant. Extended incubation up to 14 days should be performed to detect the inducible *erm* gene.

[a] For laboratories that infrequently isolate rapidly growing mycobacteria, sending isolates to an experienced reference laboratory is recommended. For laboratories that perform MIC testing, (i) proficiency testing by comparison of test results with those of an experienced reference laboratory is necessary upon initial validation and at regular intervals thereafter and (ii) identification of isolates to the species level or, at a minimum, differentiation of the *M. fortuitum* complex from the *M. chelonae* complex and *M. abscessus* subspecies is recommended.

[b] Comment: (i) the MIC is greater than expected for this species and (ii) if the drug is being considered for therapy, the laboratory should be notified so the isolate can be sent to a reference laboratory for confirmation of resistance. Please note that isolates of *M. immunogenum* are usually resistant to tobramycin (MIC >4 µg/mL) in contrast to isolates of *M. chelonae* which usually have tobramycin MICs ≤2 µg/mL. Therefore, sequence identification may also be helpful.

Table 3. Antibiotic Panels Available

Slowly Growing Mycobacteria*[1,2]	**Rapidly Growing Mycobacteria**	**Nocardia**
Amikacin	Amikacin	Amikacin
Ciprofloxacin (Augmentin)	Cefoxitin	Amoxicillin-Clavulanic Acid
Clarithromycin[3]	Ciprofloxacin	Ceftriaxone
Doxycycline or Minocycline	Clarithromycin	Ciprofloxacin
Linezolid[4]	Doxycycline	Clarithromycin[3]
Moxifloxacin[4]	Clarithromycin[3]	Doxycycline
Rifabutin	Imipenem	Imipenem
Rifampin	Linezolid	Linezolid
Trimethoprim/Sulfamethoxazole (TMP-SMX)	Minocycline	Minocycline
	Moxifloxacin	Moxifloxacin
	TMP-SMX	TMP-SMX
	Tigecycline[5]	Tobramycin
	Tobramycin[6]	

[1] Please note that the MIC testing of ethambutol (which is considered to be inconsistent and unreliable by many investigators) has recently been removed from testing by the CLSI.

[2] Isolates of *Mycobacterium avium* complex (MAC) are routinely tested for clarithromycin and amikacin susceptibility only, and rifampin susceptible *M. kansasii* are tested for susceptibility to rifampin and clarithromycin only.

[3] Class drug for newer macrolides (i.e., azithromycin and clarithromycin) .

[4] Upon request, isolates of MAC may be tested for susceptibility to moxifloxacin and linezolid but no first line TB drugs are reported.

[5] MIC reported without interpretation since no breakpoints yet established.

[6] MIC only reported for *M. chelonae* complex.

**Upon physician request, isolates of rifampin susceptible *M. kansasii* may be tested for susceptibility to other agents.

TMP-SMX=Trimethoprim-sulfamethoxazole

NOTE: Antimicrobials tested are subject to change.

For availability of susceptibilities to agents other than listed above, please call (903) 877-7685, or (903) 877-7978.

Special requests: Bedaquiline, clofazimine, eravacycline, omadacycline, tedizolid, meropenem, ertapenem. (There are no interpretive criteria or breakpoints established with these antimicrobials, other than meropenem, see Table 1).

Table 4. Suggested broth microdilution interpretive criteria for Nocardia and other aerobic actinomycetes.[1]

	Minimal Inhibitory Concentration (µg/mL) for Category		
Antimicrobial Agent	**Susceptible**	**Intermediate**	**Resistant**
Amikacin	≤8	-	≥16
Amoxicillin/Clavulanic Acid	≤8/4	16/8	≥32/16
Ceftriaxone	≤8	16-32	≥64
Ciprofloxacin	≤1	2	≥4
Clarithromycin	≤2	4	≥8
Imipenem	≤4	8	≥16
Linezolid	≤8	-	-
Minocycline/Doxycycline	≤1	2-4	≥8
Moxifloxacin	≤1	2	≥4
Rifampin	≤1	2	≥4
TMP-SMX	≤2/38	-	≥4/76
Tobramycin	≤4	8	≥16
Vancomycin	≤2	4-8	≥16

[1]Reference for breakpoints: CLSI, M24S, 2023.

TMP-SMX = Trimethoprim-Sulfamethoxazole

Vancomycin and rifampin are added for isolates of *Rhodococcus equi* (CLSI M24, 3rd ed., 2018; M24S, 2023).

Table 5. Suggested broth microdilution breakpoints for slowly growing nontuberculous mycobacteria.[1]

	Minimal Inhibitory Concentration (µg/mL) for Category		
Antimicrobial Agent	**Susceptible**	**Intermediate**	**Resistant**
Amikacin[2,3]	≤16	32	≥64
Rifampin	≤1	-	≥ 2
Ethambutol[4]	≤2	4	≥8
Rifabutin	≤2	-	≥4
Ciprofloxacin	≤1	2	≥4
TMP-SMX[5]	≤32 (2/38)	-	≥64(4/76)
Clarithromycin[3]	≤8	16	≥32
Moxifloxacin	≤1	2	≥4
Linezolid	≤8	16	≥32
Minocycline, Doxycycline	≤1	2-4	>8

[1] CLSI: M24S, 2023.

[2] Amikacin >64 µg/mL is considered resistant for inhaled treatment; ≥64 µg/mL is considered resistant using IV amikacin treatment. Confirmation of amikacin resistance can be done by ordering mutational sequencing of the 16S rRNA gene (Test Code 13).

[3] Only clarithromycin and amikacin are routinely reported for MAC isolates. Clarithromycin serves as a class drug for all newer macrolides (especially azithromycin).

[4] Please note that the MIC testing of ethambutol, which is considered to have inconsistent and unreliable MICs by many investigators, is currently not recommended by the CLSI.

[5] TMP-SMX = Trimethoprim-Sulfamethoxazole

References

1. Adekambi T, Colson P, Drancourt M: *rpoβ*-based identification of nonpigmented and late pigmenting rapidly growing mycobacteria. J. Clin.Microbiol. 41:5699-5708, 2003.

2. Body BA, Beard MA, Slechta ES, Hanson KE, Barker AP, Babady NE, McMillen T, Tang, Y-W, Brown-Elliott BA, Iakhiaeva E, Vasireddy R, Vasireddy S, Smith T, Wallace Jr. RJ, Turner S, Curtis L, Butler-Wu S, Rychert J: Evaluation of the Vitek MS v3.0 matrix-assisted laser desorption ionization-time of flight mass spectrometry system for identification of *Mycobacterium* and *Nocardia* species*.* J. Clin. Microbiol. 56(6):e00237-18, June 2018.

3. Brown BA, Lopes JO, Wilson RW, Costa JM, de Vargas AC, Alves SH, Klock C, Onyi GO, Wallace Jr. RJ: Disseminated *Nocardia pseudobrasiliensis* infection in a patient with AIDS in Brazil. Clin. Infect. Dis. 28:144-145, January 1999.

4. Brown BA, Springer B, Steingrube VA, Wilson RW, Pfyffer GE, Garcia MJ, Menendez MC, Rodriguez-Salgado B, Jost KC Jr., Chiu SH, Onyi GO, Bottger EC, Wallace Jr. RJ: *Mycobacterium wolinskyi* sp. nov. and *Mycobacterium goodii* sp. nov., two new rapidly growing species related to *Mycobacterium smegmatis* and associated with human wound infections: a cooperative study from the International Working Group on Mycobacterial Taxonomy. Int. J. Syst. Bacteriol. 49:1493-1511, 1999.

5. Brown BA, Swenson, JM, Wallace Jr. RJ: Broth microdilution MIC test for rapidly growing mycobacteria. In: Clinical Microbiology Procedures Handbook, Sect. 5: Antimicrobial Susceptibility Testing, p. 5.11.1, American Society for Microbiology. In: Clinical Microbiology Procedures Handbook, Sect. 5: Antimicrobial Susceptibility Testing, p. 5.11.1, American Society for Microbiology Book Division, Washington, DC, 1992.

6. Brown BA, Wallace Jr. RJ: Broth microdilution MIC test for *Nocardia* spp. In: Clinical Microbiology Procedures Handbook, Section 5: Antimicrobial Susceptibility Testing, p. 5.12.1. American Society for Microbiology Book Division, Washington, DC. 1992.

7. Brown BA, Wallace RJ Jr, Onyi G: Activities of clarithromycin against eight slowly growing species of nontuberculous mycobacteria, determined by using a broth microdilution MIC system. Antimicrob. Agents Chemother. 36:1987-1990, September, 1992.

8. Brown-Elliott BA: Laboratory diagnosis and antimicrobial susceptibility testing of nontuberculous mycobacteria. In: Nontuberculous Mycobacterial Disease, D.E. Griffith, ed. Humana Press, Switzerland, p. 15-59, 2018.

9. Brown-Elliott BA, Brown JM, Conville PS, Wallace Jr. RJ: Clinical and laboratory features of the *Nocardia* spp. based on current molecular taxonomy. Clin. Microbiol. Rev. 19:259-282, 2006.

10. Brown-Elliott BA, Cirillo D, Musser K ,Rowlinson M-C. Susceptibility test methods: Mycobacteria, *Nocardia*, and other actinomycetes. In: Manual of Clinical Microbiology, 13th Edition, KC Carroll, MA Pfaller, JA Karlowsky, AJ McAdam, ML Landry, R Patel, BS Pritt, eds. ASM Press, Washington, D.C., 2023, Vol 2; 79:1548-1579.

11. Brown-Elliott, BA, Cohen, S, Wallace Jr. RJ.: Susceptibility testing of mycobacteria. In: Antimicrobial Susceptibility Testing Protocols, R Schwalbe, L Steele-Moore, AC Goodwin, eds. CRC Press, Boca Raton, FL. 2007; 11:243-274.

12. Brown-Elliott BA, Crist CJ, Mann LB, Wilson RW, Wallace Jr. RJ: *In vitro* activity of linezolid against slowly growing nontuberculous mycobacteria. Antimicrob. Agents Chemother. 47:1736-1738, May 2003.

13. Brown-Elliott BA, Eagle G, Wallace Jr. RJ, van Ingen J, Pennings LJ, Berry B, Pandley S, Coulter C. Syrmis M, Winthrop KL, Griffith DE: Amikacin liposome inhalation suspension (ALIS) add-on therapy for refractory *Mycobacterium avium* complex (MAC) lung disease: Effect of *in vitro* amikacin susceptibility on sputum culture conversion. Open Forum Infect. Dis. 5(Suppl 1):S288-S289, November 2018.

14. Brown-Elliott BA, Fritsche TR, Olson BJ, Vasireddy S, Vasireddy R, Iakhiaeva E, Alame D, Wallace Jr. RJ, Branda JA: Comparison of two commercial matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS) systems for identification of nontuberculous mycobacteria. Am. J. Clin. Pathol. 152(4):527-536, October 2019.

15. Brown-Elliott BA, Hanson K, Vasireddy S, Iakhiaeva E, Nash KA, Vasireddy R, Parodi N, Smith T, Gee M, Strong A, Baker A, Cohen S, Muir H, Slechta ES, Wallace Jr. RJ: Absence of a function *erm* gene in isolates of *Mycobacterium immunogenum* and the *Mycobacterium mucogenicum* group, based on in vitro clarithromycin susceptibility. J. Clin. Microbiol. 53:875-878, 2015.

16. Brown-Elliott BA, Harrington SM, Morimoto K, Wallace Jr. RJ: *Mycobacterium:* Clinical and laboratory characteristics of rapidly growing mycobacteria. In: Manual of Clinical Microbiology, 13th Edition, K.C. Carroll, M.A. Pfaller, eds. ASM Press, Washington, D.C. 2023, Vol. 1, 33:657-680.

17. Brown-Elliott BA, Iakhiaeva E, Griffith DE, Woods G, Stout JE, Wolfe CR, Turenne C, Wallace Jr. RJ.: *In vitro* activity of amikacin against isolates of *Mycobacterium avium* complex with proposed MIC breakpoints and finding of a 16S rRNA gene mutation in treated isolates. J. Clin. Microbiol. 51:3389- 3394, 2013.

18. Brown-Elliott BA, Killingley J, Vasireddy S, Bridge L, Wallace Jr. RJ: *In vitro* comparison of ertapenem, meropenem, and imipenem against isolates of rapidly growing mycobacteria and *Nocardia*. J. Clin. Microbiol. 54(6):1586-1592, June 2016.

19. Brown-Elliott BA, Nash KA, Wallace Jr. RJ. Antimicrobial susceptibility testing, drug resistance mechanisms, and therapy for infections with nontuberculous mycobacteria. Clin. Microbiol. Rev. 25:545-582, 2012.

20. Brown-Elliott BA, Philley J: Rapidly growing mycobacteria. Microbiol. Spectrum 5(1):TNM17-0027-2016, January 2017.

21. Brown-Elliott BA, Philley JV, Griffith DE, Thakkar F, Wallace Jr. RJ: *In vitro* susceptibility testing of bedaquiline against *Mycobacterium avium* complex. Antimicrob. Agents Chemother. 61(2): 01798-16, January 24, 2017.

22. Brown-Elliott, BA., Vasireddy S, Vasireddy R, Iakhiaeva E, Howard ST, Nash K, Parodi N, Strong A, Gee M, Smith T, Wallace Jr. RJ: Utility of sequencing the *erm*(41) gene in isolates of *Mycobacterium abscessus* subsp. *abscessus* with low and intermediate clarithromycin MICs. J. Clin. Microbiol. 53:1211- 1215, 2015.

23. Brown-Elliott BA, Wallace Jr. RJ: Clinical and taxonomic status of pathogenic nonpigmented or late-pigmenting rapidly growing mycobacteria. Clin. Microbiol. Rev. 15:716-746, October 2002.

24. Brown-Elliott BA, Wallace Jr. RJ: *Mycobacterium*: Clinical and laboratory characteristics of rapidly growing mycobacteria. In: Manual of Clinical Microbiology, 12th Edition, K.C. Carroll, ed. ASM Press, Washington, D.C. 2019, Vol. 1; 34:612-629.

25. Brown-Elliott BA, Wallace Jr. RJ: Rapidly growing mycobacteria. In: Tuberculosis & Nontuberculous Mycobacterial Infections, 6th edition, D Schlossberg, ed. McGraw-Hill Companies, Inc. 37:565-577, 2011.

26. Brown-Elliott BA, Wallace Jr. RJ: *In vitro* susceptibility testing of tedizolid against nontuberculous mycobacteria. J. Clin. Microbiol. 55(6):1747-1754, June 2017.

27. Brown-Elliott BA, Wallace Jr. RJ: *In vitro* susceptibility testing of tedizolid against isolates of *Nocardia*. Antimicrob. Agents Chemother. 61(12):e01537-17, December 2017.

28. Brown-Elliott BA, Wallace Jr. RJ: *In vitro* susceptibility testing of bedaquiline against *Mycobacterium abscessus* complex. *Antimicrob. Agents Chemother.* 63(2):e01919-18, February 2019.

29. Brown-Elliott BA, Wallace Jr. RJ: *In vitro* susceptibility testing of omadacycline against nontuberculous mycobacteria (NTM). Antimicrob. Agents Chemother. 2021; 65(3):e-01947-20 doi:10.1128/AAC.01947-20. March 2021.

30. Brown-Elliott BA, Wallace Jr. RJ: *In vitro* susceptibility testing of eravacycline against nontuberculous mycobacteria (NTM). Antimicrob. Agents Chemother. 66(9):e0130422, August 2022; ERRATUM 66(11):e00689-22, November 2022.

31. Brown-Elliott BA, Wallace Jr. RJ, Wengenack NL, Workman SD, Cameron ADS, Bush G, Hughes MD, Melton S, Gonzalez-Ramirez B, Rodriguez E, Somayaji K, Klapperich C, Viers, M, Bolaji AJ, Rempel E, Alexander DC. Emergence of inducible macrolide resistance in *Mycobacterium chelonae* due to a broad-host-range plasmid and chromosomal variants of the novel 23S rRNA methylase gene, *erm*(55)**.** J. Clin. Microbiol. 61(7):e0042823, July 2023.

32. Brown-Elliott BA, Ward SC, Crist CJ, Mann LB, Wilson RW, Wallace Jr. RJ*: In vitro* activities of linezolid against multiple *Nocardia* species. Antimicrob. Agents Chemother. 45:1295-1297, April 2001.

33. Brown-Elliott, BA., Woods GL: Antimycobacterial susceptibility testing of nontuberculous mycobacteria. J. Clin. Microbiol. 57(10):e00834-19, October 2019.

34. Brown-Elliott BA, Zelazny A, Conville P. Nocardia, Rhodococcus, Gordonia, Actinomadura, Streptomyces, and other Aerobic Actinomycetes. In: Manual of Clinical Microbiology, 13th Edition, K.C. Carroll, M.A. Pfaller, eds. ASM Press, Washington, D.C., 2023, Vol 2, 79:1548-1579.

35. Burns DN, Wallace Jr. RJ, Schultz M, Zhang Y, Zubairi S, Pang Y, Gibert C, Brown BA, Noel E, Gordin FM: Nosocomial outbreak of respiratory tract colonization with *Mycobacterium fortuitum*: Demonstration of the usefulness of pulse-field gel electrophoresis in an epidemiologic investigation. Am. Rev. Respir. Dis. 144:1153-1159, 1991.

36. Caulfield AJ, Richter E, Brown-Elliott BA, Wengenack NL: *Mycobacterium*: Laboratory characteristics of slowly growing mycobacteria other than *Mycobacterium tuberculosis*. In: Manual of Clinical Microbiology, 13th Edition, KC Carroll, MA Pfaller, JA Karlowsky, AJ McAdam, ML Landry, R Patel, BS Pritt, eds. ASM Press, Washington, D.C. 2023, Vol. 1, 32:639-656.

37. Clinical and Laboratory Standards Institute. Susceptibility testing of mycobacteria, *nocardia*, and other aerobic actinomycetes; Approved Standard-Second Edition. CLSI, 2011 document M24-A2.

38. CLSI. Susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes. 3rd ed. CLSI M24. Wayne, PA: Clinical and Laboratory Standards Institute; 2018.

39. CLSI. Performance standards for susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes. 2nd ed. CLSI M24S. Wayne PA: Clinical and Laboratory Standards Institute; 2023.

40. Conville P, Brown-Elliott BA: *Nocardia, Rhodococcus, Gordonia, Actinomadura, Streptomyces* and other Actinomycetes. In: Manual of Clinical Microbiology, 12th Edition, KC Carroll, ed. ASM Press, Washington, D.C. 2019, Vol. 1; 30:525-557.

41. Conville PS, Brown-Elliott BA, Smith T, Zelazny AM: The complexities of *Nocardia* taxonomy and identification. J. Clin. Microbiol. 56:e01419-17, 2018.

42. Conville PS, Zelazny AM, Witebsky FG: Analysis of secA1 gene sequences for identification of *Nocardia* species. J. Clin. Microbiol. 2006; 44:2760-2766.

43. Forbes BA, Banaiee N, Beavis KG, Brown-Elliott BA, Della Latta P, Elliott LB, Hall GS, Hanna B, Perkins MD, Siddiqi SH, Wallace RJ Jr, Warren NG: Laboratory detection and identification of mycobacteria; Approved guideline. Clinical and Laboratory Standards Institute, M48-A, 2008.

44. BA, Miller MB, Banaiee N, Brown-Elliott BA, Das S, Pentella MA, Salfinger M, Sharma MK, Somoskovi A, Tans-Hersten J, Tenover FC, Warshauer D, Zelazny, AM: Laboratory detection and identification of mycobacteria. 2nd ed. Clinical and Laboratory Standards Institute (CLSI), M48, September 2018.

45. Griffith DE, Aksamit T, Brown-Elliott BA, Catanzaro A, Daley C, Gordin, Holland SM, Horsburgh R, Huittt G, Iademarco MF, Iseman M, Olivier K, Ruoss S, von Reyn FC, Wallace Jr. RJ, Winthrop K. An Official ATS/IDSA Statement: Diagnosis, Treatment, and Prevention of Nontuberculous Mycobacterial Diseases. Am. Respir. Crit. Care Med, 175:367-416, 2007.

46. Griffith DE, Thomson R, Flume PA, Aksamit TR, Field SK, Addrizzo-Harris DJ, Morimoto K, Hoefsloot W, Mange KC, Yuen DW, Ciesielska M, Wallace Jr. RJ, van Ingen J, Brown-Elliott BA, Coulter C, Winthrop KL, for the CONVERT Study Group. 2021. Amikacin liposome inhalation suspension for refractory MAC lung disease: Sustainability and durability of culture conversion and safety of long-term exposure. Chest. 160(3):831-842, 2021.

47. Hector JSR, Pang Y, Mazurek GH, Zhang Y, Brown Ba, Wallace Jr. RJ: Large restriction fragment patterns of genomic *Mycobacterium fortuitum* DNA as strain-specific markers and their use in epidemiologic investigation of four nosocomial outbreaks. J. Clin. Microbiol.30:1250-1255, 1992.

48. Iakhiaeva E, McNulty S, Brown-Elliott BA, Falkin ham III JO, Williams MD, Vasireddy R, Wilson RW, Turenne C, Wallace Jr. RJ: Mycobacterial interspersed repetitive-unit-variable-number tandem-repeat (MIRU-VNTR) genotyping of *Mycobacterium intracellulare* for strain comparison with establishment of a PCR-based database. J. Clin. Microbiol. 51:409-416, 2013.

49. Iakhiaeva E, Howard ST, Brown-Elliott BA, McNulty S, Newman KL, Falkinham III JO, Williams M, Kwait R, Lande L, Vasireddy R, Turenne C, Wallace Jr. RJ: Variable-number tandem-repeat analysis of respiratory and household water biofilm isolates of "*Mycobacterium avium* subsp*. hominissuis*" with establishment of a PCR database. J. Clin. Microbiol. 54:891-901, 2016.

50. Lai KK, Brown BA, Westerling JA, Fontecchio SA, Zhang Y, Wallace Jr. RJ: Long-term laboratory contamination by *Mycobacterium abscessus* resulting in two pseudo-outbreaks: Recognition with use of random amplified polymorphic DNA (RAPD) polymerase chain reaction. Clin. Infect. Dis. 27:169-175, 1998.

51. Macheras E, Roux A-L, Ripoll F, Sivadon-Tardy V, Gutierrez C, Gaillard J-L, Heym B: Inaccuracy of single-target sequencing for discriminating species of the *Mycobacterium abscessus* group. J. Clin. Microbiol. 47:2596-2600, 2009.

52. Macheras E, Roux A-L, Bastian S, Leao SC, Palaci M, Silvadon-Tardy V, Gutierrez C, Richter E, Rusch-Gerdes S, Pfyffer G, Bodmer T, Cambau E, Gaillard J-L, Heym B: Multilocus sequence analysis and *rpoB* sequencing of *Mycobacterium abscessus* (sensu Lato) strains. J. Clin. Microbiol. 49:491- 499, 2011.

53. McBride ME, Rudolph AH, Tschen JA, Cernoch P, Davis J, Brown BA, Wallace Jr. RJ: Diagnostic and therapeutic considerations for cutaneous *Mycobacterium haemophilum* infections. Arch. Dermatol. 127:276-277, February, 1991.

54. Meier A, Heifets L, Wallace Jr. RJ, Zhang Y, Brown BA, Sander P, Bottger EC. Molecular mechanisms of clarithromycin resistance in *Mycobacterium avium*: observation of multiple 23S rDNA mutations in a clonal population. The J. Infect. Dis. 174:354-60, 1996.

55. Nash KA, Andini N, Zhang Y, Brown-Elliott BA, Wallace Jr. RJ: Intrinsic macrolide resistance in rapidly growing mycobacteria. Antimicrob. Agents Chemother. 50:3476-3478, 2006.

56. Nash KA, Brown-Elliott, BA, Wallace Jr. RJ: A novel gene *erm*(41), confers inducible macrolide resistance to clinical isolates of *Mycobacterium abscessus* but is absent from *Mycobacterium chelonae*. Antimicrob. Agents Chemother, 53:1367-1376, 2009.

57. Nash KA, Zhang Y, Brown-Elliott BA, Wallace Jr. RJ: Molecular basis of intrinsic macrolide resistance in clinical isolates of *Mycobacterium fortuitum*. J. Antimicrob. Chemother. 55:170-177, 2005.

58. Olivier KN, Griffith DE, Eagle G, McGinnis li JP, Micioni L, Liu K, Daley CL, Withrop KL, Ruoss S, Addrizzo-Harris DJ, Flume PA, Dorgan D, Salathe M, Brown-Elliott BA, Gupta R., Wallace Jr. RJ**:** Randomized trial of liposomal amikacin for inhalation in nontuberculous mycobacterial lung disease. Am. J. Crit. Care Med. 195:814-823, March 2017.

59. Parrish NM, Wengenack NL, Barker A, Brown-Elliott BA, Cirillo DM, Harrington S, Khare R, Killian SB, Pfeltz R, Richter E, Rowlinson M-C, Zelazny AM: Performance standards for susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes. Clinical and Laboratory Standards Institute, 2nd ed., CLSI supplement M24S, 2023.

60. Petti CA, Bosshard PP, Brandt ME, Clarridge JE III, Feldblyum TV, Foxall P, Furtado MR, Pace N, and Procop G. Interpretive criteria for identification of bacteria and fungi by DNA target sequencing; Approved Guideline. Clinical and Laboratory Standards Institute, MM18-A, 2008.

61. Richter E, Brown-Elliott BA, Wallace Jr. RJ: *Mycobacterium*: Laboratory characteristics of slowly growing mycobacteria. In: Manual of Clinical Microbiology, 9th Edition, P.R. Murray, ed. ASM Press, Washington, D.C. 2011, Vol. 1, pp. 503-524.

62. Ruimy R, Riegel P, Carlotti A, Boiron P, Bernardin G, Monteil H, Wallace Jr. RJ, Christen R: *Nocardia pseudobrasiliensis* sp. nov., a new species of Nocardia which groups bacterial strains previously identified as Nocardia brasiliensis and associated with invasive diseases. Intern. J. Syst. Bacteriol.46:259-264, Jan.,1996.

63. Salfinger M, Brown-Elliott BA: Antimicrobial susceptibility testing for slowing growing nontuberculous mycobacteria. In: Clinical Microbiology Procedures Handbook, 4th Edition, AL Leber, CAB Burnham, eds. ASM Press Washington DC, 2022. 7.9.2.

64. Schinsky MF, Morey RE, Steigerwalt AG, Douglas MP, Wilson RW, Floyd MM, Butler WR, Daneshvar MI, Brown-Elliott BA, Wallace Jr. RJ, McNeil MM, Brenner DJ, Brown JM: Taxonomic variation in the *Mycobacterium fortuitum* third biovariant complex: description of *Mycobacterium boenickei* sp*. nov., Mycobacterium houstonense* sp. nov., *Mycobacterium neworleansense* sp. nov. and *Mycobacterium brisbanense* sp. nov. and recognition of *Mycobacterium porcinum* from human clinical isolates. Int. J. Syst. Evol. Microbiol. 54:1653-1667, March 2004.

65. Shapiro CL, Haft RF, Gantz NM, Doern GV, Christenson JC, O'Brien R, Overall JC, Brown BA, Wallace Jr. RJ: *Tsukamurella paurometabolum*: A novel pathogen causing catheter-related bacteremia in patients with cancer. Clin. Infect. Dis. 14:200-203, January, 1992.

66. Steingrube VA, Brown BA, Gibson JL Wilson RW, Brown J, Blacklock Z, Jost K, Locke S, Ulrich RF, Wallace Jr. RJ: DNA amplification and restriction endonuclease analysis for differentiation of 12 species and taxa of *Nocardia*, including recognition of four new taxa within the *Nocardia asteroides* complex. J. Clin. Microbiol. 33:3096-3101, 1995.

67. Steingrube VA, Gibson JL, Brown BA, Zhang Y, Wilson RW, Rajagopalan M, Wallace Jr. RJ: PCR amplification and restriction endonuclease analysis of a 65-kilodalton heat shock protein gene sequence for taxonomic separation of rapidly growing mycobacteria. J. Clin. Microbiol. 33:149-153, January,1995.

68. Steingrube VA, Wilson RW, Brown BA, Jost KC Jr., Blacklock Z, Gibson JL, Wallace Jr. RJ: Rapid identification of clinically significant species and taxa of aerobic actinomycetes, including *Actinomadura, Gordona, Nocardia, Rhodococcus, Streptomyces,* and *Tsukamurella* isolates, by DNA amplification and restriction endonuclease analysis. J. Clin. Microbiol. 35:817-822, April 1997.

69. Swenson JM, Wallace Jr. RJ, Silcox VA, Thornsberry C: Antimicrobial susceptibility of 5 subgroups of *Mycobacterium fortuitum* and *Mycobacterium chelonae*. Antimicrob. Agents Chemother. 28:807-811, 1985.

70. Telenti A, Marchesi F, Balz M, Bally F, Bottger EC, Bodmer,T: Rapid identification of mycobacteria to the species level by polymerase chain reaction and restriction enzyme analysis. J. Clin. Microbiol. 31:175-178, 1993.

71. Tettelin H, Davidson RM, Agrawal S, Aitken ML, Shallom S, Hasan NA, Strong M, de Moura VCN, De Groote MA, Duarte RS, Hine E, Parankush S, Su Q, Daugherty SC, Fraser CM, Brown-Elliott BA, Wallace Jr. RJ, Holland SM, Sampaio EP, Olivier KN, Jackson M, Zelazny AM: High-level relatedness among *Mycobacterium abscessus* subsp*. massiliense* strains from widely separated outbreaks. Current Opinion, Centers for Disease Control and 16 Prevention, ISSN: 1080-6059,

eid/article/20/3/13-1106 article.htm#comment. 20(3), March 2014.

72. Tortoli E, Brown-Elliott BA, Chalmers JD, Cirillo DM, Daley CL, Emler S, Floto RA, Garcia MJ, Hoefsloot W, Koh W-J, Lange C, Loebinger M, Maurer FP, Morimoto K, Niemann S, Richter E, Turenne CY, Wallace Jr. RJ, Wengenack N, van Ingen J. Same meat, different gravy: ignore the new names of mycobacteria. *Eur. Respir. J.* 54:1900795, 2019.

73. Tortoli E, Kohl TA, Brown-Elliott BA, Trovato A, Cardoso Leão S, Garcia MJ, Vasireddy S, Turenne CY, Griffith DE, Philley JV, Baldan R, Campana S, Cariani L, Colombo C, Taccetti G, Teri A, Niemann S, Wallace Jr. RJ, Cirillo DM: Emended description of *Mycobacterium abscessus, Mycobacterium abscessus subsp. abscessus, Mycobacterium abscessus* subsp. *bolletii* and designation of *Mycobacterium abscessus* subsp. *massiliense* subsp. nov. Int. J. Sys. Evol. Microbiol. 66:4471-4479, November 2016.

74. Tortoli E, Kohl TA, Brown-Elliott BA, Trovato A, Cardoso-Leão S, Garcia MJ, Vasireddy S, Turenne CY, Griffith DE, Philley JV, Niemann S, Wallace Jr. RJ, Cirillo DM: *Mycobacterium abscessus,* a taxonomic puzzle. Letter to the Editor. Int. J. Syst. Evol. Microbiol. 68:467-469, January 2018.

75. van Ingen J, Turenne CY, Tortoli E, Wallace Jr. RJ, Brown-Elliott BA. A definition of the *Mycobacterium avium* complex for taxonomical and clinical purposes, a review. Int. J. Syst. Evol. Microbiol. 68(11):3666-3677, September 2018.

76. Vasireddy, R., S. Vasireddy, Brown-Elliott BA, Wengenack NL, Eke UA, Benwill JL, Turenne C, Wallace Jr. RJ: *Mycobacterium arupense, Mycobacterium heraklionense,* and a newly proposed species, "*Mycobacterium virginiense*" sp. nov., but not *Mycobacterium nonchromogenicum*, as species of the *Mycobacterium terrae* complex causing tenosynovitis and osteomyelitis. J. Clin. Microbiol. 54(5):1340-1351, May 2016; ERRATUM 55(3):985, March 2017.

77. Villanueva A, Calderon RV, Vargas BA Ruiz F, Aguero S, Zhang Y, Brown BA, Wallace Jr. RJ: Report on an outbreak of postinjection abscesses due to *Mycobacterium abscessus*, including management with surgery and 13 clarithromycin therapy and comparison of strains by random amplified polymorphic DNA polymerase chain reaction. Clin. Infect. Dis. 24:1147-1153, 1997.

78. Wallace Jr. RJ, Brown BA, Blacklock Z, Ulrich R, Jost K, Brown JM, McNeil MM, Onyi G, Steingrube VA, Gibson JL: New *Nocardia* taxon among isolates of *Nocardia brasiliensis* associated with invasive disease. J. Clin. Microbiol. 33:1528-1533, June, 1995.

79. Wallace Jr. RJ, Brown BA, Tsukamura M, Brown JM, Onyi G: Clinical and laboratory features of *Nocardia nova*. J. Clin. Microbiol. 29:2407-2411, November, 1991.

80. Wallace Jr. RJ, Brown-Elliott BA, Crist CJ, Mann L, Wilson RW: Comparison of the *in vitro* activity of the glycylcycline tigecycline (formerly GAR-936) with those of tetracycline, minocycline, and doxycycline against isolates of nontuberculous mycobacteria. Antimicrob. Agents Chemother. 46: 3164-3167, October 2002.

81. Wallace Jr. RJ, Brown-Elliott BA, Hall L, Roberts G, Wilson RW, Mann LB, Crist CJ, Chiu SH, Dunlap R, Garcia MJ, Bagwell JT, Jost KC Jr: Clinical and laboratory features of *Mycobacterium mageritense*. J. Clin. Microbiol. 40:2930-2935, August 2002.

82. Wallace Jr. RJ, Brown-Elliott BA, Ward SC, Crist CJ, Mann LB, Wilson RW: Activities of linezolid against rapidly growing mycobacteria. Antimicrob. Agents Chemother. 45:764-767, March 2001.

83. Wallace Jr. RJ, Cook JL, Glassroth J, Griffith De, Olivier KN, Gordin F: Diagnosis and treatment of disease caused by nontuberculous mycobacteria . American Thoracic Society Statement. American Journal of Respiratory and Critical Care Medicine, 156:S1-S25, August 1997.

84. Wallace Jr. RJ, Nash DR, Steele LC, Steingrube VA: Susceptibility testing of slowly growing mycobacteria utilizing a microdilution MIC method with 7H9 broth. J. Clin. Microbiol. 24:976-981, 1986.

85. Wallace Jr. RJ, Tsukamura M, Brown BA, Brown J, Steingrube VA, Zhang Y, Nash DR. Cefotaxime-resistant *Nocardia asteroides* strains are isolates of the controversial species *Nocardia farcinica*. J. Clin. Microbiol. 28:2726-2732, December, 1990.

86. Wallace Jr. RJ, Zhang Y, Brown BA, Fraser V, Mazurek GH, Maloney S: DNA large restriction fragment patterns of sporadic and epidemic nosocomial strains of *Mycobacterium chelonae* and *Mycobacterium abscessus*. J. Clin. Microbiol. 31:2697-2701, 1993.

87. Wilson RW, Steingrube VA, Bottger EC, Springer B, Brown-Elliott BA, Vincent V, Jost KC Jr., Zhang Y, Garcia MJ, Chiu SH, Onyi GO, Rossmoore H, Nash DR, Wallace Jr. RJ: *Mycobacterium immunogenum* sp. nov., a novel species related to *Mycobacterium abscessus* and associated with clinical disease, pseudo-outbreaks and contaminated metalworking fluids: an international cooperative study on mycobacterial taxonomy. Int. J. Syst. Evol. Microbiol. 51:1751-1764, 2001.

88. Wilson, RW, Steingrube VA, BA Brown, Blacklock Z, Jost Jr. KC, McNabb A, 12 Colby WD, Biehle JR, Gibson JL, Wallace Jr. RJ: Recognition of a *Nocardia transvalensis* complex by resistance to aminoglycosides, including amikacin, and PCR-restriction fragment length polymorphism analysis. J. Clin. Microbiol. 35:2235-2242, September 1997.

89. Woods GL, Bergmann JS, Witebsky FG, Fahle GA, Wanger A, Boulet B, Plaunt M, Brown BA, Wallace Jr. RJ: Multisite reproducibility of results obtained by the broth microdilution method for susceptibility testing of *Mycobacterium abscessus*, *Mycobacterium chelonae*, and *Mycobacterium fortuitum*. J. Clin. Microbiol. 37:1676-1682, 1999.

90. Woods GL, Lin S-YG, Brown-Elliott BA, Desmond EP: Susceptibility test methods: Mycobacteria, *Nocardia*, and other actinomycetes**.** In: Manual of Clinical Microbiology, 12th Edition, KC Carroll, ed. ASM Press, Washington, D.C. 2019, Vol. 2, 78:1398-1419.

91. Woods GL, Wengenack NL, Lin G, Brown-Elliott BA, Cirillo DM, Conville PS, Desmond EP, Killian SB, Parrish NM, Pfeltz R, Richter E, Turnidge JD: Susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes; Standard 3rd ed. Clinical and Laboratory Standards Institute (CLSI)*,* M24, November 2018.

92. Woods GL, Wengenack NL, Lin G, Brown-Elliott BA, Cirillo DM, Conville PS, Desmond EP, Killian SB, Parrish NM, Pfeltz R, Richter E, Turnidge JD: Performance standards for susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes; 1st ed. Clinical and Laboratory Standards Institute (CLSI)*,* M62, November 2018.

93. Woods GL, Williams-Bouyer N, Wallace Jr. RJ, Brown-Elliott BA, Witebsky FG, Conville PS, Plaunt M, Hall G, Aralar P, Inderlied C: Multisite reproducibility of results obtained by two broth dilution methods for susceptibility testing of *Mycobacterium avium* complex. J. Clin. Microbiol. 41:627-631, February 2003.

94. Zhang Y, Rajagopalan M, Brown BA, Wallace Jr. RJ: Randomly amplified polymorphic DNA PCR for comparison of *Mycobacterium abscessus* strains from nosocomial outbreaks. J. Clin. Microbiol. 35:3132-3139, 1997.