

Toman's Tuberculosis

Case detection, treatment, and monitoring –
questions and answers

SECOND EDITION

Edited by
T. Frieden



WORLD HEALTH ORGANIZATION
GENEVA
2004

WHO Library Cataloguing-in-Publication Data

Toman's tuberculosis case detection, treatment, and monitoring : questions and answers / edited by T. Frieden. – 2nd ed.

1.Tuberculosis, Pulmonary – diagnosis 2.Tuberculosis, Pulmonary – drug therapy 3.Tuberculosis, Multidrug-resistant 4.Antitubercular agents – pharmacology I.Toman, Kurt. II.Frieden, Thomas R. III.Title: Tuberculosis case detection, treatment, and monitoring.

ISBN 92 4 154603 4 (NLM classification: WF 360) WHO/HTM/TB/2004.334

© World Health Organization 2004

All rights reserved.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

The World Health Organization does not warrant that the information contained in this publication is complete and correct and shall not be liable for any damages incurred as a result of its use.

The editor and authors alone are responsible for the views expressed in this publication.

Further information is available at: CDS Information Resource Centre, World Health Organization, 1211 Geneva 27, Switzerland; fax: (+41) 22 791 4285, e-mail: cdsdocs@who.int

Designed by minimum graphics
Typeset in Hong Kong
Printed in China

Contents

Preface to the First Edition	viii
Preface to the Second Edition	ix
Introduction	xi
Acknowledgements for the First Edition	xiii
Acknowledgements for the Second Edition	xiv
Contributors	xvi

Case detection

1. What is the role of case detection in tuberculosis control? ¹ <i>F. Luelmo</i>	3
2. What is a case of tuberculosis? ¹ <i>F. Luelmo</i>	5
3. What is the role of sputum microscopy in patients attending health facilities? <i>F. Luelmo</i>	7
4. How many bacilli are present in a sputum specimen found positive by smear microscopy? <i>K. Toman</i>	11
5. How reliable is smear microscopy? <i>K. Toman</i>	14
6. What are the main causes of false-positive and false-negative sputum smears? <i>K. Toman</i>	23
7. What are the main consequences of false-positive and false-negative sputum smears? <i>T. Frieden</i>	28
8. What are the advantages and disadvantages of fluorescence microscopy? <i>K. Toman</i>	31
9. What is the role of mycobacterial culture in diagnosis and case definition? ¹ <i>A. Van Deun</i>	35
10. What is the probability of obtaining a negative culture from a sputum specimen found positive by smear microscopy? <i>K. Toman</i>	44

¹ Based on the chapter in the previous edition by K. Toman.

TOMAN'S TUBERCULOSIS

11. What is the additional yield from repeated sputum examinations by smear microscopy and culture?¹ *A. Harries* 46
12. How reliable is chest radiography?¹ *R. Koppaka & N. Bock* 51
13. What are the relative merits of chest radiography and sputum examination (smear microscopy and culture) in case detection among new outpatients with prolonged chest symptoms?¹ *A. Harries* 61
14. How does pulmonary tuberculosis develop and how can it be detected at an early stage? *K. Toman* 66
15. What is the role of case detection by periodic mass radiographic examination in tuberculosis control?¹ *H. Rieder* 72
16. How does the diagnosis of tuberculosis in persons infected with HIV differ from diagnosis in persons not infected with HIV? *A. Harries* 80
17. What is the role of tuberculin skin testing in the diagnosis of tuberculosis? *D. Menzies* 84
18. What is the current and potential role of diagnostic tests other than sputum microscopy and culture? *D. Menzies* 87
19. How can public and private sectors cooperate to detect, treat, and monitor tuberculosis cases? *T. Frieden* 92

Treatment

20. What were the main landmarks in the development of tuberculosis treatment? *K. Toman* 99
21. How does tuberculosis treatment work? *K. Toman* 102
22. What is the role of host factors in the pathogenesis, prevention, and treatment of tuberculosis? *M. Iademarco & M. Reichler* 106
23. What is the therapeutic effect and what is the toxicity of antituberculosis drugs?¹ *T. Frieden & M. Espinal* 110
24. What is the purpose of the initial intensive phase of two-phase treatment? *K. Toman* 122
25. What are the current recommendations for standard regimens? *A. Harries* 124
26. What are the diagnostic categories and what is the rationale for these categories? *A. Harries* 128
27. What is intermittent treatment and what is the scientific basis for intermittency?¹ *T. Frieden* 130

¹ Based on the chapter in the previous edition by K. Toman.

CONTENTS

28. What is the dosage of drugs in daily and intermittent regimens? <i>H. Rieder</i>	139
29. What is the evidence for tuberculosis drug dosage recommendations? <i>H. Rieder</i>	141
30. What is the optimum duration of treatment? ¹ <i>T. Santha</i>	144
31. What are the most common adverse drug events to first-line tuberculosis drugs, and what is the procedure for reintroduction of drugs? <i>A. Harries</i>	152
32. What are the merits of thioacetazone as a companion drug to isoniazid, and what is the efficacy of the regimen of isoniazid plus thioacetazone? ¹ <i>H. Rieder</i>	159
33. How does management of extrapulmonary tuberculosis differ from that of pulmonary tuberculosis? <i>R. Balasubramanian, R. Rajeswari & T. Santha</i>	162
34. How does treatment of tuberculosis differ in patients with pregnancy, liver disease, or renal disease? <i>A. Harries</i>	166
35. How does treatment of tuberculosis differ in persons infected with HIV? <i>A. Harries</i>	169
36. What were the main findings of the Madras study comparing home and sanatorium treatment? <i>K. Toman</i>	173
37. How frequently do patients stop taking treatment prematurely? <i>J. Sbarbaro</i>	181
38. What are the advantages of direct observation of treatment? ¹ <i>J. Sbarbaro</i>	183
39. Why does treatment fail and what can be done to avoid poor treatment outcome? ¹ <i>F. Luelmo</i>	185
40. What are the advantages and disadvantages of fixed-dose combinations of antituberculosis drugs? <i>K. Laserson & M. Iademarco</i>	189
41. How does drug resistance develop? <i>K. Toman</i>	193
42. Why are special precautions needed to protect rifampicin? <i>A. Vernon</i>	195
43. What are the different types of drug resistance? ¹ <i>M. Espinal</i>	198
44. What is the “fall and rise” phenomenon and the “sequential regimen” mechanism? ¹ <i>M. Espinal</i>	200
45. How many drug-resistant tubercle bacilli can be found in the sputum of patients who have never received treatment for tuberculosis? ¹ <i>A. Pablos-Mendez</i>	203

¹ Based on the chapter in the previous edition by K. Toman.

46. What are the causes of drug-resistant tuberculosis? <i>M. Espinal & T. Frieden</i>	207
47. How can the emergence of drug resistance be prevented? <i>T. Frieden</i>	209
48. How reliable are drug susceptibility tests? ¹ <i>M. Espinal</i>	211
49. What are the possible consequences of inaccurate drug-susceptibility testing? ¹ <i>M. Espinal</i>	213
50. What reserve regimens are available and what is their place in tuberculosis control programmes? ¹ <i>M. Espinal</i>	215
51. What is the role of treatment of latent tuberculosis infection in a tuberculosis control programme? <i>M.E. Villarino</i>	220
52. What is the epidemiological impact of treatment of latent tuberculosis infection? <i>Z. Taylor</i>	226

Monitoring

53. What is the health, social, and economic burden of tuberculosis? <i>I. Smith</i>	233
54. What are the global targets for tuberculosis control, and what is the basis of these targets? <i>I. Smith</i>	238
55. What is DOTS? <i>I. Smith</i>	241
56. Is DOTS cost-effective? <i>I. Smith</i>	246
57. How can the progress of treatment be monitored? ¹ <i>T. Santha</i>	250
58. How effective is tuberculosis treatment and what are the needs for the future? ¹ <i>T. Santha</i>	253
59. Is primary drug resistance a menace to the control of tuberculosis? ¹ <i>M. Espinal & T. Frieden</i>	256
60. What are the keys to cure? <i>K. Toman</i>	260
61. What is the significance of default (treatment interruption) in the treatment of tuberculosis? ¹ <i>N Bock</i>	263
62. How important is follow-up and what is the frequency of relapse after the completion of treatment? ¹ <i>T. Santha</i>	267
63. Why is a recording and reporting system needed, and what system is recommended? <i>D. Maher & M. Raviglione</i>	270
64. When should tuberculosis patients be hospitalized, and how infectious are tuberculosis patients while on treatment? ² <i>E.A. Talbot & C.D. Wells</i>	274

¹ Based on the chapter in the previous edition by K. Toman.

² Based on the chapter in the previous edition by K. Toman.

CONTENTS

65. What is nosocomial transmission of tuberculosis and how can it be prevented? <i>P.M. Simone</i>	278
66. Where is tuberculosis usually spread and how can spread be reduced? <i>H. Rieder</i>	282
67. What are the principles and requirements of a controlled clinical trial? ¹ <i>F. Rehman</i>	285
68. What is molecular epidemiology and what is its role in tuberculosis control? <i>K. DeRiemer & P.M. Small</i>	296
69. Can tuberculosis be controlled? <i>T. Frieden</i>	301
70. Can effective case detection and treatment prevent and reverse drug resistance in a community? <i>M. Raviglione</i>	310
71. What are the indicators of an effective tuberculosis control programme? <i>F. Luelmo & T. Frieden</i>	315
72. What are examples of effective tuberculosis control programmes? <i>M. Raviglione & T. Frieden</i>	318
73. What are the relative priorities for a tuberculosis control programme, and what activities should not be undertaken? <i>F. Luelmo & T. Frieden</i>	322
74. What is the impact of HIV on the epidemiology of tuberculosis in a community? <i>A. Harries</i>	326
75. How can tuberculosis control services be promoted and sustained? <i>T. Frieden</i>	330

Preface to the First Edition

One of the basic functions of the World Health Organization (WHO) is the international transfer of scientific knowledge of direct practical value to countries in solving their health problems. A vast store of knowledge and experience has been accumulated in tuberculosis control. Through WHO-assisted projects, simplified and largely standardized control methods have been developed for general use, even in the remotest rural areas of developing countries. The concept of the “national tuberculosis control programme” was formulated by WHO to enable the new technology to be applied effectively. The Organization’s policy on tuberculosis control, contained mainly in concisely worded reports of the WHO Expert Committee on Tuberculosis, has given rise to a great many questions and requests for further information. It has long been thought, therefore, that a detailed commentary on the scientific knowledge and practical experience underlying WHO’s tuberculosis control policy would be a valuable element of WHO’s technical cooperation with Member States. This book, presented in the form of questions and answers, is a first step in that direction. I hope that it will reach all tuberculosis workers in key positions, the organizers and administrators responsible for tuberculosis control in national programmes, and the field staff concerned with the day-to-day problems of tuberculosis control in the community. The book is also directed towards those who teach about tuberculosis control in medical schools, schools of public health, nursing schools, and similar institutions.

H. Mahler
Director-General
Geneva, 1979

Preface to the Second Edition

For more than two decades, Kurt Toman's book *Tuberculosis case-finding and chemotherapy: questions and answers* has been the most authoritative reference on the rational basis of diagnosis and treatment of tuberculosis. Few scientific books last so long, particularly in these times of rapid expansion of knowledge. The book has been reprinted many times by the World Health Organization (WHO) in English, Spanish and Arabic, and translated and printed by the International Union Against Tuberculosis and Lung Disease in French and Portuguese.

Unfortunately, despite the availability of low-cost and accurate diagnosis as well as nearly 100% curative treatment for more than three decades, tuberculosis remains one of the leading infectious causes of death globally, killing nearly two million people a year. Tuberculosis accounts for more than one in four avoidable deaths among adults in developing countries. The HIV epidemic is making this bad situation even worse. Many countries in Africa have experienced a two- to fourfold rise in the incidence of tuberculosis since the advent of HIV.

Over the past decade, in consultation with partners and Member countries, WHO has refined and promoted the tuberculosis control strategy known as DOTS. DOTS ensures accurate diagnosis, reliable cure, and systematic monitoring, as well as the political and administrative support required for effective tuberculosis control. However, the basis of the DOTS strategy is sometimes questioned. DOTS is not dogma, but a framework that is based on extensive basic, clinical, and epidemiological research, and that will continue to evolve as new information becomes available. In this regard, the second edition of *Toman's Tuberculosis* comes at a particularly opportune time. Countries throughout the world are rapidly scaling up DOTS implementation, and programme managers, doctors, medical school professors, and other interested persons often have questions about the basis and background for DOTS strategies and practices.

It must be admitted that the remarkable relevance of a scientific book written 24 years ago is not only a testament to the prescience of Dr Toman, but also a sad testimony to the lack of rapid progress in the field of tuberculosis control over the past two decades. In recent years, there has been renewed interest in tuberculosis. Our understanding of the disease, our ability to diagnose and cure it, and the im-

TOMAN'S TUBERCULOSIS

plementation of effective control strategies should improve sufficiently that much less time will elapse before the next edition is required!

It is my hope that this invaluable book will provide support to those on the front lines of the battle against tuberculosis, including programme managers, policy-makers, doctors, nurses, medical school professors, and members of civil society who work together to stop tuberculosis.

LEE Jong-Wook
Director-General
Geneva, 2004

Introduction

One section of the first edition of K. Toman's *Tuberculosis case-finding and chemotherapy: questions and answers* is entitled, "What were the main landmarks in the development of tuberculosis treatment?" It could accurately be claimed that Toman's text has itself been one of these landmarks. Shortly after publication of the first edition in 1979, K. Styblo and the International Union Against Tuberculosis and Lung Disease (IUATLD) developed a model with all essential elements of tuberculosis control and applied it in several countries of Africa and the Americas. This model, further refined by the World Health Organization, is today known as DOTS, the internationally recommended strategy for effective tuberculosis control. DOTS is based on evidence available from studies and experience gained in more than 100 countries.

Once again, the evidence base for approaches to diagnosis, treatment, and monitoring is presented in a comprehensive and comprehensible form, and is extended in this edition to prevention and control. The information is intended for all persons involved in the diagnosis, treatment, prevention, and control of tuberculosis – clinical specialists and public health practitioners alike.

Toman's concept was to marshal in one place the scientific basis for WHO/IUATLD recommendations on the detection and treatment of tuberculosis. Much of what Toman wrote 24 years ago remains relevant today; that is why some of the chapters required no updating. Toman's use of clear, convincing data, lucid explanations, and sensible approach made the book a touchstone for a generation of tuberculosis experts and many general physicians, particularly in developing countries. His description of the effectiveness of respectful, sensitive treatment of tuberculosis patients is as pertinent today as when it was written. The tightly reasoned and impassioned advocacy for the role of controlled clinical trials, and for adherence to the highest scientific and ethical principles in their conduct, could have been written yesterday. Toman's systematic discussion of drug resistance and of the role and difficulty of treatment with reserve drugs is highly relevant to the current lively discussion of the appropriate role of treatment of multidrug-resistant tuberculosis. And, of course, the entire section on case detection is a classic and brilliant elucidation of the role of acid-fast smears, the role and limitations of chest radiography and culture, and the importance of detection of tuberculosis patients through the general health system.

TOMAN'S TUBERCULOSIS

This second edition of *Toman's Tuberculosis* has attempted to retain the simplicity and clarity of approach of the first, as well as the systematic scientific background for the answers given. The section on case detection has been updated and sections on human immunodeficiency virus, the tuberculin test, and newer diagnostic modalities have been added. Sections on appropriate case detection strategies are also included. The treatment section has, of necessity, been updated with information on short-course treatment, which had not been established when the original text was published. Updated information on host defences, drug resistance, drug dosages, extrapulmonary tuberculosis, treatment adherence, and direct observation of treatment has been added. Sections on the basis, role, and limitations of treatment for tuberculosis infection have been included, as has a section on monitoring programme effectiveness, based largely on the experience of DOTS implementation in various countries. The recording and reporting system established by Styblo is simple, robust, and effective; it serves as the basis for accountability and programme monitoring.

A final point – from the introduction to the first edition – should be noted: “The information given on any particular subject is far from exhaustive. The aim was not completeness but deliberate selection. From among the numerous questions that are asked, those that recur the most frequently and that appear to be most pertinent have been chosen.”

Acknowledgements for the First Edition

I am indebted to all those who, directly or indirectly, have made it possible for me to write this book.

I owe much to Dr H. Mahler, who ten years ago conceived the idea of a technical reference manual on tuberculosis control, mainly for non-specialized health personnel in the developing countries.

Grateful thanks are due to the International Union Against Tuberculosis (IUAT). Its former director, Dr J. Holm, and his successor, Dr D.R. Thomson, took the first steps towards the realization of this book and helped in its technical editing; the present director of IUAT, Professor V. Farga, made helpful suggestions. Dr Annik Rouillon, in her various areas of responsibility, gave whole-hearted cooperation. I had stimulating, candid, and fruitful discussions with the late Professor G. Canetti, Chairman of the IUAT Scientific Committees, his successor Dr J.R. Bignall, and the present Chairman of the committees and Director of the Tuberculosis Surveillance Research Unit, Dr K. Styblo. Thanks to the lively interest taken by Dr J. Meijer and the initiative of Dr H.A. van Geuns, the Sonnevank Foundation, Netherlands, generously met part of the expenses. Dr K.L. Hitze, Chief, Tuberculosis and Respiratory Infections, World Health Organization, lent his active support, counsel and encouragement.

Dr Wallace Fox, Director, Tuberculosis and Chest Diseases Research Unit, Medical Research Council, and Professor D.A. Mitchison, Postgraduate Medical School, Hammersmith, London, who have contributed decisively to the fundamental changes in the treatment of tuberculosis, are to be thanked for their interest and criticism, and for allowing me to draw heavily on their pioneering studies.

Acknowledgements are due to my co-workers and students in developing countries – physicians, health officers, auxiliary workers, educators, and community leaders determined to free their fellow men from unnecessary suffering – who made me realize that tuberculosis and many other health problems can be eliminated only when their cultural, social, and economic interdependence has been understood.

I am grateful to my wife. Without her help and forbearance, this book could not have been written.

K. Toman
1979

Acknowledgements for the Second Edition

This remarkable book remains very much *Toman's Tuberculosis*. Kurt Toman conceived and created a book that can only be regarded as a masterpiece. Written in the late 1970s, it addressed essentially all significant questions relating to the diagnosis, treatment, and control of tuberculosis. It summarized the then state-of-the-art scientific knowledge of tuberculosis – and it did so with admirable clarity and brevity. Therefore, by far the greatest debt for the current edition is to K. Toman, whose book this very much remains.

The era of single-author reference books is over, and this edition of *Toman's Tuberculosis* required the input and assistance of many individuals. It is a remarkable tribute to the esteem and affection in which this text is held by tuberculosis experts around the world that every person asked to write or revise a section readily agreed.

Dr Fabio Luelmo provided the initial impetus for a revised edition, helped conceptualize the outline, contributed many of the new and revised sections, and carefully reviewed the entire manuscript. Other colleagues from WHO in Geneva, including Drs Mario Raviglione, Ian Smith, and Marcos Espinal, provided input to the book as a whole and also contributed many sections. Drs Anthony Harries and Hans Rieder gave generously of their time and considerable expertise to write or revise a substantial number of sections and they, as well as Dr Martien Borgdorff, reviewed the entire manuscript. Many staff of the United States Centers for Disease Control and Prevention (CDC) contributed new and revised sections. We were fortunate to have expert assistance and participation from staff of the Tuberculosis Research Centre, Chennai, India. Other authors/revisers are indicated in the table of contents and the list of contributors; their efforts are greatly appreciated. All worked with good grace to a tight publication schedule. Pre-1965 reference materials were obtained with assistance from CDC, Atlanta, GA, USA; the Medical Library, Chulalongkorn University, Bangkok, Thailand; and the Tuberculosis Research Centre, Chennai, the National Tuberculosis Institute, Bangalore, and the Tuberculosis Association of India, New Delhi, India. Byword Editorial Consultants provided overall project coordination and editorial support.

In 1979, the year in which the first edition of this book was published, Dr Karel Styblo and his colleagues from the International Union Against Tuberculosis and Lung

ACKNOWLEDGEMENTS FOR THE SECOND EDITION

Disease and the Royal Netherlands Tuberculosis Association began implementing the strategy that has come to be known as DOTS. Notable aspects of this strategy are the remarkably robust monitoring system and the DOTS management package, which has enabled widespread application of the effective diagnostic, treatment, and monitoring strategies described in this book.

The editor has benefited greatly from many hours of discussions with tuberculosis workers in India and throughout south-east Asia, whose keen interest and critical approach helped to identify key questions to be addressed or re-addressed.

Many individuals contributed in many ways; responsibility for errors must rest with the editor.

Thomas R Frieden
New Delhi
India
2003

Contributors

Rani Balasubramanian MD DGO, Deputy Director, Tuberculosis Research Centre, Chennai, India

Naomi Bock MD MS, Medical Officer Research and Evaluation Branch, Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (nbock@cdc.gov)

Kathy DeRiemer PhD, Fellow, Division of Infectious Diseases and Geographic Medicine, Stanford University Medical Center, Stanford, CA, USA (kathy@molepi.stanford.edu)

Marcos Espinal MD DrPH, World Health Organization, Geneva, Switzerland (espinalm@who.int)

Thomas R. Frieden MD MPH, Medical Officer, Stop Tuberculosis Unit, WHO Regional Office for South-East Asia, World Health Organization, New Delhi, India (trieden@health.nyc.gov)

Anthony D Harries OBE MD FRCP, Technical Adviser, Malawi National Tuberculosis Control Programme, Lilongwe, Malawi (adharriesmalawi.net)

Michael F Iademarco MD MPH, Associate Director for Science, Division of Tuberculosis Elimination, National Center for HIV, TB, and STD Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (miademarco@cdc.gov)

Ram Koppaka MD PhD, Medical Officer, Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (vcr4@cdc.gov)

Kayla F Laserson ScD, Epidemiologist, International Activity Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (klaserson@cdc.gov)

Fabio Luelmo MD MPH, Consultant, TB control programmes, Geneva, Switzerland (luelmof@xs4all.nl)

Dermot Maher MB BCh FRCP, Medical Officer, Stop TB Department, World Health Organization, Geneva, Switzerland (maherd@who.int)

CONTRIBUTORS

- Dick Menzies MD MSc, Director TB clinic, Montreal Chest Institute, McGill University, Montreal, PQ, Canada (dick.menzies@mcgill.ca)
- Ariel Pablos-Mendez MD MPH, Associate Director, Health Equity, The Rockefeller Foundation, New York, NY, USA (APablos-Mendez@rockfound.org)
- Rajeswari Ramachandran MD DM PhD, Deputy Director, Tuberculosis Research Centre, Chennai, India
- Mario Raviglione MD, Coordinator, TB Strategy and Operations, Stop TB Department, Communicable Diseases, World Health Organization, Geneva, Switzerland (raviglionem@who.int)
- Fathima Rehman BSc, Senior Research Officer, Tuberculosis Research Centre, Chennai, India
- M. Reichler MD, Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control & Prevention, Atlanta, GA, USA (mrr3@cdc.gov)
- Hans L. Rieder MD MPH, Tuberculosis Division, International Union Against Tuberculosis and Lung Disease, Paris, France (TBRieder@tbrieder.org)
- T. Santha MBBS DTCD, Deputy Director (Senior Grade), Tuberculosis Research Centre, Chennai, India
- John A. Sbarbaro MD MPH FCCP, Professor of Medicine and Preventive Medicine; School of Medicine, University of Colorado Health Sciences Center, Denver, CO, USA (John.Sbarbaro@UPIColo.org)
- Patricia M. Simone MD, Chief, Prevention Support Office, Office of the Director, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (psimone@cdc.gov)
- Peter M. Small MD, Associate Professor, Division of Infectious Diseases and Geographic Medicine, Stanford University School of Medicine Stanford, CA 94305, USA (peter@molepi.stanford.edu)
- Ian Smith MD, Stop TB Department, World Health Organization, Geneva, Switzerland (smithi@who.int)
- Elizabeth A. Talbot MD, Director TB/HIV Research, The BOTUSA Project, International Activity, Division of TB Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Department of State Washington DC, USA (edt7@cdc.gov)
- Zachary Taylor MD MS, Centers for Disease Control and Prevention, Atlanta, GA, USA (Zxt0@cdc.gov)
- Armand Van Deun MD, Mycobacteriology Unit, Institute of Tropical Medicine, Antwerp, Belgium (armand.vandeun@ping.be)
- Andrew A. Vernon MD MHS, Supervisory Medical Epidemiologist, Research and Evaluation Branch, Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (avernon@cdc.gov)

TOMAN'S TUBERCULOSIS

Margarita Elsa Villarino MD MPH, Chief, Diagnostic and Therapeutics Studies Section, Research and Evaluation Branch, Division of Tuberculosis Elimination National Center for HIV, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA (mev1@cdc.gov)

Charles D. Wells MD, Associate Director for International Activities, Division of Tuberculosis Elimination, National Center for HIV, STD, and TB Prevention, Centers for Disease Control & Prevention, Atlanta, GA, USA (mev1@cdc.gov)

The WHO Stop TB Department acknowledges the crucial work of the editor Dr T. Frieden, the valuable comments on the final draft from Drs M. Borgdorff, D.A. Enarson, P. Hopewell, A. Seita, and A. van Deun, and the overall assistance of Dr F. Luélmo.