Sometimes silence and stillness prevails despite knowing the current problem of TB and the fact that DOTS when properly implemented could result in effective control of the disease. Therefore, the guarantee of success of the DOTS strategy is to have the political will to practise it.

Couple condemned to live with a stone on their head – Pedro Pablo Oliva
Oil/canvas
(80 x 100 cm)

‘And I knew there was something I should remember. Something one of us had said, but which I had forgotten.’

The Shame (Film) – Ingmar Bergman
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CHAPTER 2

The Current Status of Tuberculosis in the World: The Influence of Poverty, Prisons, HIV, Immigration, and Control Programmes

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Introduction

TB produced more than 9.4 million cases and caused more than 1.3 million deaths in the world in 2008. Although the burden of the disease lies largely in developing countries (1, 2), developed countries also had high rates of TB mortality in past centuries. Historically, studies have also shown that these rates can vary greatly according to occupation or social class (3). Among men from London in 1930, lawyers, bankers, physicians, and surgeons had very low risk of death from TB while servant classes, waiters, factory and construction labourers had the highest mortality rates (4). Historical data in Spain from the last century reveal that over 2 million of its inhabitants died from TB between 1900 and 1950, more deaths than in the Spanish Civil War. Before the introduction of effective drugs against Mycobacterium tuberculosis (MTB) in the 1950s, mortality had decreased considerably in developed countries due to improving economic and social conditions.
The objective of this chapter is to describe the epidemiology of TB worldwide—particularly in Europe (5), with Spain, and Barcelona as specific examples—by analysing the role of poverty, prisons, HIV infection, immigration, and TB control programmes. The epidemiological data from Spain in general and Barcelona in particular are from the official registries.

TB Incidence and Mortality by WHO Regions

To address TB as a global problem, the WHO defines six world regions: the African Region, the Americas Region, the Eastern Mediterranean Region, the European Region, the South-East Asian Region, and the Western Pacific Region. The number of cases as well as the rates of prevalence rates, incidence, and mortality associated with TB fluctuate by year and region.

The TB incidence in the world has appeared to be decreasing since 2003 (2). According to WHO estimates, 9.2 million cases existed in 2006, of which 1.4 million (44 per cent) were sputum smear-positive pulmonary TB cases while 700,000 (8 per cent) were due to HIV infection. In 2005, the 2,993,000 new cases in the South-East Asian Region constituted 34 per cent of the global incidence of TB. The African Region had 2,529,000 cases or 29 per cent of the total. The African, South-East Asian, and Western Pacific Regions made up 85 per cent of the total cases in the world whereas the Eastern Mediterranean, European Regions and The Americas claimed only 565,000 (5 per cent), 445,000 (5 per cent), and 352,000 (4 per cent) cases respectively (2).

The estimated global TB incidence in 2006 was 139 cases per 100,000 inhabitants; however, great variation existed by country and region (Figure 2.1). Incidence has recently decreased in five of the six WHO-defined regions. The TB epidemic in the sub-Saharan African worsened during the 1990s with an annual increase of one per cent. The incidence rates now appear to have stabilized or even began to decrease (2).

While absolute TB rates in the African and South-East Asian Regions remain similar, the estimated incidence in sub-Saharan Africa (363 cases per 100,000 inhabitants) is almost double that of the South-East Asian Region (181 cases per 100,000). These two regions also have the highest incidence rates of sputum smear-positive pulmonary TB, with 147,000 cases in sub-Saharan Africa and 81,000 cases in South-East Asia. Conversely, the average incidence in the European Region is 50 cases per 100,000 inhabitants and only 39 cases and 18 smear-positive cases per 100,000 people in the Region of the Americas (2).

In 2006, an estimated 1.7 million people died from TB, mainly in sub-Saharan Africa and South-East Asia. In 2005, the mortality rate in sub-Saharan Africa was 74 deaths per 100,000 inhabitants as compared to 31 deaths per
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Population of 100,000 in South-East Asia. Europe and the Americas Region observed mortality rates of only 7.4 and 5.5 deaths per 100,000 inhabitants, respectively. The highest mortality rates found within Europe are in the eastern countries (2).

TB incidence in the European Union (EU) remains low. In 2006, 50 per cent or more cases come from some of the western European countries (Figure 2.2). Incidence continues to rise in eastern European countries. Moreover, poor treatment results and high default percentages have also been observed in eastern European countries. Many patients from these countries have a history of TB and more than 20 per cent of the TB cases are multidrug resistant (MDR). Primary drug resistance varies by European countries and there is a general lack of data, as seen in Spain. Romania and the Baltic states have the highest TB rates within the EU and Portugal has the highest prevalence of HIV/TB coinfection.

The incidence of TB in Spain was estimated at 38.5 per 100,000 inhabitants in 1995 and 1996 with significant regional differences. The notified rate of pulmonary TB was 14.7 per 100,000 people in 2006 and ranged between 8 and 31 per 100,000 people according to region. In 2006, the WHO estimated an incidence of 30 cases per 100,000 inhabitants in Spain, double that of France.

Source: WHO.
The TB incidence in Portugal (32 cases per 100,000 inhabitants) is higher than in Spain (30/100,000) and Morocco (93/100,000) has a TB incidence three times higher than Spain's (2). TB diagnoses according to hospital release records in Spain was about 15 per 100,000 people and differ by region from 7 to 27 per 100,000 inhabitants in 2006.

**Figure 2.2 Percentage of Tuberculosis Cases in Europe by Origin**

Source: EuroTB.

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**The Influence of Poverty**

TB incidence can vary by country from 10 to over 300 cases per 100,000 inhabitants (Figure 2.1) and also mirrors the country’s Gross Domestic Product (GDP) (Figure 2.3). However, it is noteworthy that some developing countries, such as Peru or Cuba, have given TB control political priority and achieved better results than high-income countries.

The trend observed within each country is that poorer areas tend to have higher TB incidence. The relationship between socio-economic level and TB is most apparent in large cities. Metropolitan areas also have higher incidences than their country's overall incidence, and when the TB incidence is analysed by district or neighbourhood, the most disadvantaged areas have a higher
Figure 2.3  Gross Domestic Product Per Capita in the World by Country, 2007


Figure 2.4  Geographical Distribution of Tuberculosis Cases in South Raval, Barcelona, 2007
incidence, as shown in Paris, London, or Barcelona. For example, the Ciutat Vella neighbourhood in Barcelona has an incidence 5–6 times higher than that of the entire city.

This trend is due to pockets of poverty (‘inner city’) that exist within large cities. The TB risk factors in these areas include immigrants recently arrived from developing countries with high TB incidence and precarious living conditions. In Barcelona, 70 per cent of the TB cases in poor neighbourhoods are immigrants (Figure 2.4).

The Influence of Prisons

An estimated 10 million people are incarcerated in the world and the number continues to grow. It could be multiplied by four to six if the number of people admitted per year is included. The prison population is normally comprised of young men of low socio-economic status and belonging to an ethnic, political, or religious minority. Prisons tend to have problems with overcrowding, poor hygiene, violence, and few health care resources. The characteristics of the prisoners and the conditions of a prison both favour disease transmission and complicate disease control. TB can be seen as a paradigm of this phenomenon (6).

Though the highest TB incidences in prisons have never been published, the incidences that are published can exceed the country’s global rate by up to 100 times. TB prevalence in Russian and Georgian prisons are 4,560 and 5,995 cases per 100,000 inhabitants, respectively. It is estimated that TB prevalence in prisons in Europe—393 per 100,000—is 84 times higher compared to the non-incarcerated population. Similarly, TB incidence in prisons in Latin America and the Caribbean are an estimated 22 times higher (1,000 per 100,000) than those of the general population (7). The highest rates in prison populations are found in Africa, where published studies reveal rates of 3,500 to 5,800 cases per 100,000 prisoners. Published data on TB in prisons in Asia is sparse; the estimated incidence in Taiwan is 25.9 cases per 100,000 prisoners and the prevalence in Pakistan is 3,900 cases per 100,000 prisoners (8).

Lack of effective prevention and control programmes in prisons have given rise to the high prevalence of MDR-TB and XDR-TB, especially in countries where anti-tuberculosis drugs are available but not monitored. For example, in Russia and other republics of the former Soviet Union, between 12 and 55 per cent of MDR-TB patients have been previously treated. A study from Thailand also reported 19 per cent of the TB cases were MDR (7).

HIV and MTB coinfection is also an important concern in prison populations, notably in countries where coinfection prevalence is high. For example, studies
estimate that between 26 per cent and 73 per cent of TB patients in Africa are coinfected with HIV. Intravenous drug users (IDU) also have an elevated risk of coinfection. In Spain, an estimated 10 per cent of TB patients in prisons are infected with HIV (9) and 42.8 per cent of HIV patients are IDU (10). An incidence of more than 2,000 per 100,000 prisoners was calculated by molecular epidemiology: 51 per cent were in clusters and one smear-positive patient had transmitted TB to 20 HIV infected prisoners (11).

**The Influence of HIV Infection**

Although antiretroviral treatment is available and TB is curable, 2 million people still die from HIV infection and 1.5 million from TB, 12 per cent of which is attributed to coinfection (12, 13, 14). One-third of people infected with HIV are also infected with MTB. The risk of TB disease for those infected with MTB and HIV is around 10 per cent annually (15, 16) while the TB risk for those infected only by MTB is around 10 per cent during his or her lifetime.

This dual epidemic mainly occurs in developing countries, particularly in sub-Saharan Africa. It is estimated that 9 per cent of all new TB cases in adults are attributable to HIV infection in Africa. Although the proportion of coinfection among TB cases is much greater in the WHO African Region (31 per cent), high rates exist in some industrialized countries, such as the United States (26 per cent) (16). Among European countries, AIDS incidence was the highest in Spain during the 1980s and 1990s.

TB incidence in Barcelona started to increase in 1986, when the TB surveillance system was created, especially among IDU, because of the HIV epidemic. After a decrease in incidence, an excess of 2,000 cases were reported between 1991 and 1997 (Figure 2.5). This decrease in incidence has slowed in recent years because of the poor living conditions of immigrants among whom TB is prevalent. Regarding AIDS, a considerable increase occurred during the early 1990s which started to decline in 1996 due to the introduction of Highly Active Anti Retroviral Treatment (HAART). As the most frequent AIDS defining disease, TB develops in 30–35 per cent of AIDS patients and in 50 per cent of AIDS IDU. In the 1990s, TB incidence reached 60 per 100,000 inhabitants in Barcelona and 25–30 per cent of these TB cases are also HIV-infected. TB was 31 times more frequent among HIV-infected patients. An analysis of TB transmission between HIV-infected and non-infected patients showed that transmission from HIV-infected cases is more frequent and furthermore, when analysing TB transmission among HIV-infected cases, most secondary TB cases were generated from IDU cases (12, 17).
The Influence of Immigration

Economically motivated immigration patterns change according to country. For example, Germany, France, and the United Kingdom have experienced stable immigration from former colonies since the 1950s. The TB epidemic has also progressed gradually but low incidence still persists in these high income countries.

Conversely, the immigration phenomenon in Spain has followed a different pattern because it did not occur for economic reasons. Spain did not experience significant immigration until the twenty-first century and the proportion of immigrant TB patients has since reached almost 40 per cent in some regions. TB control has been poor and HIV/TB coinfection has made a great impact. As a result, TB epidemiology in Spain has changed in recent years.

In 2008, 45 million people lived in Spain and 10 per cent of them were from other countries. Recent immigrants have come from all continents: notably from Romania among EU countries, Morocco among African countries, Ecuador from South America, and China from Asia. We analysed the influence of immigration on TB incidence and found that TB among Spaniards is decreasing while TB among the foreign-born population is increasing slightly. The percentage of TB cases of foreign origin is higher in regions with a high percentage of immigrants than in regions with a low percentage of immigrants, such as Galicia and Asturias.

In Barcelona, TB incidence is highest among immigrants from India, followed by the Pakistanis, Bolivians, and Moroccans. In the neighbourhood with the lowest socio-economic level, South Raval, TB incidence was more than 200 cases per 100,000 inhabitants and 70 per cent of the TB cases identified in this neighbourhood were immigrants. We also found that 32 per cent of these immigrant cases had developed TB during their first year in Spain, suggesting that the disease was imported. The incidence among immigrants was 3.6 times higher than that of Spaniards. Approximately 600 ‘excess cases’ were estimated between 2000 and 2003 and in 2007 the incidence has increased slightly (Figure 2.5).

The Influence of TB Programmes

An effective control programme should be accompanied by an annual decline in incidence of 5–10 per cent assuming stable circumstances. External factors such as the HIV epidemic or massive immigration can increase TB infection by up to 20 individuals and TB disease by two individuals annually for each smear-positive TB case.
Political priority is fundamental to develop effective control programmes and to incorporate novel strategies such as Directly Observed Therapy (DOT). For example, when TB was considered to be controlled in New York in the 1980s, TB programmes diminished and TB and MDR-TB incidence rose with the HIV/AIDS epidemic. The control programmes were then reinforced by additional human and financial resources (around US$40 million) and TB incidence started to decline from 3,811 cases in 1992 (51.1 per 100,000 inhabitants) to less than 1,000 cases in 2005, 2006, and 2007 (only 11.7 per 100,000 inhabitants in the last year) (18).

The TB Programme of Barcelona was started in 1987 because TB was the most frequently reported disease and was still significantly under-notified. Many prevention and control interventions were implemented and strengthened by additional research. Epidemiological surveillance for TB and AIDS is based on notification by physicians, and control of microbiological results, hospital records, and TB, AIDS, and mortality registries. An epidemiological survey is completed by a public health nurse for each case where clinical, microbiological, epidemiological data, and information on contacts and treatment compliance are captured. We conduct weekly meetings with public health nurses, doctors, community health agents, and persons responsible for DOT.

When we studied the predictors of TB treatment non-compliance, we found that the homeless, prisoners, and IDU were the least compliant. It is, therefore,
important to pursue social interventions to improve treatment compliance. For example, we provide a residence hall for homeless TB cases to stay for several months under DOT. IDU, including those released from prison, are enrolled in methadone programmes to have better treatment compliance. Coordination between methadone programmes and penitentiaries has also been beneficial. Persons with complicated TB cases are informed that they will be reported to the police if treatment is not initiated. Because of the incorporation of these activities, our treatment completion rate has exceeded 95 per cent since 1995.

When TB is diagnosed, we consider the patient’s close contacts who have more than six hours of daily interaction. We also sometimes investigate additional contacts with less frequent interaction with the patient. Between 1988 and 2005, more than 55,000 Tuberculin Skin Tests (TST) were administered under contact investigations and 19.1 per cent reacted positively. To improve contact tracing among immigrants, we added public health agents who act as cultural mediators and translators. Public health nurses can also try to accommodate appointment difficulties due to a patient’s work obligations. As stated in the consensus about imported TB, we recommend incorporating community health agents and public health nurses to improve contact tracing and screening immigrants upon their first contact with the health care system.

Thinking about the Future

Goals and Strategies for the Control of Tuberculosis

The MDGs describe the following goals to control the global TB incidence:

- to halt and reverse the trend of TB incidence by 2015;
- to diagnose at least 70 per cent of the sputum smear-positive cases under DOT and cure at least 85 per cent of diagnosed cases by 2005;
- to reduce TB per capita prevalence and mortality by 50 per cent relative to rates in 1990; and
- to eliminate TB as a public health problem by 2050 by reducing incidence to less than one case per 1 million people per year (2).

The strategy illustrates six measures to implement for TB control:

1. to pursue high-quality DOT expansion and enhancement;
2. to address TB/HIV coinfection, MDR-TB and other special challenges;
3. to contribute to health system strengthening;
4. to engage all care providers;
to empower TB patients and their communities; and
to enable and promote further research.

The strategy has been underway for 10 years and is described in the Global Plan to Stop TB 2006–2015 (2).

**Advancement towards the Goals**

Global TB incidence slowly started to decline after peaking in 2003. If an annual decrease by 0.6 per cent is maintained, the MDG on incidence reduction should be reached before 2015. Similarly, if the reduction of TB prevalence and mortality continues, the Stop TB Alliance goal of reducing prevalence and mortality relative to the 1990 rates will be reached in four of WHO’s six regions: South-East Asia, Western Pacific, East Mediterranean, and the Americas. Despite these promising projections, the European and African Regions will probably not achieve the goal.

The global treatment completion rate of 84.7 per cent under DOTS is the highest ever and close to the goal of 85 per cent. The Western Pacific Region reached the case detection and treatment completion goals in 2006. In 2005, 32 countries, including some with a high TB mortality rate such as China, the Philippines and Vietnam, achieved the goal. While 58 countries of the South-East Asian and Western Pacific Regions reached 85 per cent treatment completion, the European, Asian and Americas Regions estimate completion rates of 71 per cent, 76 per cent, and 78 per cent, respectively. In the African Region, together with China and India, 69 per cent of cases are still not detected. Progress in case detection has slowed down overall and did not achieve the Global Plan goal of 65 per cent by 2006.

Although the TB burden is decreasing on a global scale, it is currently not fast enough to attain the Stop TB Alliance goal by 2015. The Americas, South-East Asian, and Western Pacific Regions are experiencing declines sufficient enough to meet the goal; however, the African, European, and the Eastern Mediterranean Regions are not. The decrease in TB burden in these regions would be improved by the implementation of the activities described in the Global Plan.

It is historically clear that TB and poverty are directly related, as shown by the complementary tendency between TB incidence and the socio-economic level of each country and region. Economically disadvantaged populations throughout all areas in the world are more affected by TB.
Conclusion

TB is still not well controlled and continues to be a significant problem in many countries. It is even more pronounced in large cities and strongly influenced by external factors such as HIV and immigration. Cooperation between high and low burden countries is helpful for both parties. We need effective TB control programmes and improved social conditions to reach acceptable limits of TB levels.

References


