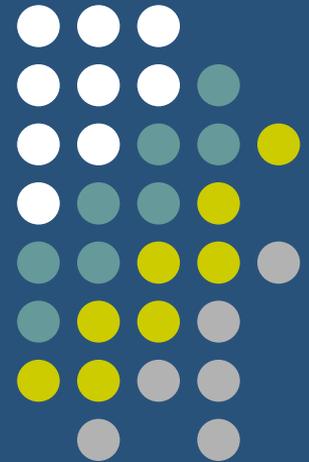


# Overview of TB

Peter Davidson, PhD  
Michigan Dept. of Community  
Health



# TB Epidemiology

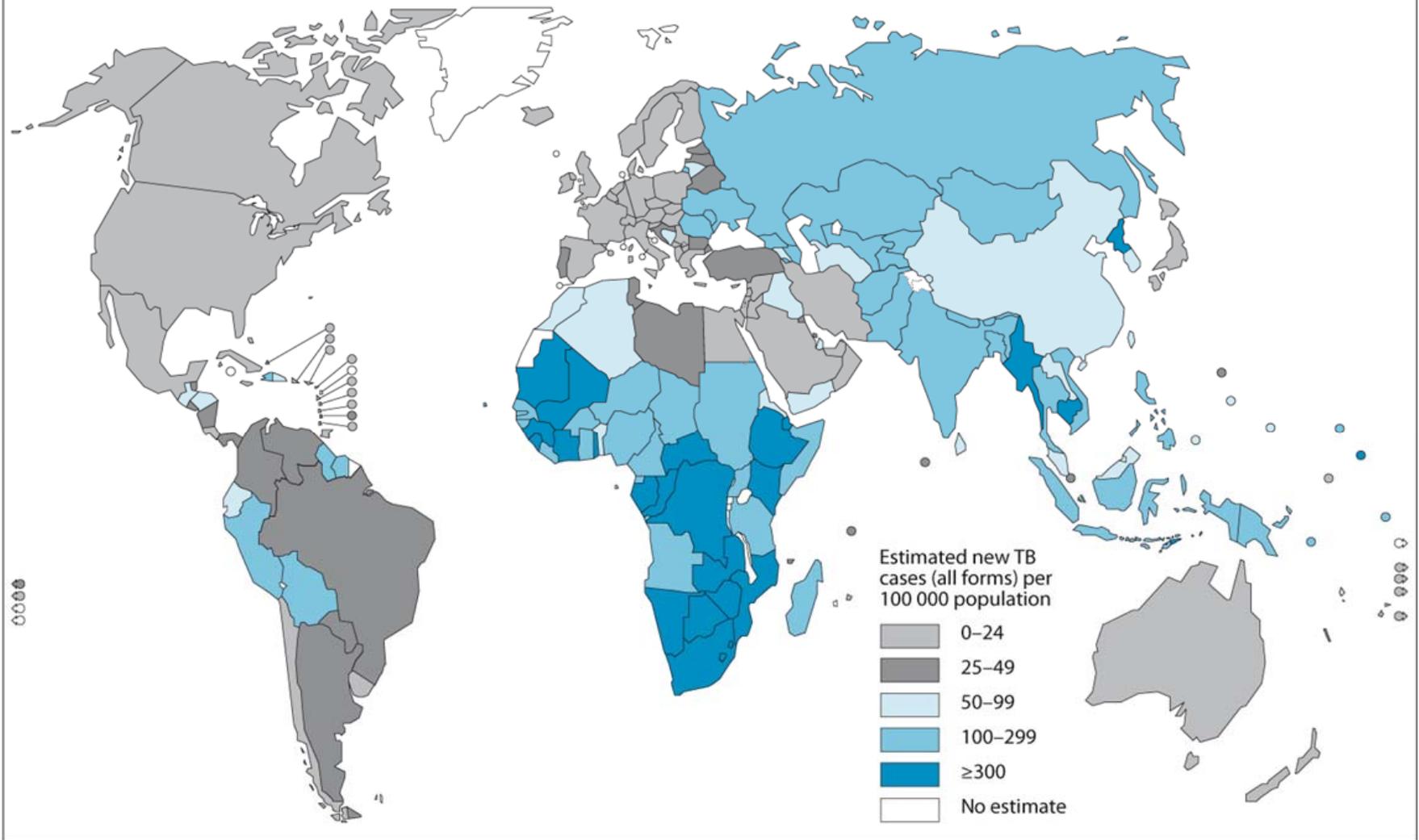


# TB around the World (2009)



- **There were 9.4 million new TB cases, including 1.1 million cases among people with HIV**
- **1.7 million people died from TB, including 380,000 people with HIV, equal to 4700 deaths a day**

## Estimated TB incidence rates, by country, 2009



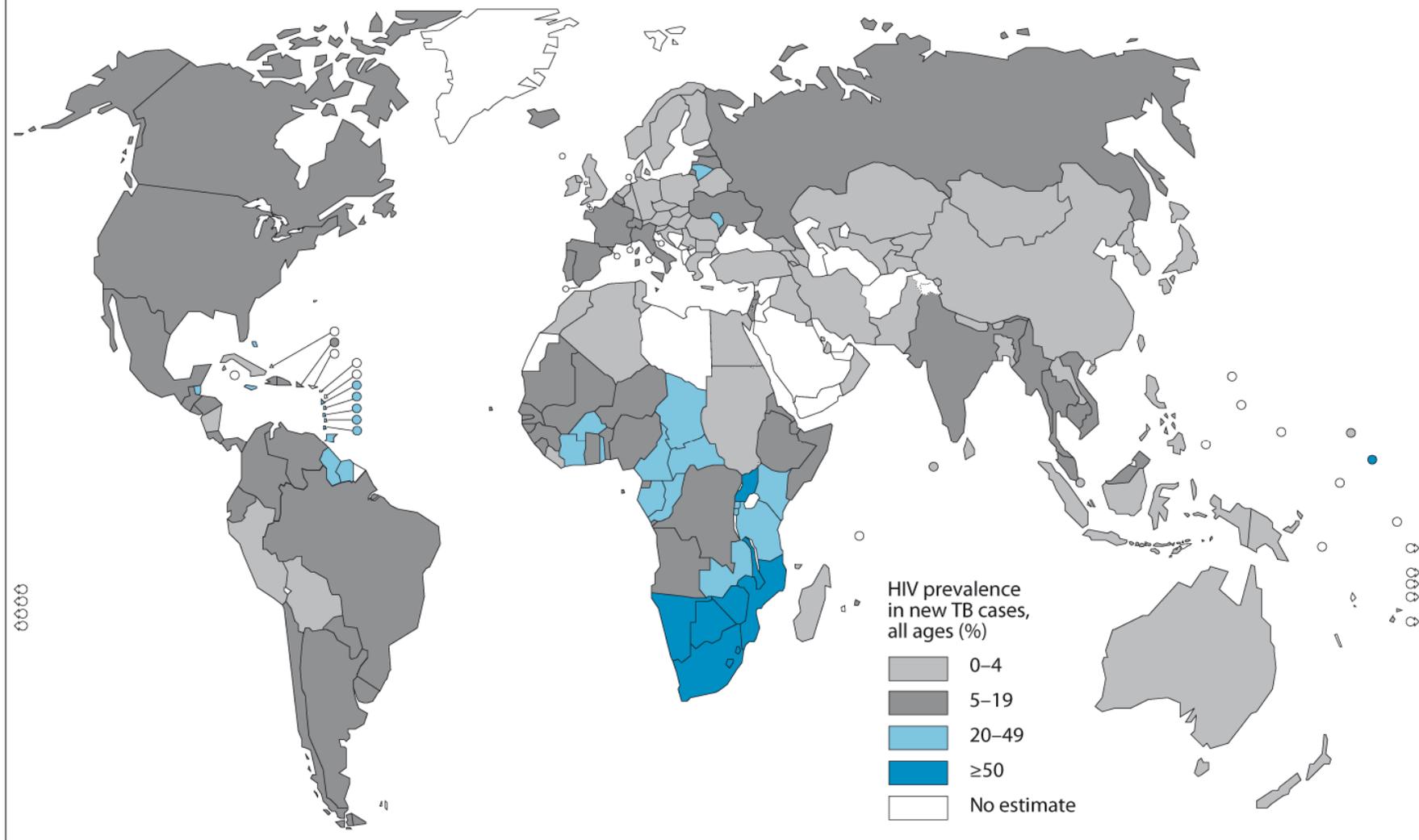
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers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

Source: *Global Tuberculosis Control 2010*. WHO, 2010.



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# Estimated HIV prevalence in new TB cases, 2009



The boundaries and names shown and the designations used on this map 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.

Source: *Global Tuberculosis Control 2010*. WHO, 2010.



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# TB around the World

- **The estimated global incidence rate fell to 137 cases per 100,000 population in 2009, after peaking in 2004 at 142 cases per 100,000.**
- **Globally, the percentage of people successfully treated reached the highest level at 86% in 2008**

# High Burden Countries (WHO)

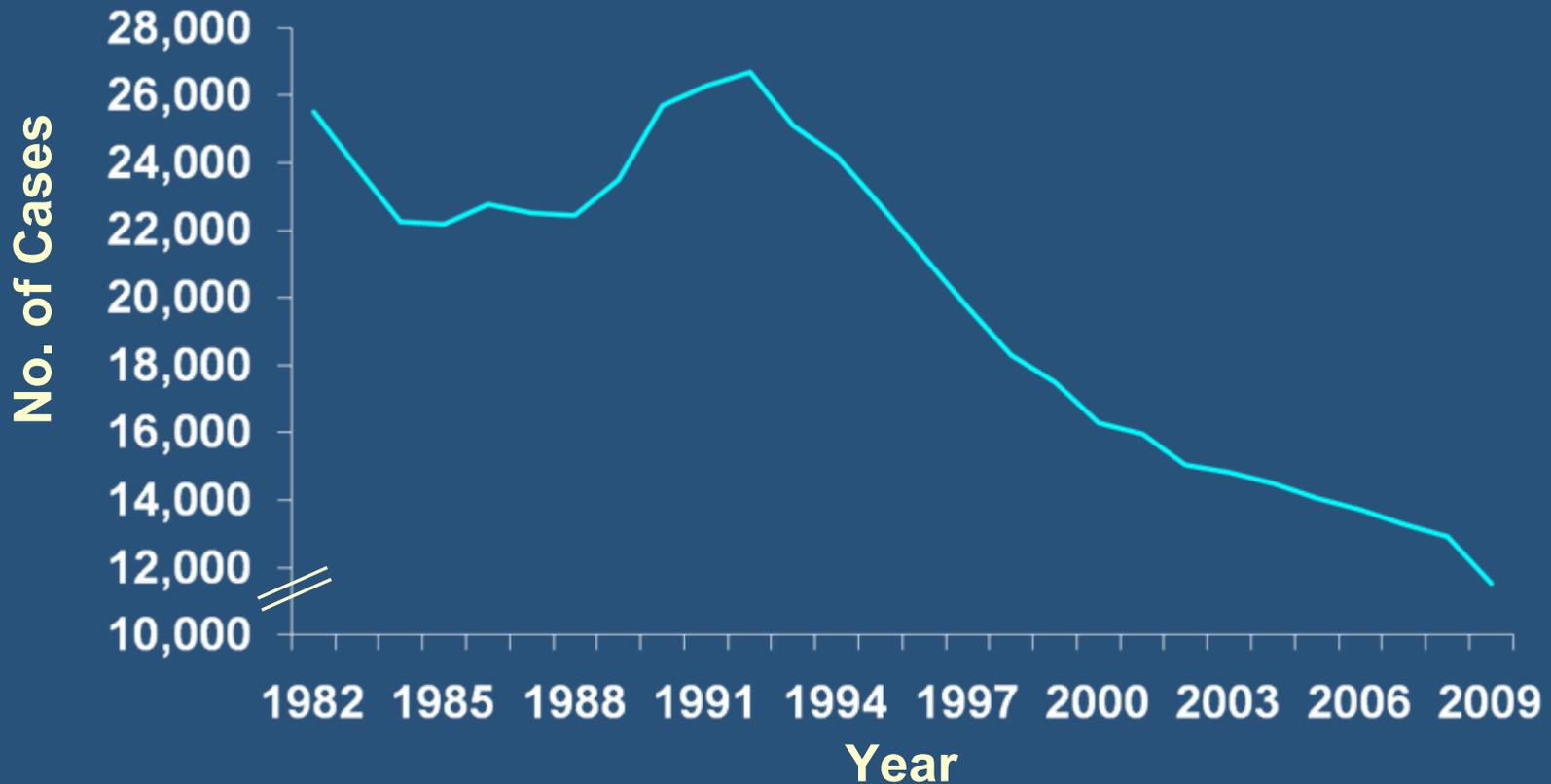


- Afghanistan
- Bangladesh
- Brazil
- Cambodia
- China
- Democratic Republic  
of the Congo
- Ethiopia
- India
- Indonesia
- Kenya
- Mozambique
- Myanmar
- Nigeria
- Pakistan
- Philippines
- Russian Federation
- South Africa
- Thailand
- Uganda
- United Republic of  
Tanzania
- Viet Nam
- Zimbabwe

# TB Epidemiology



# Reported TB Cases\* United States, 1982–2009



\*Updated as of July 1, 2010. Source: CDC

# TB Morbidity

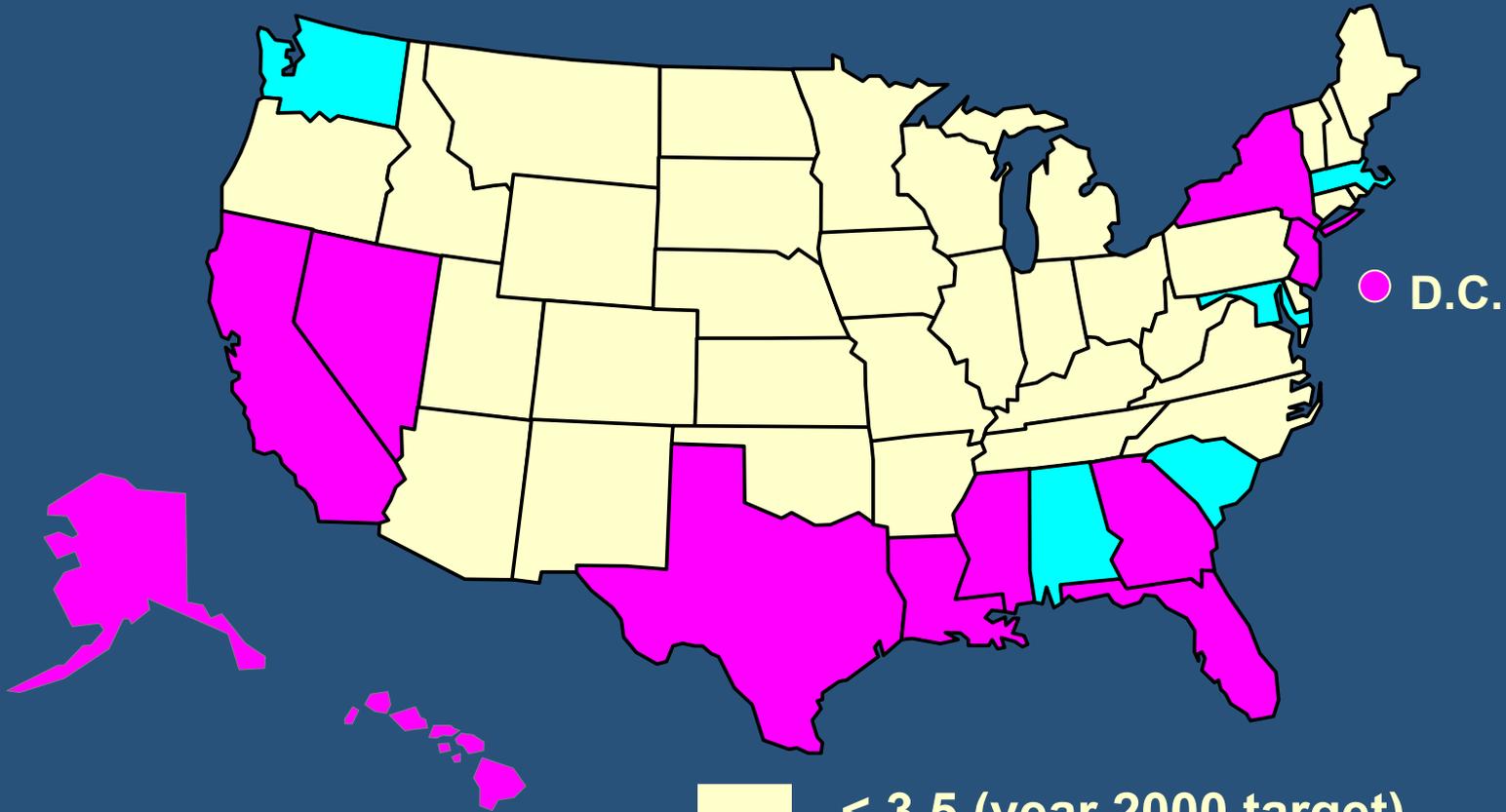
## United States, 2003–2009



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

\*Cases per 100,000, updated as of July 1, 2010. Source: CDC

# TB Case Rates,\* United States, 2009

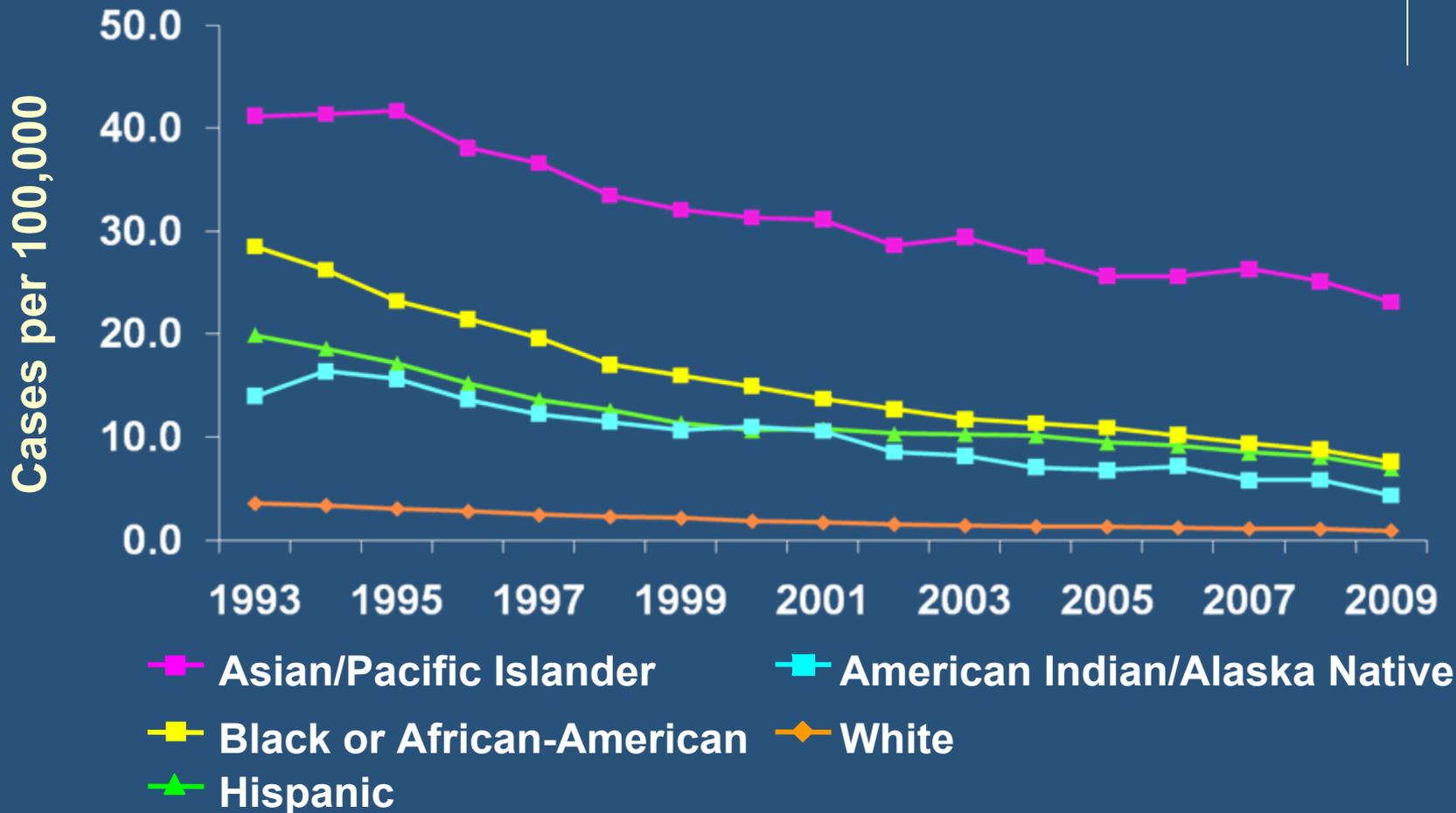


- Yellow box: ≤ 3.5 (year 2000 target)
- Cyan box: 3.6–3.8
- Magenta box: > 3.8 (national average)

\*Cases per 100,000. Source: CDC

# TB Case Rates by Race/Ethnicity\*

## United States, 1993–2009\*\*



\*All races are non-Hispanic. In 2003, Asian/Pacific Islander category includes persons who reported race as Asian only and/or Native Hawaiian or Other Pacific Islander only.

\*\*Updated as of July 1, 2010. Source CDC

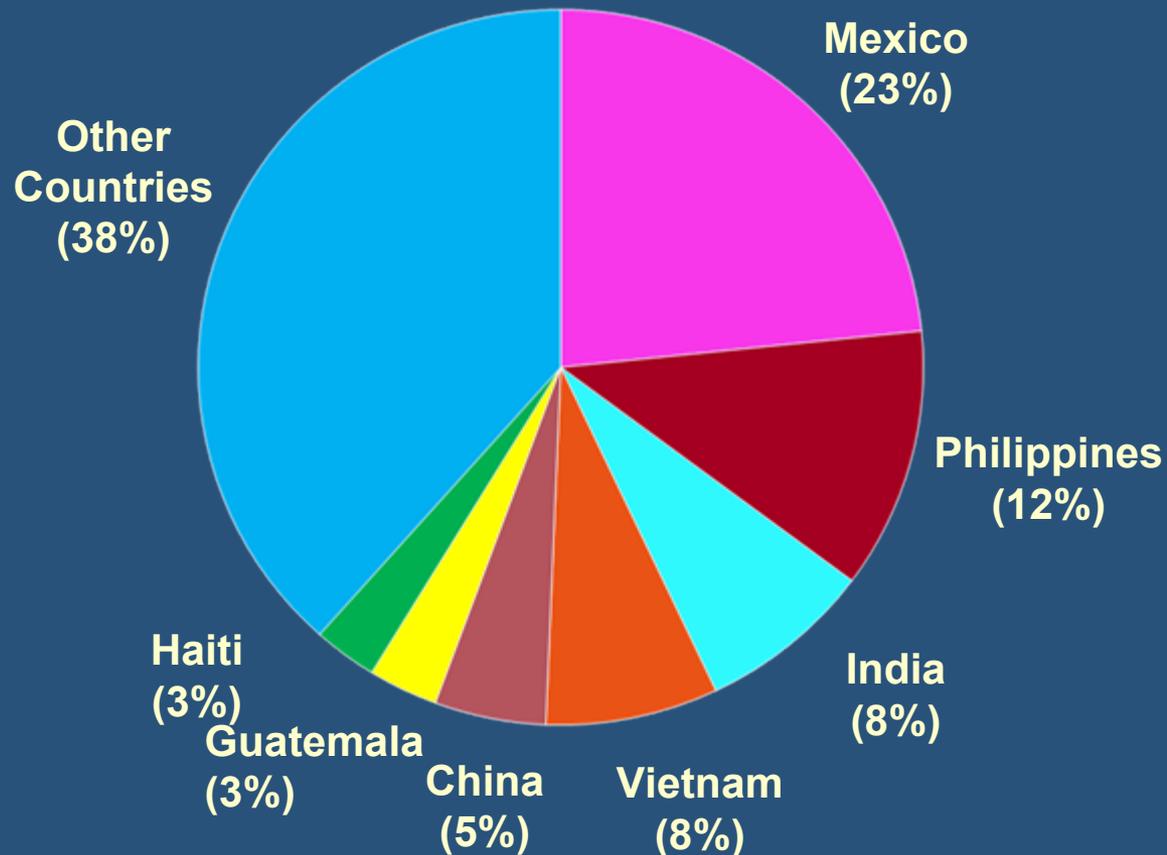
# Number of TB Cases in U.S.-born vs. Foreign-born Persons United States, 1993–2009\*



\*Updated as of July 1, 2010  
Source: CDC

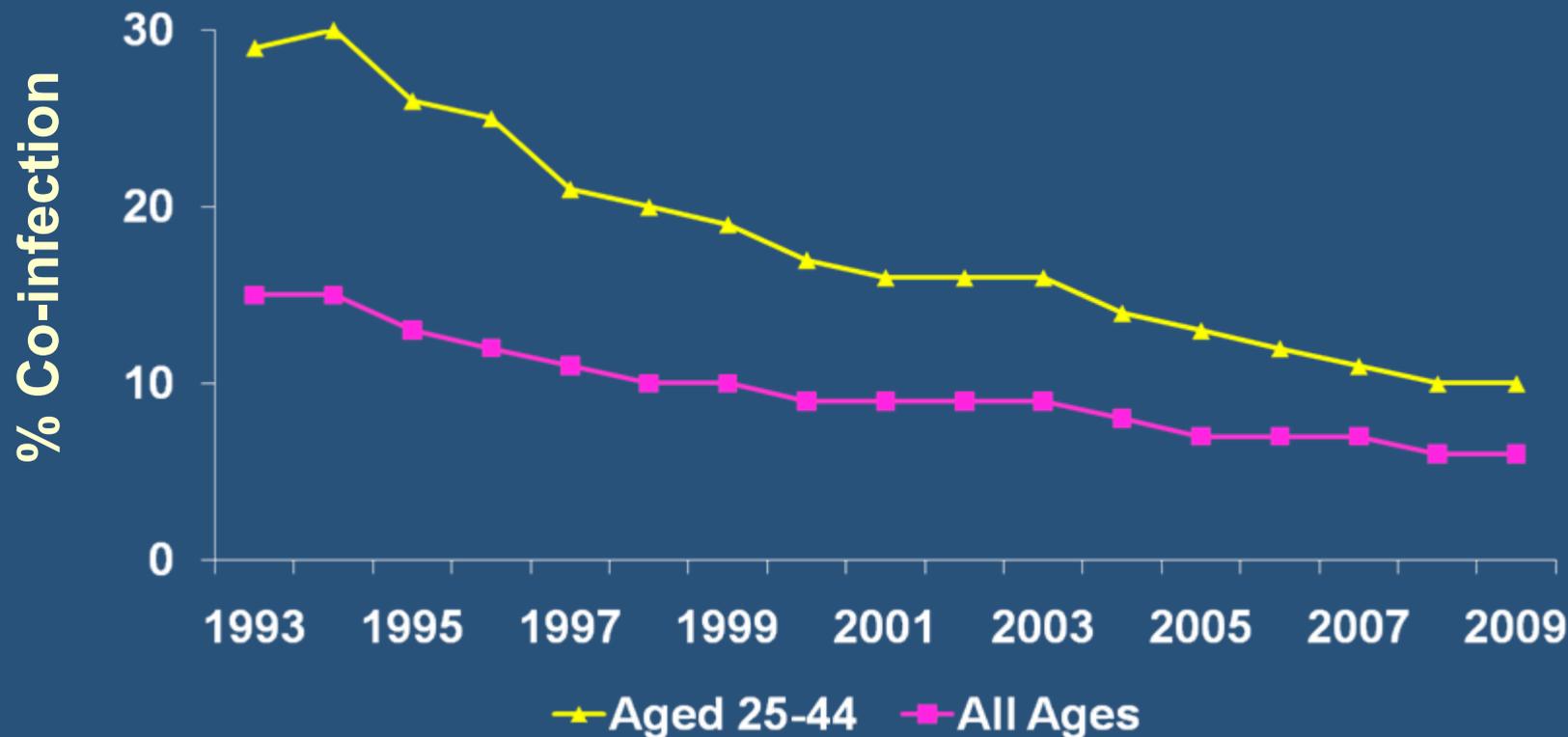


# Countries of Birth of Foreign-born Persons Reported with TB United States, 2009



Source: CDC

# Estimated HIV Co-infection in Persons Reported with TB, United States, 1993–2009\*



\*Updated as of July 1, 2010. Source: CDC

Note: Minimum estimates based on reported HIV-positive status among all TB cases in the age group.

# TB Epidemiology



# Tuberculosis in Michigan- 2010



- 184 cases reported → rate of 1.8/100,000
  - 27.8% increase from 2009
- Foreign-born cases increased to 58.3% from 50% in 2009
- 58.2% of cases are located in Metro Detroit (Wayne, Oakland and Macomb)
- 8.2% were homeless within the last year
- 18.5% abused alcohol, injection or non-injection drugs within the last year



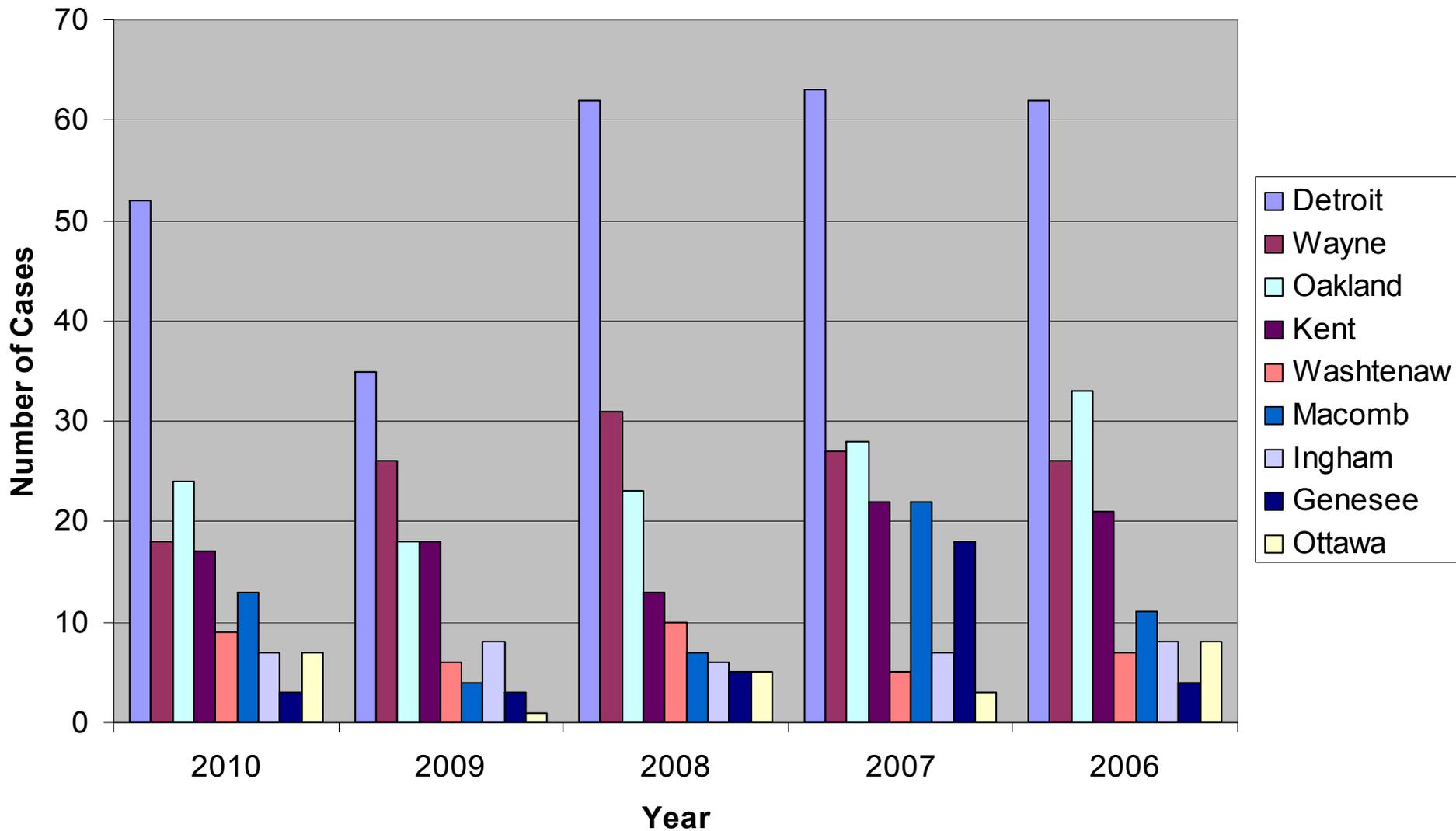
# 5 year summary on TB cases and incidence rates\* for the State of Michigan (2006-2010)



Year	2006	2007	2008	2009	2010	5 year average
Number of cases	221	226	188	144	184	193
Incident rates	2.2	2.3	1.9	1.4	1.9	1.9

\*Rate per 100,000 population

# Incidence of TB in High-Burden Areas, Michigan, 2006-2010

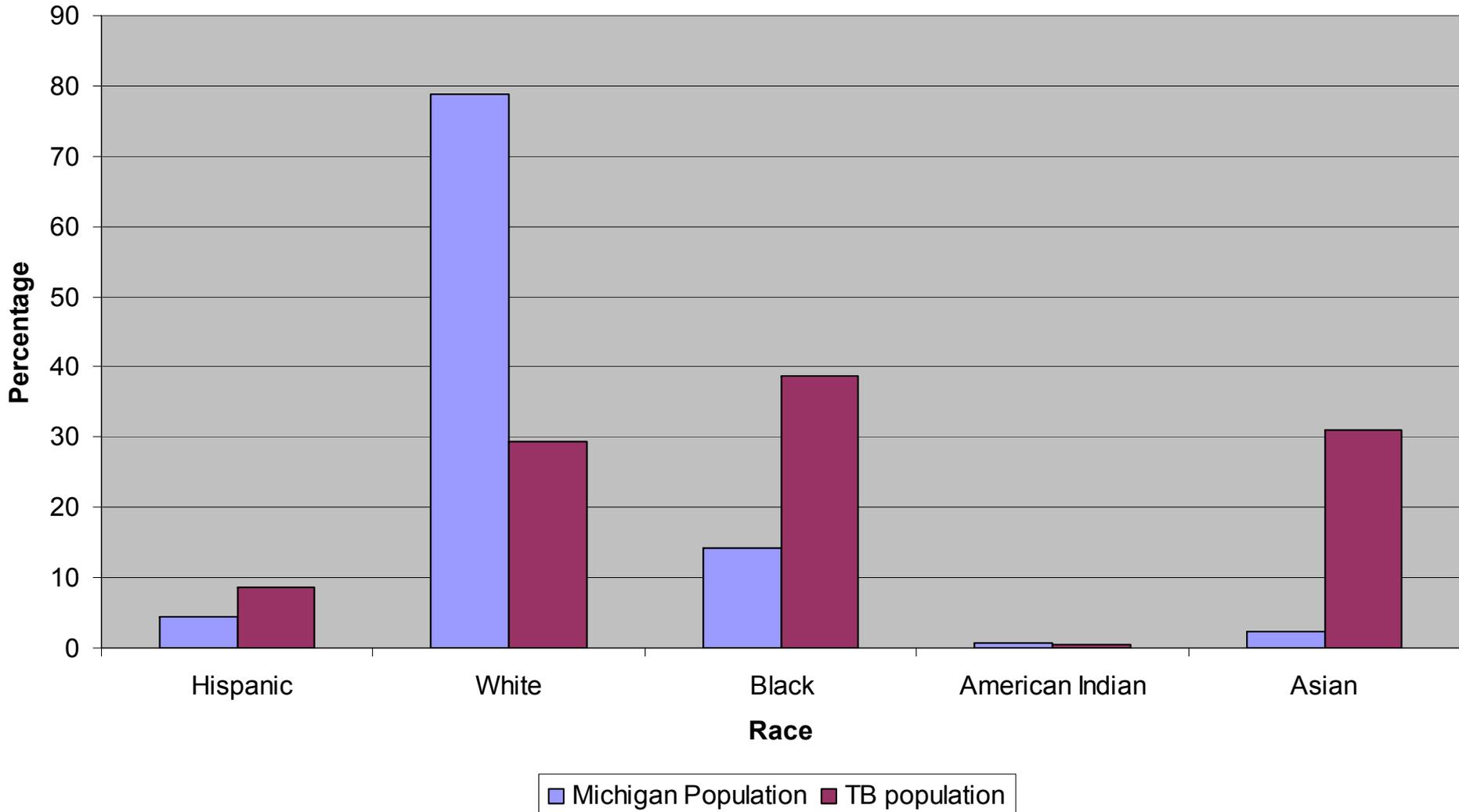




# TB in Children

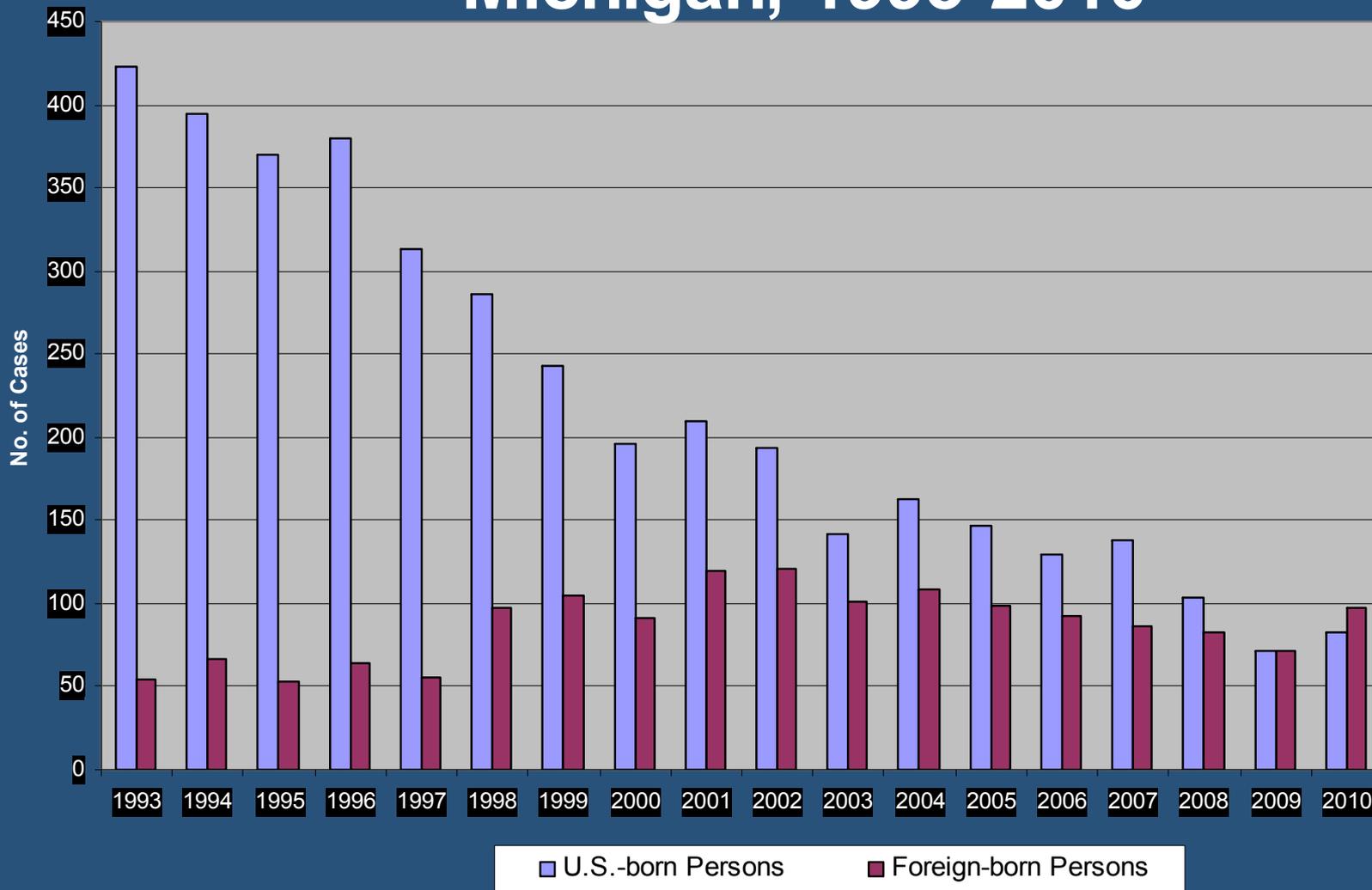
Age	2009	2010	Percent Change
<5 years	3	9	200%
5-14 years	0	2	200%
15-19 years	11	5	-54.50%
Total	14	16	

# Racial and Ethnic Disparities, TB patients in MI, 2010 \*

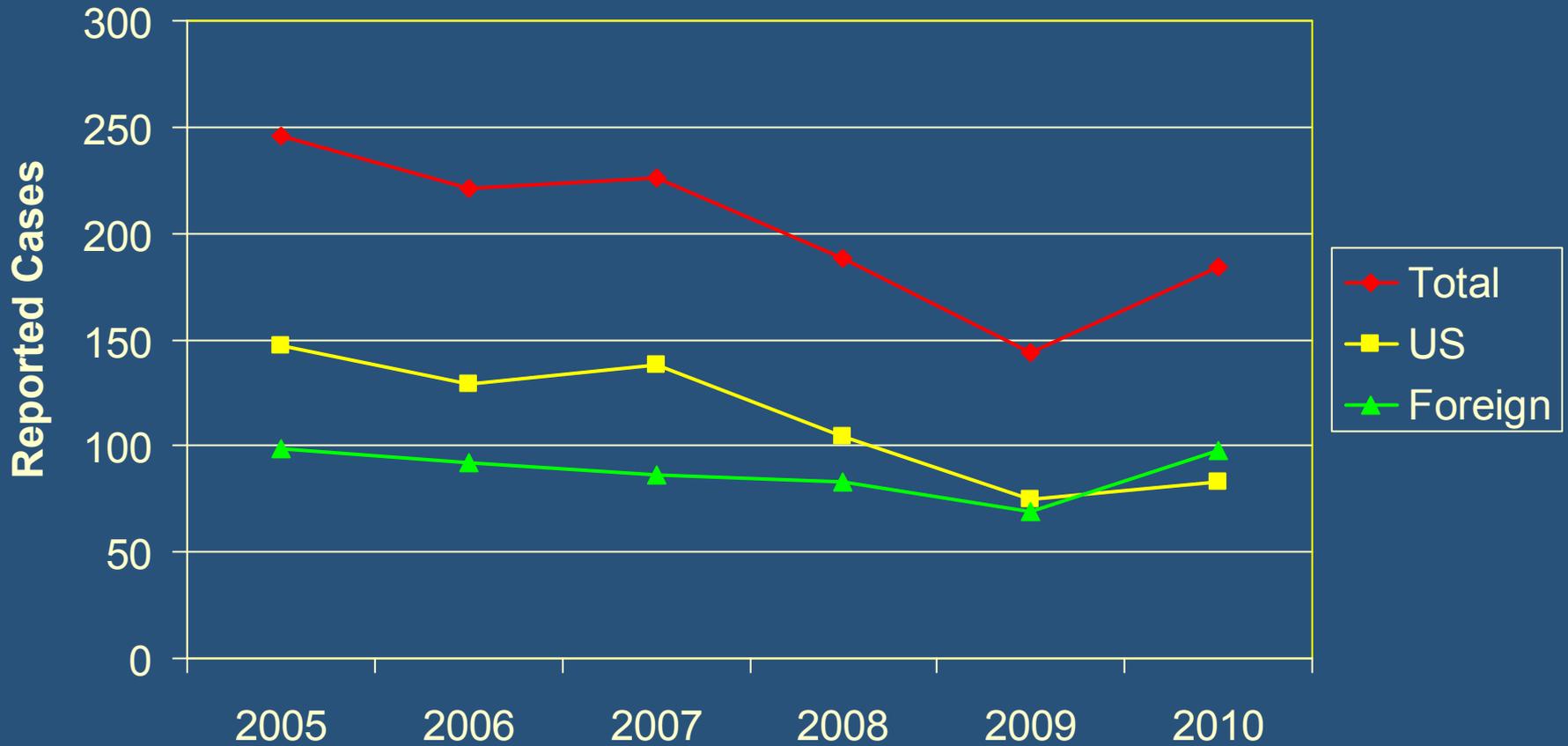


\* Based on 2010 Census Data.

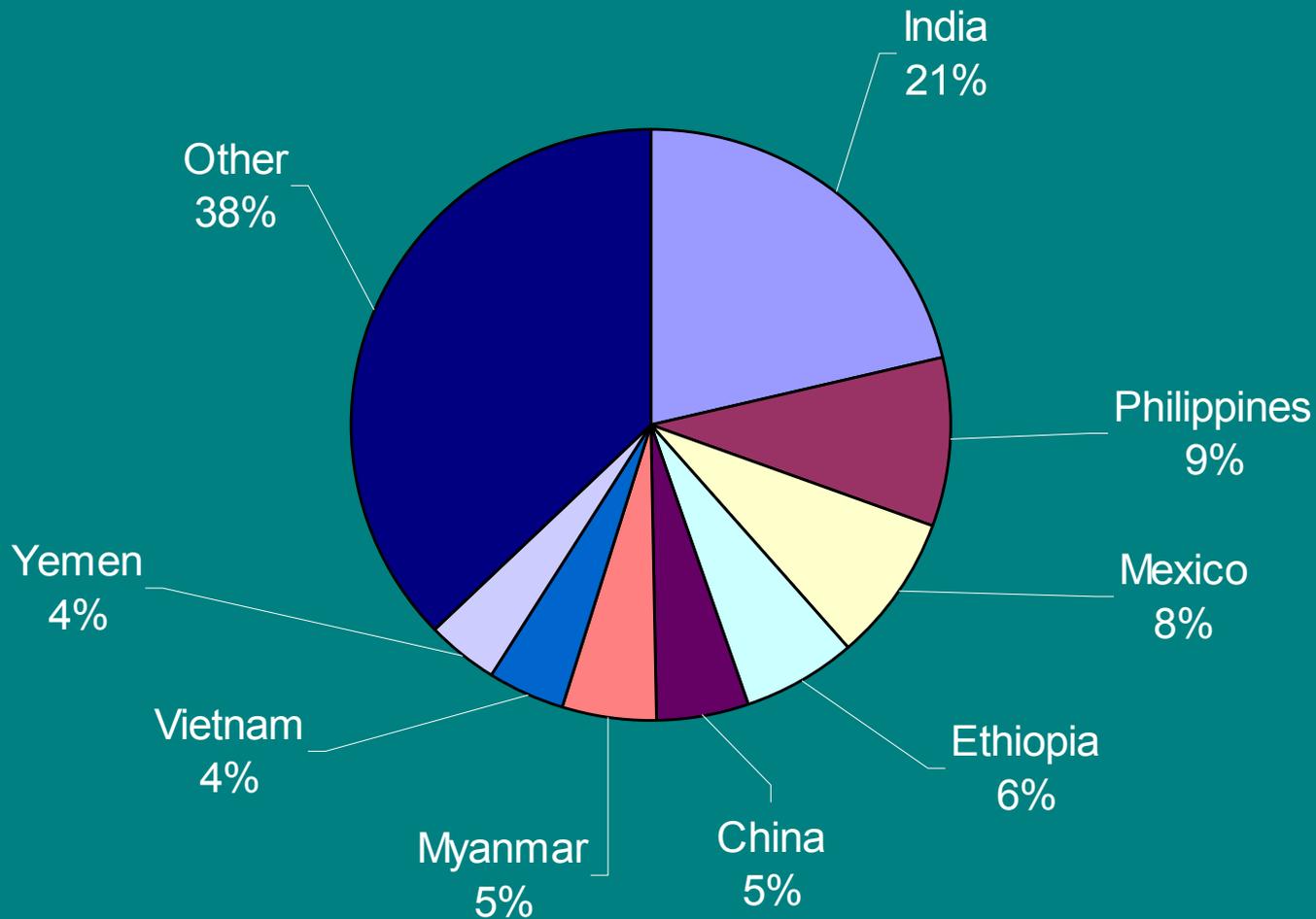
# Number of TB Cases in US-Born vs. Foreign-Born Persons, Michigan, 1993-2010



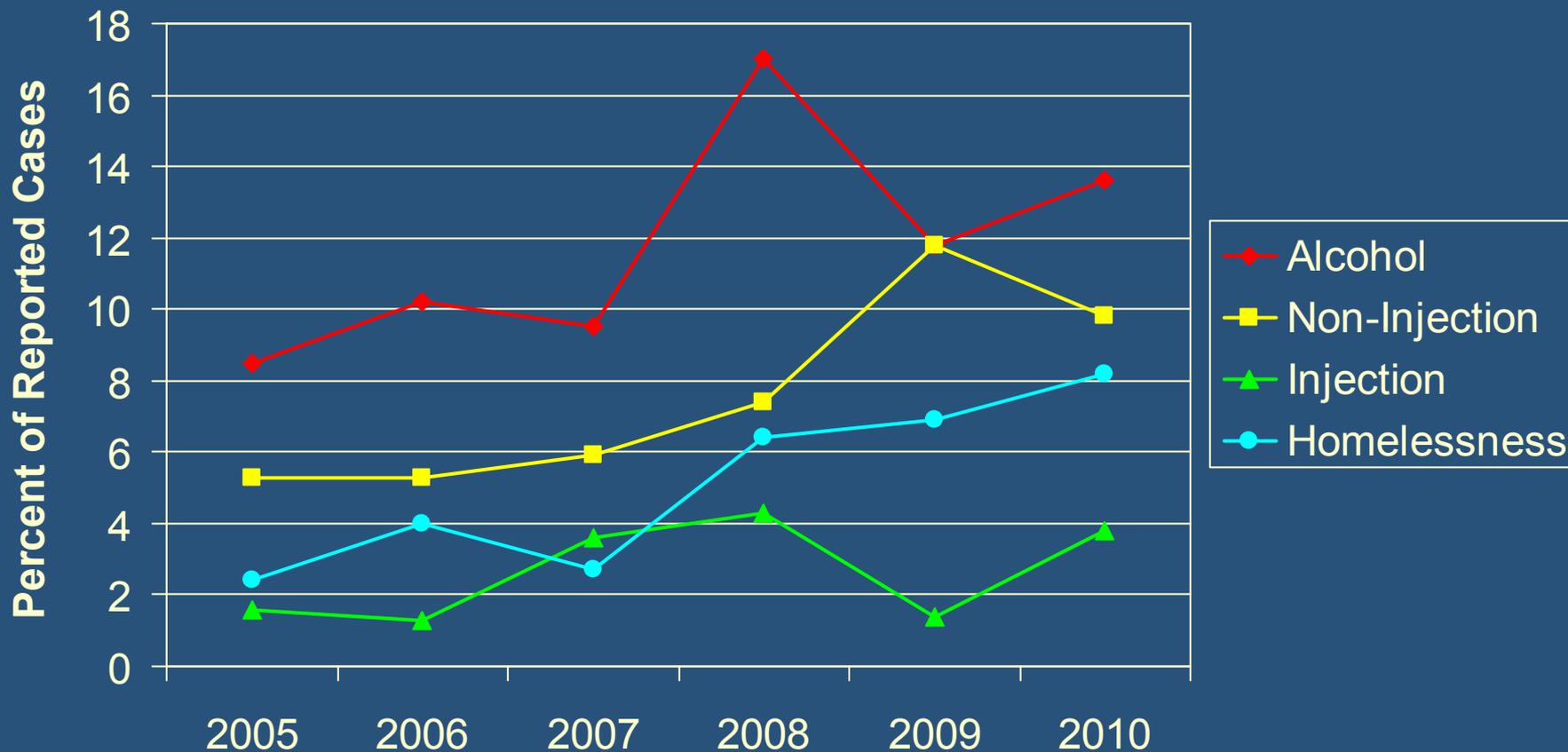
# Reported TB Cases Among US-born vs. Foreign-Born Persons, Michigan, 2005 - 2010



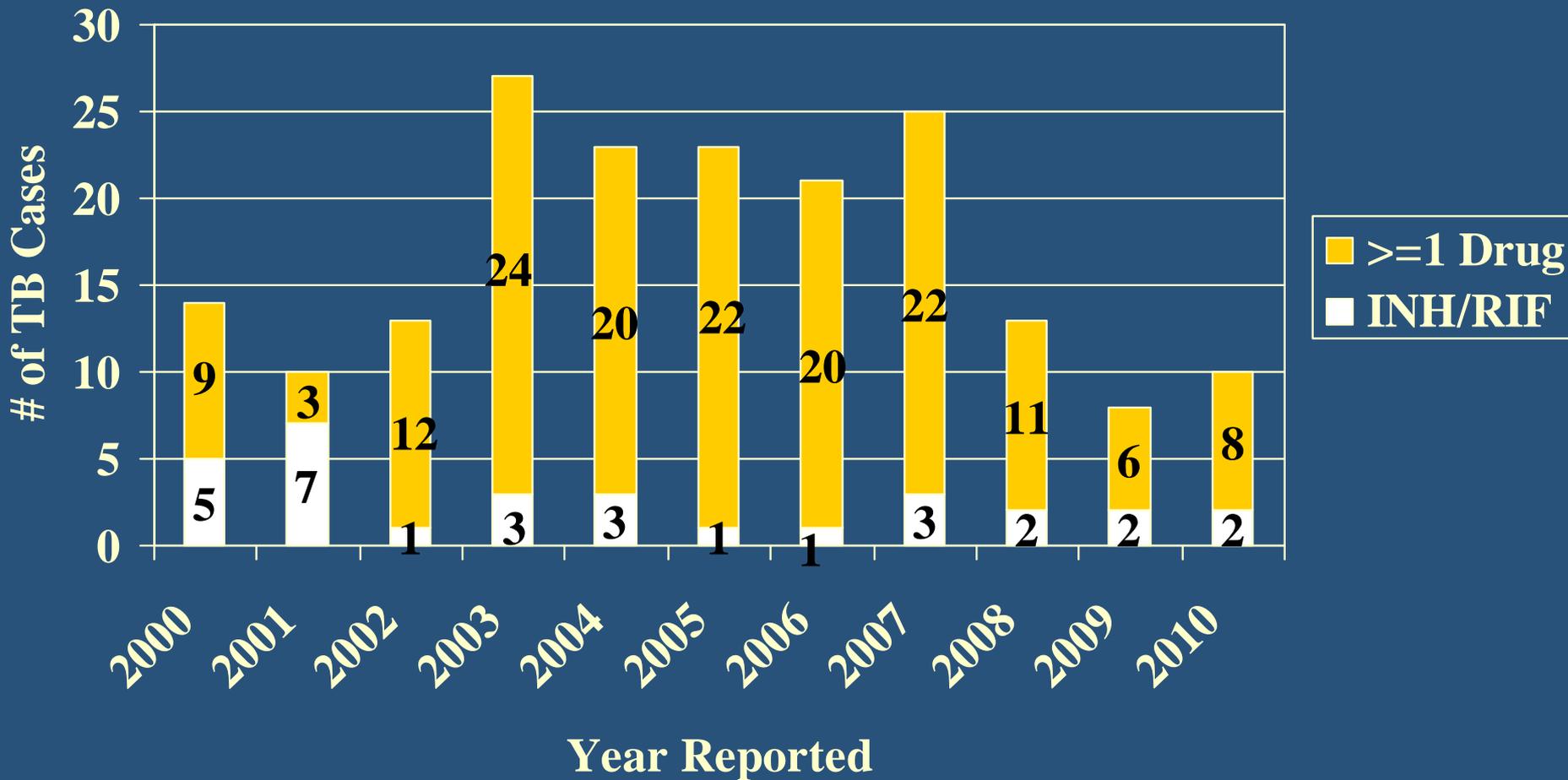
# Countries of Birth of foreign-born persons with reported TB in Michigan, 2010



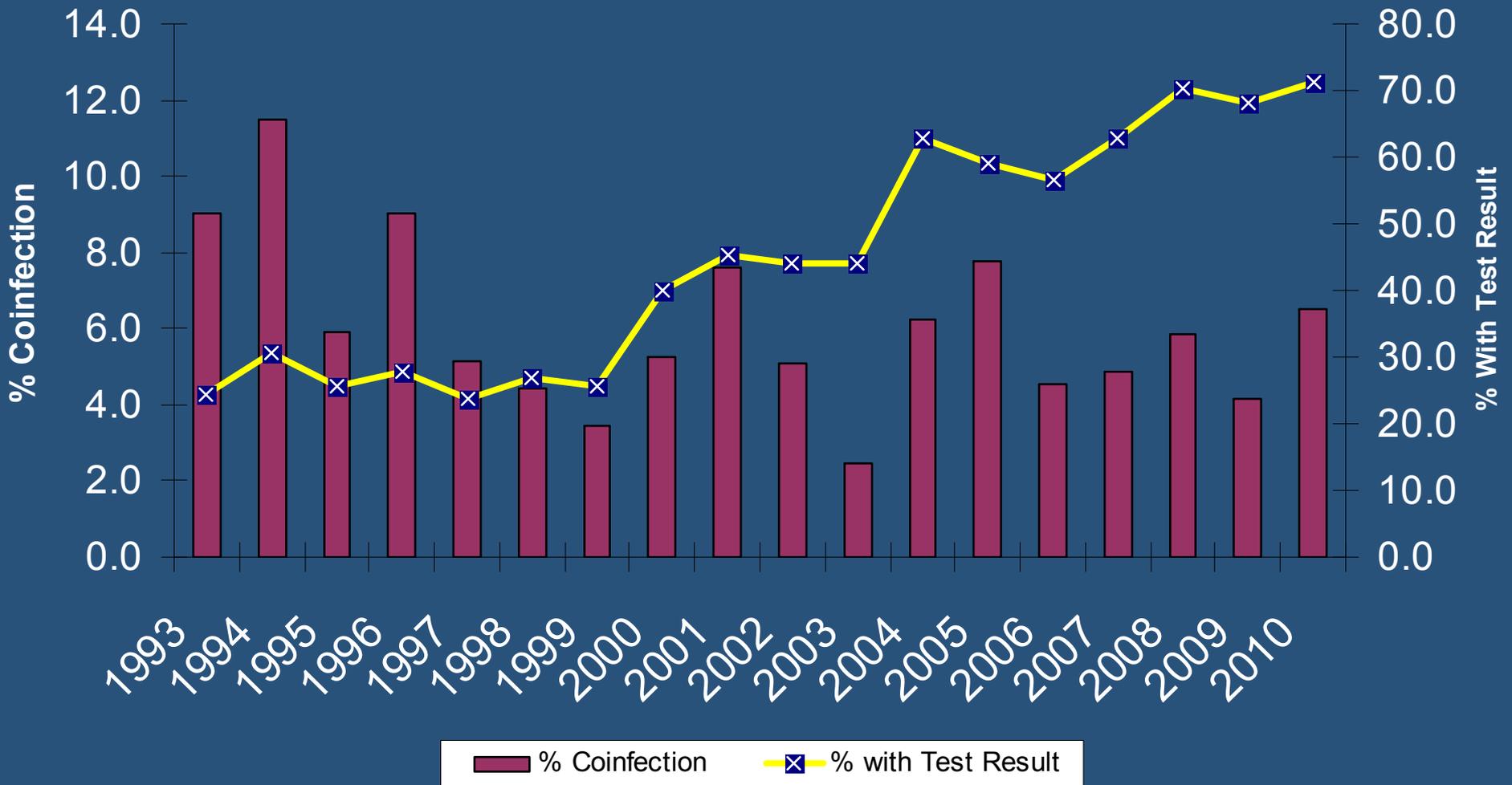
# Substance Abuse and Homelessness Among Reported TB Cases, Michigan, 2005 – 2010



# TB Drug Resistant Trends, Michigan, 2000 – 2010



# Trends in HIV-TB Coinfection, Michigan, 1993-2010

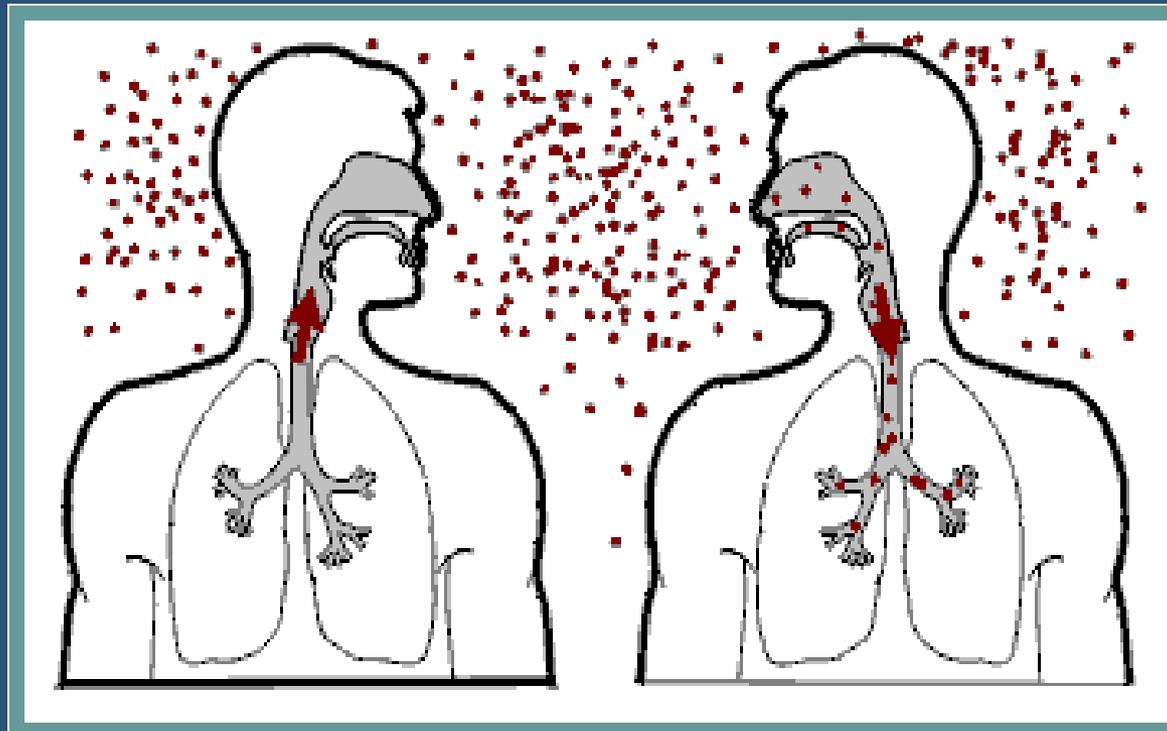


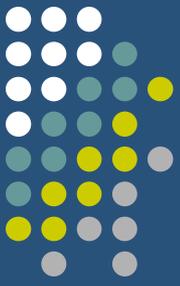


# History of *M. tuberculosis*

- Phthisis known since ancient times
- 1839 all forms designated as TB
- 1859 first sanatorium
- 1882 Koch demonstrated relationship between germ and disease
- 1896 Roentgen discovery of diagnostic x-ray
- 1940's-1950's chemotherapy

# Transmission and Pathogenesis





# Transmission

- Spread via droplet nuclei
- Organism (bacteria)- *Mycobacterium tuberculosis*
- Transmission factors:
  - Infectiousness of case
  - Environment of exposure
  - Duration of exposure
  - Virulence of the organism
- Latent TB infection (LTBI)-NOT INFECTIOUS
- TB disease-IS INFECTIOUS



# Pathogenesis

- Inhale droplet nuclei
- Bacteria multiplies in alveoli
- Macrophages consume bacteria, then die
- Travel through the bloodstream, lymph system
- It may take 2-10 weeks to develop + reaction to TST
- Containment-infection (LTBI)
- Multiplication-disease



# Pathogenesis

- 10% of infected persons with normal immune systems develop TB at some point in life
- HIV is strongest risk factor for development of TB if infected
  - Risk of developing TB disease 7% to 10% each yr
- Certain other medical conditions increase risk that TB infection will progress to TB disease



# Pathogenesis

- Common sites of TB Disease
  - Lungs
  - Pleura
  - Central nervous system
  - Lymphatic system
  - Genitourinary systems
  - Bones and joints
  - Disseminated (miliary TB)



# Drug-Resistant TB

- Drug-resistant TB transmitted same way as drug susceptible TB
- Drug resistance is divided into two types:
  - Primary resistance develops in persons initially infected with resistant organisms
  - Secondary resistance (acquired resistance) develops during TB therapy
- Terms
  - MDR-TB: Multidrug Resistant TB
  - XDR-TB: Extensively Drug Resistant TB



# Evaluation for TB

- Medical history
- Physical examination
- Test for TB Infection
  - Mantoux tuberculin skin test
  - IGRA (interferon-gamma release assay)
- Chest radiograph
- Bacteriologic or histologic exam



<b>TB Infection</b>	<b>TB Disease</b>
CXR: Normal	CXR: Abnormal
No Symptoms	Symptoms
Negative Sputum Culture	Positive Sputum Culture
Not a Case of TB	Case of TB
<b>NOT INFECTIOUS</b>	<b>INFECTIOUS</b>

# TB Disease-Signs/Symptoms



- Productive, prolonged cough (> 2 weeks)
- Shortness of breath
- Chest pain
- Hemoptysis
- Fever / chills
- Appetite loss / Unexplained weight loss
- Night sweats
- Fatigue

# TB Disease Identification



- History
  - S/S
  - Potential for exposure
  - Past TB treatment
  - Demographic risk factors
  - Medical conditions that increase risk of TB
  - HIV status is critical
- IGRA or Mantoux skin test
  - Positive result indicates TB infection; must be interpreted with overall medical evaluation
  - May be neg if:
    - Too soon after exposure
    - Severe illness
    - <6 months old
  - Useful when S/S present
  - Useful to determine how many people infected

# TB Disease Identification



- CXR
  - Abnormalities often seen in apical or posterior segments of upper lobe or superior segments of lower lobe
  - HIV: may be unusual
  - Cannot confirm dx of TB
- Specimens
  - Sputum: 3 consecutive days
    - Spontaneous
    - Induced
    - Bronchoscopy
    - Gastric aspiration
- Laboratory
  - Smear
  - Culture
  - Susceptibilities
  - Genotyping



# TB Disease Treatment

- Provide safest, most effective therapy in shortest time
- Multiple drugs to which the organisms are susceptible
- Never add a single drug to a failing regimen
- Ensure adherence to therapy

# TB Disease Treatment



- Monitoring

- Case management
- Client side effects
- Lab testing
  - Adverse reactions
  - Disease clearance

- Compliance

- Without guidance or assistance, 25% do not complete therapy within one year
- DOT-directly observed therapy
- Incentives/enablers
- Accommodations for barriers



# TB Disease Treatment

- Usually 6 months, some cases 9 months
  - Four drugs for two months
    - INH-RIF-PZA-EMB
  - Two drugs for four or seven months
    - INH-RIF
  - Intermittent therapy: option after 2 weeks of daily therapy
  - Adjust regimen when susceptibility results are known
  - Always maintain at least two effective drugs in regimen
- Extrapulmonary TB
  - Surgery may be an option
  - May require longer therapy

# TB Disease Treatment



- Children
  - Prompt and aggressive
  - EMB not recommended
- Pregnancy and lactation
  - Nine month therapy of INH, RIF, and EMB
  - PZA and SM are contraindicated
  - No toxic effect on breast milk
- Monitoring for adverse reactions
  - Baseline measurements
  - At least monthly
  - Must be individualized
  - Instruct patients to immediately report adverse reactions



# Infectiousness

Patients should be considered infectious if they

- Are coughing
- Are undergoing cough-inducing or aerosol-generating procedures, or
- Have sputum smears positive for acid-fast bacilli and they
  - Are not receiving therapy (or)
  - Have just started therapy (or)
  - Have poor clinical response to therapy

# Infection Control



- Administrative
  - Alert to S/S of *M. tb*
  - Early isolation of suspect cases
  - Prompt therapy with suspect cases
  - Alert for undiagnosed pulmonary illness with HIV
- Engineering
  - Neg. pressure isolation rooms
  - Enhanced air exchanges
  - UV lights
  - Hepa filtration systems
- Personal protection
  - Client: surgical mask
  - HCW: N-95 respirator



# Latent TB Infection-LTBI

- Positive skin test and no disease
  - Reactor: No history of skin test or negative skin test >2 yrs ago
  - Converter: History of negative skin test within past 2 yrs



# LTBI Treatment

- TB Disease must be ruled out
- If you test-you treat
- Pregnant women: treat if high risk for the progression of LTBI to active disease
- Adults and children
  - INH for 9 months (daily or intermittent)
  - RIF for 4 months (daily)

# LTBI-Therapy Monitoring



- Determine hx of tx for LTBI or disease
- Assessment for contraindications
- Obtain hx of current medications
- Concurrent medical conditions
- Recommend HIV testing



# LTBI-Therapy Monitoring

Establish rapport and emphasize

- Benefits of treatment
- Possible side effects: n/v, anorexia, malaise, hepatitis, neurotoxicity, elev T. >3 days
- Importance of adherence to regimen
- Establishment of optimal follow-up plan

# BCG (bacille Calmette-Guérin)



- Vaccine used in many countries outside the USA
- Controversial efficacy
- Response wanes with time
- NOT a contraindication for skin testing



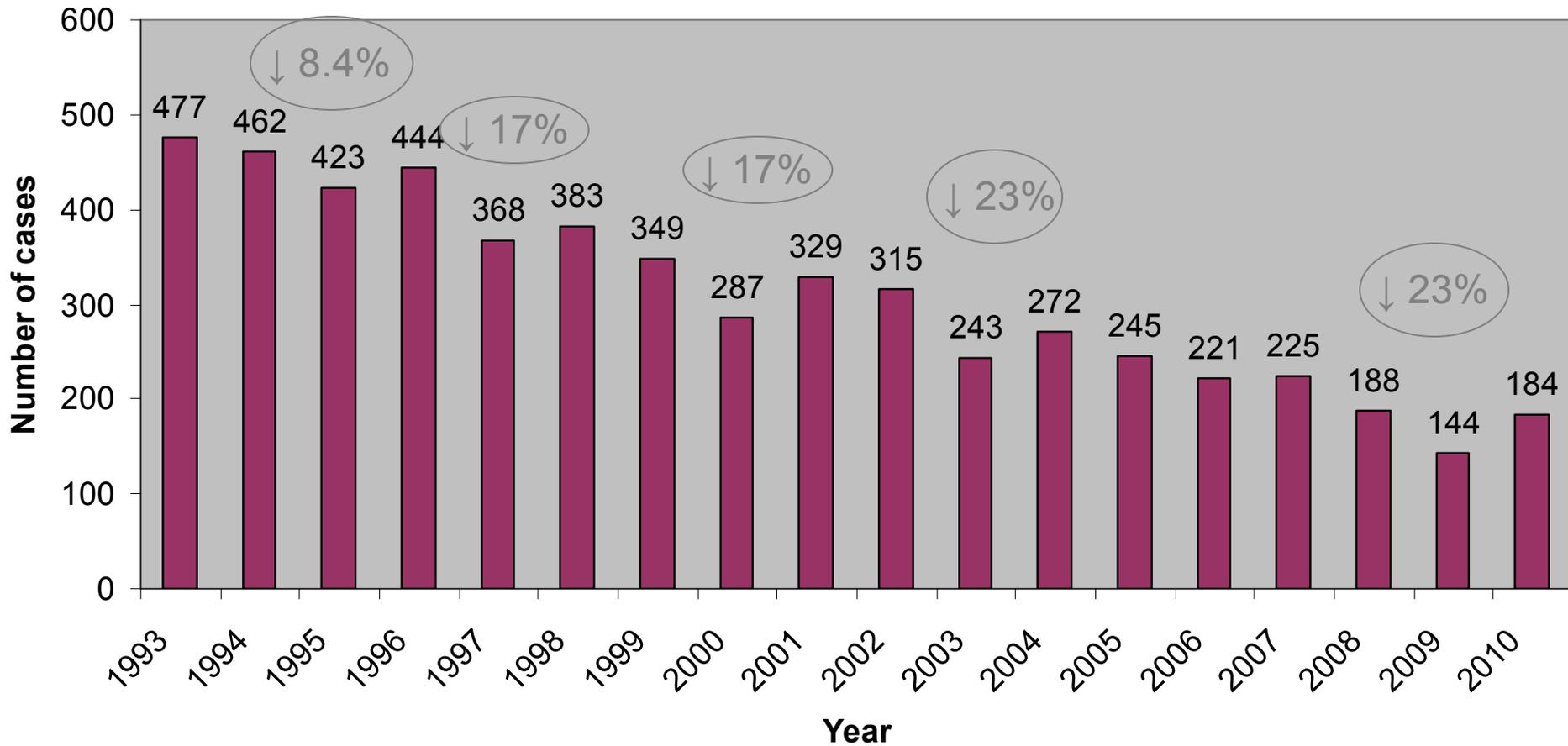
# Other Mycobacteria

- Terms
  - NTM: nontuberculous mycobacteria
  - MOTT: mycobacteria other than tuberculosis
  - Atypical: mycobacteria other than tuberculosis
- MAC: Mycobacterium avium complex
  - Found in water and soil
  - Seen with HIV
  - Treatment: surgery or chemotherapy, can be difficult to treat



**Questions?**

# Number of TB cases in MI 1993-2010

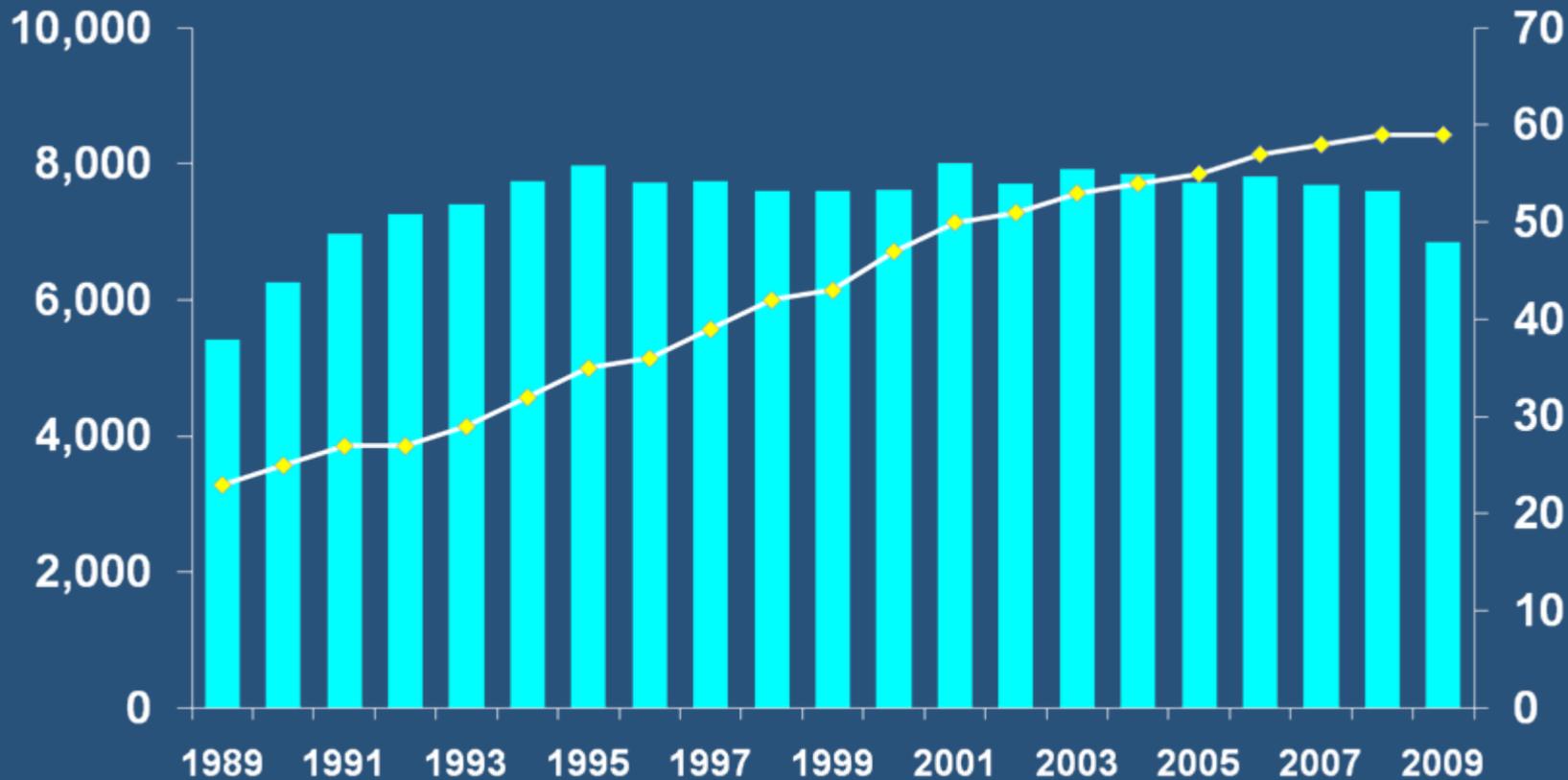


# Trends in TB Cases in Foreign-born Persons, United States, 1989–2009\*



No. of Cases

Percentage



**No. of Cases**      **Percentage of Total Cases**

\*Updated as of July 1, 2010. Source: CDC