

Treatment of Nontuberculous Mycobacterial Pulmonary Disease: An Official ATS/ERS/ESCMID/IDSA Clinical Practice Guideline

Charles L. Daley,^{1,2,a} Jonathan M. Iaccarino,³ Christoph Lange,^{4,5,6,7,a} Emmanuelle Cambau,^{8,a} Richard J. Wallace, Jr.,^{9,a} Claire Andrejak,^{10,11} Erik C. Böttger,¹² Jan Brozek,¹³ David E. Griffith,¹⁴ Lorenzo Guglielmetti,^{8,15} Gwen A. Huitt,^{1,2} Shandra L. Knight,¹⁶ Philip Leitman,¹⁷ Theodore K. Marras,¹⁸ Kenneth N. Olivier,¹⁹ Miguel Santin,²⁰ Jason E. Stout,²¹ Enrico Tortoli,²² Jakko van Ingen,²³ Dirk Wagner,²⁴ and Kevin L. Winthrop²⁵

¹Department of Medicine, National Jewish Health, Denver, Colorado, USA, ²Department of Medicine, University of Colorado School of Medicine, Aurora, Colorado, USA, ³Pulmonary Center, Boston University School of Medicine, Boston, Massachusetts, USA, ⁴Division of Clinical Infectious Diseases, Research Center Borstel, Borstel, Germany, ⁵German Center for Infection Research (DZIF), Clinical Tuberculosis Unit, Borstel, Germany, ⁶Respiratory Medicine & International Health, University of Lübeck, Lübeck, Germany, ⁷Department of Medicine, Karolinska Institute, Stockholm, Sweden, ⁸National Reference Center for Mycobacteria and Antimycobacterial Resistance, APHP - Hôpital Lariboisière, Bacteriology, Inserm, University Paris Diderot, IAME UMR1137, Paris, France, ⁹Mycobacteria/Nocardia Laboratory, Department of Microbiology, The University of Texas Health Science Center, Tyler, Texas, USA, ¹⁰Respiratory and Intensive Care Unit, University Hospital Amiens, Amiens, France, ¹¹EA 4294, AGIR, Jules Verne Picardy University, Amiens, France, ¹²Institute of Medical Microbiology, National Reference Center for Mycobacteria, University of Zurich, Zurich, Switzerland, ¹³Department of Clinical Epidemiology & Biostatistics, McMaster University Health Sciences Centre, Hamilton, Ontario, Canada, ¹⁴Pulmonary Infectious Disease Section, University of Texas Health Science Center, Tyler, Texas, USA, ¹⁵Team E13 (Bactériologie), Centre d'Immunologie et des Maladies Infectieuses, Sorbonne Université, Université Pierre et Marie Curie, Université Paris 06, Centre de Recherche 7, INSERM, IAME UMR1137, Paris, France, ¹⁶Library and Knowledge Services, National Jewish Health, Denver, Colorado, USA, ¹⁷NTM Info & Research, Miami, Florida, USA, ¹⁸Department of Medicine, University of Toronto and University Health Network, Toronto, Ontario, Canada, ¹⁹Pulmonary Branch, National Heart, Lung and Blood Institute, Bethesda, Maryland, USA, ²⁰Service of Infectious Diseases, Bellvitge University Hospital-IDIBELL, University of Barcelona, L'Hospitalet de Llobregat, Barcelona, Spain, ²¹Division of Infectious Diseases and International Health, Duke University Medical Center, Durham, North Carolina, USA, ²²Emerging Bacterial Pathogens Unit, IRCCS San Raffaele Scientific Institute, Milan, Italy, ²³Radboud Center for Infectious Diseases, Department of Medical Microbiology, Radboud University Medical Center, Nijmegen, The Netherlands, ²⁴Division of Infectious Diseases, Department of Medicine II, Medical Center - University of Freiburg, Faculty of Medicine, University of Freiburg, Freiburg, Germany, ²⁵Divisions of Infectious Diseases, Schools of Public Health and Medicine, Oregon Health and Science University, Portland, Oregon, USA

Nontuberculous mycobacteria (NTM) represent over 190 species and subspecies, some of which can produce disease in humans of all ages and can affect both pulmonary and extrapulmonary sites. This guideline focuses on pulmonary disease in adults (without cystic fibrosis or human immunodeficiency virus infection) caused by the most common NTM pathogens such as *Mycobacterium avium* complex, *Mycobacterium kansasii*, and *Mycobacterium xenopi* among the slowly growing NTM and *Mycobacterium abscessus* among the rapidly growing NTM. A panel of experts was carefully selected by leading international respiratory medicine and infectious diseases societies (ATS, ERS, ESCMID, IDSA) and included specialists in pulmonary medicine, infectious diseases and clinical microbiology, laboratory medicine, and patient advocacy. Systematic reviews were conducted around each of 22 PICO (Population, Intervention, Comparator, Outcome) questions and the recommendations were formulated, written, and graded using the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) approach. Thirty-one evidence-based recommendations about treatment of NTM pulmonary disease are provided. This guideline is intended for use by healthcare professionals who care for patients with NTM pulmonary disease, including specialists in infectious diseases and pulmonary diseases.

Keywords. nontuberculous; *Mycobacterium avium* complex; *Mycobacterium kansasii*; *Mycobacterium abscessus*; *Mycobacterium xenopi*.

EXECUTIVE SUMMARY

The American Thoracic Society (ATS), European Respiratory Society (ERS), European Society of Clinical Microbiology and Infectious Diseases (ESCMID), and Infectious Diseases

Society of America (IDSA) jointly sponsored the development of this Guideline to update the treatment recommendations for nontuberculous mycobacterial (NTM) pulmonary disease in adults. NTM represent over 190 species and subspecies (<http://www.bacterio.net/mycobacterium.html>), many of which can produce disease in humans of all ages and can affect both pulmonary and extrapulmonary sites. Attempting to cover such a broad array of species and disease in a guideline using current guideline development methods is impossible. Therefore, this guideline focuses on pulmonary disease in adults (without cystic fibrosis or human immunodeficiency virus [HIV] infection) caused by the most common NTM pathogens comprising *Mycobacterium avium* complex (MAC), *Mycobacterium kansasii*, and *Mycobacterium xenopi* among the slowly growing

Received 17 February 2020; editorial decision 18 February 2020; accepted 5 March 2020; published online July 6, 2020.

^aC. L. Daley, C. L., E. C., R. J. W. are coauthors of this guideline committee.

Correspondence: C. L. Daley, National Jewish Health, 1400 Jackson St, Denver, CO 80206 (daleyc@njhealth.org).

Clinical Infectious Diseases® 2020;71(4):e1–e36

© The Author(s) 2020. Published by Oxford University Press for the Infectious Diseases Society of America. All rights reserved. For permissions, e-mail: journals.permissions@oup.com.

This is a joint publication between Clinical Infectious Diseases and the *European Respiratory Journal*. The articles are identical except for minor stylistic and spelling differences in keeping with each journal's style. Either citation can be used when citing this article.

DOI: 10.1093/cid/ciaa241