



# The resurgence of disease: social and historical perspectives on the ‘new’ tuberculosis

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## Abstract

The resurgence of tuberculosis is one of the most serious global public health challenges of the twenty-first century. This paper argues that the decline of tuberculosis since the nineteenth century is far better understood than its resurgence over the last twenty years. It is suggested that insights gained from the historical study of disease may provide a better analytical framework for understanding the contemporary dynamics of disease epidemiology than the current emphasis on the bio-medical and behavioural characteristics of individual patients. It is concluded that tuberculosis research requires a combination of advances in bio-medical knowledge with a broader understanding of the evolving relationship between disease and modern societies. © 2002 Elsevier Science Ltd. All rights reserved.

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## Introduction

In 1993 the World Health Organization took the unprecedented step of declaring a tuberculosis global emergency, yet the number of cases worldwide has continued to rise. Decades after cheap and proven methods of treatment have been developed, tuberculosis remains the world's leading cause of preventable illness and is now more prevalent than in any previous period of human history. The World Health Organization has calculated that around one third of the world's human population has been infected by the tuberculosis bacterium. Approximately three million people now die of tuberculosis each year. These deaths are mostly young adults but also include about 100,000 children under the age of 5 years. Current morbidity data show that tuberculosis is the most prevalent infectious cause of death, being responsible for 1 in 7 adult deaths and 1 in 4 preventable adult deaths worldwide (Table 1). Only

around 15 per cent of patients worldwide receive adequately supervised therapy and as this is a chronic disease there are between 16 and 20 million persons with active tuberculosis at any given time. About half of these patients are infectious and each infects between 2 and 20 persons annually which adds a further 100 million to the total numbers of infected people each year.

The discovery of streptomycin by Selman Waksman and Albert Schatz in 1944 led to the widespread use of effective anti-tuberculosis drugs. This opened the door to the potential conquest of tuberculosis and led to the development of the effective drug treatments available today. Further advances in the early 1970s with the use of rifampicin allowed the development of shorter and more convenient forms of treatment. Not only has such therapy been convincingly shown to be highly effective but it has been calculated that it is among the most cost-effective of all therapeutic interventions (Murray, Styblo, & Rouillon, 1990). In the 1950s it was widely believed that TB could be virtually eradicated but over the last fifteen years there has been a resurgence in reported cases in both developed and developing countries (Fig. 1). Both the UK and the USA, for example, have seen a sharp rise in TB morbidity since

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Table 1  
The global burden of tuberculosis<sup>a</sup>

WHO region	Total population (= persons at risk)	Number of people infected	Incidence (new cases)	Prevalence	Deaths
South-East Asia	1,458,000,000	704,000,000	2,800,000	6,553,000	1,095,000
Western Pacific	1,630,000,000	610,000,000	1,583,000	3,429,000	591,000
Africa	611,000,000	293,000,000	1,650,000	3,586,000	770,000
Americas	788,000,000	237,000,000	448,000	988,000	160,000
Europe	859,000,000	205,000,000	342,000	710,000	118,000
Eastern Mediterranean	473,000,000	161,000,000	427,000	1,035,000	173,000
Total	5,819,000,000	2,210,000,000	7,250,000	16,301,000	2,907,000

<sup>a</sup>Source: World Health Organization (1997a).

the early 1980s (Brudney and Dobkin, 1991b; Farmer, 1997; Ryan, 1993). In much of the developing world the return of TB has been even more dramatic and threatens to overwhelm existing medical facilities (Bloom & Murray, 1992; Young, 1998). There is growing recognition that the conquest of this disease cannot be achieved by medical advances alone. Little progress can be made in tackling the crisis unless there is political willingness to address gross inequalities in healthcare provision (Benatar, 1995; Farmer, 1997; Zumla & Grange, 1998, 1999). This is why bio-medical research must be complemented by work from within the social and historical sciences.

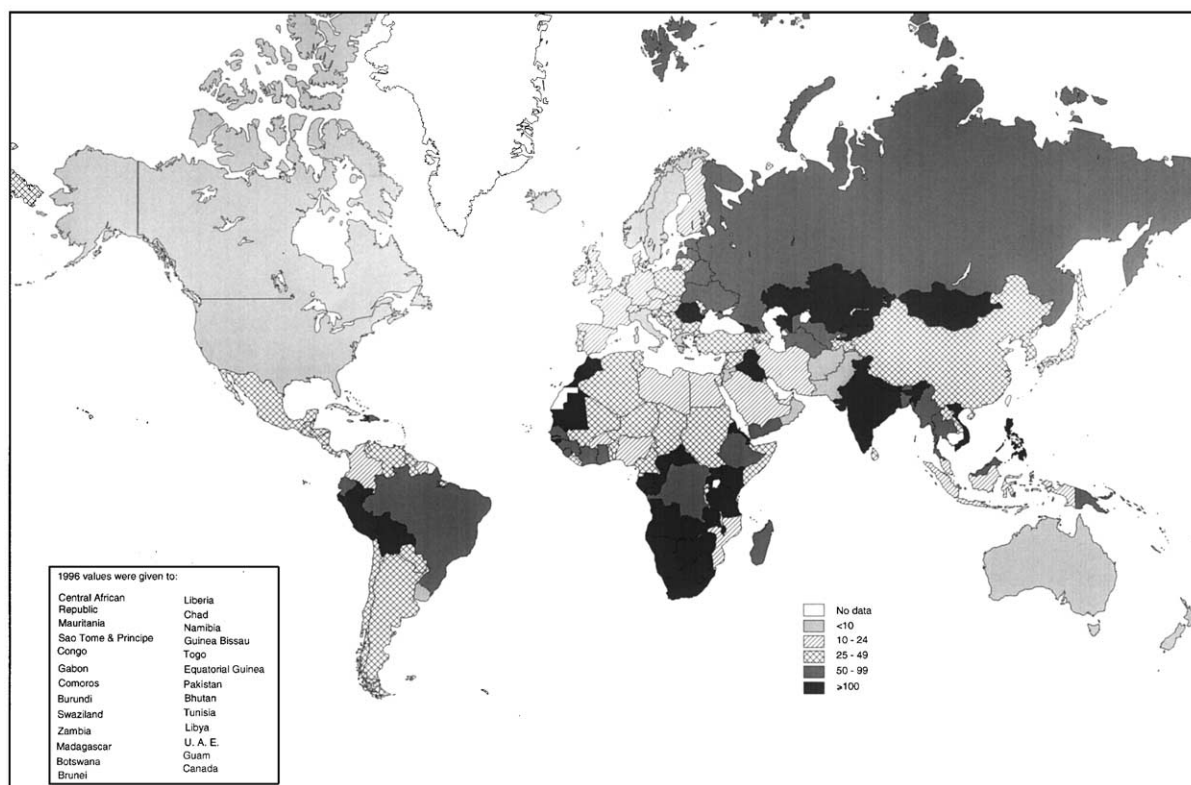
The study of TB from within the social sciences includes the contributions of history, social anthropology, spatial science and social policy. What is currently lacking, however, is a detailed analysis of the interaction between regional shifts in TB incidence and wider social and economic developments at different spatial scales. This requires an interdisciplinary approach capable of moving beyond disciplinary specialisms towards a fully integrated and contextual form of analysis employing the kind of insights derived from historical studies which have revealed so much about the incidence of TB and other diseases in the past (see Ranger & Slack, 1992). This article suggests that whilst some aspects to the crisis are biological we cannot restrict our explanation to the bio-medical sciences alone. What we are confronted with is a complex interplay between political, social, economic, cultural and biological factors.

We begin the article by outlining the main characteristics of the 'new' tuberculosis in order to emphasize the combination of biological and socio-economic developments which have contributed to the spread of disease. Secondly, we explore some of the key debates surrounding the decline and resurgence of tuberculosis. We suggest that although the decline of TB in the twentieth century has been widely studied, the emergence of the 'new' tuberculosis is much less well understood. Finally, we turn to a series of conceptual and theoretical themes

which may illuminate a more productive kind of approach to the understanding of the evolving relationship between disease and society. A series of critical themes is identified which require further investigation as part of an interdisciplinary research agenda capable of combining advances in the bio-physical sciences with insights derived from the social and historical sciences.

### The 'new' tuberculosis

Recent research into the epidemiology of the 'new' tuberculosis has revealed a number of different contributory factors. It is useful to distinguish between three principal developments: the emergence of drug-resistant strains of TB; the prevalence of co-infection with HIV; and social and economic developments affecting access to medical care. In order to make sense of the contemporary crisis we need to consider a range of interrelationships between these contributory factors in order to build a full picture of the global dynamics of disease. The emergence of drug resistance is thought to be responsible for around 10 per cent of new TB cases (Neville, Bromberg, & Bromberg, 1994; Nolan, 1997; Small, Shafer, & Hopewell, 1993; Small & Moss, 1993; Simone & Dooley, 1998). The problem of drug resistance was encountered soon after the discovery of streptomycin and other anti-tuberculosis drugs and led to the universal recognition of the need to use multi-drug treatment programmes. The emergence of world-wide drug resistance has been caused by a variety of factors including the poor supervision of therapy, the use of badly prepared combination preparations, inconsistent prescribing practices, erratic drug supplies, and unregulated over-the-counter sales of drugs (including cough mixtures containing isoniazid) (see Okeke, Lamikanra, & Edelman, 1999). The most commonly encountered resistance is to a single drug, usually streptomycin or isoniazid, and most patients with such resistance respond adequately to a multi-drug treatment



Source: World Health Organisation

Fig. 1. Tuberculosis notification rates 1997.

programme. The emergence of resistance to rifampicin is much more serious as this is the most powerful anti-tuberculosis drug with the ability to sterilize lesions by destroying near-dormant 'persister' bacilli. Furthermore, most rifampicin-resistant strains are also resistant to isoniazid and, by convention, tuberculosis due to strains resistant to these two agents, with or without additional resistances, is said to be multi-drug resistant. The use of standard short-course treatment becomes not only ineffectual but may even be positively harmful as resistance to other drugs such as pyrazinamide and ethambutol also develops as part of the so-called 'amplifier effect' (see Farmer & Kim, 1998). In Russia, for example, mutant forms of TB, variously referred to as multi-drug resistant tuberculosis (MDR-TB), have been rapidly spreading in response to chronic overcrowding in the prison system and severe cutbacks in primary health care (Meek, 1998). The problems and costs of managing each case of MDR-TB are enormous. Successful therapy requires prolonged courses of less effective, more expensive, and more toxic drugs, under long-term supervision (Kochi, Vareldzis, & Styblo, 1993). The incidence of MDR-TB in New York has been reduced by such a strategy, although at a very great

cost: the management of a single case can exceed US\$250,000 (Farmer & Kim, 1998). In the case of New York the spread of MDR-TB was facilitated by reductions in public health expenditure but the city ended up having to spend ten times more than they saved in order to bring TB under control (Boseley, 1999). There is little prospect that these kind of expensive and complex medical interventions could be widely applied on a worldwide scale, yet it is the breakdown in existing disease control programmes which is facilitating the emergence of a far more serious public health crisis to be faced in the future. A significant barrier to the control of MDR-TB is the lack of good epidemiological data on the prevalence and distribution of such resistance and the lack of adequate laboratory facilities for its detection, evaluation and monitoring. In order to tackle this dimension to the problem the World Health Organization, together with the International Union Against Tuberculosis and Lung Disease, has undertaken a global survey which has found very wide regional variations in the incidence and monitoring of MDR-TB (World Health Organization, 1997b; 1999).

A second factor is the pandemic of HIV infection and AIDS which is estimated to have contributed towards

8–10 per cent of TB cases worldwide. In Africa, however, HIV is responsible for at least 20 per cent of TB cases (Hart, Beeching, & Duerden, 1996; Kumarasan, 1996; Murray & Lopez, 1996; Schulzer, Fitzgerald, Enarson, & Grzybowski, 1992; Zumla, Johnson, & Miller, 1997). Given that a third of the world's population carry quiescent TB infection the effects of immune system damage can be expected to have devastating consequences: the most recent data suggest that in parts of sub-Saharan Africa, for example, a quarter of the adult population are now infected with HIV (Altman, 1998). Infection by HIV is currently the most important predisposing factor for the development of overt tuberculosis in those infected by *M. tuberculosis* before or after becoming HIV positive (Chretien, 1990; Coker & Miller, 1997). In the absence of immunosuppression, people who have overcome primary tuberculosis have about a 5 per cent chance of developing post-primary tuberculosis at some time during the remainder of their lives. HIV-positive persons have an 8 per cent chance annually of developing tuberculosis rising to a total of 50 per cent during the remainder of their shortened life span (Dolin, Raviglione, & Kochi, 1994). By late 1997, there were an estimated 30 million HIV-infected persons worldwide and, assuming that one third had been infected with *M. tuberculosis*, there would have been around 10 million co-infected persons. The burden of HIV-associated tuberculosis has also particularly affected women and children. One study found that HIV seroprevalence rates in Zambia among hospitalised children with tuberculosis rose from 18 to 67 per cent over an eight year period, while remaining at a constant 10 per cent among children admitted with surgical conditions (Chintu & Zumla, 1995). In Zambia, at least 1 in 4 pregnant women are HIV positive and tuberculosis has overtaken direct obstetric complications as a cause of pregnancy-related mortality (Ahmed et al., 1999; Fylkesnes, Musonda, & Kasumba, 1997). The increasing recognition of links between TB and HIV among patients has also had the adverse effect of adding to the stigma of TB symptoms and has hindered cooperation between patients, health care workers and local communities (Van Cleef & Chum, 1995).

A third factor covers what we might term social and economic 'disruption'. Mass movements of people in response to war, economic insecurity, community disruption and other factors have been involved in the spread of TB and other infectious diseases associated with crowding, makeshift housing and poor sanitation (Farmer, 1997; McKenna, McCray, & Onorato, 1995; Mutatkar, 1995; Smallman-Raynor & Cliff, 1991, 1998). In addition to short-term disruption we must consider longer term social and economic shifts which have emerged over the post-war period and particularly since the early 1970s. There is now increasing evidence that growing poverty, infrastructural decay and declining

health services have facilitated the spread of TB (Brudney & Dobkin, 1991a,b; Elender, Bentham, & Langford, 1998; Greenberg, Schneider, & Martell, 1995; Lewontin & Levins, 1996; Snider, 1997; World Health Organization, 1996; Zumla & Grange, 1998). An emerging theme is the extent to which the resurgence of TB can be related to contemporary processes of social and economic restructuring in response to changes within the global economy since the late 1960s and early 1970s associated with a shift towards neo-liberal patterns of policy making. A more market-orientated approach to public policy making has sharply altered the rationale and distribution of health care services. A substantial body of evidence suggests that tuberculosis has a disproportionate impact on the economically poor: 95 per cent of all TB cases and 98 per cent of TB deaths occur in the developing world where problems of ill-health contribute towards vicious cycles of economic hardship in the context of high unemployment and weak social security and health care provision. Even in developed economies such as the United Kingdom, the current increase of the disease can be attributed to widening social inequalities. Between 1980 and 1992, for example, there was a 35 per cent increase in the incidence of tuberculosis among the poorest 10 per cent of the population of England and Wales, a 13 per cent increase among the next poorest 20 per cent but no significant increase among the remaining 70 per cent of the population (Bhatti, Law, & Morris, 1995). The latest figures for the UK suggest that the prevalence of the disease has continued to rise during the 1990s with the rate of infections increasing from 9.4 to 10.9 per 100,000 people over the decade (Boseley, 1999). It is in developing countries, however, where the poverty-disease cycle is most striking. The poor have few health advocates, either in their own communities or in the wealthier nations, and in comparison with other major health afflictions the disease remains relatively neglected: the funding of tuberculosis control worldwide, for example, continues to be very low in comparison with other infectious disease with just 8 dollars of external aid spent for each patient death compared with 137 dollars for malaria, 925 for AIDs and over 38,000 for leprosy (World Health Organization, 1994).

### Tuberculosis in historical context

There is an extensive literature on the decline of tuberculosis over the twentieth century (see, for example, Bates, 1992; Bryder, 1988; Johnston, 1995; Packard, 1989; Smith, 1988). Historical studies have emphasized the role of advances in medical science, along with more general improvements in nutrition, housing and other indicators of social well-being. The precise contribution of these different developments is the subject of

continuing scholarly debate (see Barnes, 1992; Chretien, 1993; Guerrand, 1984; Mitchell, 1992; Ranger & Slack, 1992; Wilson, 1990; Szretzer, 1988) but there is little doubt that the decline of TB can be clearly related to a set of identifiable social, political, economic and scientific developments. A critical divide exists in the historical literature between those accounts which attribute declining mortality from TB to economic growth (variously referred to as the demographic or epidemiological transition) and alternative views which stress the variety of different paths towards higher living standards under the influence of contrasting political responses and institutional arrangements for sanitation and public health.

An influential view is the so-called McKeown thesis whereby the decline of infectious diseases and high mortality rates is attributed to general improvements in nutrition and welfare associated with economic development. These ideas have been developed in relation to the history of tuberculosis by the use of empirical evidence to show that the disease was in decline before the widespread use of sanatoria and other public health measures. In contrast, alternative perspectives developed by Simon Szreter, Constance Nathanson and others emphasize the critical importance of institutional and legislative change fostered by the political salience of public health advocates (Nathanson, 1996; Szreter, 1997). An emphasis on public health advocacy reveals the significance of specific measures aimed against tuberculosis such as effective patient segregation, housing improvements and the control of bovine tuberculosis (see Fairchild & Oppenheimer, 1998). This is an important distinction because the former position tends to downplay the politically contested nature of historical outcomes in public health whereas the latter position draws our attention to the diversity of possible outcomes. For Constance Nathanson, a critical dimension to the politics of public health is the capacity of the state to intervene on behalf of a putative public interest. She argues that where states are strong and clearly centralized this facilitates the coordination and implementation of public health policies. A variety of studies have illustrated this across diverse fields such as pre-natal health care, water fluoridation, and the modernization of sanitation practices. In other words, the advance and retreat of disease is not only related to the broader dynamics of economic growth but is also affected by the outcome of political conflict and social reform. In the case of Glasgow, for example, historical research has revealed that the decline of tuberculosis was closely related to political efforts to improve overcrowded and inadequate housing rather than the outcome of more general nutritional improvements (McFarlane, 1989; see also Castells, 1983; Chapman, 1971; Dubos & Dubos, 1992; Gauldie, 1974; Melling, 1980).

Research into the contemporary resurgence of tuberculosis has repeatedly emphasized behavioural and biological aspects to the epidemiology of TB to the relative neglect of social and historical context. Individual (behavioural) approaches have focused on non-compliance with treatment regimes as the main barrier to the control of TB (see, for example, Bayer & Dupuis, 1995; Menzies, Rocher, & Vissandjee, 1993). Much research suggests that non-compliance with therapy is the major cause of the failure to control tuberculosis. Unfortunately, the word 'non-compliance' implies that the fault lies with the patient, while in fact most breakdowns in therapy are due to failure on the part of the health care provider (Chintu & Zumla, 1995; Chowdhury, Chowdhury, & Islam, 1997; Gittler, 1994). Common faults include poor prescribing practices, an interrupted supply of drugs, demands (sometimes clandestine) on patients for payment for the drugs, arrogant and patronising behaviour of health care staff, and a requirement for excessive traveling to health care facilities (see Ellner et al., 1983; Needham, Godfrey-Faussett, & Foster, 1998; Saunderson, 1995). Much of the existing literature has adopted the analytical approach of 'bio-medical individualism' with respect to the epidemiology of disease through an emphasis on qualitative ethnographic accounts of individual patients or a quantitative scaling up from individual patient history (see Fee & Krieger, 1994). Yet accounts which focus on individual patients fail to advance any overall conception of the dynamics of disease epidemiology as part of a broader set of social processes (see Benatar, 1995). If we take the example of MDR-TB, the growth of drug resistance is related to changing patterns of health care provision and cannot be explained in bio-medical terms alone or simply by blaming patients for non-compliance.

The emergence of the World Health Organization's directly observed therapy (DOTS) strategy is based on ensuring patient compliance through a closely monitored programme of treatment (see, for example, Wilkinson & Davies, 1997). Although the DOTS strategy is a crucial element in any coordinated response to TB there remain significant difficulties in relation to funding, staff recruitment, and the fear of stigma by patients who are reluctant to regularly meet health workers in the clinic, workplace or home. The DOTS strategy is approaching the limits of what can be achieved without more fundamental changes in public health policies as part of a wider programme to tackle poverty and social inequality (see Dievler & Pappas, 1999; Gittler, 1994; Young, Rachal, Bailey, Tate, & Nelson, 1997). Beyond individual non-compliance with treatment programmes the two most common explanations to be found in the bio-medical literature for the return of tuberculosis are the advent of HIV and the emergence of TB strains resistant to drugs (Farmer,

1997). These two factors are routinely used in reference to the 'new' tuberculosis yet they constitute only part of the changing picture. The most decisive set of changes contributing towards the re-emergence of this disease lie at a structural level in society rather than at the level of the individual patient or TB bacillus. As the microbiologist René Dubos has argued: "Tuberculosis is a social disease...its understanding demands that the impact of social and economic factors on the individual be considered as much as the mechanisms by which tubercle bacilli cause damage to the human body" (quoted in Farmer, 1997, p. 348). By shifting our analytical emphasis from the individual to society an individualized mode of explanation is replaced by a structural framework within which we can trace changing patterns of disease as a broader set of 'bio-social' processes.

Some of the most innovative insights into the relationship between the individual patient and their social context have been derived from anthropological studies of disease. Extensive anthropological research has examined the mis-match between (Western) medical belief systems and alternative traditional forms of knowledge held by local cultures (see, for example, Caldwell, Orubuloye, & Caldwell, 1992; de Villiers, 1991; Ingstadt, 1990; Moloantoa, 1982; Vecchiato, 1997). In developed economies, by contrast, a discourse of 'non-compliance' has emerged to differentiate between different categories of patients and their degree of cooperation with medical authorities (Lerner, 1997). In order to advance our understanding of the 'new' tuberculosis we need to make the methodological and analytical leap between individual and society. In altering the scope of our analysis a series of further issues are raised. How, for example, can we account for the changing epidemiology of tuberculosis? Under what material conditions has the disease been able to spread so rapidly over the last twenty years? In what ways must we alter our conceptions of the relationship between disease and modern societies in order to formulate an adequate explanation and policy response for this public health crisis?

### **Rethinking the epidemiology of disease**

Changing patterns of economic and social investment have contributed towards a new geography of wealth and poverty with significant implications for the epidemiology of disease. This presents a very different picture from the political dynamics of disease prevention in the nineteenth-century city where different social classes lived in much closer proximity. With the advent of more diffuse patterns of urbanization and the greater mobility of capital investment it has become far easier for public health crises to be effectively ignored where

they present no generalized threat to the overall well-being of an increasingly globalized economic system. Indeed, the combined impact of the greater marketization of health care and the growth of new insurance based financial derivatives is making the management of health risk increasingly remote from democratic forms of government. In order to make sense of the global dynamics of the tuberculosis epidemic, we need an analytical framework within which we can explore nested scales of causality and interdependence linking the dynamics of urban and regional change to processes of global economic restructuring (Table 2). These insights can be used to explore the interaction between processes of institutional change, shifting public health discourses, and the social production of the human environment. What is clearly needed is some kind of conceptual vocabulary which allows us to integrate the analysis of disease into the broader dynamics of social and political change associated with post-war fluctuations in the global economy. Much scholarly attention has been devoted to establishing what kind of social and economic structures are emerging from the ashes of the relatively stable era of economic growth which was experienced in Western economies from the late 1940s until the early 1970s (see, for example, Amin, 1994; Brenner, 1998; Lipietz, 1985). This period saw significant improvements in fields such as education, health care and employment and was marked by sustained advances in the arena of public health. There has been little attempt, however, to trace substantive connections between twentieth-century economic history and changing patterns of public health.

The resurgence of disease in the so-called 'de-developing' enclaves of urban America and the poverty stricken cities of the former Soviet Union can only be fully understood with reference to the dynamics of global post-war political and economic change (see Tulchinsky & Varavikova, 1996; Wallace, Wallace, Andrews, Fullilove, & Fullilove, 1995; Wallace, Wallace, & Andrews, 1997; Wallace, Wallace, Ullman, & Andrews, 1999; Whiteis, 1997; 1998). This suggests an implicit challenge to the emerging literature on the 'healthy city' which explores quality of life issues in an intellectual context which is divorced from the underlying dynamics of urban change (see, for example, Milewa & de Leeuw, 1996). In the case of New York City, for example, we can identify an interconnection between disease epidemiology and urban decline. In the wake of the city's 1975 fiscal crisis there was a dramatic fall in public health expenditure on the control of tuberculosis which led to cuts in the number of health care workers and a cessation of patient tracking to ensure compliance with treatment. The disruption of treatment and very limited detention of non-compliant patients contributed towards the emergence of MDR-TB in the 1980s. Coupled with growing poverty and high

Table 2  
The 'new' tuberculosis: a typology of contributory factors

General categories	Specific outcomes
<i>Bio-medical factors</i>	The evolution of MDR-TB The dynamics of co-infection with HIV The creation of 'ecological niches' for the spread of disease
<i>Political factors</i>	The transition towards neo-liberal (market driven) patterns of public policy making since the 1970s The shift from collective to more individualized approaches to health care Cuts in social expenditure War, political instability and mass movements of refugees
<i>Cultural factors</i>	The continuing stigmatization of tuberculosis The impacts of racism The impacts of gender inequalities Tensions between different systems of medical knowledge
<i>Economic factors</i>	Global economic changes since the 1970s leading to widening international and regional disparities in wealth and income Unprecedented levels of global poverty and inequality New patterns of urban and regional change with deteriorating sanitation and housing conditions for the world's poor Unprecedented levels of capital mobility with new patterns of investment in financial derivatives and other non-productive commodities

levels of HIV infection the stage was set for a dramatic return of tuberculosis (Brudney & Dobkin, 1991a,b; Lerner, 1993). This observation is taken further by Wallace (1997) and Wallace et al. (1999) who argue that the legacy of neo-liberal policy making has created an 'ecological niche' within which disease can spread through American inner cities and that only a systematic 'integrated ecosystem intervention' can tackle the root causes of persistent and pervasive ill-health. We need to re-integrate the control of disease with a progressive social agenda since narrow bio-medical interventions can only tackle surface manifestations of the problem.

A range of historical studies have highlighted the crucial significance of public health issues in contributing towards the emergence of new kinds of institutional structures during the nineteenth century (see Barnes, 1995; Craddock, 1998; Evans, 1987, 1992; Pickstone, 1992; Rosne, 1992). A critical theme for investigation is whether the contemporary threat of disease is sufficient to challenge current approaches to public health in a similar fashion to the impacts of cholera, typhoid and other diseases in the past. A distinction must be drawn here between the impact of short-term epidemics such as plague and cholera and the longer term impact of chronic illnesses such as syphilis and tuberculosis (Slack, 1992). The changing character of urbanization is crucial since the spatially compressed industrial cities of the nineteenth century were a key motor behind the modernization of public health and social policy more generally. In contrast, contemporary patterns of urba-

nization are marked by systematic social and spatial discontinuities which facilitate the mobility of capital investment rather than regional resolutions to chronic problems of social and environmental underinvestment. This is a decisive difference between past and present processes of urbanization which necessitates a new kind of theorization of the relationships between disease, urbanization and political change. In particular, we need to know why a long period of relative stability and progression in public health care from the middle decades of the nineteenth century until the late twentieth century has come to an abrupt end. This radical break in the incidence of TB cannot be explained by economic change alone but involves a complex interaction between social, cultural and biological factors which are widely neglected within political-economy research into health and the urban environment.

Issues of poverty, gender inequality, disease stigmatization and the adequacy of medical services are central elements in any full explanation of the contemporary resurgence of this disease. In developing countries, for example, the treatment of tuberculosis is closely linked with pregnancy and childbirth as one of few instances when many women come into contact with modern health services. The incidence of tuberculosis-related maternal mortality is in turn related to pervasive gender inequalities in access to health care (Connolly & Nunn, 1996; Holmes, Hausler, & Nunn, 1998; Miller & Miller, 1996; Mofenson, Rodriguez, & Hershow, 1995). The interaction between race and tuberculosis is also

striking. In the case of South Africa, for example, the nineteenth-century spread of tuberculosis was closely related to patterns of industrialization and the overcrowded conditions endured by migrant workers. The South African state sought to cover up the extent of TB among miners and intensified race-based health inequalities through its Apartheid legislation (Andersson, 1990; Collins, 1982; Packard, 1989). Recent research has highlighted the interaction between race, gender and place in contributing towards differential vulnerability towards disease (see Hudelson, 1996; Nair, George, & Chacko, 1997; Packard, 1989; Warren, 1997). The analytical challenge is to combine an understanding of the diversity of local contexts for disease transmission with a wider intellectual framework engaged with processes of global economic and political change.

A further omission in much of the existing social science literature is any detailed consideration of the interaction between bio-physical and social systems. How, for example, can we integrate biological changes such as mutations in TB strains with social and historical modes of analysis? Recent interdisciplinary scholarship drawn from both the biological and social sciences has advocated a historical approach to understanding relations between social and bio-physical systems where nature itself is perceived as a social product (see Cronon, 1983; Harvey, 1996; Levins & Lewontin, 1985). The highly fragmentary methodologies of the bio-physical sciences tend to not only split nature from society but also divide physical reality into ever smaller units of analysis. The study of disease requires a combination of small-scale molecular and experimental insights with a full appreciation of the social context in which the understanding of human health has developed in modern societies. We need to recognize that tuberculosis is as much a social as a biological phenomenon: ever since the emergence of tuberculosis with the domestication of cattle some 7000 years ago the disease has undergone a series of transformations. In the modern era, however, the relationship between tuberculosis and society has entered a new and more complex phase.

## Conclusions

The spread of tuberculosis is a multi-faceted phenomenon comprising many different dimensions ranging from neo-liberal policy making to the evolution of bacterial resistance to drugs. In view of the seriousness of the global emergency of tuberculosis and the increasing impact of the HIV/AIDS pandemic and the spread of multi-drug resistance, a radical revision of control strategies is essential. From a social perspective, the effective control of tuberculosis requires attention to the gross global inequalities in wealth and living

standards which limit access to adequate health care. To improve treatment compliance and to standardize the various national tuberculosis programmes the World Health Organization has advocated the so-called DOTS strategy which involves not only direct observation of patients but also government commitment to a national tuberculosis programme, case detection through sputum smear microscopy, short-course drug treatments, adequate medical infrastructure to ensure an uninterrupted supply of drugs, and regular monitoring and evaluation of the programme. Yet only about 15 per cent of TB patients globally have been able to receive treatments which meet the DOTS criteria. Although there is evidence that the DOTS strategy has begun to make a real impact in parts of China, India and Bangladesh, there remain formidable social, cultural and economic barriers to its effective worldwide implementation. Even in developed economies the advocacy of a more integrated approach has not been without difficulty. In the UK, for example, there is a shortage of clinical nursing staff specialized in the treatment of tuberculosis and it is doubtful whether district nurses would be willing to take on this additional responsibility (Coker & Miller, 1997).

There is now a wealth of empirical data to demonstrate the changing incidence of tuberculosis over the last twenty years. In order to account for this shift we need to find out what changes have occurred in the field of public health policy which have contributed towards the resurgence of disease. In particular, we need to know to what extent the failure of public agencies to intervene effectively is due to changing socio-economic circumstances. Since tuberculosis is a disease of poverty we need to know whether existing institutional arrangements for disease control are genuinely powerless to prevent the spread of disease. In order to investigate this theme we need to relate the changing epidemiology of disease to shifting relations between government agencies, the economy and civil society. A key challenge is to relate changing patterns of TB infection to broader social and economic processes operating at different spatial scales and across different historical periods. This will involve the identification of structural as opposed to individual or behavioural barriers to the control of TB as part of nested hierarchy of causality ranging from local to global scales of analysis.

In the late nineteenth century and early twentieth century the control of tuberculosis was closely related to public health advocacy in order to improve the living conditions of the poor: the links between poverty and ill health were clear and unambiguous. With scientific advances in the twentieth century, however, there has been a shift away from this holistic advocacy approach towards a bio-medical emphasis on individual patients (see Lerner, 1993). The increasing use of out patient drug treatments has reduced the need for institutional



interventions such as sanatoria and indirectly led to shifting priorities in public health policy. The early success of new medical interventions such as the BCG, isoniazid, and rifampicin, disguised the complexity of tuberculosis epidemiology and masked the continuing interconnections between poverty and ill-health. Yet to return to the highly moralistic public health discourses of the past with their emphasis on segregation and control raises another set of dilemmas around the stigmatization of illness which cannot contribute to more effective public health policies (see Abel, 1997). The principal motor behind the resurgence of tuberculosis has been the sharp rise in global poverty which has undermined many of the public health advances of the twentieth century. The challenge for scholars, public health advocates and health care workers is to build a coherent and persuasive policy agenda which lays bare the interconnections between tuberculosis and social injustice in order to galvanize political action.

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