

# Homelessness and Tuberculosis Transmission in Urban America

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## Abstract

Among industrialized countries, the U.S has arguably struggled most with alleviating homelessness, ever since the issue breached the federal policy agenda in the 1970s. Homelessness is associated with a diverse range of risk factors that increase an individuals vulnerability to infectious disease: poor living conditions, compromised mental and physical health, and risky behavior such as intravenous drug use. Within the U.S, the re-emergence of tuberculosis in the 1990s disproportionately affected the homeless in urban areas. This paper critically reviews the effects of homelessness on tuberculosis transmission in cities across the United States. I approach the peer-reviewed literature with three objectives: to determine first what risk factors and transmission mechanisms characterize TB cases among the urban homeless, second, what methods have been used to monitor transmission, and third, what treatment techniques have proven most effective for managing transmission. The literature effectively addresses these objectives through descriptive case studies in cities throughout the U.S, though does not satisfactorily contextualize observed trends within broader-level social, political, and economic forces, which are together changing what it means to be homeless in urban America. Specifically, efforts to monitor and treat the new tuberculosis should account for the new homelessin light of differential effects of treatment noncompliance, multi-drug resistant strains, concurrent infection with HIV/AIDS, and behavior on the health risk of these populations.

## Introduction

Among curable communicable diseases, pulmonary tuberculosis (TB) is the leading cause of death worldwide [7]. About

one third of the global population is infected with the bacteria *Mycobacterium tuberculosis*, which may lie latent in a human hosts lungs for many years before progressing into an active infec-

tion [7]. Symptoms include coughing, chest pains, weakness, weight loss, and fever, and if left untreated, the disease may lead to death. A host with a weakened immune system may trigger the transition from latent to active TB. Once afflicted with active TB, the host becomes infectious and may transmit bacteria to others via droplets from the throat and lungs expelled into the air [35]. Tuberculosis is an ancient disease, largely reflective of poverty, whose prevalence is distally patterned by a multitude of social, political and economic forces [28, 29]. In industrialized countries, reports of TB cases have declined since the nineteenth century [28]. However, this trend reversed in the 1980s when widespread HIV infection caused the disease to re-emerge [28]. Increased migration of populations from countries with high TB prevalence, development of multiple drug resistant strains of the bacteria, and deterioration of health care infrastructure supporting TB control, have all contributed to global re-emergence of the disease [28]. In fact, the World Health Organization (WHO) declared tuberculosis a global emergency in 1983 [34]. It is argued that the historical decline of tuberculosis is better understood than this re-emergence [11]. Today, tuberculosis persists in industrialized countries as an important public health problem, with the majority of cases occurring in poor and minority

groups, such as displaced, migrant, and cross-border populations, injection drug users, sex workers, and the homeless [9]. Homelessness is a socioeconomic phenomena associated with disadvantaged populations and ill health throughout the life course, and is growing in industrialized nations [19]. Homelessness is a public health problem that is increasing in severity, and homeless populations are more susceptible to emerging and re-emerging infectious diseases such as TB because of poor living conditions and limited access to healthcare systems [2]. Homelessness and associated social exclusion may worsen health status, while those whose health is already compromised by mental or physical illnesses are more susceptible to homelessness or poor-quality housing, due to unemployment and poverty [32]. Among the homeless, TB rates may be twenty-times higher than general populations in the U.S across rural and urban areas [4]. In urban populations, persisting high incidence rates are largely due to ongoing transmission in homeless shelters [13].

In light of this trend of new or re-emerging tuberculosis among marginalized groups like the homeless, Paul Farmer (1997) calls for research in the social sciences to discern the mechanisms by which social forces affect TB transmission, and also to identify barriers that prevent those with multiple-drug-resistant TB from accessing proper

care. To contribute to Farmers call-to-action, I aim to evaluate how the social process of urban homelessness has affected the re-emergence of tuberculosis in the U.S from the 1980s onwards. In order to do this, I approach the peer-reviewed literature with three sub-objectives: to determine first what risk factors and transmission mechanisms characterize TB cases among the urban homeless, second, what methods have been used to monitor transmission, and third, which treatment techniques have proven most effective for managing transmission. To address these objectives, I analyze research conducted in cities throughout the U.S, with a special focus on the New York City case study, where the 1990s TB outbreak was most prominent.

## Analysis

### I. Risk Factors and Mechanisms of TB Transmission Among the Homeless

Homelessness in the U.S stands out as an endemic social problem, with prevalence rates between 200-500% greater than those in Western European countries [31]. Among all developed nations, the highest concentration of homeless people occur in the traditionally poorest areas of large urban settings [16]. Though structural forces such as housing policy are crucial in shap-

ing these settings, the literature relevant to my aim largely focuses on the lived experience of poverty in evaluating risk. A study regressing structural risk factors with homeless rates in 52 U.S metropolitan areas demonstrated that poverty rates strongly affect homelessness, more so than factors such as lack of affordable housing, unemployment rates, and impact of government benefits [12]. This finding adds a new dimension to preceding literature that describes homelessness as a macro-economic and housing problem [12]. In regards to poverty, characterizing the homeless became more flexible with the emergence of new homelessness in the 1980s, as homeless status was conferred from middle-aged, single men with chronic drug or alcohol addictions, onto new and different groups not previously identified as homeless [30, 22, 16]. These groups are vulnerable to poverty and include families, women, youth, the elderly, and marginalized ethnic or migrant groups experiencing episodic bouts of absolute homelessness, insecure housing, or inadequate housing (ibid).

In urban settings, crowded emergency shelters have been identified as the primary origins for the U.S tuberculosis epidemic in the 1990s [31]. However, outside of homeless shelters it is unclear what characteristics of the urban environment may foster TB outbreaks. To address broader determinants of TB

transmission in urban environments, a systematic review examined population-based studies that attempted to quantitatively identify risk factors for geographic clustering of tuberculosis cases [10]. Prevalence of homelessness was not a statistically significant risk factor for clustering, though percent locally born, percent pulmonary TB, percent HIV-seropositive, and percent alcohol abuse had positive influences, while mean age had a negative influence on clustering [10]. Though homelessness was not a significant predictor of clustering, a high proportion of locally born people in an area probably indicates a lack of mobility due to poverty or poor health, which may covary with other variables investigated, such as alcohol abuse, HIV seropositivity, and homelessness.

### **The New York City Case Study**

There is a large body of literature discussing the tuberculosis transmission among homeless populations in New York City (NYC) in the 1990s, when citywide TB incidence rates peaked upwards of 3,000. However, by 2006 TB case rates in the city were still three times higher than the national average [17]. Due to the quantity and methodological quality of research in response to this issue, NYC provides an informative case study for analyzing homelessness and TB transmission over time. The re-emergence of tuberculosis there

and throughout the world has largely been attributed to the AIDS epidemic. However, rises in homelessness predating AIDS have also contributed to the resurgence [5], though this is unexplored in the literature. Evidence from a cross-sectional survey of high-risk homeless men residing in a NYC shelter revealed that total time homeless correlated positively with active and latent tuberculosis infection, and most cases of active tuberculosis were among individuals with AIDS or AIDS-related complexes [33]. This finding has important policy implications – if someone is more likely to acquire TB the longer they have been homeless, then interventions may target treatment towards the chronically homeless, and surveillance/preventative measures towards the newly homeless, as well as those with HIV/AIDS.

Noncompliance with TB treatment among the homeless is associated with behavioral factors and pre-existing health conditions such as HIV/AIDS, and may lead to multiple drug resistance. A retrospective study resembling a case-control design demonstrates this by examining TB cases in an urban community hospital in New York City, and comparing frequency of drug resistant strains between homeless and non-homeless populations [27]. Drug resistance was found to be significantly higher among homeless populations, and particularly among those

with HIV/AIDS. Drug resistance was also significantly higher among black populations (*ibid*). The link between HIV/AIDS and TB in the urban homeless is also evident in a prospective cohort study of 224 TB patients admitted to a hospital in New York City in 1988 [5]. Of total patients discharged on TB treatment, 89% were lost to follow-up and failed to complete therapy, and 27% of discharged patients were readmitted within 12 months with confirmed active TB. Noncompliance with treatment was significantly associated with having AIDS or an AIDS-related complex, homelessness, and alcoholism (*ibid*). Because HIV infection and tuberculosis affect subpopulations with high rates of substance abuse and homelessness, treatment noncompliance is a particular issue.

These trends hold true in other U.S cities, even on the opposite coast. Analysis of TB surveillance data on high-risk populations in San Francisco from 1993 through 2005 reveals that the timing of contacts with HIV positive individuals and emergence of new TB cases is temporally consistent as a matter of cause-preceding-effect. This supports the theory that HIV is a key factor in sustaining TB transmission among the homeless in San Francisco [23]. Self-reported health and behavioral characteristics of patients is another (albeit limited) means of evaluating risk factors

for TB infection. A study assessed perceived health status of homeless adults with latent TB undergoing a treatment program in Los Angeles [25]. Women were more likely than men to self-report worse overall and mental health status, as well as using drugs daily. Homeless adults reporting worse health were more likely to have used injection drugs, to report depressive symptoms and poor mental health, and also to be homeless for more than three years. This supports the previously discussed finding of Torres et al. (1990) that the chronically homeless are more likely to experience poor health, TB, and/or HIV infection, which may be compounded by behavioral risk factors.

## II. Methods for Monitoring Tuberculosis Transmission Among the Urban Homeless

Contact investigations are monitoring methods that aim to establish transmission pathways from person-to-person, and involve having TB patients list close contacts [18]. However, this technique can be difficult in homeless populations because it requires patients to divulge personal and sensitive information. Improving interview skills of contact investigation workers may help establish trust and make homeless TB patients more willing to provide information, thereby increasing the number of contacts identified among homeless populations (*ibid*).

In contrast to contact investigations, analyzing the genetic information of TB infection within populations may reveal transmission networks and sites that might not otherwise be discovered. In a recent study, *Mycobacterium* genotype clusters associated with outbreaks among homeless adults in New York City allowed researchers to identify and differentiate risk factors linked with particular strains of the bacteria [17]. TB cases in clusters of strains that have circulated in a community over an extended period require additional investigation as to whether clustering resulted from recent TB transmission, or reactivation of remote infection (ibid). Another study in Denver, Colorado used DNA fingerprinting of *Mycobacterium tuberculosis* from positive cases identified by homeless shelter screening, to identify cases resulting from recent transmission. Cases with identical DNA fingerprints clustered within two years served as an indicator for recent transmission, and researchers saw that the frequency of these clusters decreased over four years, in which the screening program was implemented, indicating that early screening at the shelter was effective in limiting TB transmission [13]. This monitoring method is thus capable of assessing treatment effectiveness in addition to descriptive transmission patterns. In another study, DNA finger-

printing was combined with medical histories and interviews to identify epidemiological connections and clusters between TB cases around the Washington D.C area [15]. Through these methods, over half of the cases were connected directly to a large urban homeless shelter, or were connected by time and place pending histories of homelessness, social networks, and shared boarding or transitional housing (ibid). This suggests that mixed monitoring methods involving personal interviews and contact investigations, in addition to genetic analysis, may prove most effective.

### III. Methods for Treating Tuberculosis Cases Among the Urban Homeless

The task of treating TB in homeless populations provides a compelling opportunity for collaboration between diverse public and private agencies at the municipal level. The Centers for Disease Control and Prevention (CDC) has clearly outlined priorities for TB prevention and control programs to evaluate transmission pathways through contact investigation, and to treat TB patients with latent or active infections [30]. However, the capacity for these plans to address the needs of homeless populations has varied in practice, as demonstrated by the following examples.

An urban homeless shelter in Charleston, South Carolina successfully

implemented a prevention and control plan addressing priorities highlighted by the CDC, involving collaboration between different municipal institutions [20]. The program involved screening new guests to the shelter for TB within a week of arrival and every six months from thereon, while a public health nurse provided preventative therapy at the shelter twice a week. This program had a 77% therapy completion rate for TB patients (a dramatic success in comparison to the 11% completion rate found by the aforementioned Brudney and Dobkin study in NYC), and the authors attribute this success to the collaboration between the shelter, a nursing clinic, and the local health department.

In Baltimore, Maryland a resource-intensive alternative to existing City Health Department TB treatment programs for the homeless increased treatment completion rates from 11% to 33% [14]. The improvement seems modest, but is in fact three-fold. The program involved collaboration between a faith-based organization, an academic institution, and local government. The collaborative effort provided intensive tracking and coaching interventions for homeless TB patients over a nine-month period. Given the modest improvements in treatment completion relative to conventional programs, however, the feasibility of implementing such a resource-intensive treatment collaborative pro-

gram may be limited in other settings (ibid). Importantly, the authors acknowledge that nurses are integral in developing supportive relationships with homeless patients, and in providing primary care. The importance of nurses also comes through in a cross-sectional study in Los Angeles, California [26]. The study assessed predictors of therapy completion among homeless TB patients who received either a nurse case-managed program or a usual program without a nurse. Treatment completion was significantly and positively associated with participation in nurse case-managed program, older age, and less illicit drug use (ibid). The nurse case-managed program also predicted satisfaction with treatment and greater TB knowledge, indicating that this approach to treatment may prove a viable option among groups such as the homeless, who are transient and difficult-to-treat by conventional methods (ibid).

Other methods to monitor and control tuberculosis transmission include rapid genotyping systems [6] and computer simulation models [4]. A simulation model revealed that improving access to treatment among homeless populations with active and latent TB was more effective in reducing TB cases and deaths over ten years, in comparison to improvements in the effectiveness of the treatment programs (ibid). This suggests that intervention studies similar

to those just discussed should also address the extent to which homeless populations would be able to access programs under investigation, rather than program effectiveness in isolation.

## Discussion

The ways in which urban homelessness affects and is affected by re-emergence of tuberculosis are largely influenced by national and international social, political, and economic forces, including urban housing markets, social networks, employment trends, and government spending on social welfare programs [22, 16]. These forces manifest themselves in terms of the risk factors and transmission mechanisms that pattern my preceding discussion of TB incidence, monitoring methods, and treatment methods. While homeless shelters provide a social safety net for those without secure housing, my analysis demonstrates that over the past twenty years they have proven extremely important in proliferating and sustaining active tuberculosis infection and transmission among homeless populations. Monitoring and treating these groups is extremely difficult due to their transient nature and social marginalization – that is, TB patients that are homeless are more likely to not comply with treatment or surveillance efforts.

In reference to broader struc-

tural forces, framing discourse of new or re-emerging tuberculosis in terms of new homelessness could respond to McMichaels (2004) contemporary human-microbe transition, brought on by widespread demographic, environmental, and technological change in human ecology, and compounded by the improper use of antibiotics. While determinants of TB emergence have recurred throughout history, social and environmental changes of unprecedented complexity and intensity have created more opportunities for emergence and re-emergence than ever before [3, 24]. However, my analysis has demonstrated that the literature does not adequately address the dynamic nature of homelessness and its effects on tuberculosis transmission within urban U.S. populations. That is, the literature neglects the new homeless, characterized by more episodic rather than chronic states of homelessness, families, women, youth, and minority populations experiencing a wide range of insecure or inadequate housing circumstances [16]. These homeless populations do not fit into the models of homelessness discussed in the literature on urban TB transmission in the U.S. over the past twenty years. The new homeless tend to rely on social networks and transitional housing rather than homeless shelters for housing assistance (*ibid*), and may be characterized by a different set of risk factors for

TB acquisition than factors such as drug use, HIV/AIDS infection, and treatment noncompliance, which dominate this paper's analysis of transmission. Differing transmission pathways will, in turn, affect what TB monitoring and treatment methods are best suited to these populations.

## Conclusion

My analysis demonstrates that tuberculosis transmission among the urban homeless in the U.S is characterized by pre-existing HIV/AIDS complexes, alcohol abuse, intravenous drug use, poverty, and treatment noncompliance, and the resulting development of drug resistant strains. Diverse methodological developments to monitor and treat TB cases have achieved varying levels of success, while mixed methods for monitoring transmission and collaborative, nursing-based treatment programs have shown the strongest results. However, the literature overall lacks discussion of how the changing nature of urban homelessness,

specifically the emergence of the new homeless within the past three decades, has affected TB transmission in the U.S. This discussion would have important implications for evaluating which methods are most appropriate to monitor and treat particular cases. The case studies explored in this paper of localized TB outbreaks within urban American homeless populations create an enriching and descriptive mosaic of how TB transmission varies with particular risk factors. However, there is a need for more dynamic research to address how these patterns are changing in the context of broader structural trends in the U.S, such as housing and social welfare policies, as well as economic and social change.

*Katie is finishing her B.A Honours degree in Geography, and looks forward to co-founding a small organic vegetable farm this summer in New Mexico! Besides agriculture, she is interested in the impacts of urban policy on health and environmental equity worldwide.*

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