

**Tuberculosis Among Foreign-born in Multnomah County  
1990-1996**

by  
Peyton D. Willert

A THESIS

Presented to the Department of Public Health and Preventive Medicine

and the Oregon Health Sciences University

in partial fulfillment of

the requirements for the degree of

Master of Public Health

August 1999

School of Medicine  
Oregon Health Sciences University

CERTIFICATE OF APPROVAL

This is to certify that the M.P.H. thesis of  
Peyton D. Willert  
has been approved

[Redacted]

Professor in charge of thesis ()

[Redacted]

[Redacted]

Member

---

Associate Dean for Graduate Studies

## TABLE OF CONTENTS

<u>Section</u>	<u>Page(s)</u>
Acknowledgments	ii
Abstract	iii
Introduction	1-4
Background	5-11
Methods	12-14
Results	15-21
Discussion	22-25
References	26-28
Appendix A	29
Appendix B	30
Appendix C	31

## **ACKNOWLEDGEMENTS**

I would like to thank Dr. Katrina Hedberg and Dr. Hanyu Ni who have provided me with tremendous support and have stood by me since the beginning. I would also like thank Dr. Mark Loveless who so willingly agreed to be a part of my committee at the final hour. A final thank you is given to the Tuberculosis Management Clinic of the Multnomah County Health Department who graciously opened their door to this study.

## ABSTRACT

The number of cases of tuberculosis (TB) in foreign-born persons in the United States (US) during 1995 was 8,042, 36% of the national total. Current screening practices may be missing opportunities for prevention in this population.

*Objectives:* This study reviews the epidemiology of foreign-born in Multnomah County, Oregon from 1990-1996, and enumerates the cases of TB in foreign-born that could have been prevented based on current US screening guidelines.

*Methods:* All foreign-born cases (235) of TB diagnosed in Multnomah County between 1990-1996 were selected from the Oregon Health Division TB Case Registry. Medical records reviews were performed to determine preventability status for each case.

*Results:* The mean annual rate for foreign-born cases was almost twelve times the rate in US born cases; 82/100,000 and 7/100,000 respectively. Most cases originated from Southeast Asia (50%) and Central America (17%). Overall, cases were diagnosed before 6 months (33%) and 5 years (38%) after arrival to the US. Of the 111 cases (47%) who were determined to be preventable, 64 (27%) did not receive screening upon arrival in the US and would have been eligible for preventive therapy, 29 (12%) did not receive adequate treatment, 6 (3%) did not have preventive therapy prescribed despite indications, and 12 (5%) missed other opportunities for prevention despite indications.

*Conclusions:* Foreign-born TB morbidity could be reduced if prevention strategies were fully practiced. Due to the large number of cases that were diagnosed within a short time of arrival to the US, increased efforts should be made for prompt evaluation of new immigrants and refugees.

## INTRODUCTION

From 1985 through 1993 the number of cases of tuberculosis (TB) in the United States (US) rose from 22,201 to a high of 25,313--a 14% increase. Four main factors have been identified as contributing to the increase: 1) the coincident HIV/AIDS epidemic; 2) immigration from countries where there is a high prevalence of TB; 3) transmission of TB in congregate settings such as prisons and nursing homes; and 4) a reduction in TB control funding.<sup>1</sup> In response to this increase, TB control efforts were sharpened. By 1996, 21,327 cases of TB were reported in the United States. This represented a decrease of approximately 7% since 1995--the fourth consecutive year that the number of TB cases has decreased.<sup>2</sup> However, while the overall number of cases has begun to decline, increases are still being observed in foreign-born populations. Nationally, foreign-born TB cases increased from 4,925 cases (22%) in 1989 to 7627 cases (32%) in 1994.<sup>3</sup> By 1995, foreign-born cases represented 36% (8,042 cases) of the national total.<sup>4</sup>

Similar to the national trend, the proportion of TB cases occurring in foreign-born in Oregon is increasing. From 1990-1996, a total of 1102 cases of TB were reported in Oregon. In 1990, 32% (48 cases) of cases were among the foreign-born, increasing to 51% (96 cases) in 1996.<sup>5</sup> In Multnomah County, Oregon's largest county (which includes the city of Portland)<sup>6</sup>, 48% (235 cases) of cases reported during 1991-1996 were among foreign born.<sup>5</sup> With the increasing proportion of TB disease among foreign-born, it is important to identify effective screening strategies for prevention in this population.

TB is caused by the bacterium *Mycobacterium tuberculosis*. TB is spread when a person with active TB disease coughs or sneezes, expelling droplet nuclei containing *M.tuberculosis* into the air. If another person inhales the air containing *M.tuberculosis*, transmission may occur. If transmission occurs, the *M.tuberculosis* begins to multiply in

the body. For most individuals (90%), the multiplication and spread of the *M.tuberculosis* is halted by the immune system shortly after transmission and remains latent in the body. This latent stage is frequently referred to as “TB infection”. Individuals having TB infection are not infectious and do not have any symptoms of illness. For the remaining 10% in whom transmission occurred, TB infection progresses to “active TB” disease (TB). Individuals with active disease are infectious and have symptoms of illness. Progression of infection to disease can occur shortly after transmission, many years after infection, or may never occur. For healthy persons, the probability of developing TB disease from latent TB infection has been estimated as 5% within the first 2 years after infection, and an additional 5% over the rest of an individual's lifetime. <sup>1</sup>

Three groups have been involved in the establishment of guidelines for the prevention, diagnosis and treatment of TB in the US. The Advisory Council for the Elimination of Tuberculosis (ACET) provides recommendations on the basic strategy for TB elimination in the US, the American Thoracic Society (ATS) has published guidelines for diagnosis and treatment of TB infection and disease, and the Centers for Disease Control and Prevention (CDC) oversees and coordinates these activities. The ACET recommends that state and local health departments follow a three-tiered approach to TB elimination. First, identify and treat active cases of TB. Second, screen and treat contacts to cases, and third, screen high-risk populations to detect persons who have TB infection and who would benefit from isoniazid preventive therapy (IPT). <sup>7</sup> The CDC has identified the groups of people at high risk, and recommends that they be screened for TB and TB infection. Foreign-born persons are among those at highest risk. (See Appendix A for a full list of those identified by the CDC to be at risk.)

Screening for TB infection is done with the Mantoux method tuberculin skin test (TST).

The TST is performed by a health care worker who injects 0.1 ml of purified protein derivative (PPD) tuberculin containing 5 tuberculin units into either the volar or dorsal surface of the forearm. Reaction, or absence of a reaction, to the test should be evaluated by a health care worker between 48 and 72 hours after the PPD injection. A positive reaction is based on the determined degree of risk. For foreign-born persons, a reaction  $\geq 10$ mm is considered a positive, while for others (i.e., HIV positive)  $\geq 5$ mm is positive. For patients with a confirmed positive PPD reaction, an additional medical evaluation consisting of a complete medical history, physical exam, chest radiograph and bacteriologic exam is necessary to rule out the possibility of active TB.<sup>8</sup>

Antibiotic treatment is available and recommended for individuals found to have active TB or TB infection. The ATS, in collaboration with the CDC, has established the US guidelines for treatment of TB and TB infection in adults and children. According to the guidelines, preventive therapy for TB infection is generally recommended for all persons 35 years of age or younger. However, some persons should be considered for preventive therapy regardless of age. These persons include: HIV positive, close contacts of a person with infectious TB disease, injection drug users, at risk medical conditions, and persons who have developed a positive TST within two years of a documented negative TST. All persons diagnosed with active TB should be placed on an ATS recommended course of antibiotic treatment for 6-9 months (Appendix B). The ATS/CDC treatment guidelines are recognized as the standard for TB treatment in the US. Treatment regimens that do not follow the ATS/CDC guidelines can result in inadequate treatment.<sup>9</sup>

While standard screening and treatment guidelines have been established, little research has been done to assess how many cases of active TB are potentially preventable based on these screening strategies. In addition, more attention needs to be placed on prevention strategies for foreign-born as the rate of disease within this risk group



continues to increase. Recent research has emphasized the need for TB control programs to, "...conduct epidemiologic studies to help identify strategies to decrease the number of TB cases in foreign-born." <sup>10</sup> This study attempts to respond to this need. Objectives of the study are: 1) to review the epidemiology of TB among foreign-born cases in Multnomah County Oregon from 1990-1996; and 2) determine how many foreign-born TB cases were potentially preventable based on their screening history.

## BACKGROUND

In 1986, the CDC began collecting information on place of birth for reported cases of TB in the US. However, it was not until recently that researchers began to take closer look at this information to assist them with forming strategies for TB prevention and control.

In 1995, McKenna and colleagues published the first study that reviewed effects of immigration on the epidemiology of foreign-born in the US from 1986 to 1993. In this time period, the percent of overall TB cases that occurred in foreign-born increased substantially from 21.6% (4925 cases) in 1986 to 29.6% (7346 cases) in 1993. The majority of cases were from Latin America (43.9%), followed by Southeast (SE) Asians (34.6%). The overall case rate among foreign-born US residents (30.6/100,000) was found to be 4 times greater than native born US residents (8.1/100,000). Also of special importance was the finding that 55% of immigrants were diagnosed with TB within the first 5 years from the date of their arrival in the US, suggesting that many had arrived in the US with active TB. The study by McKenna and colleagues provides a valuable profile of foreign born TB cases in the US as well as emphasizes the need for better TB control efforts of immigrants and refugees both in the US and in the country of origin.<sup>11</sup>

Since 1993, cases of TB in the US have been declining. However, in a study published by McCray and colleagues in 1997 the decline in cases is occurring only in US born. Cases among foreign-born continue to increase. McCray and colleagues cite several factors as contributing to the increase: “prevalence of TB in the country of origin, duration of residence in the US after immigration, inadequate screening for or treatment of TB before entering the US, and inadequate follow-up of those who have entered the US with noninfectious TB.”<sup>12</sup> Similar findings were observed in another study published by McKenna in 1998.<sup>13</sup>

To appreciate better the factors that influence TB among foreign-born in the US, it is necessary to understand the overseas screening process. By US law all immigrants and refugees must undergo a medical evaluation before entering the US. The purpose of the medical screening process is to exclude persons with communicable diseases of public health significance, persons with physical or mental disorders associated with harmful behavior, persons who abuse drugs or are addicted to drugs, or persons who are likely to become a ward of the state.<sup>14</sup> TB is considered a disease of public health significance and persons diagnosed with active disease can be excluded from immigrating to the US. The overseas medical evaluation is performed by an appointed physician in the country of origin of the immigrant or refugee, and may be completed up to one year before the applicant immigrates.

The purpose of the TB screening portion of the overseas medical evaluation is to identify cases of active (therefore infectious) TB disease. The TB evaluation consists of a chest radiograph for all persons 15 years of age or older, and three sputum specimens for microscopic examination if the radiograph is suggestive of TB disease. It should be noted that because the tuberculin skin test (TST) is used for identifying TB *infection* (which is not considered an excludable condition), the TST is not a required part of the overseas medical evaluation. Persons with chest radiographs suggestive of active or old TB are classified into three groups: 1) Class A, x-ray and sputum suggest active TB; 2) Class B-1, x-ray suggestive of active TB but sputum negative; and 3) Class B-2, x-ray suggestive of old healed TB. For a full description of the classes please see Appendix C. Persons with Class A TB may only enter the US after completing a full course of TB treatment and received three consecutive negative sputum smears, or they may receive treatment until they are negative and apply for a waiver to the US. Waivers are granted under very special circumstances and allow an applicant to finish their TB therapy under

the direct supervision of a physician and/or local health department in the US.

Individuals with Class A waivers can be deported if they do not adhere to the treatment regimen specified in their waiver.<sup>15</sup> Persons classified as B1 and B2 are considered non-infectious and may enter the US without a waiver, but are encouraged to report to the local health department at their destination in the US to receive an additional TB evaluation. State health departments are notified by the Centers for Disease Control and Prevention about Class B immigrants and refugees entering their state. The state health department notifies the appropriate local health departments who then attempt to locate and provide TB follow-up to the Class B individual.<sup>16</sup> Because Class B individuals have been identified prior to their arrival in the US as having an increased risk for TB disease, follow-up by the local health department is an ideal opportunity for TB prevention. However, immigrants who do not enter the US through the legal immigration process do not receive an overseas medical evaluation.

Recently, several studies have been performed to review the epidemiology of TB in foreign-born and assess how the overseas screening process influences the number of foreign-born cases in the US. In 1995, the CDC reviewed foreign-born cases of TB in Hawaii from 1992-1993, and Los Angeles County for 1993. The study assessed the impact of screening on the identification of TB among foreign-born persons residing in the US for  $\leq 1$  year. This report represents the first review of the screening process for immigrants and refugees since the US Public Health Service changed the classification system in 1991. Hawaii and Los Angeles County were chosen because the proportion of foreign-born cases exceeded that for US-born cases; 82% (429 cases) and 64%(1228 cases) respectively. Significant differences were observed between the two locations when the researchers looked at the number of cases diagnosed with TB within one year of arrival in the US. In Hawaii, 61% (261 cases) were diagnosed within one year of arrival to the US, but in Los Angeles County, only 21% (261 cases) were diagnosed within one

year of arrival. The study also looked at cases that had been classified as B1 or B2 prior to arrival. Interestingly, the proportion of cases who were classified as B1 or B2 at the overseas screening, and were diagnosed within one year in the US, were similar for both areas. In Hawaii, 30% were B1 and 7% were B2. In LA 25% were B1 and 11% were B2. The proportion of cases for whom the Class B condition was unknown was 64% in both locations. While the proportion of B1 and B2 cases appears to be similar for both areas, the study reveals differences in demographic characteristics between the two groups. In the Hawaiian group, approximately half of the cases were World War II veterans from the Philippines who were exempted from overseas medical screening prior to their immigration to the US. In Los Angeles County, immigrants from Central America and Mexico represented the largest proportion of the cases, and of them, only 3% had received a known medical screening before entering the US. Identification of these two large groups of cases suggests that they may have been detected earlier or prevented if they had received overseas screening. The report suggests that modifications to the overseas screening process, coupled with TB control programs conducting epidemiologic studies of their foreign born populations, could prove beneficial to prevention efforts.<sup>17</sup>

In 1995, Zuber and colleagues from the Division of TB Elimination at the CDC investigated the screening and diagnostic outcomes of immigrants and refugees in Hawaii from 1992 to 1993. The study evaluated 124 cases that were diagnosed within one year of arrival. Of these, 14% had been classified as B1 and 23% as B2. This study expanded on previous work and tried to identify risk factors that predicted culture-confirmed TB cases upon arrival in the US. The proportion of culture-confirmed cases among class B1s and B2s was 56%.<sup>10</sup> (Nationally, 74% of foreign-born cases are culture-confirmed compared to 82% of US-born cases<sup>18</sup>). A positive skin test was found to have the highest odds (**OR:10.7; 95% CI:1.4-80.1**) for predicting culture confirmed TB, followed by the

age group 15-19 years (**OR:4.8; 95% CI:1.5-15.4**). These results underscore the need for timely and efficient screening of immigrants and refugees identified as Class B by the overseas screening process.<sup>10</sup>

A second study published by Zuber and colleagues in 1995 reviewed the epidemiology and screening practices of immigrants and refugees in Los Angeles County from 1992 to 1994. Most cases were from Mexico and Central America (1425 cases), but the greatest standardized annual incidence was among cases from the Philippines and Vietnam; 135/100,000 and 187.3/100,000 respectively. Further, 41% of cases from Mexico and Central America were diagnosed with TB five years or more after arrival in the US, but 38% of the cases from SE Asia were diagnosed within one year.<sup>19</sup> Like the report by the CDC in 1995,<sup>17</sup> these results reinforce the observation that the overseas medical evaluation is effective for screening SE Asians, but is not as effective for screening persons from Mexico and Central America. Because the characteristics and screening history of persons from SE Asia and Mexico/Central America appear to be different, this study also recommends that TB programs conduct similar studies in order to adopt effective programs to reduce TB cases.<sup>19</sup>

In 1996, Wells and colleagues, also from the Division of TB Elimination at the CDC, performed a study on the prevention of TB among foreign-born in King County (Seattle), Washington. The first objective of the study was similar to the studies performed by Zuber et. al.<sup>10,19</sup> in that the authors were interested in evaluating the outcomes of classified immigrant and refugee screening. The study by Wells et. al. had the additional objective to evaluate the outcomes of case contact investigation for foreign-born cases. From January 1992 to September 1994, 84% (1086 cases) of class B1 and B2 immigrants received a TB evaluation by a Seattle-King County clinic. Seventy-six percent of Class B1s and 72% of Class B2s were found to have a positive skin test. Only 5% of the

subjects were found to be TB suspects and placed on therapy for disease, while 34% were found to be eligible for preventive therapy. Review of the contact investigation revealed a significant difference between the number of foreign-born case contacts and US-born contacts; 6.0 vs. 3.4 per case,  $p=0.04$ .<sup>20</sup> This study further emphasizes the need for increasing US-based screening of new immigrants and refugees.

A study published in 1995 by McAnulty and colleagues in Oregon more specifically evaluated the effectiveness of the current US screening recommendations. In their study, all active cases of TB reported to the Oregon Health Division from July 1991 to June 1992 were evaluated to determine whether they had undergone preventive procedures in accordance with current ACET recommendations. Over one half (59%) of the 153 cases reviewed were determined to have missed an opportunity for prevention. Sixty-six cases (43%) should have received screening but did not, 10 (7%) failed to complete treatment for previously diagnosed TB, 2 (2%) did not complete a prescribed course of preventive therapy, and 12 (8%) had a previous positive skin test and were candidates for IPT, but never received it. Another interesting finding was that cases who were treated by a private health care provider were more likely to have missed opportunities for prevention than those cases treated through the public health system. Due to their discovery that the majority of cases could have been prevented if TB screening had been done according to the ACET recommendations, it is not surprising that McAnulty concluded by stressing the need for more research regarding the effectiveness of current screening strategies and guidelines.<sup>21</sup>

In 1998, DeReimer and associates published a study looking at the screening practices of Class A, B1 and B2 immigrants and refugees in San Francisco. Of 893 immigrants and refugees who immigrated between July 1992 and December 1993, 83.4% received a

follow-up medical evaluation in the US. Of these, 6.9% had active TB, and 39.7% were eligible for IPT. The study emphasizes the need for effective evaluation of Class A, B1, and B2 immigrants and refugees due to the large number in this population who are found to have TB, and an even greater number with TB infection that could potentially be prevented with the administration of IPT.<sup>22</sup>

The studies summarized above demonstrate that effectiveness of screening new immigrants can vary depending upon the country of origin, and that in many cases opportunities to prevent disease may have been missed either in the US or in the country of origin. These findings point to the utility of local TB control programs studying TB in local foreign-born populations as a means to focus their TB control effort.



## METHODS

### **Study Population:**

This study was conducted in Multnomah County, Oregon's largest county comprising of 20% of the state's population.<sup>6</sup> For this study we reviewed all cases of TB in foreign-born persons diagnosed in Multnomah County and reported to the Multnomah County Health Department between January 1, 1990 and December 31, 1996.

### **Case Definition:**

To be reported as a confirmed case of TB in Oregon, the case must meet the ATS diagnostic criteria for "clinically active" TB. Active cases must have at least clinical and/or radiographic evidence of TB.<sup>8</sup> For this study, a foreign-born active TB case was defined as any case of TB diagnosed in an individual whose country of origin was not the US.

### **Case Ascertainment**

Active TB cases in Oregon are reportable by law to the local health department by the diagnosing health care provider and/or any laboratory that identifies *M. tuberculosis* in human specimens. The local health department reports the cases to the Oregon Health Division (OHD) which maintains a comprehensive TB case registry on demographics, country of origin, diagnosis and treatment for all cases reported in Oregon from 1982 to present (OHD-TB database). All foreign-born cases diagnosed from 1990-1996 were identified using the OHD-TB database.

### **Preventability:**

The potential preventability of each case was assessed based on the recommendations of the ACET.<sup>7</sup> The case was considered preventable if: 1) the case did not receive TB

screening upon arrival in the US, but would have been IPT eligible at the time of arrival; 2) the case received inadequate treatment or follow-up failure in the US or in their country of origin; 3) in the past the case failed to take a course of IPT that was recommended by a health care provider; 4) a health care provider failed to prescribe IPT when appropriate; 5) the case failed to complete a course of therapy for active TB disease in the past; and 6) the case had never been screened for TB in the past despite medical risk factors in addition to their risk of being foreign-born. A case was considered to be *not preventable* if the elapsed time between the date of entry in the US and diagnosis of disease was too short for preventive screening strategies in the US to have been effective.

All factors of preventability were coded and hand tabulated using the data extracted from chart reviews. Cases having more than one factor of preventability were grouped to reveal common themes of preventability.

### **Chart Review**

Factors for determining the preventability of all foreign born cases were collected through chart review of the Multnomah County Tuberculosis Management Clinic (MCTBC) medical records and transcribed onto a data collection form. All cases of TB in Multnomah County are reported to the MCTBC, and most are referred to and managed by, the MCTBC. Data collected included: demographic information, date patient entered country, skin test history, presence of known medical risk factors, history of preventive therapy, and history of disease and treatment. Medical chart reviews were performed at the MCTBC and the Multnomah County archives department.

### **Data Analysis**

Frequency counts and cross tabulations were the primary statistical analyses performed in this study. Mean annual disease rates were calculated using the native (542,623) and

foreign-born (41,264) population estimates from the 1990 Census of Population for Multnomah County, Oregon.<sup>23</sup> A more current estimate of the population of foreign-born in Multnomah County was unavailable. Data processing was performed using Microsoft Access 2.0 for Windows, and Statistical Program for Social Scientists (SPSS) for Windows. All statistical analysis was performed using SPSS.

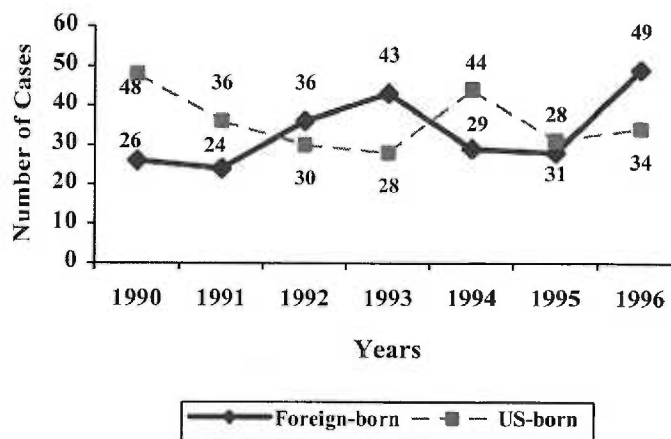
## RESULTS

### I. Epidemiology of Tuberculosis among Foreign-Born in Multnomah County

A total of 1102 cases of TB were reported to the OHD from 1990-1996; almost half of these (486 cases or 44%) in Multnomah County. Of the Multnomah County cases 48% (235) were among foreign-born. The mean annual rate for foreign-born TB cases in Multnomah County was almost twelve times the rate in US born cases (82/100,000 compared to 7/100,000<sup>23</sup>). During the years 1992 to 1993 and 1995-1996, the number of foreign-born cases exceeded US-born cases (Figure 1).

Figure 1.

Foreign-born and US-born TB Cases  
Multnomah County, 1990-1996



#### *Demographic characteristics of foreign-born cases:*

The number of foreign-born cases varied by world region of origin. Most foreign-born cases originated from Central America, SE Asia, and Eastern Europe (Table 1).

**Table 1.**  
**Foreign-born TB Cases by Age and Region of Origin**  
**Multnomah County, 1990-1996**

World Region of Origin	Cases (%)	Male/Female	Median Age (Min./Max.)
SE Asia	116(50)	58/58	33 (12/62)
Central America	39(17)	19/20	37 (7/85)
Eastern Europe	29 (12)	14/15	67 (15/91)
China and Hong Kong	15(6)	7/8	57 (19/80)
Africa	12 (5)	9/3	28 (17/73)
Japan and Korea	10 (4)	5/5	49 (24/92)
India	9 (4)	2/7	30 (23/66)
Other	5 (2)	1/4	67 (39/81)
Total	235 (100)	115/120	39 (7/92)

The median age overall for the period was 39 years, although it increased slightly from 37 years in 1990-1992 to 40 years in 1993-1996. The youngest cases were from India and Africa, while the oldest were from Eastern Europe (Table 1).

*Date of Arrival and Date of Diagnosis:*

For all foreign-born cases, 33% occurred during the first 6 months after arrival; however, 38% occurred 5 or more years after arrival. Time in the US until active TB diagnosis varied by country of origin. Whereas 42% of cases from SE Asia occurred within 6 months of arrival, 49% of cases in Central Americans and 52% in Eastern Europeans occurred 5 years after arrival (Table 2).

**Table 2.**  
**Distribution of TB Cases by Month/Year in US before Date of Diagnosis**  
**Multnomah County, 1990-1996**

Region of Origin	0-6 mos.	>6mos.-2yrs.	>2yrs.-5yrs.	>5yrs.	Total (%)
Central America (a)	10 (27)	3 (8)	6 (16)	18 (49)	37 (100)
SE Asia (b)	48 (42)	11 (10)	19 (17)	36 (31)	114 (100)
China/Hong Kong	2 (13)	1 (7)	4 (27)	8 (53)	15 (100)
Japan/Korea (c)	1 (11)	2 (22)	3 (33)	3 (33)	9 (100)
Eastern Europe	8 (27)	4 (14)	2 (7)	15 (52)	29 (100)
India	4 (44)	1 (11)	3 (33)	1 (11)	9 (100)
Africa	1 (8)	4 (33)	4 (33)	3 (25)	12 (100)
Other	1 (20)	0 (0)	0 (0)	4 (80)	5 (100)
Total/months	75 (33)	26 (11)	41 (18)	88 (38)	230 (100)

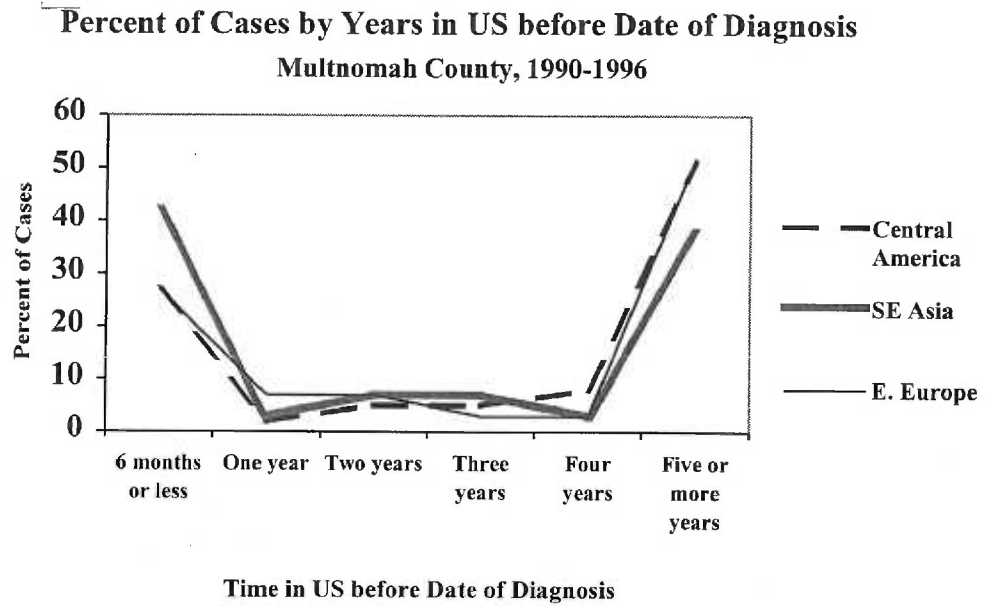
(a) Date of entry was unknown for 2 cases.

(b) Date of entry was unknown for 2 cases.

(c) Date of entry was unknown for 1 case.

Figure 2 illustrates the percent of cases diagnosed from 6 months to 5 years after arrival by SE Asia, Central America and Eastern Europe. As reported in Table 2, the majority of cases were diagnosed within 6 months of arrival (33%), but between 6 months to 1 year the proportion drops sharply to 4%. The date of entry was unknown for 5 cases.

Figure 2.



*Tuberculin skin test (TST) history:*

According to the medical chart reviews, 79 cases (34%) had received a TST before their date of diagnosis of disease; of these, 58 (73%) were positive and 21 (27%) were negative. However, for 108 cases (46%), the first known positive TST was at the date of their TB diagnosis. TST screening history was unavailable or unclear in the medical charts for 48 cases (20%).

*Class B status:*

Medical chart reviews revealed that 46 cases (20%) had been classified as B1 or B2 before entering the US. Of these, 39 cases (85%) were diagnosed with TB within 6 months of arrival, 2 cases (4%) within 1 year, and 4 cases (9%) within 3 years or more. Date of entry in the US was unknown for one case.

## II. Preventability

Chart reviews to identify preventability factors were completed for 212 (90%) of the 235 reported cases to OHD. Table 3 shows cases by preventability status.

Overall, 111 (47%) of cases were preventable. Of the cases that were determined to be preventable, two main groups emerged. In the first, 64 (27%) had no known screening upon arrival in the US. Cases making up this group included: cases with no history of a TB evaluation at the time of entry in the US and may have been IPT eligible, cases with additional at-risk medical conditions but had no history of a TB evaluation at the time of entry; and cases who entered the country as a student or visitor and received no overseas TB evaluation prior to leaving their country of origin or upon entry in the US. The second group, 29 cases (12%), included those cases that received inadequate TB therapy for known disease. This group included cases that had a history of taking IPT but the chart noted that it was probably inadequate, cases that were inadequately treated for TB disease in the past, IPT was recommended to the patient but they never took it, and cases that had a positive skin test and/or abnormal chest x-ray but no follow-up with the patient was noted in the chart. Known preventability for the remaining cases fell into two smaller groups. Six cases (3%) should have had IPT prescribed for a positive skin test or additional risk factors, and 12 cases (5%) had multiple preventability factors. For 12 cases (5%) there was not adequate information to determine their preventability. Many of the cases in this group were managed by a primary care physician outside of the MCTBC and little information was available.

Almost half the cases (48%) were determined to be *not* preventable. Cases that fell into this group included: cases that arrived in the US with active TB disease; patients who moved to Multnomah county after their date of entry in the US; patients with a history of a negative PPD; cases found through contact investigation; cases who would not have



been IPT eligible at their date of entry and/or screening; cases who were discovered within 9 months of their date of entry and most likely arrived in the US with active TB disease.

**Table 3.**

**Screening Practices Related to TB Prevention Factors  
Multnomah County, 1990-1996**

<b>Prevention Factor</b>	<b>Cases (%)</b>
<b>Preventable</b>	111(47)
No screening upon arrival, IPT eligible	64(27)
Inadequate treatment	29(12)
IPT not prescribed despite indications	6(3)
Other	12(5)
Unknown	12(5)
<b>Not Preventable</b>	112(48)
<b>Total</b>	235(100)

Within the preventability factors, differences were observed among world region of origin. Of the cases who were determined to be preventable, the majority (41%) were SE Asians, followed by Central Americans (27%) and the fewest were from India (3%). Of those cases determined to be not preventable, again SE Asians made up the largest proportion (61%), followed by Eastern Europeans (15%), and fewest were from Japan/Korea and Africa (3%). By region, the majority of cases from Central America (77%) were determined to be preventable, whereas the majority of cases from SE Asia (58%) and Eastern Europe (59%) were not preventable (Table 4).

Table 4.

TB Preventability Factors by Country of Region of Origin

	Preventable cases* (% down) [% across]	Not preventable cases (% down) [% across]	Preventability of case unknown (% down) [% across]	Total
Central America	30 (27) [77]	8 (7) [20]	1(8) [3]	39 [100]
SE Asia	46 (41) [40]	68 (61) [58]	2(17) [2]	116 [100]
China, Hong Kong	9 (8) [60]	5 (4) [33]	1(8) [7]	15 [100]
Japan, Korea	5 (5) [50]	3 (3) [30]	2(17) [20]	10 [100]
Eastern Europe	8 (7) [27]	17 (15) [59]	4(33) [14]	29 [ 100]
India	3 (3) [33]	6 (5) [67]	0	9 [100]
Africa	7 (6) [64]	3 (3) [27]	1(8) [9]	11 [100]
Other Countries	3 (3) [50]	2 (2) [33]	1(8) [17]	6 [100]
<b>Total</b>	<b>111 (100)</b>	<b>112 (100)</b>	<b>12(99)</b>	<b>235</b>

\*Includes all factors.

## DISCUSSION

This study demonstrates that the epidemiology of foreign-born TB cases in Multnomah County for 1990-1996 closely mirrors national and regional trends that show an increase in the proportion of foreign-born cases.<sup>10-13,19,26</sup> The majority of cases in our study are from SE Asia and Latin America, which is not remarkable given that Mexico and Vietnam are among those countries with frequent immigration to the US.<sup>24</sup> Most cases were diagnosed within 6 months (33%), or more than five years (38%), after arrival in the US--a pattern which has been observed in recent regional studies.<sup>10-11, 17,25</sup> For those that were diagnosed with disease within 6 months, it is likely that the majority arrived in the US with disease rather than developed it within the first few months of living in the US. However, those that developed disease 5 years or more after arrival either arrived in the US with TB infection which later progressed to disease, or acquired TB infection in the US. The epidemiology of foreign-born cases in Multnomah County highlights the need for prevention efforts to be specifically designed for, and targeted to, these high-risk populations in order to be effective.

Assessment of the preventability factors revealed three main conclusions; 1) one-fourth (27%) of the cases could have been prevented had they received screening upon arrival, 2) 12% could have been prevented had they received adequate treatment (in accordance with ATS guidelines) for TB infection and/or disease, and 3) overseas screening needs to be improved due to the large number of cases most likely arriving in the US with disease (48%).

The 27% (64 cases) who did not receive screening upon arrival in the US would have been IPT eligible if they had had a positive TST. Both this study and the one by McNulty et.al.<sup>21</sup> which looked at TB cases in Oregon from 1991-1992, found that almost

one-third of foreign-born cases did not receive screening. Unfortunately, this suggests that no improvements in screening new immigrants were made between 1993-1996. While it is unknown if all 64 cases would have been TST positive if screened, it is likely that at least one-third of these cases would have tested positive due to evidence from other studies which looked at TB infection rates in similar populations.<sup>26, 27, 28</sup> In addition, this study revealed that among cases that did receive a TST prior to diagnosis (34%), almost three-quarters had a positive result (73%). IPT is estimated to be approximately 90% effective in reducing the risk of disease if taken correctly. This supports the conclusion that the majority of these cases could have been prevented.<sup>1</sup>

Those cases who were determined to be preventable due to inadequate treatment, included both failure to complete treatment for TB disease and/or TB infection (12%), and failure of a health care provider to prescribe IPT despite indications (3%). In Oregon, the overall use of directly observed therapy (DOT) has improved from 77% in 1991 to 91% in 1995, but the IPT completion rates for recent skin test converters ranged from 54% in 1991 to 59% in 1995.<sup>5</sup> This result emphasizes the need for TB control programs to expand DOT programs and challenges them to come up with new ways to improve IPT compliance in a cost-effective way.

Examination of the cases that were found to be *not* preventable (48%) also revealed several trends. The majority of cases that made up this group were those who appeared to arrive in the US with disease (within 6 months), and cases that did or did not have screening upon arrival but would not have been IPT eligible at that time, thereby precluding any US prevention effort. Of special interest were the differences among world regions of origin. Of regions with the most cases, 61% of SE Asian cases were *not* preventable, while only 7% Central Americans were *not* preventable, again suggesting a

difference in effectiveness of overseas screening for these two populations. Overseas screening misses those immigrants who come to the US through other means than the legal immigration process. While this study was not able to confirm the immigration status of all cases, based on other studies of similar populations, it is likely to assume that the majority of cases from Latin America did not immigrate through the legal immigration process, and therefore did not receive overseas screening.<sup>17</sup> However, for those that do receive an overseas medical evaluation, it may be up to 1 year before they actually arrive in the US--adequate time in which to develop TB disease from undetected TB infection. Clearly there are limitations to the overseas screening process. In a study published by Binkin et.al. which specifically reviewed the effectiveness of the overseas screening process, 4 areas were identified for improvement: sensitivity of diagnostic tests, training of panel physicians, transmission of classification (A, B1, B2) data to state health departments, and knowledge of local health departments regarding the overseas screening process and the need for prompt evaluation. Improving the screening of immigrants who do not go through the legal immigration process is more problematic. The CDC in cooperation with the Immigration and Naturalization Service are looking into ways to facilitate effective screening for these immigrants (i.e., asylum seekers, students, and migrant farm workers).<sup>29</sup>

From a public health perspective, the identification of the three groups which had missed opportunities for prevention, 1) no screening upon arrival; 2) screening but inadequate treatment; and 3) screening but no treatment was prescribed despite indications, can be useful for helping TB control programs design effective interventions. Most local public health departments have limited resources with which to screen and treat tuberculosis. Understanding which groups have the greatest need can help public health departments prioritize their efforts and allocate resources effectively. During the study period the number of foreign-born cases (235) was close to that of US born cases (251), however,

the impact to each population is potentially quite different, as observed through the mean annual incidence—82/100,000 and 7/100,000 respectively. Allocating efforts and resources based on the number of cases alone could have less impact than if the population is taken into account. This study identified that just screening and providing IPT to new immigrants upon arrival could have prevented 13% (64 cases) of the total number of cases (foreign and US born) for Multnomah County. In addition to the identification of more efficient resource allocation, consideration should be given to the potential dollars saved by preventing a case rather than treating an active case. While information regarding the cost-effectiveness of preventing a case of TB was not collected by this study, several studies have found significant savings when they looked at various screening and treatment methods for case prevention.<sup>29,30</sup>

This study had several limitations. First, medical charts reviewed for data were sometimes incomplete. It is possible that data missing from a chart could have altered the preventability status of that case. Charts were less complete for early study years than for later years, and definite patterns of chart completeness were observed among different case managers. Second, the 1990 Census was used for calculating incidence rates. As a result, these rates could be slightly underestimated for the later years of the study. Third, Class B information was obtained through the medical charts rather than from the OHD which maintains a database of all Class B immigrants and refugees. Prior to 1995, Class B data was not centralized at the OHD, and therefore, accurate records for the study period could not be obtained. Had these data been available, more information about the effectiveness overseas screening and the influence of immigration status (immigrant or refugee) could have been revealed. Finally, while this study has similar findings to other current research, generalizability is limited due to the uniqueness of health departments and differences in regional immigration patterns.

## REFERENCES

1. Centers for Disease Control. Core curriculum on tuberculosis: what the clinician should know. Atlanta: Centers for Disease Control and Prevention, 1994.
2. Centers for Disease Control. Tuberculosis morbidity. MMWR 1996;46:695-700.
3. Centers for Disease Control. Tuberculosis morbidity-US 1994. MMWR 1995, 44:387-395.
4. Centers for Disease Control and Prevention. Reported Tuberculosis in the United States, 1995. Atlanta: Centers for Disease Control and Prevention, 1996.
5. Oregon Health Division, Tuberculosis Control Program. Tuberculosis summary 1996. Portland OR; 1996.
6. Portland State University, Center for Population Research and Census. Population Estimates for Oregon:1996. Portland, OR; 1996.
7. Centers for Disease Control and Prevention. Essential components of a tuberculosis prevention and control program. Screening for tuberculosis and tuberculosis infection in high-risk populations: recommendations of the Advisory Council for the Elimination of Tuberculosis. MMWR 1995;44(RR-11):1-34.
8. American Thoracic Society. Diagnostic Standards and Classification of Tuberculosis. Am J Respir Dis 1990; 142:725-735.
9. American Thoracic Society. Treatment of tuberculosis and tuberculosis infection in Adults and children. Am J Respir Crit Care Med 1994;149:1359-1374.
10. Zuber PLF, Binkin NJ, Ignacio AC et al. Tuberculosis screening for immigrants and refugees. Diagnostic outcomes in the state of Hawaii. Am J Respir Crit Care Med 1996;154:151-5.
11. McKenna MT, McCray E, Onorato I. The epidemiology of tuberculosis among foreign-born persons in the United States, 1986 to 1993. N Engl J Med 1995;332:1071-1076.
12. McCray E, Weinbaum CM, Braden CR, Onorato IM. The epidemiology of tuberculosis in the United States. Clin Chest Med 1997;18:99-113.

13. McKenna MT, McCray E, Jones JL, Onorato IM, Castro KG. The fall after the rise: Tuberculosis in the United States, 1991 through 1994. *Am J Public Health* 1998;88:1059-63.
14. Immigration Act: Section 601. Washington, DC: United States Government, 1990.
15. 42 Code of Federal Regulation: 56 FR 25001-25004. Washington, DC: United States Government, 1991.
16. Centers for Disease Control and Prevention. Technical instructions for medical examination of aliens. Atlanta: Centers for Disease for Disease Control and Prevention, 1993.
17. Centers for Disease Control and Prevention. Tuberculosis among foreign-born persons who had recently arrived in the United States—Hawaii, 1992-1993, and Los Angeles County, 1993. *MMWR* 1995;44:703-7.
18. McCombs S, McCray E, Onorato I. Epidemiology of culture negative tuberculosis in the United States. Presented at the 35<sup>th</sup> Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, CA. September 17-20, 1995.
19. Zuber PL, Knowles LS, Binkin NJ, Tipple MA, Davidson PT. Tuberculosis among foreign-born in Los Angeles County, 1992-1994. *Tuber Lung Dis* 1996; 77:524-30.
20. Wells CD, Zuber PL, Nolan CM, Binkin NJ, Goldberg SV. Tuberculosis prevention among foreign-born persons in Seattle—King County, Washington. *Am J Respir Crit Care Med* 1997;156:573-7.
21. McAnulty JM, Fleming DW, Hawley MA, Baron RC. Missed Opportunities for Tuberculosis Prevention. *Arch Intern Med* 1995;155:713-716.
22. DeRiemer K, Chin DP, Schechter GF, Reingold AL. Tuberculosis among immigrants and refugees. *Arch Intern Med* 1998;158:753-60.
23. 1990 Census of population and housing. Social and Economic Characteristics. Washington, DC: Bureau of the Census, 1993.
24. MacIntyre CR, Plant AJ. Tuberculosis in South-East Asian refugees after resettlement—can prevention be improved by better policy and practice? *Prev Med* 1998;27:815-20.
25. Morse DL, Hansen RE, Grabau JC, Cauthen G, Redmond SR, Hyde RW. Tuberculin conversions in Indochinese refugees. *JAMA* 1982; 248:2983-6.



26. Menzies R, Vissandjee B, Amyot D. Factors associated with tuberculin reactivity among the foreign-born in Montreal. *Am Rev Respir Dis* 1992; 146:752-756.
27. Blum RN, Polish LB, Tapy JM, Catlin BJ, Cohn DL. Results of screening for tuberculosis in foreign-born persons applying for adjustment of immigration status. *Chest* 1993; 103:1670-4.
28. Binkin NJ, Zuber PL, Wells CD, Tipple MA, Castro KG. Overseas screening for tuberculosis in immigrants and refugees to the United States: current status. *Clin Infect Dis* 1996;23:1226-32.
29. Catlos EK, Cantwell MF, Bhatia G, Gedin S, Lewis J, Mohle-Boetani JC. Public health interventions to encourage TB class A/B1/B2 immigrants to present for TB screening. *Am J Respir Crit Care Med* 1998;158:1037-41.
30. Gourevitch MN, Alcabes P, Wasserman WC, Arno PS. Cost-effectiveness of directly observed chemoprophylaxis of tuberculosis among drug users at high risk for tuberculosis. *Int J Tuberc Lung Dis* 1998;2:531-40.

## Appendix A

### Groups to be Screened with the Tuberculin Skin Test

1. Close contacts of persons known or suspected to have TB
2. Persons infected with HIV; persons who inject illicit drugs
3. Persons who have medical risk factors known to increase the risk for disease if infection occurs (i.e., HIV, injection drug use, silicosis, cancer, chronic renal failure, or diabetes)
4. Residents and employees of high-risk congregate settings
5. Health-care workers
6. Foreign-born persons, including children, recently arrived (within 5 years) from countries that have a high TB prevalence or incidence
7. Some medically underserved, low income populations; infants, children and adolescents exposed to adults in high-risk categories.

Source: Centers for Disease Control and Prevention. Essential components of a tuberculosis prevention and control program. Screening for tuberculosis and tuberculosis infection in high-risk populations: recommendations of the Advisory Council for the Elimination of Tuberculosis. MMWR 1995;44(RR-11):1-34.

## Appendix B

### Summary of the ATS treatment guidelines for a standard, non-drug resistant, case of TB and treatment for TB infection

TB Treatment		
	Infection	Disease
<b>Adults</b>	<b>For persons with no additional risk factors: 6 months isoniazid (INH) for persons &lt;35 yrs. For HIV positive individuals, 12 months INH therapy.</b>	<b>Standard treatment for patients with fully susceptible TB and adhere to treatment: INH, rifampin, pyrazinamide and ethambutol (or streptomycin) for 2 months, or until susceptibility results are known, followed by 4 months INH and rifampin.</b>
<b>Children</b>	<b>9 months INH therapy.</b>	<b>Same as adults, except for children with miliary, bone/joint, or meningitis TB, who should receive a minimum of 12 months of therapy.</b>

Source: American Thoracic Society. Treatment of tuberculosis and tuberculosis infection in Adults and children. *Am J Respir Crit Care Med* 1994;149:1359-1374.

## Appendix C

**Description of Class A, B1 and B2 Tuberculosis in Immigrants and Refugees**

Classification	Description	Chest X-ray results	Sputum smear results
<b>A</b>	<b>Active TB disease, infectious</b>	<b>Abnormal, suggestive of active disease</b>	<b>Positive</b>
<b>B1</b>	<b>Clinically active TB, not infectious</b>	<b>Abnormal, suggestive of active disease</b>	<b>Negative</b>
<b>B2</b>	<b>Not clinically active TB, not infectious</b>	<b>Normal/evidence of old healed TB</b>	<b>Negative or not performed.</b>

Source: Centers for Disease Control and Prevention. Technical instructions for medical examination of aliens. Atlanta: Centers for Disease Control and Prevention, 1993.