The increasing burden of drug-resistant tuberculosis introduces new challenges to traditional TB control and treatment programs and calls upon the global health community to collaborate and share scientific information in new and different ways. This 3-day workshop is sponsored by the Forum on Drug Discovery, Development, and Translation of the U.S. National Academy of Sciences, Institute of Medicine (IOM) and the Institute of Microbiology of the Chinese Academy of Sciences (CAS). Following an inaugural meeting in Washington, D.C. in 2008, this workshop in Beijing is the fourth in a series of international workshops convened by the U.S. IOM. The objective of the workshop series is to realistically assess the impact of and challenges resulting from drug-resistant TB globally and in the four countries with the most people affected (China, India, Russia, and South Africa). A public workshop was also convened in July/August 2012 in Washington, DC to identify opportunities to improve the global supply chain for second-line TB drugs. Specifically the goals of the workshop series include:

- Consider a wide spectrum of issues pertaining to the science and policy around drug-resistant tuberculosis – from biology, epidemiology, and surveillance; to diagnosis, treatment, and infection control; to issues pertaining to the drug supply chain, laboratory capacity, and needs of vulnerable populations. Each workshop will address some or all of these multiple disciplines and facilitate discussion about a global “blueprint for action.”
- Present promising new research, and also to identify specific gaps in knowledge and consider potential needs for additional research, funding, and international attention.

The workshop series has been hosted over a period of several years, creating a venue and body of knowledge that explicitly considers and addresses developments over a period of time, thus permitting relatively quick adjustments in knowledge and strategy. The workshop series convenes international experts, permitting exchange of information among experts from each of the participating countries and globally. Each workshop in the series results in a U.S. National Academies publication summarizing the workshop presentations and discussions.

This workshop in Beijing will address the current status of drug-resistant tuberculosis globally, and in China, and consider lessons learned from the other three high burden countries; highlight global challenges to controlling the spread of drug-resistant strains; and discuss innovative strategies to advance and harmonize local and international efforts to prevent and treat drug-resistant TB. The workshop will consider urgent themes relating to the problem of multidrug-resistant (MDR) TB, extensively drug resistant (XDR) TB, and emergent TB strains that are potentially untreatable with drugs available and will consider the critical leadership role of the BRICS countries in addressing the threats and opportunities in drug-resistant TB.

Wednesday, January 16, 2013
Beijing, China

DAY 1

7:00 a.m. Registration

8:30 a.m. Welcome and Introductory Remarks (Moderator: LIXIN ZHANG)

YAPING ZHANG
Vice President
Chinese Academy of Sciences

9:00 a.m. Group Photo

9:15 a.m. Global Burden, Themes from Institute of Medicine Workshops in other BRICS Countries, and Workshop Goals

GAIL CASSELL
Chair, IOM Planning Committee
Harvard Medical School
Infectious Disease Research Institute

GEORGE F. GAO
Vice Director General
Chinese Center for Disease Control and Prevention
Beijing Institute of Biological Sciences, CAS

9:45 a.m. Opening Keynote Address

Twenty-Five Years after the First Major MDR-TB Outbreak: Is it Time for a New Strategy?

PAUL FARMER
Chair, Department of Global Health and Social Medicine
Harvard Medical School

10:15 a.m. BREAK
Panel Discussion: Challenges and Opportunities for the BRICS Country Leadership

The BRICS countries, represented by the Ministers of Health of the Federative Republic of Brazil, the Russian Federation, India, People’s Republic of China and Republic of South Africa, met in New Delhi on 11 January 2013 at the Second BRICS Health Ministers’ Meeting. The Ministers recognized that multi-drug resistant tuberculosis is a major public health problem for the BRICS countries due to its high prevalence and incidence mostly on the marginalized and vulnerable sections of society. They resolved to:

- collaborate and cooperate for development of capacity and infrastructure to reduce the prevalence and incidence of tuberculosis through innovation for new drugs/vaccines, diagnostics and;
- promotion of consortia of tuberculosis researchers to collaborate on clinical trials of drugs and vaccines;
- strengthening access to affordable medicines and delivery of quality care.

The Ministers also recognized the need to cooperate for adopting and improving systems for notification of tuberculosis patients, availability of anti-tuberculosis drugs at facilities by improving supplier performance, procurement systems and logistics and management of HIV-associated tuberculosis in the primary health care system.

The Ministers also recognized the importance and need of technology transfer as a means to empower developing countries. In this context, they underlined the important role of generic medicines in the realization of the right to health. The Ministers renewed their commitment to strengthening international cooperation in health, in particular South-South cooperation, with a view to supporting efforts in developing countries to promote health for all and resolve to establish the BRICS network of technological cooperation. (Delhi Communiqué, January 12, 2013 http://pib.nic.in/newsite/erelease.aspx?relid=91533).

RIFAT ATUN
Professor of International Health Management
Imperial College
London

KRISTINA WALLENGREN
Clinical Advisor
KwaZulu-Natal Research Institute for Tuberculosis and HIV (K-RITH)

SALMAAN KESHAVJEE
Associate Professor, Department of Global Health and Social Medicine
Harvard Medical School

GRIGORY VOLCHENKOV
Head Doctor
Vladimir Oblast TB Dispensary
Center of Excellence for TB Infection Control
YAN-LIN ZHAO
Vice Director, National Center for Disease Control and Prevention
Director, National Tuberculosis Reference Laboratory
Chinese Center for Disease Control and Prevention

11:30 a.m. Discussion with speakers and audience

Moderators:

GAIL CASSELL
Harvard Medical School
Infectious Disease Research Institute

YAN-LIN ZHAO
Vice Director, National Center for Disease Control and Prevention
Director, National Tuberculosis Reference Laboratory
Chinese Center for Disease Control and Prevention

12:00 p.m. LUNCH
SESSION I: DRUG-RESISTANT TB IN CHINA

Session Objectives:
- Describe the health care delivery system in China and recent surveillance results of drug-resistant TB in China. Identify where data are missing and are most needed.
- Discuss the burden of drug-resistant TB in China from the perspective of clinicians and health care providers.
- Present data on the burden of drug-resistant TB in vulnerable populations such as domestic migrant workers and individuals with co-morbidities, including HIV and diabetes.
- Present international perspectives on the impact of health delivery systems on DR TB control and care.

Session Chairs:
- China co-chair: FABIO SCANO, World Health Organization
- U.S. co-chair: PAUL FARMER, Harvard Medical School

1:30 p.m.  
Overview of the Health Care Delivery System and Programmatic Management of MDR-TB in China  
MINGTING CHEN  
Vice Director/Researcher  
National Center for Tuberculosis Control and Prevention  
Chinese Center for Disease Control and Prevention

2:00 p.m.  
2007 National Survey of Drug Resistance in China  
YAN-LIN ZHAO  
Vice Director, National Center for Disease Control and Prevention  
Director, National Tuberculosis Reference Laboratory  
Chinese Center for Disease Control and Prevention

2:30 p.m.  
Panel Discussion: Perspectives from Public Health and Hospital Systems in China  
[20 min. each speaker]

Clinical Diagnosis and Treatment of Drug-Resistant TB:  
WENHONG ZHANG  
Huasan Hospital of Fudan University, Shanghai, China

M/XDR TB Chemotherapy in China:  
SHOU-YONG TAN  
Guangzhou Chest Hospital

3:10 p.m.  
BREAK
3:30 p.m.  **Panel Discussion: Treating Drug-Resistant TB in Vulnerable Populations in China**  
[20 min. each speaker]  

**Drug-Resistant TB and HIV in China:**  
LIU FEIYING  
Guangxi Center for Disease Control and Prevention, China  

**Drug-Resistant TB and Diabetes in China:**  
CHU NAIHUI  
Beijing Chest Hospital  

4:10 p.m.  Discussion with speakers and audience  

4:30 p.m.  **Panel Discussion: Impact of Health Care Delivery Systems on DR TB**  
[20 min. each speaker]  

**Peru, Russia, and Lesotho:**  
SALMAAN KESHAVJEE  
Associate Professor  
Department of Global Health and Social Medicine  
Harvard Medical School  

**Community-based care in South Africa:**  
KRISTINA WALLENGREN  
Clinical Advisor  
KwaZulu-Natal Research Institute for Tuberculosis and HIV (K-RITH)  

**Direct Collaboration and “South-to-South Transfer” in Cambodia and Ethiopia:**  
ANNE GOLDFELD  
Harvard Medical School/Global Health Committee  

5:30 p.m.  Discussion with speakers and audience  

6:00 p.m.  Closing remarks and adjourn day 1

Thursday, January 17, 2013
Beijing, China

DAY 2

SESSION II: TRANSMISSION AND INFECTION CONTROL: EPIDEMIOLOGICAL AND GENOTYPIC EVIDENCE AND CONSEQUENCES

Session Objectives:
- Provide an overview of the epidemiological, phenotypic, and genotypic evidence for primary transmission of drug-resistant TB.
- Discuss the consequences of transmission of drug-resistant TB in communities and hospitals.
- Consider the scientific evidence for active case finding, rapid diagnosis, and treatment based on drug susceptibility testing (DST) to stop transmission.
- Discuss the role of infection control in China today and consider infection control policies and practices in other countries with a high prevalence of drug-resistant TB.
- Describe drug-resistant TB risk factors (e.g., inadequate treatment, losing patients during follow up, drug shortages, exposure to drug-resistant TB due to inadequate infection control) and provide in-country perspectives of the issues and current strategies for prevention and control.

Session Chairs:
- China co-chair: WENHONG ZHANG, Huashan Hospital of Fudan University
- U.S. co-chair: EDWARD NARDELL, Harvard School of Public Health

8:00 a.m. Global Perspective on Transmission: Value in Genotype Mapping of Disease Transmission Dynamics

NEEL GANDHI
Associate Professor
Department of Epidemiology
Rollins School of Public Health
Emory University
8:30 a.m. **Current Status of Infection Control in China: Different Perspectives**

[20 min. each speaker]

*Hospital System Perspective:*
LIANG LI
Clinical Center for Tuberculosis, China CDC

*Public Health Systems:*
GUANGXUE HE
Chinese Center for Disease Control and Prevention

*Infection Control Challenges:*
CAROL RAO
U.S. Centers for Disease Control and Prevention

9:30 a.m. Discussion with speakers, panelists and audience

10:00 a.m. BREAK

10:20 a.m. **Perspectives on Infection Control in Other Countries**

[20 min. each speaker]

*South Africa:*
CARRIE TUDOR
Fogarty Global Health Postdoctoral Fellow
Johns Hopkins School of Nursing

*Institutional Infection Control in Russia:*
GRIGORY VOLCHENKOV
Head Doctor
Vladimir Oblast TB Dispensary
Center of Excellence for TB Infection Control

11:00 a.m. **Redesign of Healthcare Facilities, Active Case Finding, Rapid Diagnosis, and Effective Treatment Based on DST to Stop Transmission in Institutional and Community Settings**

EDWARD NARDELL
Associate Professor
Departments of Environmental Health and Immunology and Infectious Diseases, Harvard School of Public Health

11:30 a.m. Discussion with speakers and audience

11:45 a.m. LUNCH
SESSION III: RAPID DIAGNOSTIC TECHNOLOGY: CURRENT STATUS AND LIMITATIONS

Session Objectives:
- Provide an overview of the methods of drug-susceptibility testing (DST) used globally and the advantages and disadvantages of different tests.
- Discuss the current use of diagnostic tests for drug susceptible and drug-resistant TB in China and identify the barriers to rapid diagnosis and management of patients. Consider challenges in diagnosing TB and drug-resistant TB vs. nontuberculous mycobacteria (NTM). Provide a laboratory and hospital-based perspective on DST.
- Discuss work from other countries in implementing programs for rapid diagnosis of drug-resistant TB and consider the populations in which various DSTs work best.

Session Chairs:
- China co-chair: JACK ZHANG, PATH
- U.S. co-chair: JEAN-LUC BERLAND, Fondation Mérieux

1:00 p.m.  
**DST in Detecting DR TB, Overview of Other Technologies and Roll Out of GeneXpert in South Africa: What are the Gaps?**

MARK NICOL  
Division of Medical Microbiology and Institute for Infectious Diseases and Molecular Medicine  
University of Cape Town and National Health Laboratory Service  
South Africa

1:30 p.m.  
**Panel Discussion: Perspectives on Drug-Resistant TB Diagnostic Technologies in Use in China**  
[15 min. each speaker]

**SAT-TB Assay:**  
JIN CHEN  
Shanghai Pulmonary Disease Hospital

**GeneXpert:**  
YAO-JU TAN  
Guangzhou Chest Hospital

**GenoType MTBDRplus:**  
WEI GE  
Shandong Chest Hospital

**Line probe assay (LPA):**  
HAIRONG HUANG  
Beijing Chest Hospital
Cross priming amplification (CPA):
PANG YU
Chinese Center for Disease Control and Prevention

2:45 p.m.  Genetic Diversity of DR TB: Implication for Future Diagnostics
MEGAN MURRAY
Professor
Department of Global Health and Social Medicine
Harvard Medical School

3:15 p.m.  Discussion with speakers and audience

3:30 p.m.  BREAK

SESSION IV: ADDRESSING DIAGNOSIS AND TREATMENT ACROSS THE SPECTRUM OF DRUG RESISTANCE

Session Objectives:
- Describe the prevalence of MDR, pre-XDR, XDR, and untreatable TB in key countries.
- Consider the diagnosis and treatment challenges associated with MDR, pre-XDR, and XDR TB. How can a TB program effectively meet the needs of patients?

Session Chairs:
- China co-chair: JIN LIANG JU, Shanghai Pulmonary Disease Hospital
- U.S. co-chair: NEEL GANDHI, Emory University

3:45 p.m.  MDR and XDR TB
Clinical Perspective:
RICHARD CHAISSON
Johns Hopkins University

4:05 p.m.  Panel Discussion: Treating the Spectrum of Drug Resistance in China
[20 min. each speaker]

New Diagnostic Marker Screening in TB Meningitis:
XIAOYOU CHEN
Tuberculosis Department, Beijing Chest Hospital
Beijing Tuberculosis & Thoracic Tumor Research Institute

Surgical Treatment of M/XDR TB:
XIAO NING
Beijing Chest Hospital, Capital Medical University
4:45 p.m.  
*The Need for a Paradigm Shift in Treatment of the Spectrum of Drug Resistant TB*

MARKUS MAEUER
Professor and Head, Therapeutic Immunology Division
Karolinska Institute

5:15 p.m.  
*MDR, XDR, and Untreatable TB from a Laboratory Perspective*  
[20 min. each speaker]

MARTIE VAN DER WALT
Interim Director, TB Epidemiology and Intervention Research Unit
South African Medical Research Council

SVEN HOFFNER
Director, WHO Supranational TB Reference Laboratory  
Associate Professor, Department for Preparedness  
Swedish Institute for Communicable Disease Control

5:55 p.m.  
*Totally Drug-Resistant TB in India: Lessons and Opportunities from a Clinical Perspective*

ZARIR UDWADIA  
Consultant Chest Physician  
Hinduja Hospital  
Mumbai, India

6:25 p.m.  
Discussion with speakers, panelists and audience

7:15 p.m.  
Closing remarks and adjourn day 2
SESSION V: DRUG-RESISTANT TB IN PEDIATRIC POPULATIONS

Session Objectives:
- Review the global burden and transmission of pediatric DR-TB.
- Discuss challenges in diagnosis and treatment of DR-TB in children.

Session Chairs:
- China co-chair: QIAN GAO, Fudan University, China
- U.S. co-chair: MERCEDES BECERRA, Harvard Medical School

8:00 a.m. Children as Sentinels for Transmission and Policy Response

MERCEDES BECERRA
Associate Professor
Department of Global Health and Social Medicine
Harvard Medical School

8:30 a.m. Pediatric Drug-Resistant TB in China

SHUIHUA LU
(Oral presentation by Tao Li)
Shanghai Public Health Clinical Center

8:50 a.m. Drug Resistant TB in Meningitis

SHUNYING ZHAO
(Oral presentation by Huimin Li)
Beijing Children’s Hospital

9:10 a.m. Status of Pediatric MDR/XDR TB in the Russian Federation and Other FSU Countries: Managing Pediatric Drug-Resistant TB in a Setting with Separate Medical Structures for Adults and Children
SESSION VI: LOOKING FORWARD: DEVELOPING AND STRENGTHENING THE DRUG SUPPLY CHAIN FOR DRUG-RESISTANT TB

Session Objectives:
- Consider to what extent and in what ways current supply chain mechanisms are or are not effectively accomplishing what is needed, in China and beyond, including consideration of bottlenecks.
- Consider the current allocation of responsibilities and roles of the private (including industry and not-for profit public health organizations) and public sectors, and examination of opportunities for enhancing and optimizing collaboration.
- Identify potential innovative solutions to the supply chain problem.

Session Chairs:
- China co-chair: WENHONG ZHANG, Huasan Hospital, Fudan University
- U.S. co-chair: BARRY BLOOM, Harvard School of Public Health

10:00 a.m.  
**Barriers, Challenges, Needs and Potential Solutions for the SLD Supply Chain**

BARRY BLOOM  
Co-chair, IOM workshop Developing and Strengthening the Global Supply Chain for Second-Line Drugs for MDR TB  
Distinguished Service Professor  
Department of Immunology and Infectious Diseases  
Harvard University  
Dean of the Harvard School of Public Health (former)

10:20 a.m.  
**Panel: Different Perspectives on the Global Supply Chain**

RIFAT ATUN  
Professor of International Health Management  
Imperial College  
London
SESSION VII: LOOKING FORWARD: EMBRACING A NEW VISION FOR RESEARCH

Session Objective:
- Review the state-of-the art in TB research and identify opportunities to apply new research tools to the problem of DR TB.

Session Chairs:
- China co-chair: MIN FANG, Institute of Microbiology, Chinese Academy of Sciences
- U.S. co-chair: ANNE GOLDFELD, Harvard Medical School/Global Health Committee

1:00 p.m.  
**The Need for a Paradigm Shift in TB Research: Synergy of Discovery and Delivery of Care**

ANNE GOLDFELD  
Harvard Medical School/Global Health Committee

1:30 p.m.  
**New Tools to Facilitate TB Research**

[10 min. each speaker]

**NIH Global TB Research Resources:**  
MARIA GIOVANNI  
Director, Office of Genomics and Advanced Technologies  
Division of Microbiology and Infectious Diseases  
National Institute of Allergy and Infectious Diseases  
U.S. National Institutes of Health
**SESSION VIII: CREATING AN EVIDENCE-BASED BLUEPRINT FOR ACTION:
IDENTIFICATION OF FOUR STEPS**

**Session Objective:**
- Present highlights from the workshop and identify a blueprint for action based on discussions from the previous two and a half days.

**Session Chairs:**
- China co-chair: YAN-LIN ZHAO, Chinese Center for Disease Control and Prevention
- U.S. co-chair: GAIL CASSELL, Harvard Medical School and Infectious Disease Research Institute

2:30 p.m.  
**Action #1: Expose and Address the Silent Epidemic of DR TB in Children: Evidence Challenges and Mobilization of a Global Network**

MERCEDES BECERRA  
Associate Professor  
Department of Global Health and Social Medicine  
Harvard Medical School

QIAN GAO  
Fudan University, Shanghai

2:45 p.m.  
**Action #2: Adopt Genomic Tools to Map the Epidemic of Drug-Resistant TB and Address Diagnostic Challenges**

SVEN HOFFNER  
Director, WHO Supranational TB Reference Laboratory  
Associate Professor, Department for Preparedness  
Swedish Institute for Communicable Disease Control
YAN-LIN ZHAO
Vice Director, National Center for Disease Control and Prevention
Director, National Tuberculosis Reference Laboratory
Chinese Center for Disease Control and Prevention

3:00 p.m.

**Action #3: Block Transmission of Drug-Resistant TB**

EDWARD NARDELL
Associate Professor
Departments of Environmental Health and Immunology and Infectious Diseases
Harvard School of Public Health

LIXIN ZHANG
Deputy Director, CAS Key Laboratory of Pathogenic Microbiology & Immunology
Inaugural Director of Drug Discovery Center for Tuberculosis
Institute of Microbiology, Chinese Academy of Sciences

3:15 p.m.

**Action #4: Revolutionize Drug Distribution, Guarantee Drug Quality, and Reform Regulatory Approval and Registration Policies**

BARRY BLOOM
Distinguished Service Professor
Department of Immunology and Infectious Diseases
Harvard University
Dean of the Harvard School of Public Health (former)

3:30 p.m. BREAK
SESSION IX: A BIOSOCIAL APPROACH: SCIENCE AND ECONOMIC INTERVENTION FOR DR TB CONTROL--BRICS AT THE FOREFRONT

Session Objective:
- Discuss the leading role of BRICS countries in the effort to combine science and evidence-based policies with economic interventions to combat DR TB.

Session Chairs:
- China co-chair: YAN-LIN ZHAO, Chinese Center for Disease Control and Prevention
- U.S. co-chair: RIFAT ATUN, Professor of International Health Management, Imperial College London

3:45 p.m.  
**What will be Required for Zero Deaths from Drug-Resistant TB?**

SALMAAN KESHAVJEE  
Associate Professor  
Department of Global Health and Social Medicine  
Harvard Medical School

4:15 p.m.  
**Reflections from BRICS Countries: What are the Next Steps?**

RIFAT ATUN  
Professor of International Health Management  
Imperial College  
London

PAUL FARMER  
Chair, Department of Global Health and Social Medicine  
Harvard Medical School

KIRSTINA WALLENGREN  
Clinical Advisor  
KwaZulu-Natal Research Institute for Tuberculosis and HIV (K-RITH)

GRIGORY VOLCHENKOV  
Head Doctor  
Vladimir Oblast TB Dispensary  
Center of Excellence for TB Infection Control

YAN-LIN ZHAO  
Vice Director, National Center for Disease Control and Prevention  
Director, National Tuberculosis Reference Laboratory  
Chinese Center for Disease Control and Prevention

5:15 p.m.  
Discussion with speakers and audience
6:00 p.m.  
*Reflections on the New Delhi Communique*

JARVAS BARBOSA (*by teleconference*)
Vice-Minister of Health
Federative Republic of Brazil

6:15 p.m.  
Adjourn day 3 and workshop

7:00 p.m.  
BANQUET