

ACTIVE TUBERCULOSIS IN MACOMB COUNTY, 1996-2010

A Review of TB Program Data, 1996-2010

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DATA AND REFERENCE SOURCES

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Highlights of the 2006-2010 Report

- 1. Case counts:** During 2006-2010, 56 active TB cases were reported, representing a 39.8% decrease from the 5-year period 2001-2005 when 93 cases were reported (**Table 2**).
 - Whites or Caucasians represent the largest racial group (44.6%) among active TB cases reported during 2006-2010, surpassing Asians who were the largest group in 2001-2005 (**Chart 8 & Table 7**).
 - Whites or Caucasians born in the United States represented 61.1% of active TB cases in US-born persons and accounted for 44.6% of Macomb County total (**Chart 8 & Table 7**).
 - Blacks or African-Americans born in the United States represented 33.3% of active TB cases in US-born persons and accounted for 12.5% of Macomb County total (**Chart 8 & Table 7**).
 - Asians born outside of the United States represented 60.6% of TB cases in foreign-born persons and accounted for 42.9% of Macomb County total (**Chart 8 & Table 7**).
- 2. Case rates:** During the 3-year period 2008-2010, average annual TB case rate declined from 2.2 per 100,000 persons to **0.9 per 100,000 persons**, representing a 59.1% decrease from the 3-year period 2005-2007 (**Chart 1**). For the 5-year period 2006-2010, the average annual TB case rate was 1.3 per 100,000 (**Table 2**), reflecting the decline seen in more recent years.
 - Asians have the highest case rate (18.7 per 100,000 persons) among the racial groups (**Table 2**).
 - The average annual TB case rate was 9.7 per 100,000 for foreign-born persons and 0.5 per 100,000 for US-born persons (**Table 2**).
 - The TB case rate among Blacks or African-Americans (2.5 per 100,000) exceeded the overall average County rate of 1.3 per 100,000 (**Table 2**).
- 3. Burden among the foreign-born:** During 2006-2010, as in 2001-2005, the percentage of cases occurring in foreign-born persons exceeded 65% of the case total (**Chart 11 & Table 12**).
 - Foreign-born Asians represented 60.5% of TB cases in foreign-born persons, and accounted for 41.1% of the county case total (**Table 28**).
 - The top 5 countries of origin of foreign-born persons with TB during 2006-2010 were Philippines (7), India (6), Iraq (4), Albania (3) and Vietnam (3).
- 4. Drug Resistance:** Primary drug resistance (*defined as no previous history of TB disease and resistance to at least isoniazid and rifampin*) could not be appropriately assessed in this report.

ACTIVE TUBERCULOSIS IN MACOMB COUNTY, 1996-2010

TUBERCULOSIS

Tuberculosis, or TB, is an infectious bacterial disease caused by *Mycobacterium tuberculosis* and most commonly affects the lungs (pulmonary TB). Tuberculosis is transmitted from person-to-person via droplets from the throat and lungs of people with the active respiratory disease. In healthy people, infection with *M. tuberculosis* often causes no symptoms, since the person's immune system acts to "wall off" the bacteria, producing latent tuberculosis infection (or LTBI). The symptoms of active TB disease of the lungs are coughing, sometimes with sputum or blood, chest pains, weakness, weight loss, fever and night sweats. Tuberculosis is treatable with a six-month course of antibiotics (*Source: <http://www.who.int/topics/tuberculosis/en/>*).

The most cost-effective public health measure for the control of tuberculosis is the identification and cure of active, infectious TB cases, that is, patients with smear-positive pulmonary TB. The strategic plan for the elimination of TB issued in 1989 by CDC and the Advisory Committee for the Elimination of Tuberculosis (ACET) set a goal for the USA of TB elimination (less than one case per 1 million population) by 2010 and an interim target case rate of 3.5 per 100,000 population by 2000. These goals have not been met.

<p style="text-align: center;"><u>CDC / ACET</u></p> <p style="text-align: center;">Goal: Elimination of tuberculosis (<i><1.0 case per 1,000,000 population</i>)</p> <p style="text-align: center;">2010 Target: 3.5 new cases per 100,000 population.</p> <p style="text-align: center;"><u>USA Achievement 2008-2010</u></p> <p style="text-align: center;">4.0 new cases per 100,000 population</p>

CASE DEFINITIONS

The diagnosis of tuberculosis refers to the recognition of an active case, i.e. a patient with symptomatic disease due to *M. tuberculosis*. Beyond the diagnosis of TB disease, the type of TB case should also be defined to allow appropriate treatment to be given and the outcome of treatment evaluated.

Case of tuberculosis: A patient in whom TB has been bacteriologically confirmed or diagnosed by a clinician. **Note:** *Any person given treatment for tuberculosis should be recorded as a case.*

Definite case of tuberculosis: A patient with positive culture for the *M. tuberculosis* complex.

Pulmonary tuberculosis refers to disease involving the lung parenchyma. A patient with both pulmonary and extra-pulmonary TB is classified as a case of pulmonary TB.

Extra-pulmonary tuberculosis refers to tuberculosis of organs other than the lungs, e.g. pleura, lymph nodes, abdomen, genitourinary tract, skin, joints, bones, and meninges. Diagnosis should be based on one culture-positive specimen, or histological or strong clinical evidence consistent with active extra-pulmonary TB, followed by a decision by a clinician to treat with a full course of tuberculosis chemotherapy.

TB INCIDENCE IN MACOMB COUNTY

The overall number of TB case for 3-year periods (52-55 persons in Macomb County) remained steady over the period 1993-2007, and then decreased to 23 persons for the period 2008-2010. For the State of Michigan, the numbers decreased from 1,451 in 1990-92 to to 532 in 2008-2010 (**Table 1**).

Table 1: New Reported Tuberculosis Cases in Macomb County, Michigan & USA; 1996-2010 (by 3-year periods)

GEOGRAPHIC AREA	1990-1992	1993-1995	1996-1998	1999-2001	2002-2004	2005-2007	2008-2010
Macomb County		52	54	55	52	53	23
Mid-period Population Est. (1 Jul 2009)						831,427	
State of Michigan	1,451	1,370	1,201	968	830	693 [#]	532 ^{**}
Mid-period Population Est. (1 Jul 2009)						9,969,727	
United States of America	78,657	72,040	59,248	49,756	44,406	41,078	35,632 [*]
Mid-period Population Est. (1 Jul 2009)						307,006,550	

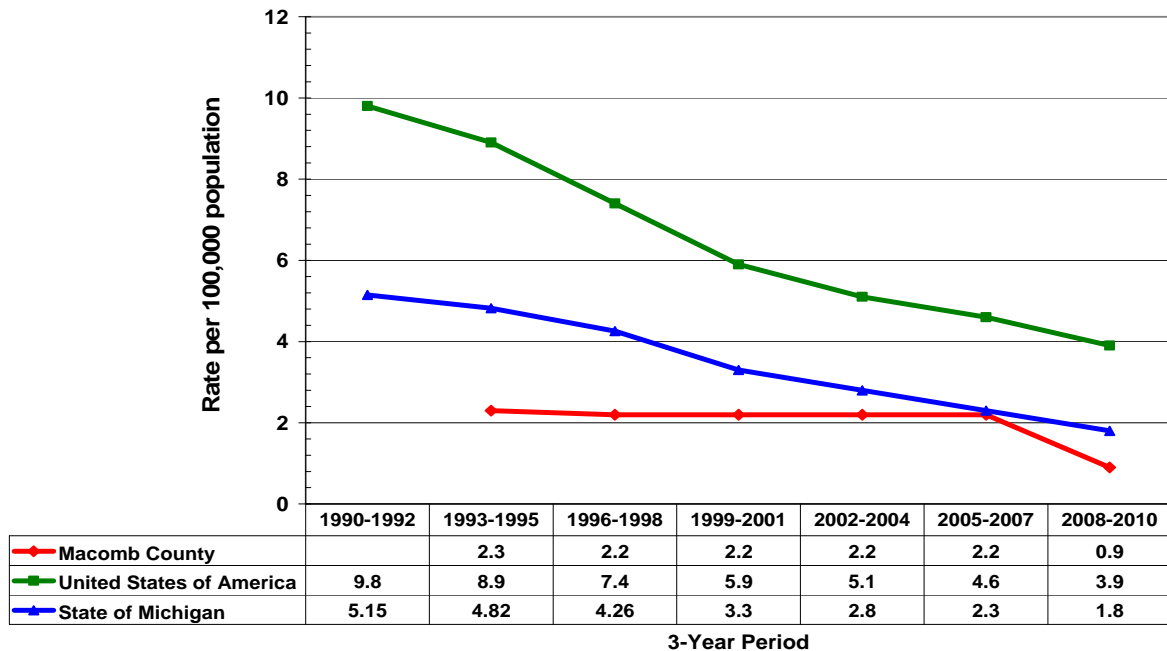
^{*} 2008–2009 data for USA (SOURCE: CDC, *Reported Tuberculosis in the United States, 2009*)

[#] From MDCH 2007 Report

^{**} SOURCE: Weekly Surveillance Report 2008-2010, MDCH

The overall 3-year average TB incidence rate of 2.2 per 100,000 persons in Macomb County remained steady over the period 1993-2007, and then decreased to 0.92 per 100,000 for the period 2008-2010 (**Chart 1** below).

**Chart 1: TB Case Rates 1990-2010;
US, MI and Macomb County**



The 3-year average TB rate per 100,000 persons also declined during the 2008-2010 period at the Michigan state level (from 2.3 to 1.8) and USA national level (from 4.6 to 3.9) – see **Chart 1**.

Healthy People 2010
Objective 14.11: Reduce tuberculosis
Target: 1.0 new cases per 100,000 population.
Macomb County Achievement 2008-2010
0.9 new cases per 100,000 population

The average annual TB case rate by race and birth origin for Macomb County in 2006-2010 is shown in **Table 2** below.

Table 2: TB Case Rate by Race & Birth Origin for Macomb County in 2006-2010

RACE	Number of TB Cases	Est. Mid-point Population (2005-09)*	5-year TB Case Rate (per 100,000)	Avg. Annual TB case Rate (per 100,000)
Asian	24	25,625	93.7	18.7
Black	7	55,197	12.7	2.5
White	25	727,799	3.4	0.7
BIRTH ORIGIN				
Foreign	38	78,187	48.6	9.7
US	18	745,689	2.4	0.5
TOTAL MACOMB	56	831,427	6.7	1.3

* Source: 2005-2009 American Community Survey 5-Year Estimates

The average annual TB case rate for Macomb County in the 5-year period 2006-2010 was 1.3 per 100,000 reflecting the more recent decline in rates. Asians have the highest case rate (18.7 per 100,000 persons) among the racial groups, with Blacks also having a higher than average TB case rate of 2.5 per 100,000 persons. Whites have a TB case rate of 0.7 per 100,000 persons which is below the County average rate of 1.3 per 100,000 (**Table 2**).

The average annual TB case rate was 9.7 per 100,000 for foreign-born persons and 0.5 per 100,000 for US-born persons (**Table 2**).

TUBERCULOSIS DISEASE CLASSIFICATION

The source of infection is people with TB affecting the lungs (i.e. pulmonary TB). Defining the smear result in pulmonary cases is therefore very important in order to:

1. identify smear-positive cases, because they are the most infectious cases and usually have higher mortality;
2. record, report and evaluate program performance (smear-positive cases are the cases for which bacteriological monitoring of treatment progress is most practicable).

In 2001-2005, a total of 93 tuberculosis (TB) cases were reported in Macomb County averaging of 18 cases of TB per year. Extra-pulmonary TB cases accounted for 29.0% of all reported cases during the period. For the period 2006-2010, there were 56 reported TB cases, averaging 11 cases per year. Extra-pulmonary TB cases decreased to 17.9% of all reported cases during the period (**Table 3**).

Pulmonary tuberculosis, sputum smear-positive is classified based on:

- a) two or more initial sputum smear examinations positive for acid-fast bacilli (AFB), or
- b) one sputum smear examination positive for AFB plus radiographic abnormalities consistent with active PTB as determined by a clinician, or
- c) one sputum smear positive for AFB plus sputum culture positive for *M. tuberculosis*.

Pulmonary tuberculosis, sputum smear-negative is defined as a case of pulmonary TB that does not meet the above definition for smear-positive TB. This group includes cases without smear result, which should be exceptional in adults but are relatively more frequent in children. In keeping with good clinical and public health practice, diagnostic criteria for sputum-negative pulmonary TB should include:

- a) at least three sputum specimens negative for AFB, and
- b) radiographic abnormalities consistent with active pulmonary TB, and
- c) no response to a course of broad-spectrum antibiotics, and
- d) decision by a clinician to treat with a full course of anti-tuberculosis chemotherapy.

In Macomb County during the period 2001-2005, pulmonary tuberculosis accounted for 71.0% of all reported TB cases, a decrease compared to 78.4% during the period 1996-2000. During the period 2006-2010, pulmonary tuberculosis accounted for 82.1% of all reported TB cases (**Table 3**).

Table 3: Pulmonary and Smear- positive Pulmonary TB, Macomb County 1996-2010

INDICATOR	1996-2000	2001-2005	2006	2007	2008	2009	2010	2006-2010
Total TB cases	88	93	11	22	7	4	12	56
Pulmonary	69	66	9	18	5	4	10	46
Extra-pulmonary	19	27	2	4	2	0	2	10
% Pulmonary Cases	78.4%	71.0%	81.8%	81.8%	71.4%	100.0%	83.3%	82.1%
% Extra-pulm. TB	21.6%	29.0%						17.9%
PULMONARY TUBERCULOSIS CASES								
Sputum AFB +ve	42	28	4	7	4	4	6	25
Sputum AFB -ve	26	28	4	6	1	0	4	15
Sputum not done	1	10	1	5	0	0	0	6
% Sputum AFB not done	1.4%	15.2%						13.0%
Sputum AFB +ve as % of Pulm. TB Cases	60.9%	42.4%	44.4%	38.9%	80.0%	100.0%	60.0%	54.3%
Sputum AFB +ve as % of ALL TB cases	47.7%	30.1%	36.4%	31.8%	57.1%	100.0%	50.0%	44.6%

Smear-positive pulmonary TB cases represented 60.9% of all pulmonary TB cases in 1996-2000, compared to 42.4% in 2001-2005, and 54.3% in 2006-2010. Smear-positive pulmonary TB cases represented 44.6% of all TB cases in 2006-2010 compared to 47.7% of all TB cases during 1996-2000, and 30.1% of all TB cases during 2001-2005 (**Table 3**).

When microscopy laboratory services are available and diagnostic criteria are properly applied, smear-positive pulmonary TB cases represent at least 65% of the total of pulmonary TB cases in adults, and 50% or more of all TB cases (*Source: WHO, 2003*).

World Health Organization

Objective: Proper application of diagnostic criteria for TB

Target: Smear-positive pulmonary TB cases represent at least 65% of the total of pulmonary TB cases in adults, and 50% or more of all TB cases.

Macomb County Achievement 2006-2010

Smear-positive pulmonary TB cases represent 54.3% of pulmonary TB cases

Smear-positive pulmonary TB cases represent 44.6% of all TB cases

For the period 2006-2010, 6 out of 46 (13.0%) cases of reported pulmonary tuberculosis cases had no evidence in the case report of sputum being examined for acid-fast bacilli. This has increased from 1.4% during 1996-2000, and decreased slightly from 15.2% in 2001-2005 (**Table 3**). Apparent criteria for classifying the 6 cases as pulmonary TB (2006-2010) and commencing treatment (in addition to an abnormal chest X-ray consistent with TB), appeared to be: culture-positive sputum (3 cases), PPD positive test (2 cases), and other specimen testing positive for acid-fast bacilli (1 case).

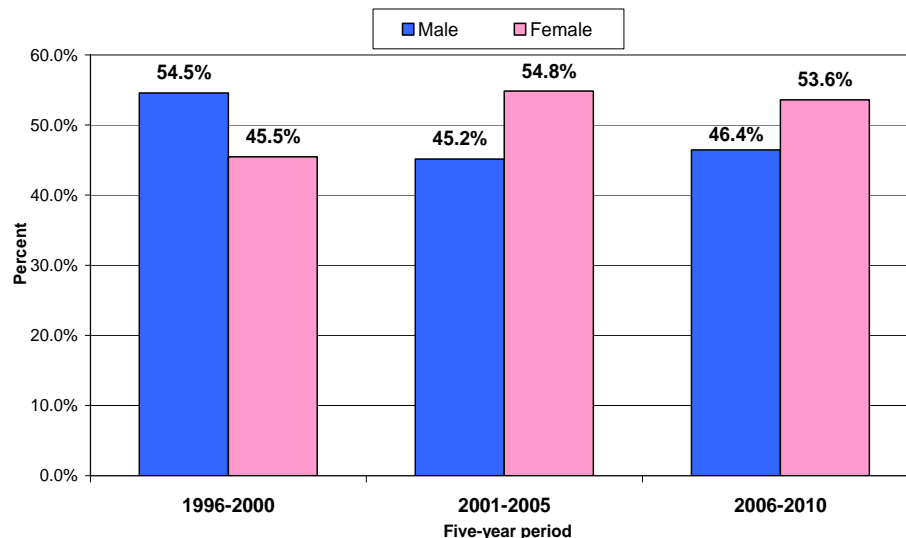
Although culture is useful to diagnose TB, it is not as important as smear microscopy for TB control. Smear-negative, culture-positive patients are less infectious and, except in immuno-depressed individuals, have fewer bacilli. In general, the treatment regimens are the same for culture-positive and culture-negative patients. The trend in proportion of active TB cases that do not have sputum examined for acid-fast bacilli is increasing and is of concern for public health control of TB disease.

DEMOGRAPHICS

Gender

During the 5-year period 2006-2010, females accounted for 30 or 53.6% and males for 26 or 46.4% of the 56 reported TB cases (**Chart 2**).

**Chart 2: Gender Distribution of Reported TB cases
Macomb County 1996-2010**



This distribution has changed from the period 1996-2000, when males accounted for 54.5% and females for 45.5% of all reported cases (**Chart 2**), and continues to show the reversal that became evident in 2001-2005, when males accounted for 45.2% and females for 54.8% of reported TB cases.

The gender distribution of pulmonary and extra-pulmonary cases, by 5-year period is shown below in **Table 4** and **Chart 3**.

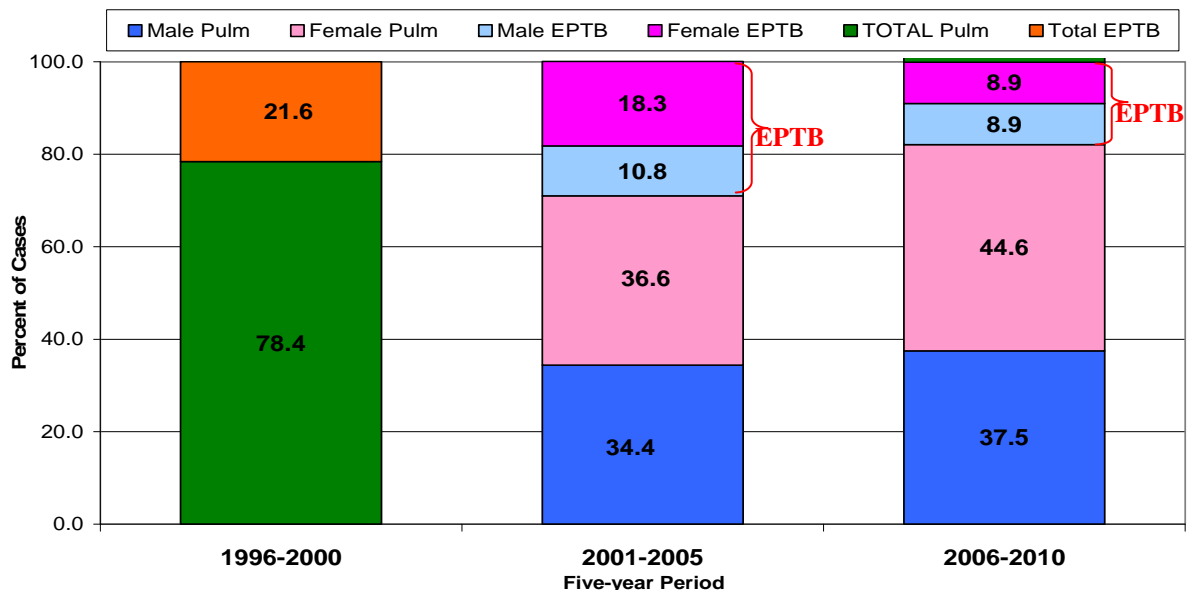
Table 4: Gender Distribution of Cases of Tuberculosis in Macomb County, 1996-2010

5-YEAR (Number)	PULMONARY			EXTRA-PULMONARY			TOTAL		
	M	F	Total	M	F	Total	M	F	All Cases
1996-2000	n/a	n/a	69	n/a	n/a	19	48	40	88
2001-2005	32	34	66	10	17	27	42	51	93
2006-2010	21	25	46	5	5	10	26	30	56
TOTAL	53*	59*	181	15*	22*	56	116	121	237
5-YEAR (Percentage)									
1996-2000			78.4%			21.6%	54.5%	45.5%	100.0%
2001-2005	34.4%	36.6%	71.0%	10.8%	18.3%	29.0%	45.2%	54.8%	100.0%
2006-2010	37.5%	44.6%	82.1%	8.9%	8.9%	17.9%	46.4%	53.6%	100.0%
2001-2005 Data									
% Site of Disease	48.5	51.5		37.0	63.0				
% Gender	76.2	66.7		23.8	33.3		45.2	54.8	
2006-2010 Data									
% Site of Disease	45.7	54.3		50.0	50.0				
% Gender	80.8	83.3		19.2	16.7		46.4	53.6	

* Includes Reports from 2001-2010 only.

During the period 2006-2010, male pulmonary TB cases accounted for 37.5% and female pulmonary TB cases for 44.6% of all TB cases. Male and female extra-pulmonary TB (EPTB) cases accounted for 8.9% each of all cases in this period (**Chart 3**).

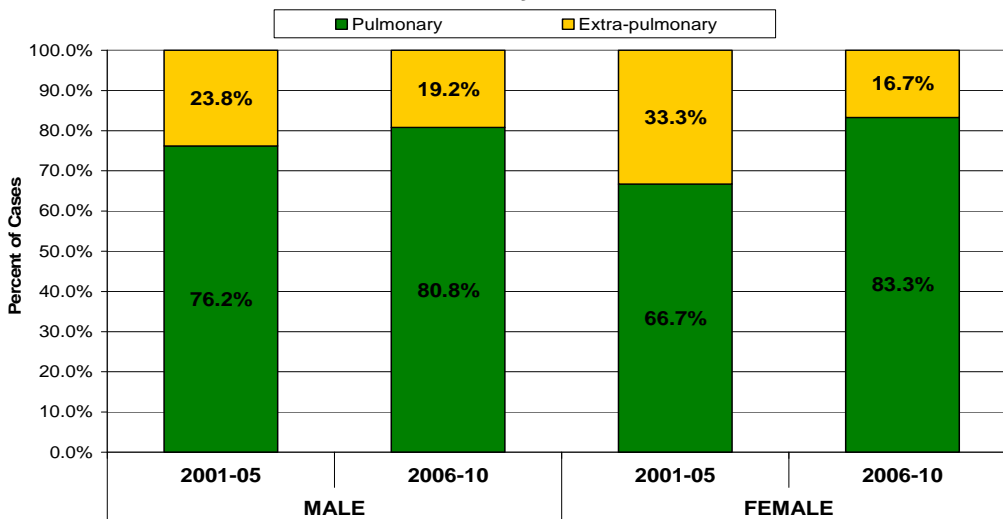
**Chart 3: TB Cases by Gender and Disease Site
Macomb County 1996-2010**



During the period 2006-2010, males accounted for 21/46 or 45.7% and females for 25/46 or 54.3% of all pulmonary TB cases. Males and females each respectively accounted for 5/10 or 50.0% of all extra-pulmonary TB cases in this period (**Table 4**).

Among the 30 female TB cases reported during 2006-2010, 25 or 83.3% were pulmonary cases, whilst among the 26 male TB cases, 80.8% were pulmonary TB (**Chart 4**). This has changed from the 2001-2005 period when 33.3% of female TB cases were extra-pulmonary disease.

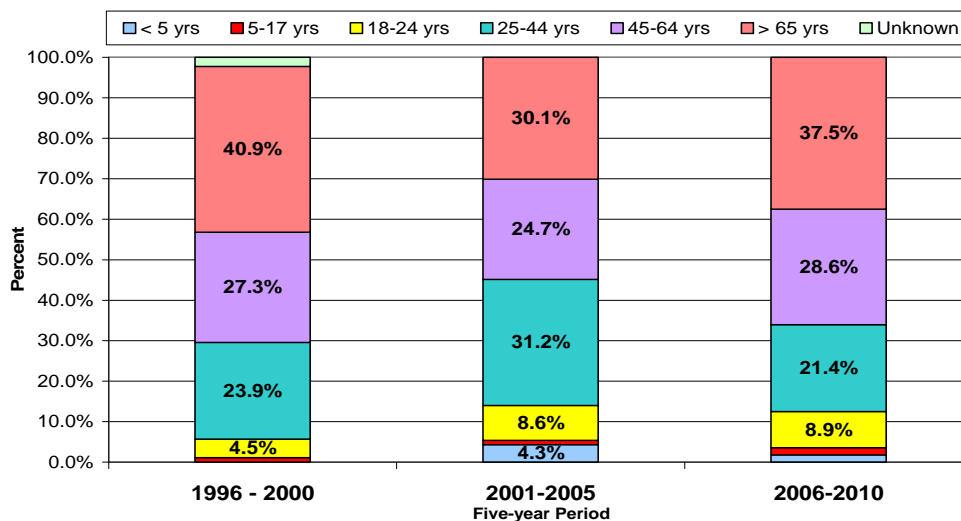
**Chart 4: Gender Distribution of Site of Disease of TB Cases
Macomb County 2001-2010**



Age

Between the years 1996-2000, the mean age at diagnosis/referral to MCHD of all TB cases was 56.8 years. For the period 2001-2005, the mean age at diagnosis was 48.2 years; and for the period 2006-2010, it was 53.9 years. The age distribution of all reported TB cases is shown in **Chart 5** below.

**Chart 5: Age Distribution of All Reported TB Cases
Macomb County, 1996-2010**



Between the years 1996-2000, the mean age at diagnosis/referral to MCHD of foreign-born cases was 52 years; for the period 2001-2005, it was 48.5 years; and for the period 2006-2010, it was 55.2 years.

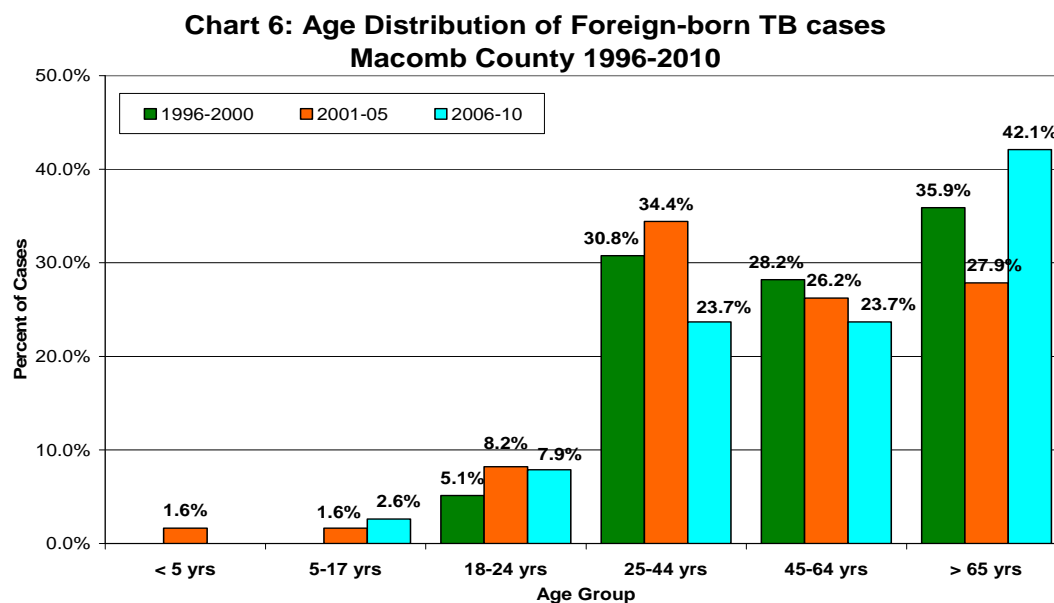
Between the years 1996-2000, the mean age at diagnosis/referral to MCHD of US-born cases was 61 years; for the period 2001-2005, it was 47.7 years; and for the period 2006-2010, it was 51.2 years (see **Table 5** below).

Table 5: Age at Diagnosis for Foreign- and US-born TB Cases, Macomb County 1996-2010

AGE GROUP*	1996 - 2000				2001 - 2005			2006-2010		
	Foreign	US	Unk	TOTAL	Foreign	US	TOTAL	Foreign	US	TOTAL
< 5 yrs	0	0	0	0 (0.0%)	1	3	4 (4.3%)	0	1	1 (1.8%)
5-17 yrs	0	1	0	1 (1.1%)	1	0	1 (1.1%)	1	0	1 (1.8%)
18-24 yrs	2	2	0	4 (4.5%)	5	3	8 (8.6%)	3	2	5 (8.9%)
25-44 yrs	12	7	2	21 (23.9%)	21	8	29 (31.2%)	9	3	12 (21.4%)
45-64 yrs	11	13	0	24 (27.3%)	16	7	23 (24.7%)	9	7	16 (28.6%)
> 65 yrs	14	21	1	36 (40.9%)	17	11	28 (30.1%)	16	5	21 (37.5%)
Unknown	1	1	0	2 (2.3%)	0	0	0 (0.0%)	0	0	0 (0.0%)
TOTAL	40	45	3	88 (100.0%)	61	32	93 (100.0%)	38	18	56 (100.0%)
Mean Age	52	61	-	56.8 yrs	48.5	47.7	48.2 yrs	55.2	51.2	53.9 yrs
Age Range	18-88	10-87			4-92	1-88		16-89	2-84	

* These age-groups were used to ensure comparability with data from 1996-2000.

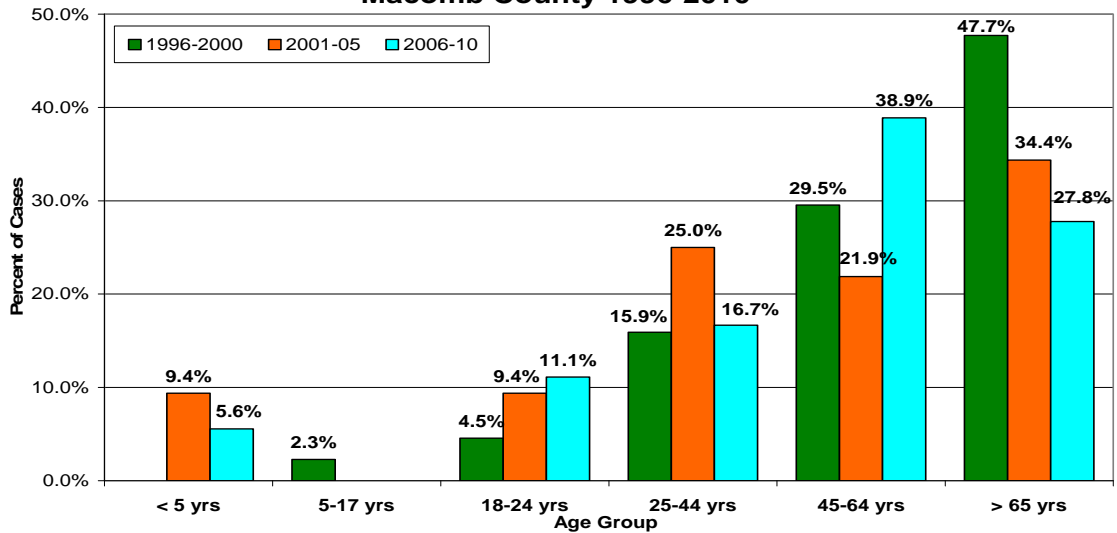
The age distribution of foreign-born TB cases from 1996-2010 is shown below in **Chart 6**.



The predominance of youthful (18 to 44 yrs old) foreign-born TB cases has shown somewhat of a decreasing trend between 1996-2000 (35.9% of all foreign-born cases) to 42.6% in 2001-2005, and 31.6% in 2006-2010. The proportion of older (i.e. 45 yrs and older) TB cases increased from 64.1% in 1996-2000 to 65.8% of all foreign-born TB cases in 2006-2010.

The age distribution of US-born TB cases for the period 1996-2010 is shown below in **Chart 7**.

**Chart 7: Age Distribution of US-born TB Cases
Macomb County 1996-2010**



In 1996-2000, the proportion of US-born TB cases increased in relation to age group - 20.4% were between 18-44 yrs and 77.2% were aged 45 years and older. During 2001-2006, 34.4% of US-born TB cases were aged 18-44 years, and 56.3% were 45 years of age or older. Between 2006 and 2010, 27.8% were aged between 18 and 44 year, and 66.7% were 45 years or older (**Chart 7**).

The mean ages for both males and females have increased between the two 5-year periods 2001-2005 and 2006-2010 – males from 50.5 to 55.7 years, and females from 46.4 to 52.3 years. The age distribution and mean age of male and female TB cases is shown in **Table 6** below.

Table 6: Age at Diagnosis for Male and Female TB Cases, Macomb County 2001-2010

AGE GROUP*	2001 - 2005			2006-2010		
	Male	Female	TOTAL	Male	Female	TOTAL
< 5 yrs	1	3	4 (4.3%)	1	0	1 (1.8%)
5-17 yrs	1	0	1 (1.1%)	1	0	1 (1.8%)
18-24 yrs	1	7	8 (8.6%)	1	4	5 (8.9%)
25-44 yrs	12	17	29 (31.2%)	5	7	12 (21.4%)
45-64 yrs	15	8	23 (24.7%)	7	9	16 (28.6%)
> 65 yrs	12	16	28 (30.1%)	11	10	21 (37.5%)
TOTAL	42	51	93 (100.0%)	26	30	56 (100.0%)
<i>Mean Age (yrs)</i>	<i>50.5</i>	<i>46.4</i>	<i>48.2</i>	<i>55.7</i>	<i>52.3</i>	<i>53.9</i>
<i>Age Range</i>	<i>4 - 88 yrs</i>	<i>1- 92 yrs</i>		<i>2 - 89 yrs</i>	<i>20 - 84 yrs</i>	

The mean age of pulmonary TB cases increased from 48.5 years (2001-2005) to 54.5 yrs in 2006-2010. The mean age of extra-pulmonary TB cases increased from 47.6 years (2001-2005) to 51.1 yrs in 2006-2010. The age distribution of TB cases based on site of disease (pulmonary or extra-pulmonary TB) is shown in **Table 7** below.

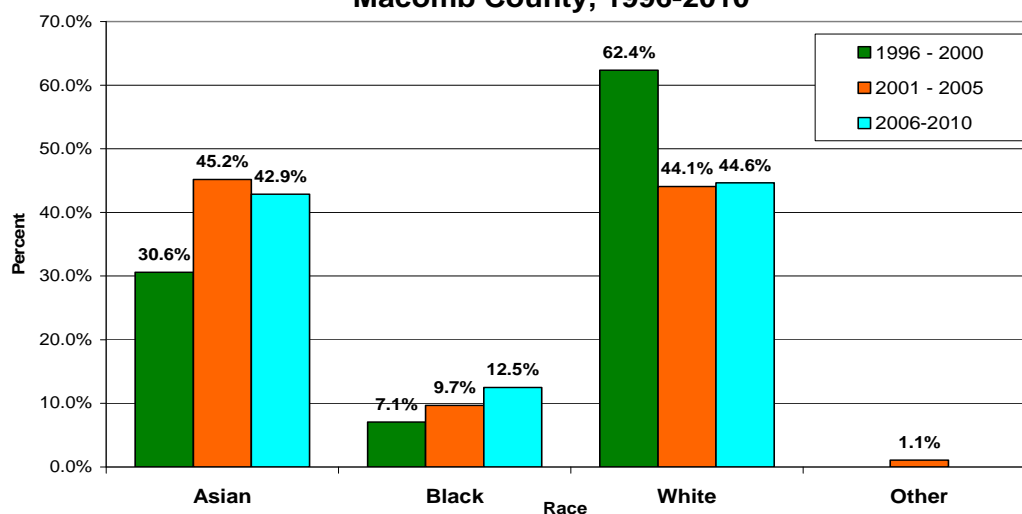
Table 7: Age at Diagnosis for Pulmonary and Extra-pulmonary TB (EPT) Cases, Macomb County 2001-2010

AGE GROUP*	2001 - 2005			2006-2010		
	Pulm	EPT	TOTAL	Pulm	EPT	TOTAL
< 5 yrs	4	0	4 (4.3%)	1	0	1 (1.8%)
5-17 yrs	0	1	1 (1.1%)	1	0	1 (1.8%)
18-24 yrs	5	3	8 (8.6%)	5	0	5 (8.9%)
25-44 yrs	19	10	29 (31.2%)	10	2	12 (21.4%)
45-64 yrs	18	5	23 (24.7%)	10	6	16 (28.6%)
> 65 yrs	20	8	28 (30.1%)	19	2	21 (37.5%)
TOTAL	66	27	93 (100.0%)	46	10	56 (100.0%)
<i>Mean Age (yrs)</i>	<i>48.5</i>	<i>47.6</i>	<i>48.2</i>	<i>54.5</i>	<i>51.1</i>	<i>53.9</i>
<i>Age Range</i>	<i>1 - 87 yrs</i>	<i>13 - 92 yrs</i>		<i>2 - 89 yrs</i>	<i>36 - 66 yrs</i>	

Racial & Ethnic Characteristics

During 1996-2000, White or Caucasian persons accounted for 62.4% of all TB cases, Asians for 30.6% and Blacks or African-Americans for 7.1%. During the period 2001-2005, Asians accounted for 45.2%, Whites for 44.1% and Blacks accounted for 9.7%. There was 1 case whose race/ethnicity was listed as Hispanic (see **Chart 8** and **Table 8** below). During the period 2006-2010, Asians accounted for 42.9%, Whites for 44.6% and Blacks accounted for 12.5%.

**Chart 8: Race Distribution of TB cases
Macomb County, 1996-2010**



While the proportion of TB cases who are Asians appears to have decreased to just below 43%, and the proportion of Whites remained steady at just about 44%, the proportion of Blacks has increased from 7.1% in 1996-2000 to 12.5% in 2006-2010.

US-born Whites represented 45.9% (39/85) of reported TB cases during the period 1996-2010. This proportion was 26.9% (25/93) during 2001-2005, and further declined to 19.6% (11/56) during 2006-2010 (**Table 8**).

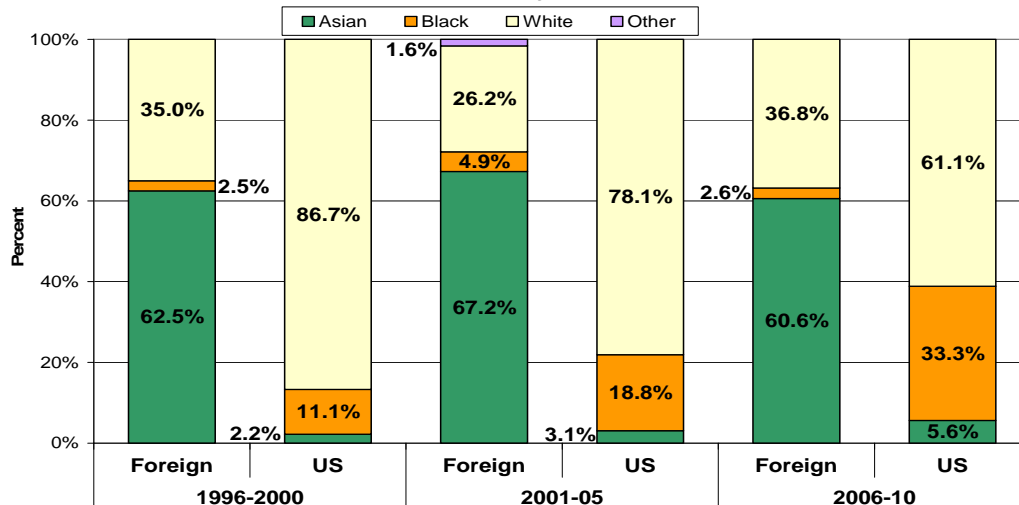
Asians born outside the United States represented 29.4% (25/85) of all reported TB cases in 1996-2000, and 62.5% (25/40) of TB cases in foreign-born persons. During 2006-2010, Asians born outside the United States represented 60.5% (23/38) of TB cases in foreign-born persons.

Table 8: Race/Ethnicity of TB Cases by Origin of Birth, Macomb County 1996-2010

RACE	1996-2000				2001-2005				2006-2010			
	Foreign	US	TOTAL		Foreign	US	TOTAL		Foreign	US	TOTAL	
Asian	25	1	26	30.6%	41	1	42	45.2%	23	1	24	42.9%
Black	1	5	6	7.1%	3	6	9	9.7%	1	6	7	12.5%
White	14	39	53	62.3%	16	25	41	44.1%	14	11	25	44.6%
Other	0	0	0	0.0%	1	0	1	1.1%	0	0	0	0.0%
TOTAL	40	45	85	100.0%	61	32	93	100.0%	38	18	56	100.0%
Race as Percent of All Cases by Origin of Birth during 5-Year Period												
Asian	62.5	2.2			67.2	3.1			60.5	5.6		
Black	2.5	11.1			4.9	18.8			2.6	33.3		
White	35.0	86.7			26.2	78.1			36.8	61.1		
Other	0.0	0.0			1.6	0.0			0.0	0.0		
%TOTAL	100.0	100.0			99.9	100.0			99.9	100.0		
Origin of Birth as Percent of All Cases by Race during 5-Year Period												
Asian	96.2	3.8	100.0		97.6	2.4	100.0		95.8	4.2	100.0	
Black	16.7	83.3	100.0		33.3	66.7	100.0		14.3	85.7	100.0	
White	26.4	73.6	100.0		39.0	61.0	100.0		56.0	44.0	100.0	
Other	-	-	-		100.0	0.0	100.0		-	-	-	

Table 8 also shows that among foreign-born TB cases, the proportion of Asians has been over 60%, the proportion of Blacks has been below 5.0%, and the proportion for Whites has been between 26.2 – 36.8% for the periods 1996-2000, 2001-2005 and 2006-2010 respectively. This shows some level of consistency. However for US-born TB cases, the proportion of Blacks has increased from 11.1% in 1996-2000, to 18.8% in 2001-2005 and to 33.3% in 2006-2010. Consequently the proportion of US-born White TB cases has decreased in both number and proportion from 39/45 (86.7%) in 1996-2000, to 25/41 (78.1%) in 2001-2005, and to 11/25 (61.1%) in 2006-2010. The proportion of US-born Asians has also increased from 2.2% in 1996-2000 to 5.6% in 2006-2010 (**Chart 9**)

Chart 9: Racial Distribution of Foreign- and US-born TB Cases Macomb County 1996-2010



The gender distribution by race for TB cases in Macomb County for 2001-2007 is shown in **Table 9** below.

Table 9: Gender Distribution by Race of TB Cases, Macomb County 2001-2010

RACE	2001-2005				2006-2010				TOTAL	
	Male	Female	TOTAL		Male	Female	TOTAL		MALE	FEMALE
Asian	17	25	42	45.2%	12	12	24	42.9%	29	37
Black	5	4	9	9.7%	1	6	7	12.5%	6	10
White	20	21	41	44.1%	13	12	25	44.6%	33	33
Other	0	1	1	1.1%	0	0	0	0.0%	0	1
TOTAL	42	51	93	100.0%	26	30	56	100.0%	68	81
Race as Percent of All Cases by Gender during 5-Year Period										
Asian	40.5	49.0			46.2	40.0	24	42.9%		
Black	11.9	7.8			3.8	20.0	7	12.5%		
White	47.6	41.2			50.0	40.0	25	44.6%		
Other	0.0	2.0			0.0	0.0	0	0.0%		
% TOTAL	100.0	100.0			100.0	100.0	56	100.0%		
Gender as Percent of All Cases by Race during 5-Year Period										
Asian	40.5	59.5	100.0		50.0	50.0	100.0			
Black	55.6	44.4	100.0		14.3	85.7	100.0			
White	48.8	51.2	100.0		52.0	48.0	100.0			
Other	0.0	100.0	100.0		-	-	-			

Asian females accounted for 26.9% (25/93) of all reported TB cases during 2001-2005. White females accounted for 22.6% (21/93), white males for 21.5% (20/93) and Asian males for 18.3% (17/93). By 2006-2010, White males accounted for 23.2% (13/56); and Asian males, Asian females and White females each accounted for 21.4% (12/56) respectively.

The race distribution by disease classification (primary site) of TB cases in Macomb County for 2001-2010 is shown in **Table 10** below.

Table 10: Race by Classification of TB Cases (Pulmonary & Extra-pulmonary), Macomb County 2001-2010

RACE	2001-2005				2006-2010			
	Pulm.	EPT	TOTAL		Pulm.	EPT	TOTAL	
Asian	26	16	42	45.2%	17	7	24	42.9%
Black	7	2	9	9.7%	6	1	7	12.5%
White	32	9	41	44.1%	23	2	25	44.6%
Other	1	0	1	1.1%	0	0	0	0.0%
TOTAL	66	27	93	100.0%	46	10	56	100.0%
Among All Reported TB cases by Disease Classification for 5-year Period								
% Asians	39.4%	59.3%			37.0%	70.0%		
% Whites	48.5%	33.3%			50.0%	20.0%		

In the period 2001-2005, 48.5% (32/66) of pulmonary TB cases were White persons. Asians accounted for 39.4% (26/66). Persons classified by race as White accounted for 50.0% (23/46) of pulmonary TB cases in 2006-2010, while Asians accounted for 37.0% (17/46).

Among extra-pulmonary TB cases, during 2001-2005, Asians accounted for 59.3% (16/27). This proportion increased to 70.0% (7/10) in 2006-2010.

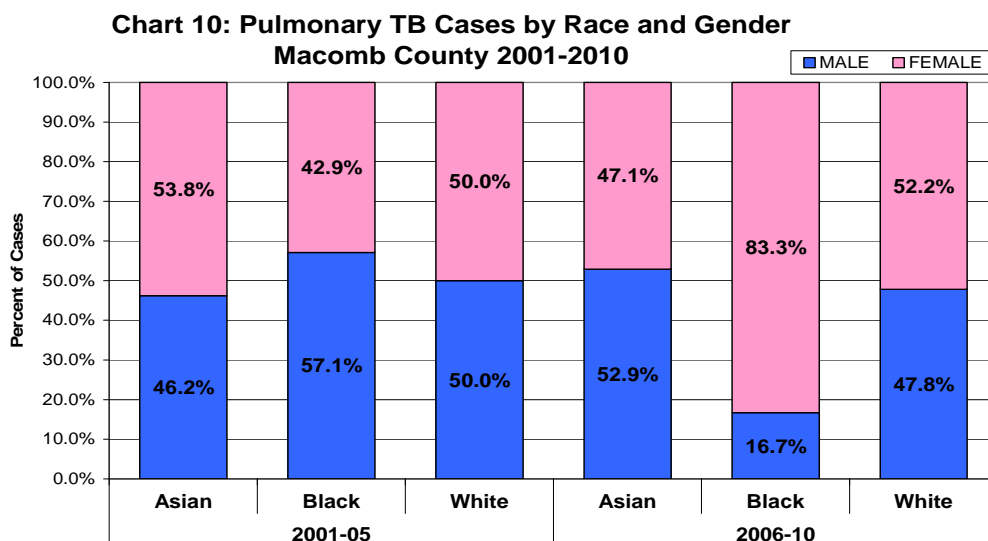
Asians accounted for 3.3% of Macomb County’s population (according to 2006 American Community Survey – ACS report), and for 42.9% of active TB cases for the period 2006-2010. Blacks or African-Americans accounted for 6.6% of the County’s population but 12.5% of the active TB cases during 2006-2010 period.

The gender distribution, race/ethnicity and disease classification for TB cases in Macomb County for 2001-2010 is shown in **Table 11** below.

Table 11: Gender, Race/Ethnicity and Disease Classification of TB Cases, Macomb County 2001-2010

RACE	Pulmonary TB			Extra-Pulmonary TB		
	Male	Female	TOTAL	Male	Female	TOTAL
2001-2005						
Asian	12	14	26	5	11	16
Black	4	3	7	1	1	2
White	16	16	32	4	5	9
Other	0	1	1	0	0	0
TOTAL	32	34	66	10	17	27
2006-2010						
Asian	9	8	17	3	4	7
Black	1	5	6	0	1	1
White	11	12	23	2	0	2
Other	0	0	0	0	0	0
TOTAL	21	25	46	5	5	10

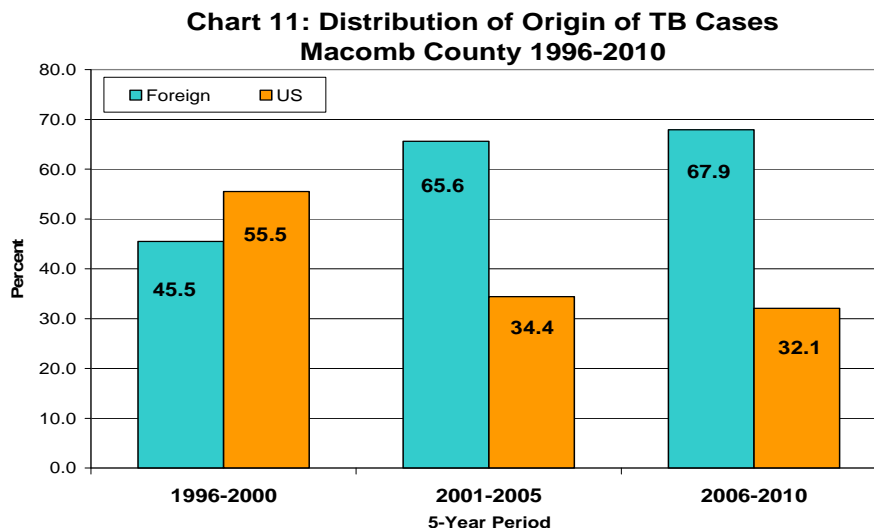
The gender distribution of pulmonary and extra-pulmonary TB cases shows no significant differences except that Black females were more likely to be a case of pulmonary TB during 2006-2010 than black males (**Chart 10**)



Origin of Birth & Duration of US Residency Prior to Diagnosis

Foreign-born persons continue to bear a disproportionate burden of TB disease, accounting for 59.4% of all cases reported in the USA in 2009. In 2009, 49.3% of TB cases reported in Michigan were foreign-born. (SOURCE: CDC, *Reported Tuberculosis in the United States, 2009*).

In Macomb County, the proportion of foreign-born TB cases was 67.9% in the period 2006-2010. During the period 1996-2000, the proportion of foreign-born TB cases was 45.5%; this increased to 65.6% during 2001-2005, and to 67.9% during 2006-2010 (**Chart 11**).



Among US-born TB cases reported in Macomb County during 2006-2010, 38.9% were male and 61.1% were female. Among foreign-born cases, males accounted for 47.4% and females for 53.6%. For both foreign- and US-born TB cases, females were more affected than males since 2001 (**Table 12**). This represents a shift from the situation in 1996-2000 when males were predominantly more affected among both US- and foreign-born cases.

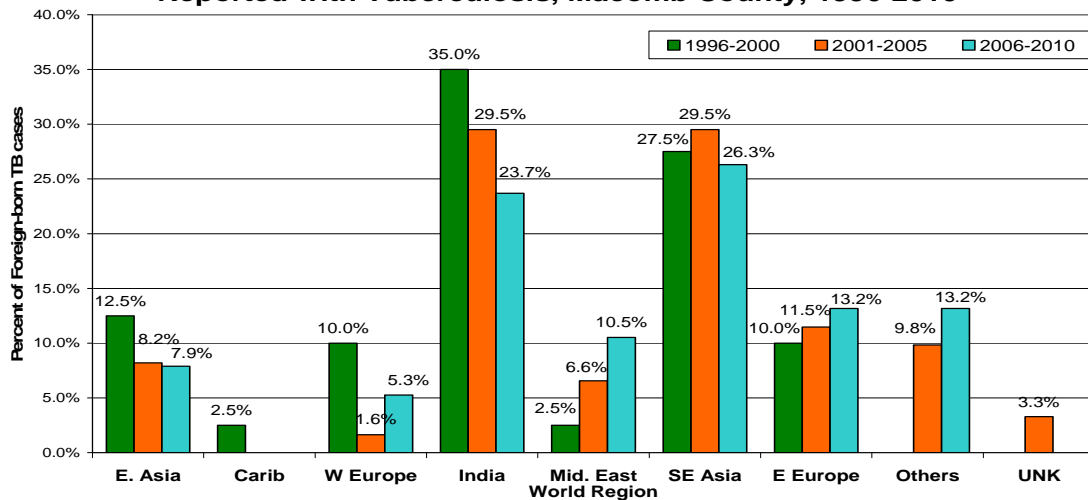
Table 12: TB Cases by Gender and Origin of Birth, Macomb County 1996-2010

YEAR	US-born			Foreign-born			% Foreign-born
	Male	Female	Total	Male	Female	Total	
1996-2000	24	21	45*	22	18	40	45.5
% Gender	53.3	46.7	100.0	55.0	45.0	100.0	
2001	8	3	11	4	6	10	47.6
2002	1	4	5	4	9	13	72.2
2003	1	3	4	4	11	15	78.9
2004	3	3	6	8	1	9	60.0
2005	2	4	6	7	7	14	70.0
2001-2005	15	17	32	27	34	61	65.6
% Gender	46.9	53.1	100.0	44.3	55.7	100.0	
2006	0	3	3	5	3	8	72.7
2007	4	2	6	6	10	16	72.7
2008	1	3	4	2	1	3	42.9
2009	0	2	2	0	2	2	50.0
2010	2	1	3	5	4	9	75.0
2006-2010	7	11	18	18	20	38	67.9
% Gender	38.9	61.1	100.0	47.4	53.6	100.0	

* 3 (2 M and 1 F) Country of birth unknown

The World Region (origin of birth) for foreign-born TB cases reported in Macomb County during 1996-2000, showed that 35.0% were from the Indian Sub-continent, 27.5% from SE Asia, 12.5% from East Asia and 10% each from Eastern and Western Europe. Between 2001 and 2005, 29.5% each were from SE Asia and the Indian Sub-continent, 11.5% from Eastern Europe, 8.2% from E. Asia and 6.6% from the Middle East (see **Chart 12** below).

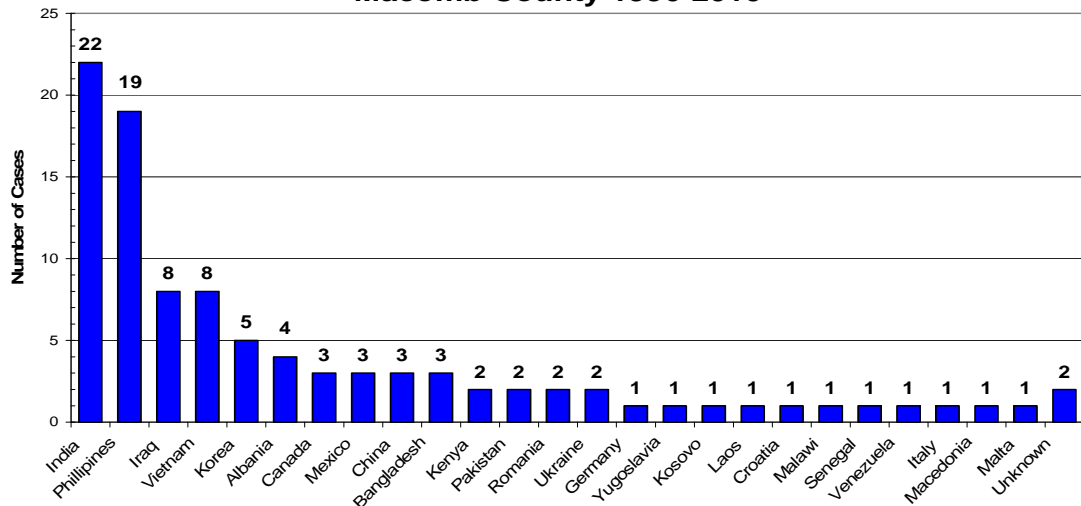
Chart 12: World Region of Birth of Foreign-born Persons Reported with Tuberculosis, Macomb County, 1996-2010



Between 1996-2000 and 2006-2010, there was a steady decreasing trend seen in proportion of cases from East Asia (from 12.5% to 7.9%) and the Indian Sub-continent (from 35.0% to 23.7%). There was also a steadily increasing trend seen in reported cases originating from the Middle East (2.5% to 10.5%), and Eastern Europe (from 10.0% to 13.2%).

From 2001 through 2010, the top 5 countries of origin of foreign-born cases reported with TB in Macomb County were India (22 cases), the Philippines (19 cases), Vietnam and Iraq (8 cases each) and Korea (5 cases) – **Chart 13** below.

Chart 13: Country of Origin of Foreign-born TB Cases Macomb County 1996-2010

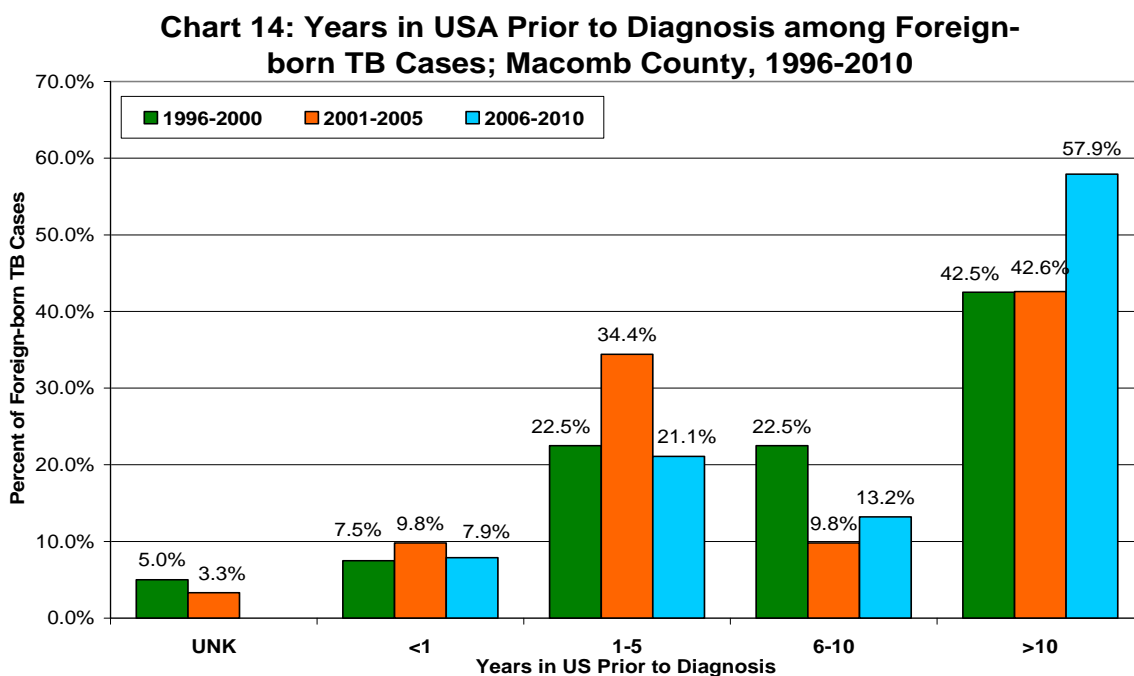


The breakdown of the Top 4 countries of origin of foreign-born cases by five-year period is shown in **Table 13**.

Table 13: Rank of Top 4 Countries of Origin & Number of Foreign-born TB Cases

Country of Origin	2001-2005		2006-2010	
	RANK	Number	RANK	Number
India	1	16	2	6
Philippines	2	12	1	7
Vietnam	3	5	4	3
Iraq	4	4	3	4

The distribution of the duration of time (years) that foreign-born clients resided in the US prior to diagnosis (by 5-year time period) is shown in **Chart 14**. For the entire period 1996-2010, over half (70 out of 139 cases or 50.4%) of the foreign-born cases had resided in the US for less than 10 years at the time of diagnosis. Twelve cases (or 8.6%) had been in the USA for less than 1 year at the time of referral to the Macomb County Health Department, and 38 or 27.3% had resided in the US for between 1-5 years.



Over the period 2001-2010, 48.5% of reported TB cases among foreign-born persons were diagnosed within 10 years of residing in the United States (**Chart 15**).

**Chart 15: Time in USA Prior to Diagnosis
Foreign-born TB Cases, Macomb County, 2001-2010**

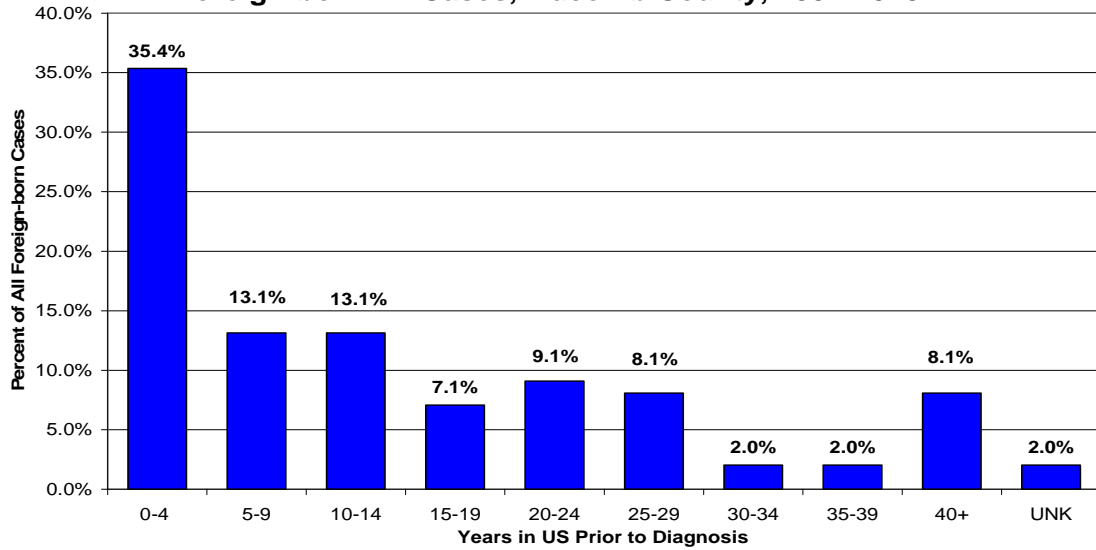


Table 14 below shows the length of time of US residence prior to TB diagnosis of foreign-born cases during the period 2001-2010, by geographic region of origin. Forty-eight foreign-born persons developed TB within 10 years of residing in the US during the period 2001-2010. 15 (or 31.3%) of these persons were from the Indian Sub-continent and 14 (or 29.2%) were from Southeast Asia.

Table 14: Geographic Region of Origin & Time in US before Diagnosis, Macomb County 2001-2010

Geographic Region	Time in US Before Diagnosis (years)					TOTAL
	0-9	10-19	20-29	30-39	40+	
East Asia	2	2	3	0	1	8
Americas	4	0	2	0	1	7
Western Europe	0	0	0	0	3	3
Indian Sub-continent	15	9	3	0	0	27
Middle East	6	2	0	0	0	8
Southeast Asia	14	3	7	3	1	28
Eastern Europe	4	4	1	1	2	12
Africa	3	0	1	0	0	4
Unknown	-	-	-	-	-	2
TOTAL	48	20	17	4	8	99
<i>Percent</i>	<i>48.5%</i>	<i>20.2%</i>	<i>17.2%</i>	<i>4.0%</i>	<i>8.1%</i>	<i>100.0%</i>

13 out of 40 (32.5%) foreign-born cases of tuberculosis in Macomb County during 1996-2000, 22 out of 61 (36.1%) during 2001-2005, and 8 out of 38 (21.1%) in 2006-2010, were classified as extra-pulmonary tuberculosis compared to 8.9%, 15.6% and 11.1% respectively of US-born cases (**Table 15**). A foreign-born TB case was almost 5 times more likely to be an extra-pulmonary TB case than a US-born case in 1996-2000 - a difference which achieved statistical significance. However, this statistically significant difference was not apparent for the 2 subsequent 5-year periods 2001-2005 and 2006-2010.

Table 15: TB Case Classification by Origin of Birth, Macomb County 1996-2010

INDICATOR 1996-2000	Extra-pulmonary	Pulmonary	TOTAL
Foreign-born	13	27	40
US-born	4	41	45
TOTAL	17	68	85
<i>OR = 4.94 (1.30<OR<20.27); chi-square = 5.98; p-value =0.014*</i>			
2001-2005	Extra-pulmonary	Pulmonary	TOTAL
Foreign-born	22	39	61
US-born	5	27	32
TOTAL	27	66	93
<i>OR = 3.05; chi-square = 3.05; p-value =0.068</i>			
2006-2010	Extra-pulmonary	Pulmonary	TOTAL
Foreign-born	8	30	38
US-born	2	16	18
TOTAL	10	46	56
<i>OR = 2.13; chi-square = 0.28; p-value =0.594</i>			

* Signifies achieving statistical significance at p<0.05

Geographic Distribution (City of Residence)

During 1996-2000, almost half of all reported TB cases (40 of 85 or 47.1%) lived in Sterling Heights and Warren. During 2001-2005, 44 of 93 or 47.3% lived in the two cities. During 2006-2010, over a half (30 of 56 or 53.6%) lived in Sterling Heights and Warren.

Sterling Heights was the residence of 3/50 or 6.0% of US-born cases and 38/99 or 38.4% of foreign-born cases during the period 2001-2010. The geographic distribution of cases is shown in **Table 16** below.

Table 16: Cities of Residence of TB Cases, Macomb County 1996-2010

CITY IN MACOMB	1996-2000		2001-2005				2006-2010			
	Total cases	% All cases	Foreign-born	US-born	Total cases	% All Cases	Foreign-born	US-born	Total cases	% All Cases
Clinton Twp	6	7.1	7	7	14	15.1	2	1	3	5.4
Eastpointe	2	2.3	1	3	4	4.3	0	2	2	3.6
Harrison Twp	2	2.3	0	2	2	2.2	1	1	2	3.6
Macomb Twp	3	3.5	6	3	9	9.7	2	0	2	3.6
Mt. Clemens	2	2.3	1	1	2	2.2	0	0	0	0.0
Roseville	5	5.9	2	2	4	4.3	0	3	3	5.4
Utica/Shelby Twp	4	4.7	4	0	4	4.3	5	3	8	14.3
St. Clair Shores	6	7.1	0	3	3	3.2	0	0	0	0.0
Sterling Heights	14	16.5	23	2	25	26.9	15	1	16	28.6
Warren	26	30.6	12	7	19	20.4	9	5	14	25.0
Chesterfield/New Baltimore	2	2.3	1	0	1	1.1	1	0	1	1.7
All Others	13	15.3	4	2	6	6.5	3	2	5	8.9
MACOMB COUNTY	85	99.9	61	32	93	100.2	38	18	56	100.1

Incidence Rates for Macomb County Municipalities

The overall 5-year incidence rate for 1996-2000 was 12.25 per 100,000 and for 2006-2010 it was 6.77 per 100,000. Similar rates were calculated for cities within Macomb County to determine the burden of disease and whether the numbers were simply reflective of the population size of the respective cities. The data from 1996-2000 and for 2006-2010 are shown in **Table 17** below.

Table 17: TB Incidence Rates for Macomb County Cities/Municipalities; 1996-2000 and 2006-2010

CITY / MUNICIPALITY	1996-2000	2006-2010		
	Incidence Rate	TB Cases	2009 Population	Incidence Rate
Center Line		1	8,156	12.26
Chesterfield / New Baltimore	7.69	1	52,967	1.89
Clinton Twp	6.97	3	95,501	3.14
Eastpointe	5.68	2	32,839	6.09
Fraser		3	14,874	20.17
Harrison Twp	8.11	2	23,464	8.52
Macomb Twp	12.98	2	81,969	2.44
Mt. Clemens	10.90	0	15,929	0.00
Roseville	9.73	3	45,633	6.57
Richmond		1	9,641	10.37
Shelby Twp / Utica	8.16	8	73,468	10.89
St. Clair Shores	8.83	0	59,879	0.00
Sterling Heights	17.83	16	129,535	12.35
Warren	17.99	14	131,516	10.65

Incidence Rates are per 100,000

During the period 1996-2000, the highest TB incidence rates per 100,000 were seen in Warren (17.99) and Sterling Heights (17.83). For the period 2006-2010, the cities/municipalities with TB incidence rates significantly exceeding the county-wide figure of 6.77 per 100,000 were Fraser (20.17), Sterling Heights (12.35), Center Line (12.26), Shelby/Utica (10.89), Warren (10.65) and Richmond (10.37)

DURATION OF THERAPY AND COMPLETION RATE

Treatment Guidelines for Active TB

The basic principles that underlie the treatment of pulmonary tuberculosis also apply to extra-pulmonary forms of the disease. The guidelines for the recommended duration of treatment for Tuberculosis are shown below.

Guidelines for the Treatment of Pulmonary and Extra-pulmonary Tuberculosis

INDICATIONS	DURATION OF TREATMENT
Pulmonary Tuberculosis	
All cases of previously untreated TB	8 weeks Initial phase 18 weeks Continuation phase
Cavitation on initial CXR with positive cultures after 2 months initial phase	8 weeks Initial phase 31 weeks continuation phase
TB cases whose initial phase of treatment did not include PZA	8 weeks Initial phase 31 weeks continuation phase
Cases treated with once-weekly INH and Rifapentine whose sputum culture after initial phase is positive	8 weeks Initial phase 31 weeks continuation phase

INDICATIONS	DURATION OF TREATMENT
Extra-pulmonary Tuberculosis	
Lymph node	6 months
Bone & joint	6 - 9 months
Pleural disease	6 months
Pericarditis	6 months
CNS Tuberculosis (incl. meningitis)	9 – 12 months
Disseminated Disease	6 months
Genitourinary	6 months
Peritoneal	6 months

Source: American Thoracic Society/Centers for Disease Control and Prevention/Infectious Disease Society of America: Treatment of Tuberculosis (Oct 2002).

The current minimal acceptable duration of treatment for all children and adults with culture positive tuberculosis is 6 months (26 weeks). The exception to the recommended length of drug therapy for most types of TB (for 6-9 months), is for a 9-12 month regimen for tuberculous meningitis.

For public health TB control, the highest priority is to ensure that persons with the disease complete curative therapy. If treatment does not continue for a sufficient length of time, such persons often become ill and contagious again. Completion of therapy is essential to prevent transmission of the disease as well as to prevent outbreaks and the development and spread of drug-resistant TB. Current therapy guidelines recommend that patients with drug-susceptible TB should complete a successful regimen within 12 months. The mean duration of treatment for TB cases in Macomb County during the period 2001-2010, was 205 days (approx. 29 weeks or just over 7 months). **Table 18** shows the distribution of duration of treatment by site of TB disease, and by 5-year period.

Table 18: Duration of Treatment for TB by Site of Disease, 2001-2010 by five-year periods

DURATION OF TREATMENT	2001-2005			2006-2010			All Cases 2001-2010
	Pulmonary	EPTB	TOTAL	Pulmonary	EPTB	TOTAL	
<6 months <26 weeks	3	12	15	2	11	13	28
6-9 months 26-39 weeks	13	29	42	5	12	17	59
9-12 months 39-52 weeks	10	16	26	0	9	9	35
> 12 months >52 weeks	1	5	6	0	5	5	11
Not recorded	0	4	4	3	9	12	16
TOTAL	27	66	93	10	46	56	149

EPTB = Extra-pulmonary TB

Table 19 shows the distribution of duration of treatment by birth origin, and by 5-year period.

Table 19: Duration of Treatment for TB by Origin of Birth, 2001-2010.

DURATION OF TREATMENT	2001-2005			2006-2010			All Cases 2001-2010
	Foreign	US-born	TOTAL	Foreign	US-born	TOTAL	
<6 months <26 weeks	10	5	28	12	1	13	28
6-9 months 26-39 weeks	29	13	59	10	7	17	59
9-12 months 39-52 weeks	14	12	35	6	3	9	35
> 12 months >52 weeks	4	2	11	3	2	5	11
Not recorded	4	0	16	7	5	12	16
TOTAL	61	32	149	38	18	56	149

Twenty-eight of 149 (or 18.8%) cases were treated for less than the recommended minimum of 6 months. This was comprised of 23 pulmonary and 5 extra-pulmonary or 22 foreign-born and 6 US-born cases. The final disposition of these 28 cases were as follows: 5 completed treatment (duration: 175-181 days), 12 died, 3 discontinued therapy and 8 moved out of the health district's jurisdiction. Of the 11 cases that were treated for a period in excess of 1 year, 10 completed the treatment regimen and 1 case died.

There is no record of duration of treatment for 16 persons (13 pulmonary and 3 extra-pulmonary or 11 foreign-born and 5 US-born cases). Eight of these persons are still under-going therapy at the time of this report. The remaining 8 persons for whom no duration of treatment was recorded, were reported after death, and so did not commence therapy. The distribution of 25 deaths occurring during the 2001-2010 period is shown in **Table 20** below.

Table 20: Distribution of Deceased Cases of TB by Origin of Birth & Site of Disease, 2001-2010

INDICATOR	BIRTH COUNTRY		SITE OF DISEASE		TOTAL
	Foreign-born	US-born	Pulmonary	Extra-pulmonary	
Died before Commencement of Therapy	5	3	7	1	8
Died within 4 weeks/1 month (0-27 days)	2	3	5	0	5
Died 5-12 weeks/1-3 months (28-83 days)	5	0	3	2	5
Died 13-25 weeks/3-6 months (84-181 days)	1	1	2	0	2
Died after >182 days of therapy	3	2	5	0	5
TOTAL DEATHS (2001-2010)	16	9	22	3	25

The details of the final disposition of the TB cases (by duration of therapy and site of disease) are shown in **Table 21**.

Table 21: Duration and Completion of Treatment for Tuberculosis by Site of Disease; 2001-2010

DURATION	EXTRA-PULMONARY				PULMONARY				TOTAL ALL TB CASES
	Comp	Moved Discont	Died	TOTAL	Comp	Moved Discont	Died	TOTAL	
< 6 mths	1	2	2	5	4	9	10	23	28
6 – 9 mths	17	1	0	18	36	3	2	41	59
9 – 12 mths	9	1	0	10	22	1	2	25	35
> 12 mths	1	0	0	1	9	0	1	10	11
No Record	0	0	1	1 (+2)*	0	0	7	7 (+6)*	16
TOTAL	28	4	3	37	71	13	22	112	149
% Cases	75.7	10.8	8.1		63.4	11.6	19.6		

Comp = completed therapy; Discont = discontinued therapy.

*6 PTB and 2 EPT cases' duration of treatment = on-going.

During 2001-2010, eight persons died prior to commencing therapy. Of the 141 persons who started therapy, 89 or 63.1% of TB clients completed therapy within 1 year, which is below the *Healthy People 2010* target of 90% (Objective 14-12). Seventeen (11.4%) discontinued therapy or moved out of the jurisdiction, and another 16 (10.7%) died within one year of the case being reported. Eight persons are presently undergoing tuberculosis treatment. **Note that should all 8 cases complete therapy within 1 year, the maximum rate achieved would be 68.8%.**

Regardless of duration of treatment, during the period 2001-2010 among extra-pulmonary TB cases, 28/36 or 77.8% completed therapy compared to 71/105 or 67.6% of pulmonary TB cases. A larger

proportion of pulmonary TB cases (19.6%) died compared to 8.1% of extra-pulmonary cases (**Table 21**).

<p>Healthy People 2010</p> <p>Objective 14.12: Increase the proportion of all tuberculosis patients who complete curative therapy <i>within 12 months</i>.</p> <p>Target: 90 percent of patients.</p> <p>Macomb County Achievement, 2001-2010</p> <p>63.1%* of all TB cases completed curative therapy within 12 months</p>
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Table 22 below shows the rate of therapy completion for persons commencing TB treatment, regardless of duration of therapy for the period 2001-2010, by site of TB disease. This Chart excludes the 8 cases that were reported after death occurred, and so did not commence treatment for tuberculosis.

Table 22: Completion Rates for TB Cases Commencing Therapy by Disease Site and Year

YEAR	EXTRA-PULMONARY			PULMONARY			ALL CASES	
	Number Completing Therapy	Total Number of Cases	% Completion	Number Completing Therapy	Total Number of Cases	% Completion	ALL Cases Starting Therapy	% Completion ALL CASES
2001	2	4	50.0	11	14	78.6	18	72.2
2002	7	7	100.0	8	11	72.7	18	83.3
2003	7	7	100.0	11	12	91.7	19	94.7
2004	5	6	83.3	7	8	87.5	14	85.7
2005	3	3	100.0	11	17	64.7	20	70.0
2001-2005	24	27	88.9	48	62	77.4	89	80.9
2006	0	2	0.0	4	9	44.4	11	36.4
2007	3	4	75.0	13	18	72.2	22	72.7
2008	1	1	100.0	3	4	75.0	5	80.0
2009	0	0	-	2	4	50.0	4	50.0
2010	0*	2	-	1*	8	-	10	-
2006-2010	4*	9	44.4	23*	43	53.5	52	51.9
TOTAL	28*	36	77.8	71*	105	67.6	141	70.2

* 2 EPT and 6 Pulmonary TB cases reported in 2010 have therapy on-going

Completion rates during the 2001-2005 period averaged 80.9% (77.4% for pulmonary TB and 88.9% for extra-pulmonary TB). For the 2006-2010 period completion rates declined to average 51.9% - 44.4% for extra-pulmonary TB and 53.5% for pulmonary TB (**Table 22**). 8 cases referred in 2010 are still undergoing treatment.

Table 23 below shows the rate of therapy completion for persons commencing TB treatment, regardless of duration of therapy for the period 2001-2010, by country of origin. Completion rates during the 2001-2005 period averaged 82.5% for foreign-born TB cases and 78.1% for US-born TB cases. For the 2006-2010 period completion rates declined to average 45.9% for foreign-born TB cases and 66.7% for US-born TB cases.

Table 23: Completion Rates for Persons Commencing Therapy by Origin of Birth & Year

YEAR	FOREIGN-BORN			US-BORN			ALL CASES	
	Number Completing Therapy	Total Number of Cases	% Completion	Number Completing Therapy	Total Number of Cases	% Completion	ALL Cases Starting Therapy	% Completion ALL CASES
2001	5	7	71.4	8	11	72.7	18	72.2
2002	11	13	84.6	4	5	80.0	18	83.3
2003	14	15	93.3	4	4	100.0	19	94.7
2004	7	8	87.5	5	6	83.3	14	85.7
2005	10	14	71.4	4	6	66.7	20	70.0
2001-2005	47	57*	82.5	25	32	78.1	72*	80.9
2006	2	8	25.0	2	3	66.7	11	36.4
2007	11	16	68.8	5	6	83.3	22	72.7
2008	3	3	100.0	1	2	50.0	5	80.0
2009	0	2	0.0	2	2	100.0	4	50.0
2010	1	8	-	0	2	-	10	-
2006-2010	17	37*	45.9	10	15*	66.7	52*	51.9
TOTAL	64	94*	68.1	35	47*	70.0	141*	70.2

* Excludes 8 Cases that did not commence therapy

DOT Coverage

Directly Observed Therapy (DOT) is defined as the direct observation of the patient by a nurse or other TB Program staff person as they ingest tuberculosis medication. Directly Observed Therapy can be used for treatment of active TB or LTBI, and is the best method to ensure patient compliance with prescribed treatment regimen. DOT is a proven strategy to improve patient compliance and completion rates. Non-compliance with TB medication regimens produce serious consequences, including:

- Prolonged illness and disability for the patient
- Continued infectiousness of the patient, causing ongoing transmission of tuberculosis
- Development of drug-resistant tuberculosis, and
- The possibility of death

The DOT coverage by year of report and site of disease is given in **Table 24** below.

Table 24: DOT Coverage by Year of Report and Site of Disease; 2001-2010

YEAR OF REPORT	PULMONARY				EXTRA-PULMONARY				TOTAL DOT Coverage	
	YES	NO	TOTAL	DOT%	YES	NO	TOTAL	DOT%		
2001	5	12	17	29.4	0	4	4	0.0	5 / 16	23.8%
2002	6	5	11	54.5	2	5	7	28.6	8 / 18	44.4%
2003	6	6	12	50.0	4	3	7	57.1	10 / 19	52.6%
2004	3	6	9	33.3	0	6	6	0.0	3 / 15	20.0%
2005	9	8	17	52.9	2	1	3	66.7	11 / 20	55.0%
2001-2005	29	37	66	43.9	8	19	27	29.6	37 / 93	39.8%
2006	6	3	9	66.7	0	2	2	0.0	6 / 11	54.5%
2007	10	8	18	55.6	3	1	4	75.0	13 / 22	59.1%
2008	2	3	5	40.0	1	1	2	50.0	3 / 7	42.9%
2009	4	0	4	100.0	0	0	0	0.0	4 / 4	100.0%
2010	4	6	10	40.0	1	1	2	50.0	5 / 12	41.7%
2006-2010	26	20	46	56.5	5	5	10	50.0	31 / 56	55.4%

KEY: YES = DOT; NO = No DOT

Overall DOT coverage for TB clients during the period of 1996-2000 when DOT became a national strategy was 29%. For the period 2001-2005, DOT coverage was 37/93 or 39.8% which is well below

the Michigan Department of Community Health’s target of 70%. For the period 2006-2010, DOT coverage increased to 31/56 or 55.4%.

MDCH Target

Objective: Increase the coverage of all tuberculosis patients who are treated using DOT.

Target: 70 percent of patients.

Macomb County 2006-2010 Achievement

55.4% of TB clients treated using DOTs

During the period 2006-2010, DOT coverage was 21/38 or 55.3% for foreign-born clients and a very similar 10/18 or 55.6% for US-born clients (see **Table 25** below).

Table 25: DOT Coverage by Origin of Birth & Site of Disease; 2001-2010

PERIOD	FOREIGN-BORN				US-BORN				TOTAL DOT Coverage	
	YES	NO	TOTAL	DOT%	YES	NO	TOTAL	DOT%		
2001-2005	24	37	61	39.3	13	19	32	40.6	37 / 93	39.8%
2006-2010	21	17	38	55.3	10	8	18	55.6	31 / 56	55.4%

Chart 16 shows the increasing trend in DOT coverage in Macomb County from 1996-2000 to 2006-2010.

**Chart 16: Trend in DOT Coverage for Foreign-born, US-born and All TB Cases
Macomb County, 1996-2010**

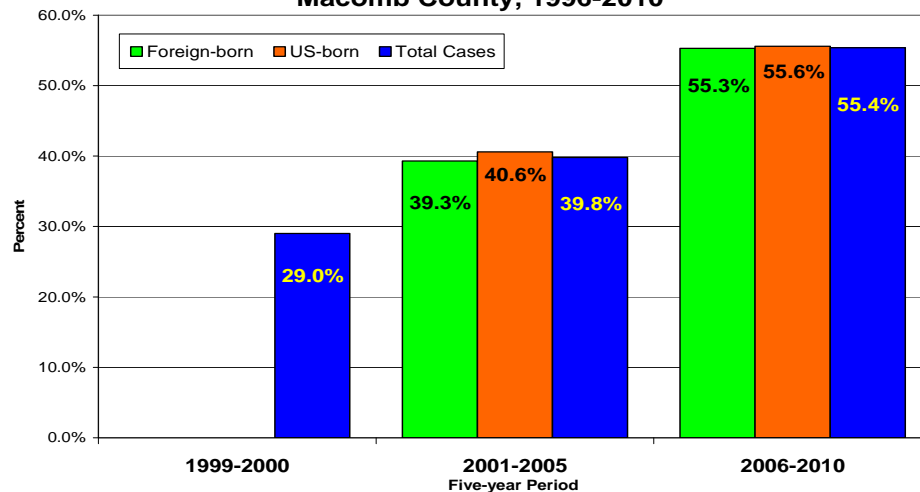


Table 26 shows the effect that DOT has on treatment completion for both foreign- and US-born TB cases. Among foreign-born cases treated using DOT, completion of therapy rates were 83.3% in 2001-

2005 and 61.9% in 2006-2010. In contrast, foreign-born cases not treated with DOT had completion rates of 45.9% (2001-2005) and 23.5% (2006-2010) respectively.

Among US-born cases treated using DOT, completion of therapy rates were 76.9% in 2001-2005 and 70.0% in 2006-2010. In contrast, US-born cases not treated with DOT had completion rates of 78.9% (2001-2005) and 37.5% (2006-2010) respectively.

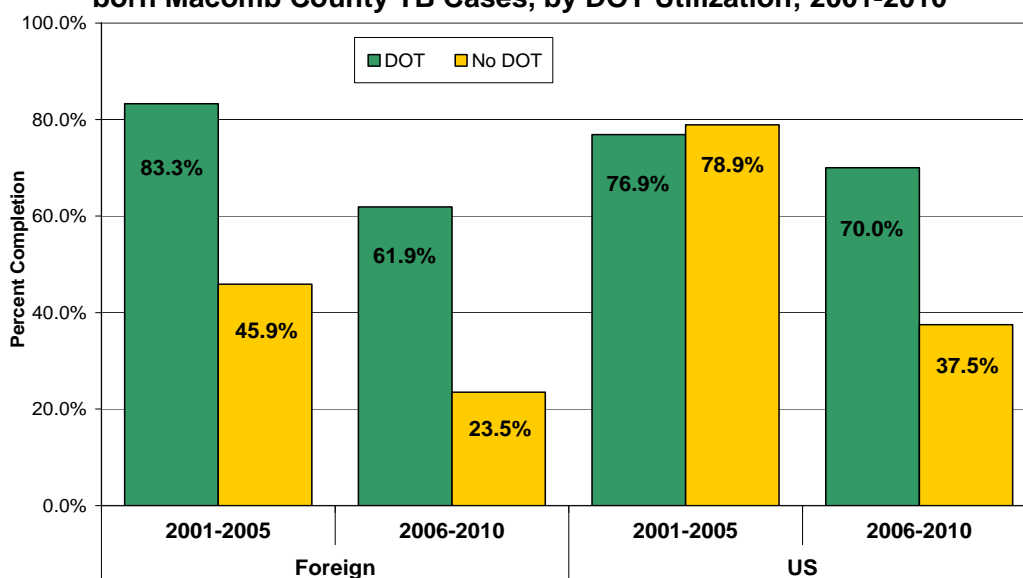
Table 26: DOT and Completion of Treatment for Tuberculosis by Origin of Birth; 2001-2010

Result of Therapy	2001-2005								Total Completed on DOT	Total Completed Not on DOT
	Foreign-born				US-born					
	DOT	No DOT	UNK	Total	DOT	No DOT	UNK	Total		
Completed	20	10	17	47	10	7	8	25	30	42
Died	1	1	8	10	1	0	3	4		
Discontinued	2	0	0	2	2	1	0	3		
Moved	1	0	1	2	0	0	0	0		
Total	24	11	26	61	13	8	11	32	37	56
% Completion	83.3	45.9		77.0	76.9	78.9		78.1	81.1	75.0

Result of Therapy	2006-2010								Total Completed on DOT	Total Completed Not on DOT
	Foreign-born				US-born					
	DOT	No DOT	UNK	Total	DOT	No DOT	UNK	Total		
Completed	13	4	0	17	7	3	0	10	20	7
Died	1	3	2	6	2	1	2	5		
Discontinued	1	1	0	2	0	0	0	0		
Moved	3	4	0	7	0	1	0	1		
On-going	3	2	1	6	1	1	0	2		
Total	21	14	3	38	10	6	2	18	31	25
% Completion	61.9	23.5		44.7	70.0	37.5		55.6	64.5	28.0

The usefulness of the DOT strategy is substantiated by the findings in Macomb County during 2001-2010 showing that DOT improves completion rates regardless of Origin of Birth (**Chart 17**).

Chart 17: Completion of Therapy Among Foreign- and US-born Macomb County TB Cases, by DOT Utilization; 2001-2010



Foreign-born TB clients' completion rate without DOT was 45.9% (2000-2005) and 23.5% (2006-2010). With DOT, foreign-born cases' completion rates were 83.3% (2001-2005) and 61.9% (2006-2010). US-born TB clients' completion rates with and without DOT were similar in 2000-2005 - 76.9% and 78.9% respectively. In 2006-2010 with DOT, the completion rate was 70.0% compared to 37.5% for US-born clients not treated using DOT.

Table 27 shows the effect that DOT has on treatment completion for both pulmonary and extra-pulmonary TB cases. Among pulmonary TB cases treated using DOT, completion of therapy rates were 75.9% in 2001-2005 and 65.5% in 2006-2010. In contrast, pulmonary TB cases not treated with DOT had completion rates of 70.3% (2001-2005) and 30.0% (2006-2010) respectively.

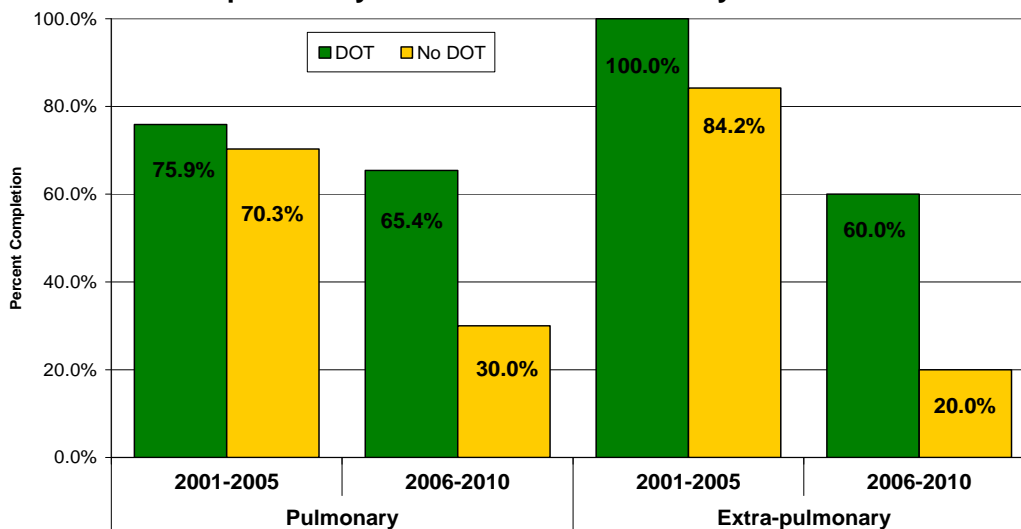
Table 27: DOT and Completion of Treatment for Tuberculosis by Site of Disease; 2001-2010

2001-2005									Total Completed on DOT	Total Completed Not on DOT
Result of Therapy	PULMONARY TB				EXTRA-PULMONARY TB					
	DOT	No DOT	UNK	Total	DOT	No DOT	UNK	Total		
Completed	22	11	15	48	8	6	10	24	30	42
Died	2	1	9	12	0	0	2	2		
Discontinued	4	1	0	5	0	0	0	0		
Moved	1	0	0	1	0	0	1	1		
Total	29	13	24	66	8	6	13	27	37	56
% Completion	75.9	70.3		72.7	100.0		84.2	88.9	81.1	75.0
2006-2010									Total Completed on DOT	Total Completed Not on DOT
Result of Therapy	PULMONARY TB				EXTRA-PULMONARY TB					
	DOT	No DOT	UNK	Total	DOT	No DOT	UNK	Total		
Completed	17	6	0	23	3	1	0	4	20	7
Died	3	4	3	10	0	0	1	1		
Discontinued	0	0	0	0	1	1	0	2		
Moved	3	4	0	7	0	1	0	1		
On-going	3	2	1	6	1	1	0	2		
Total	26	16	4	46	5	4	1	10	31	25
% Completion	65.4	30.0		50.0	60.0		20.0	40.0	64.5	28.0

Among extra-pulmonary TB cases treated using DOT, completion of therapy rates were 100.0% in 2001-2005 and 60.0% in 2006-2010. In contrast, extra-pulmonary TB cases not treated with DOT had completion rates of 84.2% (2001-2005) and 20.0% (2006-2010) respectively.

Chart 18 shows that DOT improves completion rates whether the client has pulmonary or extra-pulmonary TB. Pulmonary TB clients' completion rate without DOT was 70.3% (2000-2005) and 30.0% (2006-2010). With DOT, pulmonary TB cases' completion rates were 75.9% (2001-2005) and 65.4% (2006-2010). Extra-pulmonary TB clients' completion rate with DOT was 100.0% in 2001-2005 and without DOT was 84.2%. In 2006-2010 with DOT, the completion rate was 60.0% compared to 20.0% for extra-pulmonary TB clients not treated using DOT.

Chart 18: Completion of Therapy Among Pulmonary and Extra-pulmonary TB Cases Macomb County 2001-2010



Overall, during 2001-2005, completion rates for clients receiving DOT was 81.1% compared to 75.0% for clients not receiving DOT. During 2006-2010, completion rates for clients receiving DOT was 64.5% compared to 28.0% for clients not receiving DOT. For the period 2006-2010, 8 clients (4 on DOT and 4 not receiving DOT) are continuing treatment, at the time of this report.

HEALTH DISPARITIES

Health disparity is defined as a difference in health outcomes between population groups. Specific population groups are considered disparately affected if one or more of the following is present:

- 1) higher prevalence rates
- 2) limited access to treatment resources
- 3) greater health consequences because of disease and the social determinants (e.g. education, employment etc).

Origin of Birth: Foreign-born versus US-born

There are 99 persons recorded as foreign-born and 50 as US-born during 2001-2010. As previously shown in **Table 14** (on page 20 of this report), a foreign-born TB case was more likely to be an extra-pulmonary TB case than a US-born case. This continues a trend also noted during the period 1996-2000.

During 2001-2010, foreign-born cases were less likely to have their household contacts skin-tested for TB than were US-born cases (*statistically significant, OR=0.30; 95%CI - 0.12, 0.75; p-value = 0.007*). However there were no statistically significant differences among foreign- and US-born cases in terms of DOT coverage, completion of treatment, or deaths occurring due to the diagnosis of active TB infection (**Table 28** below).

Table 28: Origin of Birth by Other TB Program Indicators; 2001-2010

COUNTRY OF ORIGIN	Household Tested #		DOT Coverage		Rx Completion		Death		CATEGORY TOTAL
	Y	N	Y	N	Y	N	Y	N	
Foreign-born	51	43	45	54	64	35	16	83	99
US-born	35	9	23	27	35	15	9	41	50
TOTAL	86	52	68	81	99	50	25	124	149
Odds Ratio	0.30*		0.98		0.78		0.88		
95% C.I.	0.12, 0.75		0.47, 2.05		0.35, 1.73		0.33, 2.37		

* Statistically significant at $p < 0.05$

Total does not include Cases with No Information

Overall, 99 of 149 (66.4%) TB cases reported during 2001-2010 were foreign-born. For the period 2001-2005, the variation among the races showed that 33.3% of blacks, 39.0% of whites and 97.6% of Asians were foreign-born. For the period 2006-2010, 14.3% of blacks, 56.0% of whites and 95.8% of Asians were foreign-born (**Table 29**).

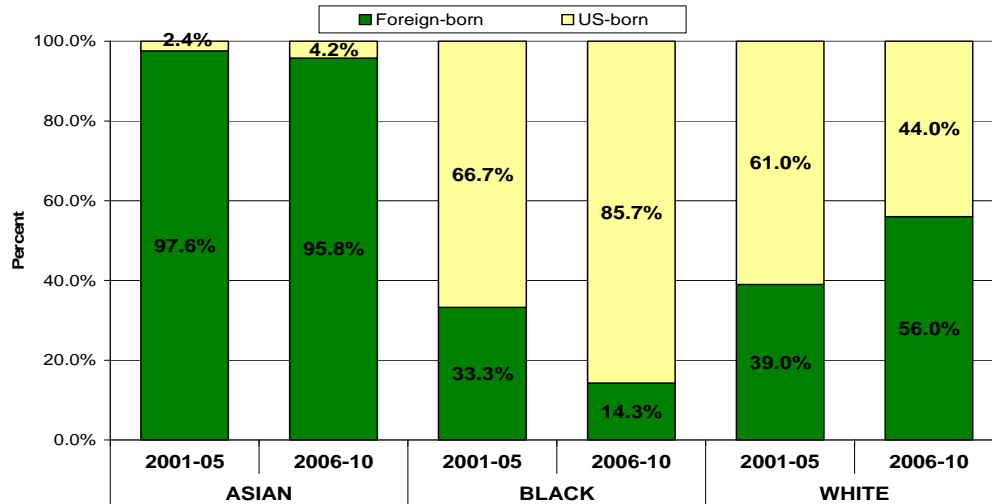
Table 29: Origin of Birth by Race; 2001-2010

2001-2005					
COUNTRY OF ORIGIN	RACE				TOTAL
	Asian	Black	White	Other	
Foreign-born	41	3	16	1	61
US-born	1	6	25	0	32
TOTAL	42	9	41	1	93
% Foreign-born	97.6%	33.3%	39.0%	100.0%	65.6%
2006-2010					
COUNTRY OF ORIGIN	RACE				TOTAL
	Asian	Black	White	Other	
Foreign-born	23	1	14	0	38
US-born	1	6	11	0	18
TOTAL	24	7	25	0	56
% Foreign-born	95.8%	14.3%	56.0%	-	67.9%

Asian TB cases are more likely to be foreign-born than Blacks or Whites in Macomb County. Among Black TB cases, the proportion that is US-born has increased from 66.7% in 2001-05, to 85.7% in 2006-2010. Among White TB cases, the proportion that is US-born has decreased from 61.0% (2001-05) to 44.0% in 2006-2010 (**Chart 19**). These findings suggest a trend that Black TB cases are more likely US-born and White TB cases are more likely foreign-born.

In 2006, Asians accounted for 3.3% of Macomb County's population (2006 ACS report), but for 42.9% of active TB cases for the period 2006-2010. Blacks accounted for 6.6% of the County's population but 12.5% of the active TB cases during 2006-2010 period.

**Chart 19: Origin of Birth of Racial Groupings of TB Cases
Macomb County 2001-2010**



Race Distribution of TB Program Indicators

Age at Onset and Age Distribution: The mean age of TB cases varies by race. For the period 2001-2010, the mean age was lowest among Blacks at 36.8 years and highest among Whites at 56.5 years. Asian cases had a mean age of 47.7 years.

The age distribution of TB cases for the two 5-year periods is shown in **Table 30** below. The majority of TB cases among Whites are in the older age-groups (45 years and older), while among Blacks and Asians the majority of cases are in the 25-64 year age group.

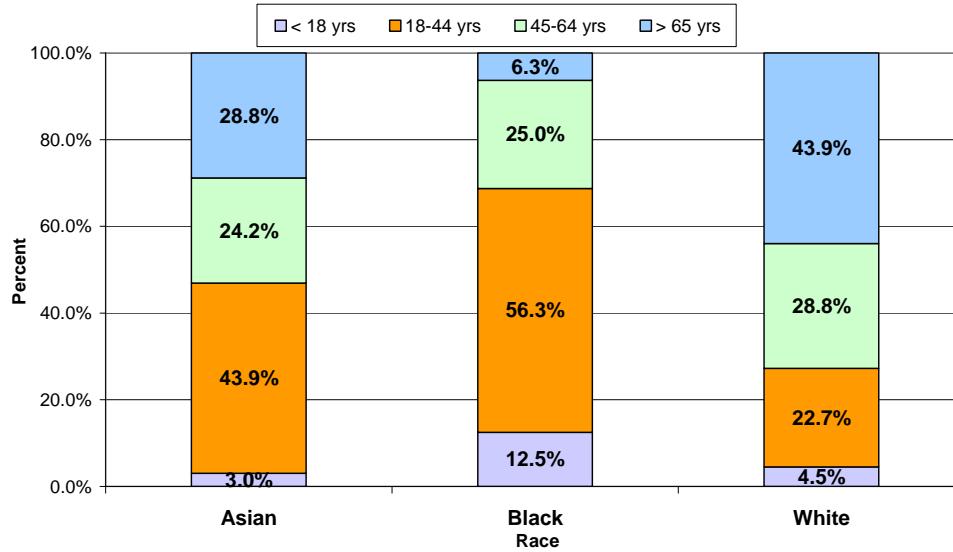
Table 30: Age Distribution by Race of TB Cases; 2001-2010

AGE GROUP*	2001-2005				2006-2010			
	Asian	White	Black	TOTAL	Asian	White	Black	TOTAL
< 5 yrs	1	1	2	4	1	0	0	1
5-17 yrs	0	1	0	1	0	1	0	1
18-24 yrs	4	3	1	8	2	3	0	5
25-44 yrs	18	5	5	28*	5	4	3	12
45-64 yrs	10	12	1	23	6	7	3	16
> 65 yrs	9	19	0	28	10	10	1	21
TOTAL	42	41	9	92*	24	25	7	56
Statistical Age Data by Race (2001-2010)								
AGE INDICATOR	ASIANS			BLACKS	WHITES			
Mean Age	47.7 years			36.8 years	56.5 years			
Median Age	47.0 years			35.0 years	60.5 years			
Standard Deviation	20.638 years			20.098 years	24.029 years			
Range (minimum - maximum age)	2 – 86 years			1 – 82 years	1 – 92 years			

* 1 case classified as "OTHER" Race, aged 24-44 yrs, is not included.

The proportional age distribution of TB cases varies by race and is shown graphically in **Chart 20** below. Twenty-nine of 66 (or 43.9%) of White TB cases are aged over 65 years, whereas 29 of 66 or 56.3% of Black cases and 9 of 16 (or 43.9%) of Asians are aged 18-44 years.

**Chart 20: Age Distribution by Race of TB Cases
Macomb County 2001-2010**



Duration of Therapy & Completion Rates: The duration of tuberculosis therapy for cases was also explored by race. The mean duration of treatment for Asians was 219 days, 253 days for Blacks and 180 days for Whites.

Table 31: Duration of Treatment for TB by Race, 2001-2010

DURATION	2001-2005				2006-2010			
	Asian	White	Black	TOTAL	Asian	White	Black	TOTAL
<6 months / <182 days	4	9	2	15	9	2	2	13
6-9 months / 182-272 days	21	17	3	41	7	8	2	17
9-12 months / 273-363 days	13	10	3	26	3	6	0	9
> 12 months / >363 days	4	1	1	6	2	1	2	5
Not recorded	0	4	0	4**	1	2	1**	4
On-going Treatment	0	0	0	0	2~	6~	0	8~
TOTAL	42	41	9	92*	24	25	7	56
Number completed therapy	37	26	8	72	12	12	7	27
Percent Completion	88.1	63.4	88.9	78.3	54.5~	66.7~	100.0	56.3~
Statistical Age Data by Race (2001-2010)								
DURATION OF TREATMENT INDICATOR	ASIANS	BLACKS	WHITES	ALL CASES				
Mean Duration	218.576 days	253.250 days	180.197 days	205.154 days				
Median Duration	198.00 days	204.50 days	186.50 days	195.00 days				
Standard Deviation	123.492	152.770	135.038	132.968				

* 1 case classified as "OTHER" Race, aged 24-44 yrs, is not included.

** Represents All Deaths

~ Excludes cases on-going treatment

Forty-four of 66 (or 66.7%) Asians received an appropriate duration of therapy (6-12 months) and an additional 6 cases received treatment for over 12 months. Among the 66 Whites, 41 (or 62.1%) received appropriate duration of therapy for 6-12 months and an additional 2 cases received treatment for over 12 months. Eight Blacks (50.0%) received therapy for between 6-12 months and an additional 3 cases received treatment for over 12 months (**Table 31**).

Completion of treatment was achieved by 66.2% of clients during 2001-2010. Among Asians the completion rate was 74.2%, among blacks – 68.8% and among Whites, the completion rate for tuberculosis therapy was 57.6% (**Table 32**).

Table 32: Outcome of Treatment for TB by Race, 2001-2010

OUTCOME OF TREATMENT	Completion Rate by Race			TOTAL
	Asian	Black	White	
Completed Treatment / Cured	49	11	38	98
Moved or Discontinued	8	3	6	19
Died	7	2	16	25
On-going Treatment	2	0	6	8
TOTAL	66	16	66	148
Completion Rate (%)	74.2	68.8	57.6	66.2

* 1 case classified as "OTHER" Race, aged 24-44 yrs, is not included.

Certain indicators can be explored by race to determine whether any health disparities exist. Some indicators (site of disease, testing household contacts, DOT coverage, completion of therapy, and death rates) are shown in **Table 33** below.

Table 33: Race by TB Program Indicators, 2001-2010

RACE	INDICATORS										Category TOTAL*
	Pulmonary Disease		Household Tested		DOT Coverage		Completion of Therapy		DEATH		
	N	%	N	%	N	%	N	%	N	%	
Asian	43	65.2%	33	50.0%	29	43.9%	49	74.2%	7	10.6%	66
White	55	83.3%	41	62.1%	27	40.9%	38	57.6%	16	24.2%	66
Black	13	81.3%	11	68.8%	11	68.8%	11	68.8%	2	12.5%	16

* The race of 1 Case reported as "OTHER"

Asians had the lowest rate of pulmonary disease (65.2%), testing of household contacts (50.0%) and deaths (10.6%), and the highest rate of completion of therapy (74.2%). Whites had the highest rate of pulmonary disease (83.3%) and deaths (24.2%), and the lowest rates of DOT coverage (40.9%) and completion of therapy (57.6%). Blacks had the highest rate of testing of household contacts (68.8%) and DOT coverage (68.8%).

Whites versus All Other Races: Compared to Michigan as a whole, Macomb County is relatively less racially diverse. In Macomb County white persons comprised 89.7% of the population in 2006, exceeding that of the USA (79.96%) and Michigan (81.16%). African-Americans comprised 6.6% of the population in 2006 and Asians accounted for 3.3%.

There were 66 persons whose race was recorded as white, and 83 who were of other racial/ethnic groups during 2001-2010. There are no statistical differences seen between whites and all other races in relation to testing of household contacts, DOT coverage, completion of therapy, death, or site of disease (**Table 34**).

Table 34: Race versus Other Variables; 2001-2010 Data

RACE	Household Tested #		DOT Coverage		Completion		Death		Site of Disease		CATEGORY TOTAL
	Y	N	Y	N	Y	N	Y	N	EPTB	PTB	
White	41	17	27	39	38	28	16	50	11	55	66
Other	45	35	41	42	61	22	9	74	26	57	83
TOTAL	86	52	68	81	99	50	25	124	37	112	149
Odds Ratio	1.88		0.71		0.49		2.63		0.44		
95% C.I.	0.86, 4.10		0.35, 1.43		0.23, 1.03		1.00, 7.06		0.18, 1.04		

* Statistically significant at p<0.05 # Total does not include Cases with No Information EPTB=Extra-pulmonary TB PTB=Pulmonary TB

There was no statistically significant difference noted between Whites and all other races and the primary site of TB disease. Although Whites were less likely to have extra-pulmonary disease than other races (29.7% of all extra-pulmonary cases, and only 16.7% of White TB cases) – **compared to 70.3% of all EPTB cases and 31.3% of TB cases in other Races** - the relatively small number of cases may account for the data approaching, but not achieving statistical significance.

There was no statistically significant difference noted between Whites and other races and the risk of dying from TB disease. Although Whites were more likely to die from TB disease than other races (64.0% of all deaths, and 24.2% of all White TB cases) – **compared to 36.0% of all deaths and 10.8% of TB cases in other Races** - the data approached, but did not achieve statistical significance.

There was no statistically significant difference noted between Whites and other races and the completion of therapy for TB disease. Although Whites were less likely to complete TB treatment than other races (38.4% of all completely treated cases, and 57.6% of all White TB cases) – **compared to 61.6% of all completely treated cases and 73.5% of TB cases in other Races** - the data approached, but did not achieve statistical significance.

HIV Co-Infection

Co-infection with the human immunodeficiency virus (HIV) significantly increases the risk of developing TB. Documentation was scanty in regards to HIV status of active TB cases. Performance of HIV Test was documented for 34 persons, with 108 cases designated as not having the test done, and information was unavailable for 7 cases. Of the 34 persons who had documented HIV testing done, 2 or 5.9% were positive (**Table 35**).

Table 35: HIV Testing of Reported TB Cases and Results; 2001-2010

HIV Testing Done	HIV TEST RESULT				TOTAL
	Positive	Negative	Unknown	Not Done	
YES	2	32	0	0	34
NO	0	0	11	97	108
NO RECORD	0	0	7	0	7
TOTAL	2	32	18	97	149

One hundred and eight or 72.5% of reported active TB cases had documentation of not having done a HIV test. The HIV status of TB cases (by country of origin and site of disease) is presented in **Table 36** below.

Table 36: HIV Testing by Origin of Birth & Disease Site; 2001-2010

DOCUMENTED HIV STATUS	ORIGIN OF BIRTH		SITE OF DISEASE		TOTAL
	US-born	Foreign-born	Extra-pulmonary	Pulmonary	
No record	10 (20.0%)	8 (8.1%)	4 (10.8%)	14 (12.5%)	18 (12.1%)
Test not done	26 (52.0%)	71 (71.7%)	24 (64.9%)	73 (65.2%)	97 (65.1%)
Negative	13 (26.0%)	19 (19.2%)	7 (18.9%)	25 (22.3%)	32 (21.5%)
Positive	1 (2.0%)	1 (1.0%)	2 (5.4%)	0 (0.0%)	2 (1.3%)
TOTAL	50 (100.0%)	99 (100.0%)	37 (100.0%)	112 (100.0%)	149 (100.0%)

DRUG RESISTANCE

Drug resistance (caused by poorly managed TB treatment) is a growing problem of serious concern. Testing for susceptibility of the *M. tuberculosis* organism to available drugs revealed the information shown in **Table 37** below.

Table 37: Drug Resistance of M. tuberculosis isolates by Origin of Birth & Site of Disease, 2001-2010

DRUG RESISTANCE INFORMATION	2001-2005				TOTAL
	COUNTRY OF ORIGIN		SITE OF DISEASE		
	US-born	Foreign-born	Extra-pulmonary	Pulmonary	
No record/Unknown	5 (15.6%)	13 (21.3%)	5 (18.5%)	13 (19.7%)	18 (19.4%)
No drug resistance	26 (81.3%)	40 (65.6%)	19 (70.4%)	47 (71.2%)	66 (71.0%)
One drug (not stated)	0 (0.0%)	2 (3.3%)	1 (3.7%)	1 (1.5%)	2 (2.1%)
Two drugs (not stated)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Isoniazid only	0 (0.0%)	6 (9.8%)	2 (7.4%)	4 (6.1%)	6 (6.4%)
Rifampicin only	1 (3.1%)	0 (0.0%)	0 (0.0%)	1 (1.5%)	1 (1.1%)
Three drugs (not stated)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Multi-drug	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
TOTAL	32 (100.0%)	61 (100.0%)	27 (100.0%)	66 (100.0%)	93 (100.1%)
DRUG RESISTANCE INFORMATION	2006-2010				TOTAL
	COUNTRY OF ORIGIN		SITE OF DISEASE		
	US-born	Foreign-born	Extra-pulmonary	Pulmonary	
No record/Unknown	3 (16.7%)	3 (7.9%)	2 (20.0%)	4 (8.7%)	6 (10.7%)
No drug resistance	13 (72.2%)	31 (81.6%)	7 (70.0%)	37 (80.4%)	44 (78.6%)
One drug (not stated)	0 (0.0%)	1 (2.6%)	0 (0.0%)	1 (2.2%)	1 (1.8%)
Two drugs (not stated)	1 (5.6%)	0 (0.0%)	1 (10.0%)	0 (0.0%)	1 (1.8%)
Isoniazid only	0 (0.0%)	1 (2.6%)	0 (6.1%)	1 (2.2%)	1 (1.8%)
Rifampicin only	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Three drugs (not stated)	1 (5.6%)	1 (2.6%)	0 (0.0%)	2 (4.3%)	2 (3.6%)
Multi-drug	0 (0.0%)	1 (2.6%)	0 (0.0%)	1 (2.2%)	1 (1.8%)
TOTAL	18 (100.0%)	38 (99.9%)	10 (100.0%)	46 (100.0%)	56 (100.0%)

Overall during 2001-2005, 66/93 or 71.0% of all TB cases showed no drug resistance; 9/93 or 9.7% showed resistance to one drug only; and there was no resistance to multiple drugs. Of the 9 cases that showed any drug resistance, 8/9 or 88.9% were foreign-born, and 6/9 or 66.7% were pulmonary cases. Of the 18 cases for which no information on drug resistance is documented, 14/18 or 77.8% completed therapy, 2/18 or 11.1% moved or discontinued therapy and 2/18 or 11.1% died (see **Table 38**).

During 2006-2010, 44/56 or 78.6% of all TB cases showed no drug resistance; 2/56 or 3.6% showed resistance to one drug only; and 4/56 or 7.1% showed resistance to two or more drugs. Of the 6 cases

where there was any drug resistance, 2/6 or 33.3% were US-born and 4/6 or 66.7% foreign-born cases. Five of the 6 cases (83.3%) were pulmonary TB cases. Of the 6 cases for which no information on drug resistance is documented, 3/6 or 50.0% completed therapy, none died, 2/6 or 33.3% moved or discontinued therapy and 1/6 or 16.7% have on-going treatment (see **Table 38**).

For the period of review (2001-2010) 12 of the 99 foreign-born TB cases (12.1%) had *M. tuberculosis* organisms that showed some degree of drug resistance, compared to 3/50 or 6.0% of US-born cases (**Table 37**). Overall, 11 of the 15 (or 73.3%) cases with some degree of drug resistance were pulmonary tuberculosis cases.

The outcome of therapy of TB cases based on their drug resistance information is shown in **Table 38**.

Table 38: Drug Resistance Information by Outcome of Therapy, 2001-2010

2001-2005					
DRUG RESISTANCE INFORMATION	OUTCOME OF THERAPY				TOTAL
	Completed	Died	Discontinued/Moved	On-going	
No record/Unknown	14	2	2	0	18
No drug resistance	50	12	4	0	66
One drug (not stated)	2	0	0	0	2
Isoniazid only	5	0	1	0	6
Rifampicin only	1	0	0	0	1
Three drugs (not stated)	0	0	0	0	0
Multi-drug	0	0	0	0	0
TOTAL	72	14	7	0	93
2006-2010					
DRUG RESISTANCE INFORMATION	OUTCOME OF THERAPY				TOTAL
	Completed	Died	Discontinued/Moved	On-going	
No record/Unknown	3	0	2	1	6
No drug resistance	22	9	7	6	44
One drug (not stated)	0	0	1	0	1
Two drugs (not stated)	0	1	0	0	1
Isoniazid only	0	0	0	1	1
Rifampicin only	0	0	0	0	0
Three drugs (not stated)	1	1	0	0	2
Multi-drug	1	0	0	0	1
TOTAL	27	11	10	8	56

For the entire period 2001-2010, among the 110 clients with no drug resistance, 72/110 or 65.5% completed therapy, 21/110 or 19.1% had died and 11/110 or 10.0% discontinued or moved out of the jurisdiction of the Macomb County Health Department. Six clients have on-going treatment.

Of the 11 clients with resistance to one drug (*includes "not stated", isoniazid or rifampicin*), 8 or 72.7% completed therapy and 2 or 18.2% moved or discontinued and 1 has on-going treatment.

Of the 4 clients with resistance to more than one drug, 2 completed therapy, 1 died and one has therapy on-going at the end of the period of this report (see **Table 38**).

OTHER CLINICAL INFORMATION

The major sites of disease in 2000-2005 were pulmonary (66/93 or 71.0%) and lymphatic (10/93 or 10.8%). The most frequent among the remaining 17 or 15.9% were pleural = 5 cases and peritoneal = 3 cases. A Chest X-ray was done in 88/93 or 94.6% of cases. Abnormal CXR results were reported in 74/88 or 84.1% of those x-rayed. Sputum smears for microscopy were done for 60/93 or 64.5% of cases; 28/60 or 46.7% of these cases had a positive smear. A culture was completed for 87/93 or 93.5% of cases and 76/87 or 87.4% were reported as positive. A positive PPD skin test was recorded for 38/93 or 40.9% of all cases (see **Table 39**).

Table 39: Clinical and Diagnostic Information for Macomb County TB cases by Origin of Birth, 1996-2010

CLINICAL & DIAGNOSTIC INFORMATION <i>* Refers to "Unknown" Category</i>	1996-2000				2001-2005				2006-2010			
	US	Foreign	N	%	US	Foreign	N	%	US	Foreign	N	%
Disease Site												
Pulmonary	41	27	68+1*	78.4	27	39	66	71.0	16	30	46	82.1
Extra-pulmonary	4	13	17+2*	21.6	5	22	27	29.0	2	8	10	17.9
Total	45	40	88	100.0	32	61	93	100.0	18	38	56	100.0
X-ray done												
Yes	43	35	78+2*	90.9	31	57	88	94.6	16	36	52	92.9
No	0	3	3	3.4	1	4	5	5.4	2	2	4	7.1
Unknown	2	2	4+1*	5.7	0	0	0	0.0	0	0	0	0.0
Total	45	40	88	100.0	32	61	93	100.0	18	38	56	100.0
X-ray Results	(N=80)				(N=88)				(N=52)			
Abnormal	40	26	66+1*	83.8	27	47	74	84.1	14	30	44	84.6
Normal	3	9	12+1*	16.2	4	10	14	15.9	2	6	8	15.4
Total	43	35	80	100.0	31	57	88	100.0	16	36	52	100.0
Smear Done												
Yes	39	28	67+1*	77.3	24	36	60	64.5	14	28	42	75.0
No	5	10	15+1*	18.2	5	22	27	29.0	3	10	13	23.2
Unknown	1	2	3+1*	4.5	3	3	6	6.5	1	0	1	1.8
Total	45	40	88	100.0	32	61	93	100.0	18	38	56	100.0
Smear Results	(N=68)				(N=60)				(N=42)			
Positive	27	15	42	61.8	12	16	28	46.7	8	17	25	59.5
Negative	11	13	24+1*	36.8	12	20	32	53.3	6	10	16	40.5
Unknown	1	0	1	1.5	0	0	0	0.0	0	1	1	0.0
Total	39	28	68	100.1	24	36	60	100.0	14	28	42	100.0
Culture Done												
Yes	42	36	78+3	92.0	30	57	87	93.5	17	36	53	94.6
No	3	4	7	8.0	2	4	6	6.5	1	2	3	5.4
Total	45	40	88	100.0	32	61	93	100.0	18	38	56	100.0
Culture Results	(N=81)				(N=87)				(N=53)			
Positive	36	33	69+3*	88.9	26	50	76	87.4	15	34	49	92.5
Negative	3	2	5	6.2	4	7	11	12.6	2	1	3	5.7
Unknown	2	0	2	2.5	0	0	0	0.0	0	0	0	0.0
M. avium or gordonae	1	1	2	2.5	0	0	0	0.0	0	1	1	1.9
Total	42	36	81	100.0	30	57	87	100.0	17	36	53	100.1
PPD Results												
Not done/Unk	18	15	33+2*	39.8	13	15	28	30.1	5	14	19	33.9
Positive	19	22	41	46.6	11	27	38	40.9	4	12	16	28.6
Negative	8	3	11+1*	13.6	5	8	13	14.0	6	7	13	23.2
Past Positive PPD	-	-	0	0.0	1	9	10	10.8	3	5	8	14.3
Anergic	-	-	0	0.0	2	2	4	4.3	0	0	0	0.0
Total	45	40	88	100.0	32	61	93	100.1	18	38	56	100.0
DOT												
Yes	10	7	17	19.3	13	24	37	39.8	10	21	31	55.4
No	17	22	39+2*	46.6	8	11	19	20.4	6	14	20	35.7
N/A or No Record	18	11	29+1*	34.1	11	26	37	39.8	2	3	5	8.9
Total	45	40	88	100.0	32	61	93	100.0	18	38	56	100.0

The major sites of disease in 2006-2010 were pulmonary (46/56 or 82.1%) and lymphatic (4/56 or 7.1%). The most frequent among the remaining 6 were meningeal = 2 cases and genitourinary = 2 cases. A Chest X-ray was done in 52/56 or 92.9% of cases. Abnormal results from the CXR were reported in 44/52 or 84.6% of those x-rayed. Sputum smears for microscopy were done for 42/56 or 75.0% of cases; 25/42 or 59.5% of these cases had a positive smear. A culture was completed for 53/56 or 94.6% of cases and 50/53 or 94.3% were reported as positive. A positive PPD skin test was recorded for 16/56 or 28.6% of all cases (see **Table 39**).

APPENDIX I

Macomb County, Foreign-born Tuberculosis Cases - Duration of US Residence and Age at Diagnosis, by Geographic Origin, 1996-2000

1996-2000		Years in US Before Referred to MCHD, n (%)				Age at Immigration				Age at Diagnosis	
Region of Birth	# Cases	≤ 1	1-5	6-10	>10	0-14	15-24	25-44	45+	Mean	Range
East Asia	5	0 (0.0)	2 (40.0)	0 (0.0)	2 (40.0)	0	1	2	1	55	33, 78
Caribbean	1	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0	1	0	0	49	49, 49
Western Europe	4	0 (0.0)	0 (0.0)	0 (0.0)	4 (100.0)	2	2	0	0	48	18, 88
Indian Sub-continent	14	2 (14.3)	4 (28.6)	4 (28.6)	4 (28.6)	0	3	7	4	46	25, 86
Middle East	1	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0	1	0	0	30	30, 30
SE Asia	11	1 (9.1)	1 (9.1)	5 (45.5)	3 (27.3)	0	4	2	4	71	48, 81
Eastern Europe	4	0 (0.0)	2 (40.0)	0 (0.0)	2 (50.0)	0	0	2	2	50	37, 70
TOTAL	40	3 (7.5)	9 (22.5)	9 (22.5)	17 (42.5)	2	12	13	11	52	18, 88

Years in US not available for 2 cases.

Source: Report entitled "Tuberculosis in Macomb County, Michigan 1996-2000".

Macomb County, Foreign-born Tuberculosis Cases - Duration of US Residence and Age at Diagnosis, by Geographic Origin, 2001-2005

2001-2005		Years in US Before Referred to MCHD, n (%)				Age at Diagnosis					
Region of Birth	# Cases	≤ 1	1-5	6-10	>10	0-14	15-24	25-44	45+	Mean	Range
East Asia	5	0 (0.0)	2 (40.0)	1 (20.0)	3 (60.0)	0	0	2	3	46.8	32, 66
Americas	4	0 (0.0)	1 (25.0)	1 (25.0)	2 (50.0)	1	0	2	1	40.5	4, 92
Western Europe	1	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0	0	0	1	76.0	76
Indian Sub-continent	18	0 (0.0)	9 (50.0)	3 (16.7)	6 (33.3)	0	4	9	5	38.7	18, 76
Middle East	4	0 (0.0)	3 (75.0)	0 (0.0)	1 (25.0)	1	0	0	3	52.0	13, 88
SE Asia	18	6 (33.3)	2 (11.1)	2 (11.1)	9 (50.0)	0	0	6	12	52.8	29, 73
Eastern Europe	7	0 (0.0)	2 (28.6)	0 (0.0)	5 (71.4)	0	1	0	6	62.4	20, 85
Africa	2	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	0	0	2	0	33.0	29, 37
Unknown	2*	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0	0	0	2	65.0	56, 74
TOTAL	61	6 (9.8)	21 (34.4)	7 (11.5)	27 (47.5)	2	5	21	33	48.5	4, 92

** Years in US & Geographic Origin not available for 2 cases.*

Macomb County, Foreign-born Tuberculosis Cases - Duration of US Residence and Age at Diagnosis, by Geographic Origin, 2006-2010

2006-2010		Years in US Before Referred to MCHD, n (%)				Age at Diagnosis					
Region of Birth	# Cases	≤ 1	1-5	6-10	>10	0-14	15-24	25-44	45+	Mean	Range
East Asia	3	0 (0.0)	0 (0.0)	0 (0.0)	3 (100.0)	0	0	0	3	68.7	64, 76
Americas	3	0 (0.0)	1 (33.3)	1 (33.3)	1 (33.3)	0	2	1	0	26.7	16, 43
Western Europe	2	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0	0	0	2	85.0	81, 89
Indian Sub-continent	9	0 (0.0)	2 (22.2)	1 (11.1)	6 (66.7)	0	1	1	7	58.0	23, 86
Middle East	4	0 (0.0)	3 (75.0)	0 (0.0)	1 (25.0)	0	0	2	2	42.8	31, 63
SE Asia	10	2 (20.0)	1 (10.0)	2 (20.0)	5 (50.0)	0	1	3	6	54.0	22, 84
Eastern Europe	5	1 (20.0)	1 (20.0)	0 (0.0)	3 (60.0)	0	0	0	5	69.4	64, 80
Africa	2	0 (0.0)	0 (0.0)	1 (50.0)	1 (50.0)	0	0	2	0	30.0	27, 33
Unknown	0	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0	0	0	0	-	-
TOTAL	38	3 (7.9)	8 (21.1)	5 (13.2)	22 (57.9)	0	4	9	25	55.2	16, 89

GEOGRAPHIC REGIONS:

East Asia: China, Korea.

Southeast Asia: Philippines, Vietnam, Laos, Malaysia, Thailand, Indonesia

Western Europe: Germany, Italy

Eastern Europe: Poland, Ukraine, Yugoslavia, Lithuania, Belarus, Estonia, Romania, Croatia, Serbia, Kosovo, Bosnia & Herzegovina, Albania

Indian Sub-continent: India, Pakistan, Bangladesh

Caribbean: Cuba

Americas: Mexico, Venezuela, Canada

Middle East: Iraq,

Africa: Senegal, Kenya, Malawi