TB Intensive
San Antonio, Texas
April 6-8, 2011

Epidemiology of TB
Timothy Aksamit, MD
& David Griffith, MD
Wednesday April 6, 2011

Timothy Aksamit, MD has the following disclosures to make:

• No conflict of interests

• No relevant financial relationships with any commercial companies pertaining to this educational activity.
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

RELATIONSHIPS

- World perspective (WHO) - National perspective (CDC)
- State perspective (MDH) - County / local perspective (OCPHD)

- Mayo Clinic / Olmsted County partnership: Olmsted County TB Clinic
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

How many people are infected and develop active tuberculosis worldwide?

8 million
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

The number of people who die worldwide from tuberculosis every day is?

a. 6
b. 60
c. 600
d. 6000
e. none of the above

d. 6000 : 1 dies q 15 seconds (5760)
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

How many people in the U.S. will develop TB disease at some point in their life?

1 - 1.5 million

(10% of 10–15 million infected)
Think globally! Act locally!

World TB Day
March 24

TB Elimination: Now Is The Time!
Think and act globally!

Think and act locally!

Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

**HPI:** 18 y.o. Somali male nonsmoker
- 1 week (?) h/o cough, fever, hemoptysis, myalgias
- Immigrated to US 10/00
- PPD 12mm 11/00, refugee clinic, LTBI 4 mos moved, restart 03/02
- LTBI 9 mos (<4 mos taken), CXR negative
- HIV negative, Hep B serologies negative
- Known exposure: father and sibling while in Kenya

**Exam:** Ill appearing male
- LN: no adenopathy
- Lungs: bronchial BS w/ insp crackles left post upper lung

**PPD:** 0 mm
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

Reported Cases of Tuberculosis, Minnesota, 1918-2006

Number of Cases

Year

Tuberculosis Incidence Rates per 100,000 Population, United States and Minnesota, 1992-2008

Number of Tuberculosis Cases by Place of Birth, Minnesota, 2000-2009
### Tuberculosis Morbidity by Location of Residence, Minnesota, 2009

<table>
<thead>
<tr>
<th>Location of Residence</th>
<th>No. Cases</th>
<th>(%)</th>
<th>Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hennepin County</td>
<td>61</td>
<td>(28)</td>
<td>5.3</td>
</tr>
<tr>
<td>Ramsey County</td>
<td>41</td>
<td>(25)</td>
<td>8.1</td>
</tr>
<tr>
<td>Suburban Twin Cities Metro†</td>
<td>26</td>
<td>(16)</td>
<td>2.2</td>
</tr>
<tr>
<td>Olmsted County</td>
<td>8</td>
<td>(5 )</td>
<td>5.6</td>
</tr>
<tr>
<td>Other Counties</td>
<td>25</td>
<td>(16)</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>161</strong></td>
<td>(100)</td>
<td><strong>3.1</strong></td>
</tr>
</tbody>
</table>

* Cases per 100,000 population
† Anoka, Carver, Dakota, Scott, and Washington counties
Tuberculosis Cases by Risk Category*, Minnesota, 2009

- Foreign-Born: 80%
- Substance abuse†: 2%
- Homeless: 4%
- HIV-Infected: 1%
- Nursing Home Resident: 2%
- Incarcerated: 6%

* Risk categories are not mutually exclusive.
† Alcohol abuse and/or illicit drug use

Foreign-Born Tuberculosis Cases by Region of Birth and Year of Diagnosis, Minnesota, 2005-2009

Number of Cases

- 2005: 40
- 2006: 60
- 2007: 80
- 2008: 100
- 2009: 120

Region of Birth

- South/Southeast Asia
- Sub-Saharan Africa
- East Asia/Pacific
- Latin America/Caribbean
- Eastern Europe

MDH
Foreign-Born Tuberculosis Cases by Country of Birth, Minnesota, 2004-2008

- Somalia (35%)
- Ethiopia (13%)
- Mexico (7%)
- Vietnam (5%)
- Laos (5%)
- Liberia (5%)
- Kenya (4%)
- India (5%)
- Other Countries (22%)

N = 869

Countries of Birth of Foreign-born Persons Reported with TB United States, 2008

- Mexico (23%)
- Philippines (11%)
- India (8%)
- Vietnam (8%)
- China (5%)
- Guatemala (3%)
- Haiti (3%)
- Other Countries (38%)
Refugee Arrivals to Minnesota by Region of World, 1979-2007


<table>
<thead>
<tr>
<th>Visa Status</th>
<th>Cases No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refugee</td>
<td>438 (49)</td>
</tr>
<tr>
<td>Immigrant</td>
<td>216 (24)</td>
</tr>
<tr>
<td>Other</td>
<td>122 (14)</td>
</tr>
<tr>
<td>Unknown</td>
<td>111 (13)</td>
</tr>
<tr>
<td>Total</td>
<td>887 (100)</td>
</tr>
</tbody>
</table>
### Foreign-Born Tuberculosis Cases by Interval Between Arrival in U.S. and Diagnosis of Tuberculosis, Minnesota, 2000-2004

<table>
<thead>
<tr>
<th>Interval (years)</th>
<th>Cases (No. (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>317 (37)</td>
</tr>
<tr>
<td>2 - 5</td>
<td>265 (31)</td>
</tr>
<tr>
<td>6 - 10</td>
<td>133 (16)</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>117 (14)</td>
</tr>
<tr>
<td>Unknown</td>
<td>25 (3)</td>
</tr>
<tr>
<td>Total</td>
<td>857 (100)</td>
</tr>
</tbody>
</table>

### Foreign-Born Tuberculosis Cases by Interval Between Arrival in U.S. and Diagnosis of Tuberculosis, Minnesota, 2003-2007

<table>
<thead>
<tr>
<th>Interval (years)</th>
<th>Cases (No. (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>247 (28)</td>
</tr>
<tr>
<td>1 - 2</td>
<td>170 (19)</td>
</tr>
<tr>
<td>3 - 5</td>
<td>165 (19)</td>
</tr>
<tr>
<td>&gt; 5</td>
<td>296 (33)</td>
</tr>
<tr>
<td>Unknown</td>
<td>9 (1)</td>
</tr>
<tr>
<td>Total</td>
<td>887 (100)</td>
</tr>
</tbody>
</table>
Tuberculosis Cases by Age Group and Place of Birth, Minnesota, 2004-2008

Tuberculosis Cases by Site of Disease and Place of Birth, Minnesota, 2004-2008

* Includes U.S.-born children of foreign-born parent(s)

* Includes cases with both extrapulmonary and pulmonary sites of disease
## Tuberculosis Cases by Site of Disease and Place of Birth, Minnesota, 2004-2008

<table>
<thead>
<tr>
<th>Site of Disease</th>
<th>Foreign-Born Cases</th>
<th>U.S.-Born Cases</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>409 (47)</td>
<td>123 (63)</td>
<td>532 (50)</td>
</tr>
<tr>
<td>Extrapulmonary</td>
<td>373 (43)</td>
<td>44 (23)</td>
<td>417 (39)</td>
</tr>
<tr>
<td>Both*</td>
<td>87 (10)</td>
<td>28 (14)</td>
<td>115 (11)</td>
</tr>
<tr>
<td>Total</td>
<td>869 (100)</td>
<td>195 (100)</td>
<td>1,064 (100)</td>
</tr>
</tbody>
</table>

* TB cases with both pulmonary and extrapulmonary sites of disease, including miliary TB

## Tuberculosis Cases by Drug Susceptibility Patterns and Place of Birth, Minnesota, 2004-2008

<table>
<thead>
<tr>
<th>Place of Birth</th>
<th>Cases With Susceptibility Results*</th>
<th>Any Drug Resistance†</th>
<th>INH-Resistant**</th>
<th>MDR-TB‡</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Foreign-Born Cases</td>
<td>660</td>
<td>97 (15)</td>
<td>75 (11)</td>
<td>12 ( 2)</td>
</tr>
<tr>
<td>U.S.-Born Cases</td>
<td>132</td>
<td>12 ( 9)</td>
<td>8 ( 6)</td>
<td>4 ( 3)</td>
</tr>
<tr>
<td>Total</td>
<td>792</td>
<td>109 (14)</td>
<td>83 (10)</td>
<td>15 ( 2)</td>
</tr>
</tbody>
</table>

* Culture-confirmed cases with drug susceptibility results available
† Resistance to at least one first-line anti-TB drug [i.e., isoniazid (INH), rifampin, pyrazinamide (PZA), or ethambutol]
** INH-resistant cases (also may have resistance to other drugs)
‡ Multi-drug resistant TB, with resistance to at least INH and rifampin
§§Two of these cases were resistant to INH, rifampin, PZA, and ethambutol.
The Epidemiology of Tuberculosis in Minnesota: Conclusions

- Incidence rate of TB disease in MN has fallen below that of U.S. rate as of 2008
- TB occurs statewide, with ~80% of cases in the 7-county Twin Cities metropolitan area
- High percentage (~80%) of foreign-born TB cases
- Ethnic diversity among foreign-born TB cases
- Extrapulmonary TB disease is common, especially among foreign-born TB patients
- High prevalence of drug resistance in MN

Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective
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"Knowing is not enough; we must apply. Willing is not enough; we must do."
-Goethe

"...advancement towards elimination... should include centralization of resources to improve access and deliver more efficient utilization of clinical, epidemiological, case management and laboratory services."

National Academy of Science 2000
Olmsted County TB Clinic and TB Working Group

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Timothy Aksamit, MD (Pulm)

Michael Brennan, MD
Think and act globally!

Think and act locally!

**World TB Day**
March 24

**TB Elimination: Now Is The Time!**

**Description:**
Brendo, 7, has TB and is HIV-positive. He now lives at Casa Camara, Rio de Janeiro, Brazil, where he received free TB and free ARV drugs. “Some of the medicines tasted good, but the ARV never taste like rice and beans. I feel good now.”

**Country:**
Brazil
Questions?

Tuberculosis Cases by Mode of Treatment Administration, Minnesota, 2005-2009

- DOT
- Some supervision, not DOT
- Self-administered
Tuberculosis in the 21st Century: A Minnesota and Olmsted County Perspective

Tuberculosis Intensive
San Antonio, Texas
Heartland National TB Center
6 Apr 2011

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Tuberculosis Epidemiology
Global and the U.S.

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Assistant Medical Director
Heartland National TB Center
Professor of Medicine
University of Texas Health Center, Tyler
Tuberculosis Epidemiology

- TB is highly prevalent and poorly controlled in most of the world (it is a really bad problem)
- HIV co-infection and lack of resources are the engines driving the worldwide TB epidemic
- TB in the U.S. is increasingly a reflection of the worldwide TB epidemic
- Modern TB control programs are like fire departments and work really well if given adequate resources

TB IN THE WORLD*

*We don’t know the epidemiology of TB in most of the world with certainty. In most of the world TB is diagnosed on the basis if AFB smears without cultures, and treated without in vitro drug susceptibility results
Worldwide TB
Lawn and Zumia, Lancet e-pub 3/18/11

• Estimated total number of incident cases of TB worldwide rose to 9.4 million in 2009, more than at any other time in history.
• Worldwide TB rates estimated to have peaked 2004 and to have decreased at a rate of less than 1%/year since.
• The overall worldwide burden continues to rise as a result of world population growth: estimated 2 billion people with LTBI
• Estimated 1.7 million TB-related deaths/year

---

Risk factors associated with TB

– Under-nutrition, vitamin deficiencies, overcrowded living conditions, genetic susceptibility, sex, age: ?X
– HIV 20-37X
– Diabetes 3X
– Smoking 2X
– Indoor air pollution ?2X
– Silicosis 3X
– Alcohol 3X
– End-stage renal disease 10X
– Malignancy ?X
– Corticosteroid therapy 2X
– TNF alpha inhibitor ?X (>risk TNF antibodies vs soluble TNF receptor)
Estimated total number of incident cases of TB worldwide rose to 9.4 million in 2009, more than at any other time in history.

Worldwide TB rates estimated to have peaked 2004 and to have decreased at a rate of less than 1%/year since.

The overall worldwide burden continues to rise as a result of world population growth

Estimated 1.7 million TB-related deaths/year
Worldwide TB
Lawn and Zumia, Lancet e-pub 3/18/11

• 22 countries account for 80% of the worldwide burden
• 5 countries with highest numbers of incident cases (first to last), India, China, South Africa, Nigeria and Indonesia
• Approximately 12% worldwide caseload HIV-associated (most important risk factor for progression from LTBI to active TB)
• 4/5 HIV co-infected cases in sub-Saharan Africa
• In the worst affected countries of South Africa and Swaziland about 1% of the population develops TB each year (>50% TB cases HIV coinfected)

Global Epidemiology of TB - 2009

• Countries with the largest number of incident cases:
  – India (1.6–2.4 million)
  – China (1.1–1.5 million)
  – South Africa (0.40–0.59 million)
  – Nigeria (0.37–0.55 million)
  – Indonesia (0.35–0.52 million)
• India alone accounts for an estimated one fifth (21%) of all TB cases worldwide
• China and India combined account for 35%
Global Epidemiology of TB - 2009

*Top 10 Countries with the highest NEW TB CASES per 100,000:

- **Worldwide** 137
- Swaziland 1,257
- South Africa 971
- Zimbabwe 742
- Namibia 727
- Botswana 694
- Sierra Leone 644
- Lesotho 634
- Djibouti 620
- Gabon 501
- Timor Leste 498
- Togo 446

**All in Africa!**

**#56 India – 168/100,000**

**#78 China – 96/100,000**

**#15 Myanmar (Burma): 404/100,100**

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TB, the “greatest” human plague

- Late 1600’s, TB case rates in London had reached 1000 cases/100,000 population per year.
- John Bunyan, an English Christian writer and preacher described tuberculosis as, “The Captain among these men of death”
- Current estimate of TB case rates in parts of Africa exceed 1000 cases/100,000 population.
Definitions of Drug Resistant Tuberculosis

• MDR TB: Resistant to INH and Rifampin
• MDR TB is the precursor of XDR TB
• XDR TB: MDR TB
  – PLUS
  – Resistance to any fluoroquinolone
  – Resistance to at least one of the following injectables:
    • Amikacin, Kanamycin, Capreomycin

2010 WHO MDR-TB Report

• In 2008 an estimated 440,000 case of MDR-TB emerged globally
• Among all incident TB cases globally 3.6% are estimated to have MDR-TB
• Almost 50% of MDR-TB cases are estimated to occur in China and India
• In 2008 MDR-TB caused an estimated 150,000 deaths
• In 2008, 29K MDR-TB cases reported by 127 countries
• Only 7% of MDR-TB cases estimated to have emerged that year
• In the 27 high MDR-TB burden countries, 1% of new TB cases and 3% of previously treated TB cases underwent drug susceptibility testing

• Tajikistan
  – 16.5% MDR-TB among new TB cases
  – 61.6% MDR-TB among previously treated TB patients in one city and one district
Tuberculosis among Health Care Workers
Baussana et al EID 2011, 17; 488

- Literature review 1995-2010
- Median annual rate of TB infection among HCW’s 2.9% (LIC), 8.7% (IIC), 7.2% (HIC)
- Median estimated incidence of TB among HCW’s 67 cases/100,000 (LIC), 91/100,000 (IIC) and 1,180/100,000 (HIC)
- Estimates among general population 33, 82, 311 suggesting 49%, 27% and 81% of TB cases respectively among HCW’s were attributable to exposure in health care setting.

High Incidence of Hospital Admission with MDR and EXDR TB Among South African HCW’s
O’Donnell et al, AIM 2010; 153: 516

- Retrospective study (2003-08) of 231 HCW’s and 4151 non-HCW’s with drug-resistant TB admitted to hospital in KwaZulu-Natal, SA
- Estimated incidence of MDR-TB hospitalization 64.8/100,000 HCW vs 11.9/100,000 non-HCW’s.
- 78% of HCW’s with drug resistant TB women vs 47% non-HCW’s
- HIV infection did not differ between HCW’s and non-HCW’s
• It is estimated that 1.3 million MDR-TB cases will need to be treated between 2010 and 2015 at an estimated total cost of $16,000,000,000.

• The current level of funding in 2010 (from all sources) is less than $500,000,000.

Extensively drug-resistant TB: “There must be some kind of way out of here”
Cegielski 2010, CID; 50: S195

“Unlike in affluent countries...the large majority of persons with MDR-TB worldwide do not receive a diagnosis and remain untreated. Sophisticated microbiology laboratories and complex combinations of expensive second-line drugs are not available to them, and the disease spreads unchecked.”
Drug Resistant Tuberculosis

Creation of XDR TB

- The development of XDR TB results from TB control and treatment practices in most of the world that would not be acceptable in the United States.
- Case identification and treatment response are based on AFB smears without confirmatory cultures or susceptibility testing.
- Retreatment for treatment failure not based on in vitro susceptibility studies, rather, on fixed retreatment regimens.


WHO

- Data on testing for XDR-TB from 46 countries with surveillance of second line drug resistance for MDR-TB cases.
- 5.4% of MDR-TB cases with XDR-TB.
- 8 countries reported XDR-TB in more than 10% of MDR-TB cases (E Europe, Central Asia).
- To date at least 58 countries have confirmed at least one case of XDR-TB.
Emergence of New Forms of Totally Drug-Resistant Tuberculosis Bacilli
Velayati et al Chest 2009, 136: 420

- WHO protocols for addition of 2nd line drugs:
  DST when patient failed therapy
- 146 MDR, 8XDR, 15 TDR (MDR strains resistant to all 2nd line drug classes)
- TDR 56% Iranian, 30% Afghan
- No documented sputum conversion with TDR isolates
- Genotyping: no evidence cluster transmission

Drug-Resistant Tuberculosis: What is to be done?
Neil Schluger, Chest 2009, 136; 333

- Failure to use supervised therapy to deliver medications
- Nosocomial spread of TB (especially among HIV infected)
- The use of ineffective standardized retreatment regimens ("likely a recipe for creating more drug resistance among patients who had not responded to therapy")
- Lack of availability of reliable and rapid drug susceptibility testing
- Lack of reliable supply of second-line agents
- Lack of new drugs
Picking up the pace—Scale-up of MDR TB treatment programs
Keshavjee and Farmer NEJM 2010; 363: 1781

• “MDR TB is a treatable…infectious disease that killed an estimated 1.5 million people between 2000 and 2009—an annual rate 10 times that of the H1N1 influenza virus. During this period, barely 0.5% of the estimated 5 million people who became ill with MDR TB received treatment with quality-assured second line drugs. The rest continued to transmit resistant bacteria to others…”

Picking up the pace—Scale-up of MDR TB treatment programs
Keshavjee and Farmer NEJM 2010; 363: 1781

• Addressing the MDR TB epidemic will require critical transformation in 4 areas:
  – Diagnostics
  – Drug supply
  – Treatment implementation
  – Advocacy
TB Control Programs
Healthcare System and Cultural Barriers

- Case identification
- Early recognition of drug resistant disease
- Availability of appropriate TB meds
- Administration of adequate TB regimens
- Treatment of co-existing medical problems
- Administrative and engineering controls to prevent TB transmission
- Isolation of contagious cases
- Quarantine for nonadherent patients
- Contact investigation/treatment of LTBI

Picking up the pace—Scale-up of MDR TB treatment programs
Keshavjee and Farmer NEJM 2010; 363: 1781

- “In sum, the pace of scale-up of MDR TB treatment has been abysmal. We have failed to apply relevant lessons, and our approaches are outdated. Meanwhile, the disease continues to spread, and patients continue to die.”
- “We may not have much time before this epidemic overtakes our capacity to stop TB.”
Efficacy of a 6-month versus 9-month intermittent treatment regimen in HIV-infected patients with tuberculosis: a randomized clinical trial
Swaminathan et al AJRCCM 2010; 181: 743-751

- Reg6M v Reg9M: untreated HIV/TB coinfected
- 4 drug initial phase, 2 drug continuation phase:IR
- Of 327 patients, 70% culture + TB, 1st line DST
- Favorable response to RX similar
- Bacteriologic recurrence 15% Reg6, 7%Reg9
- Mortality at 36 months 36%Reg6, 35%Reg9
- All 19 patients who failed treatment acquired rifamycin-resistant TB, with initial bacillary resistance to INH as the main risk factor!!

“...A high rate of acquired rifamycin resistance at the time of failure was noted irrespective of the length of treatment, with this Thrice-weekly fully intermittent regimen in patients with advanced HIV disease, suggesting the need for daily treatment at least in the intensive phase.”

HUH?
A trial involving HIV-TB in India
AJRCCM 2010, 181; 652

• “...5) a significant association of acquired rifampin resistance (ARR), with the presence of baseline INH resistance. These are important observations; if confirmed in other settings, they could have substantial influence on TB control programs worldwide.”
• “The finding of an association of ARR with baseline INH resistance is important...Due to the rarity of baseline drug-susceptibility testing, this may increase the exposure of INH-resistant strains to rifampin...this may be, paradoxically, both life-saving and a recipe for the creation of more MDR-TB”.

Efficacy of a 6-month versus 9-month intermittent treatment regimen in HIV-infected patients with tuberculosis: a randomized clinical trial
Swaminathan et al AJRCCM 2010; 181: 743-751

• This study created 15 MDR TB cases.
• The success rate for treating these MDR TB cases was 20% (3/15)
• What was learned from this study?
• WAS THIS AN ETHICAL STUDY??
World TB Epidemiology

• Some reasons to be cautiously optimistic
  – WHO embracing evidence based care
  – Introduction of new antituberculosis drugs
  – Rapid mycobacterial culture techniques
  – Rapid techniques for identifying drug resistant *M. tuberculosis* strains
  – Increased use of DOT
  – Improved technical instructions for TB evaluation of some immigrants to the U.S.

TB IN THE UNITED STATES
Factors Contributing to the Increase in TB Morbidity: 1985-1992

- Deterioration of the TB public health infrastructure
- Immigration from countries where TB is common
- HIV/AIDS epidemic
- Homelessness, drug and alcohol abuse

<table>
<thead>
<tr>
<th>Year</th>
<th>No.</th>
<th>Rate*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>14,836</td>
<td>5.1</td>
</tr>
<tr>
<td>2004</td>
<td>14,499</td>
<td>4.9</td>
</tr>
<tr>
<td>2005</td>
<td>14,064</td>
<td>4.8</td>
</tr>
<tr>
<td>2006</td>
<td>13,734</td>
<td>4.6</td>
</tr>
<tr>
<td>2007</td>
<td>13,280</td>
<td>4.4</td>
</tr>
<tr>
<td>2008</td>
<td>12,906</td>
<td>4.2</td>
</tr>
<tr>
<td>2009</td>
<td>11,545</td>
<td>3.8</td>
</tr>
</tbody>
</table>

*Cases per 100,000, updated as of July 1, 2010.
Decrease in Reported Tuberculosis Cases---U.S., 2009 (Updated Scorecard)
MMWR 3/19/2010, 59; 289-294

• For 2009: 11,540 TB cases reported in U.S.
• TB case rate: 3.8 cases/100,000
• 11.4% decrease in TB case rate of 4.2/100,000 from 2008
• “The 2009 rate showed the greatest single-year decrease ever recorded and was the lowest recorded rate since national TB surveillance began in 1953.”

• TB rate in foreign-born persons 11X higher than U.S. born persons
• TB rates among Hispanics and blacks 8X higher than whites (Asians 26X higher)
• 36 states and DC lower rates than 2008,
• 14 states with higher rates
• CA, FL, NY, TX > 500 cases, >50% of all TB cases reported in the U.S.
Decrease in Reported Tuberculosis Cases---U.S., 2009 (Updated Scorecard)
MMWR 3/19/2010, 59; 289-294

- 2009, 40% of TB cases US born (1.7/100,000): a ↓ of 16% c/w 2008, and a ↓ of 77% c/w 1993
- 41% of all US born cases in blacks
- The greatest annual decrease in TB rate was among whites (15%), blacks (14%), Hispanics (13.6%) and Asians (9%)

- 60% of all cases in foreign-born persons, a decrease in cases of 10.5%
- TB rate among foreign born 18.6/100,000, a 9% ↓ c/w 2008 and a 45% ↓ c/w 1993.
- In 2009, 4 countries accounted for 50% of TB cases in foreign born persons: Mexico, the Philippines, India and Vietnam
Decrease in Reported Tuberculosis Cases---U.S., 2009 (Updated Scorecard)
MMWR 3/19/2010, 59; 289-294

• 10% TB cases HIV + (CA, VT not reported)
• 1.1% MDR TB cases
  – % of MDR cases 4X higher in previously treated patients
  – Foreign born persons: 78% of MDR TB
• “To date, no new cases of extensively drug-resistant TB (XDR TB) have been reported in 2009.”

Trends in Tuberculosis-United States, 2010 (MMWR 3/24/11)

• 11,181 TB cases reported in the U.S. in 2010
• 3.6 cases/100,000 pop (3.9% ↓ c/w 2009)
• C/W whites, TB rates 7X higher in Hispanics, 8X higher in Blacks, 25X higher in Asians
• More TB cases reported among Hispanics than any other racial/ethnic group
• TB rate for foreign-born individuals 11X higher than U.S. born
• 9% TB patients co-infected with HIV
• 2009 1.3% MDR, one XDR case reported in 2010
Decrease in Reported Tuberculosis Cases---U.S., 2009 (Updated Scorecard)
MMWR 3/19/2010, 59; 289-294

• Improved TB control or population demographic shifts
• Under-diagnosis or under-reporting of TB
• New technical instructions for pre-immigration TB screening
• Reductions in immigration and increases in recent immigrants returning to their native country (esp Mexico)
• Provisional data/census adjustment: “subject to change”

Tuberculosis and Substance Abuse in the United States, 1997-2006
Oeltmann et al Arch Int Med 2008, 169; 189

• Substance abuse is the most commonly reported behavioral risk factor among patients wit TB in the U.S.
• Patients who abuse substances are more contagious and remain contagious longer because treatment failure extends periods of infectiousness
Substance Abuse-related barriers

- Associated with sputum smear-positive disease and delayed care seeking (prolonged infectiousness)
- Unwilling or unable to recall names of contacts
- Contacts are more difficult to locate and less likely to get screened for LTBI
- Contacts who abuse substances are less likely to initiate, adhere to, and complete treatment

Drug resistant TB in foreign-born individuals

- INH resistance as high as 20% of patients from Vietnam and 18% from Peru
- Foreign born individuals accounted for:
  - 82% of MDR-TB in the U.S. in 2005
  - 85% of MDR-TB in the U.S. in 2006
Primary MDR TB
United States, 1993–2009*

*No. of Cases

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
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<tbody>
<tr>
<td>1993</td>
<td>470</td>
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<tr>
<td>1995</td>
<td>350</td>
</tr>
<tr>
<td>1997</td>
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<tr>
<td>2003</td>
<td>100</td>
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<tr>
<td>2005</td>
<td>80</td>
</tr>
<tr>
<td>2007</td>
<td>70</td>
</tr>
<tr>
<td>2009</td>
<td>60</td>
</tr>
</tbody>
</table>

*Updated as of July 1, 2010.
*Note: Based on initial isolates from persons with no prior history of TB.
*MDR TB defined as resistance to at least isoniazid and rifampin.

Primary Isoniazid Resistance in U.S.-born vs. Foreign-born Persons
United States, 1993–2009*

*% Resistant

<table>
<thead>
<tr>
<th>Year</th>
<th>U.S.-born</th>
<th>Foreign-born</th>
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</thead>
<tbody>
<tr>
<td>1993</td>
<td>13%</td>
<td>11%</td>
</tr>
<tr>
<td>1995</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td>1997</td>
<td>11%</td>
<td>9%</td>
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<tr>
<td>1999</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>2001</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>2003</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>2005</td>
<td>8%</td>
<td>6%</td>
</tr>
<tr>
<td>2007</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>2009</td>
<td>6%</td>
<td>4%</td>
</tr>
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</table>

*Updated as of July 1, 2010.
*Note: Based on initial isolates from persons with no prior history of TB.
Primary MDR TB in U.S.-born vs. Foreign-born Persons, United States, 1993–2009*

*Updated as of July 1, 2010.
*Note: Based on initial isolates from persons with no prior history of TB.
MDR TB defined as resistance to at least isoniazid and rifampin.

XDR TB Case Count defined on Initial DST† by Year, 1993–2009*

†Drug susceptibility test.
*Reported incident cases as of July 1, 2010.
Extensively drug-resistant TB (XDR TB) is defined as resistance to isoniazid and rifampin, plus resistance to any fluoroquinolone and at least one of three injectable second-line anti-TB drugs.
TUBERCULOSIS IN THE HEARTLAND REGION
### Reporting Area Cases Case Rates Rank by Rate Population Estimates July 1, 2009

<table>
<thead>
<tr>
<th>Reporting Area</th>
<th>2009</th>
<th>2008</th>
<th>2009</th>
<th>2008</th>
<th>09</th>
<th>08</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
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<td>4.2</td>
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<td>466</td>
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<td>3.6</td>
<td>19</td>
<td>19</td>
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<td>49</td>
<td>1.4</td>
<td>1.6</td>
<td>39</td>
<td>40</td>
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<td>57</td>
<td>2.1</td>
<td>2.6</td>
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<td>32</td>
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<td>4.1</td>
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<tr>
<td>Missouri</td>
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<td>36</td>
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<tr>
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<tr>
<td>North Dakota</td>
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<td>45</td>
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<tr>
<td>South Dakota</td>
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<td>2.6</td>
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<td>29</td>
<td>674,583</td>
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<tr>
<td>Texas</td>
<td>1,501</td>
<td>1,501</td>
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<td>6.2</td>
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<td>4</td>
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<td>Wisconsin</td>
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<td>68</td>
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<td>1.2</td>
<td>43</td>
<td>43</td>
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</table>

### Heartland National TB Center Metropolitan Areas 2004

<table>
<thead>
<tr>
<th>City</th>
<th>TB Cases</th>
<th>Case Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houston, TX</td>
<td>512</td>
<td>11.2</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>294</td>
<td>7.6</td>
</tr>
<tr>
<td>San Antonio, TX</td>
<td>121</td>
<td>7.0</td>
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<tr>
<td>Austin, TX</td>
<td>72</td>
<td>5.9</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>508</td>
<td>5.9</td>
</tr>
<tr>
<td>Oklahoma City, Ok</td>
<td>59</td>
<td>5.2</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td>42</td>
<td>5.1</td>
</tr>
<tr>
<td>Minneapolis/St. Paul MN</td>
<td>157</td>
<td>5.0</td>
</tr>
</tbody>
</table>
TB INCIDENCE IN TEXAS

- 2008 1501 cases
- 2009 1501 cases
- 2010 1385 cases*

*Estimated

Heartland National TB Center 2004

<table>
<thead>
<tr>
<th>State</th>
<th>%TB Cases in Foreign-born</th>
<th>%Foreign-born TB Cases from Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>45</td>
<td>59</td>
</tr>
<tr>
<td>Illinois</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Missouri</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>North Dakota</td>
<td>25</td>
<td>0</td>
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<tr>
<td>Oklahoma</td>
<td>21</td>
<td>35</td>
</tr>
<tr>
<td>South Dakota</td>
<td>18</td>
<td>100</td>
</tr>
</tbody>
</table>
## Heartland National TB Center 2004

<table>
<thead>
<tr>
<th>States</th>
<th>%TB Cases in Foreign-born</th>
<th>% Foreign-born TB Cases from Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>82%</td>
<td>8%</td>
</tr>
<tr>
<td>Nebraska</td>
<td>80</td>
<td>32</td>
</tr>
<tr>
<td>Iowa</td>
<td>66</td>
<td>19</td>
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<tr>
<td>Arizona</td>
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<td>64</td>
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<td>Wisconsin</td>
<td>56</td>
<td>34</td>
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<tr>
<td>New Mexico</td>
<td>45</td>
<td>89</td>
</tr>
</tbody>
</table>

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### Overseas Screening for Tuberculosis in U.S.-bound Immigrants and Refugees

Liu et al NEJM 2009, 360; 2406

- **Top 5 birth countries of immigrants with overseas diagnosis of TB:**
  - Philippines, Vietnam, China, Mexico, India
- **Top 5 birth countries of refugees with overseas diagnosis of TB:**
  - Ukraine, Vietnam, Somalia, Bosnia/Herzegovina, Sudan
Overseas Screening for Tuberculosis in U.S.-bound Immigrants and Refugees  
Liu et al NEJM 2009, 360; 2406

• Improvements in overseas screening of immigrants and refugees:
  – Mycobacterial cultures
  – Drug-susceptibility testing
  – Directly observed therapy
  – TST for children 2-14 years
  – Shorter interval between screening and departure for the U.S.

Estimated Migrants “Entering” U.S.

• Visitors without visas
  ~ 30,000,000

• Non-immigrant visas
  27,907,139

• Immigrants and refugees
  411,266

• Undocumented migrants
  ~ 275,000 ????

• Status adjusters in U.S.:
  679,305

• N = ~ 59,000,000

Entering the U.S. with Active TB

- Enter the U.S. as a tourist, for business, as a student or as a temporary worker, etc…
- Enter the U.S. illegally
- A classification on medications
- B1 classification with false negative smears
- B2 classification with false negative CXR
- “Asymptomatic” children, (immuno-compromised adults) with primary TB
Pulmonary Impairment After TB
Pasipanodya et al Chest 2007, 131; 1817

• 107 TB patients compared with 210 LTBI patients
• Pulmonary function impairment present in 59% of TB patients vs 20% LTBI patients
• TB survivors more than 5.4 times more likely to have abnormal pulmonary function tests than LTBI patients
• “For many persons with TB, a microbiological cure is the beginning not the end of their illness.”
TB Epidemiology

• Scorecard: How are we doing? Pretty darned good (so far).
• Radar: What’s coming next? A tsunami of drug resistant cases in foreign-born individuals?
• GPS: Which direction do we need to go?
  – Minority populations in the U.S.
  – Foreign-born persons in the U.S.
  – The rest of the world!

Tuberculosis Testing in Texas
After the Next Legislative Session
Detecting Tuberculosis: No

IN TRAINING While the Gambian rat is accepted as a diagnostic tool in Tanzania, “the medical community is still skeptical.”