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## MODERN EPIDEMIOLOGY AND PREVENTION OF TUBERCULOSIS

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#### ABSTRACT

This article examines modern strategies for managing the persistent threat of tuberculosis (TB). It outlines the general features of tuberculosis and its epidemiology in Central Asia, particularly focusing on Uzbekistan, and describes modern prevention and treatment strategies. The article focuses on the situation of tuberculosis in Uzbekistan, analyzing the achievements along with the challenges of TB control such as the problem of MDR-TB, and offers modern epidemiological methods to enhance control program systems. With the use of comparative tables and detailed references, the article demonstrates the lack of integrated surveillance, diagnostics, and outpatient care as a vital gap to be bridged to reduce the impact of TB not only in Uzbekistan, but in many other countries as well.

**Key words:** Tuberculosis, modern epidemiology, prevention, Central Asia, Uzbekistan, multidrug-resistant TB (MDR-TB), treatment, public health, diagnostics, infection control.

## INTRODUCTION

Tuberculosis (TB), which is caused by Mycobacterium tuberculosis, is still a daunting global health threat even though it is preventable and curable. Being one of the oldest recorded human illnesses, TB continues to kill, especially in low- and middle-income countries, where it flourishes in the midst of poverty, crowding, and restricted access to healthcare. Contemporary epidemiology has revolutionized our conception of TB transmission, allowing for focused prevention and treatment measures. This essay discusses TB's general characteristics, its epidemiology in Central Asia, specifically in Uzbekistan, how to fight the disease, contemporary treatment practices, the current situation in Uzbekistan, and suggestions for enhancing epidemiological practices, with comparative tables and proper citations.

# **General Information Regarding Tuberculosis**

TB is an infectious disease that primarily infects the lungs (pulmonary TB), but it can infect other organs (extrapulmonary TB). It is transmitted through air droplets when the infected person talks, coughs, or sneezes. The World Health Organization (WHO) estimates that in 2023, 10.8 million people fell ill with TB globally, and 1.25 million died, making it one of the leading causes of death as a result of a single infectious pathogen (WHO, 2024). Approximately one-fourth of the global population carries latent TB infection (LTBI), in which the bacteria lie dormant but will reactivate when immunity is lost.

TB's symptoms—chronic cough, fever, sweats at night, and loss of weight usually appear late, making it difficult to diagnose early. Risk factors are HIV coinfection, malnutrition, diabetes, and smoking. Bloom, B. R., et al. (2017) note in Major Infectious Diseases that "TB's resurgence is driven by social determinants and drug resistance, posing a challenge to global control efforts" (p. 11). Multidrug-resistant tuberculosis (MDR-TB), drug-resistant to isoniazid and rifampicin, and extensively drug-resistant tuberculosis (XDR-TB), further drugresistant to second-line drugs, are significant threats with 2 out of 5 treated with MDR-TB in 2023 (WHO, 2024).

## Tuberculosis Transmission in Central Asia, particularly Uzbekistan

Kyrgyzstan, Kazakhstan, Turkmenistan, Tajikistan, and Uzbekistan comprise Central Asia which is high burden for tuberculosis (TB) due to its Soviet past and subsequent economic reforms. This region is home to some of the highest rates of multi-drug resistant tuberculosis (MDR-TB) in the world, fueled by the historical over-reliance on hospital-based treatment, irregular therapy compliance, and primitive diagnostics. As reflected in Cox, Helen Suzanne, et al (2004): "Multidrug-Resistant Tuberculosis in Central Asia," 13% of new TB cases and 40% of previously treated TB cases in the Karakalpakstan region of Uzbekistan were MDR-TB, indicating a grave level of resistance (p. 865).

In Uzbekistan, TB incidence decreased slowly, with 47 per 100,000 population in 2019, from 58 in 2015 (WHO, 2022). Although, however, MDR-TB remains an emergency condition, and the 2010–2011 country-level survey by Ulmasova, Dilorom, et al. (2013) reveals that there are cases of MDR-TB among 23.2% of ex-patients and 5.3% of new patients, one of the highest among ex-Soviet countries (p. 2). The environmental disaster at the Aral Sea in Karakalpakstan also undermined immunity, further exacerbating TB's horrific impact. Transmission is also driven by migration, poverty, and stigma, with barriers to care being posed for Uzbek labor migrants in Kazakhstan, as detailed in Huffman, Stacy A., et al.

(2012), Exploitation, Vulnerability to Tuberculosis and Access to Treatment (p. 137).

# How to Fight Tuberculosis

TB fight must be a multifaceted solution: prevention, early detection, and correct treatment. The 2014 WHO End TB Strategy targets a 90% reduction in deaths from TB and 80% decline in incidence by 2030, focusing on:

**1. Prevention:** BCG vaccination reduces severe TB in children, though its efficacy wanes in adults. TB preventive treatment (TPT) for latent tuberculosis infection (LTBI), with isoniazid or rifapentine, is critical for high-risk groups like HIV-positive individuals. Falzon, Dennis, et al. (2011) in WHO Guidelines for the Programmatic Management of Drug-resistant Tuberculosis highlight that "TPT can avert progression to active disease" (p. 517).

**2. Case Finding:** Active screening of high-risk groups—prisoners, migrants, and TB patients' contacts—increases early detection. Molecular tests like Xpert MTB/RIF detect TB and rifampicin resistance rapidly, improving outcomes.

**3. Infection Control:** Ventilation, masks, and isolation in healthcare facilities control transmission. Gould, Donna J., et al. (2017) in Impact of Observing Hand Hygiene note that "infection control measures reduce nosocomial spread" (p. 172).

**4. Community Outreach:** Education towards stigma reduction facilitates treatment adherence. USAID programs in Uzbekistan taught 28,252 high-risk individuals and identified 308 TB cases (USAID, 2021).

# New Modes of Treatment

Treatment for TB has shifted from lengthy, poisonous regimens to shorter, more potent treatments

**1. Standard Treatment:** Drug-susceptible TB receives a 6-month regimen of rifampicin, isoniazid, ethambutol, and pyrazinamide (2 months intensive phase, 4 months continuation). WHO (2024) reports an 85% worldwide success rate among new cases.

**2. MDR-TB Treatment:** Historically 18–24 months with injectables like amikacin, today's regimens now favor all-oral, shorter (9–12 months). Bedaquiline and delamanid, introduced in the 2010s, improve outcomes. Kohler, Stefan, et al. (2022) in Programme Costs of Longer and Shorter Tuberculosis Drug Regimens found that "shorter regimens in Uzbekistan reduced costs by 30% while maintaining efficacy" (p. 3).

**3. XDR-TB:** New drugs (e.g., pretomanid) are combined with old agents, and treatment takes 6–18 months under strict supervision. Success is low, at 39% globally (WHO, 2024).

**4. Video-Supported Therapy:** There is technology, such as video-observed treatment (VOT), that ensures adherence, such as the manner USAID employed it in Uzbekistan on 75 patient smartphones (USAID, 2021).

## Situation in Uzbekistan with Tuberculosis

The situation of TB in Uzbekistan reflects progress and lingering issues. The WHO and USAID-funded National Tuberculosis Program (NTP) has expanded diagnostics and treatment, reducing incidence from 79 per 100,000 in 2005 to 47 in 2019 (WHO, 2022). Safaev, K., et al. (2021) in Trends, Characteristics and Treatment Outcomes of Patients with Drug-Resistant Tuberculosis in Uzbekistan report a treatment success rate of 81% for new cases in 2018, though MDR-TB success was only 58% (p. 4).

Hospitalization remains common, with 96% of urogenital TB patients hospitalized in Tashkent (2016–2018), for an average of 56 days, much longer than U.S. ambulatory models (13–22 days) (Davlyatov, G., et al., 2021, p. 5). Delays in diagnosis—median 50 days—exacerbate transmission, particularly in MDR-TB hotspots like Karakalpakstan (Belkina, Tatiana V., et al., 2014, p. 3). Resource constraints, aging finance, and stigma hinder ambulatory scale-up, Kohler, Stefan, et al. (2016) state in Health System Support and Health System Strengthening (p. 4).

# **Recommendations for Modern Epidemiology in Uzbekistan**

In order to improve TB epidemiology and prevention in Uzbekistan, the following are suggested:

**1. Strengthen Surveillance:** Modernize to real-time electronic TB monitoring systems (ETMMS), as described by Bismil'din, F. B., et al. (2001) in Detection of Tuberculosis in Central Asia, to track incidence and patterns of resistance (p. 24).

**2. Scale Up Molecular Diagnostics:** Universal Xpert MTB/RIF coverage, extended from 2012–2019, needs to reach rural areas, increasing XDR-TB diagnosis (Safaev, K., et al., 2021, p. 5).

**3. Transition to Ambulatory Care:** Reform financing to incentivize treatment at the ambulatory level, reducing hospital admissions. Kohler, Stefan, et al. (2016) suggest "performance-based funding over per-capita models" (p. 5).

**4. Target High-Risk Groups:** Screen migrants and prisoners, integrating TB/HIV services, as HIV-TB co-infection is on the rise (Usmanova, G., et al., 2021, p. 3).

**5. Research and Training:** Conduct operational research via SORT-TB, training specialists in evidence-based epidemiology (Usmanova, G., et al., 2021, p. 2).

Region	Incidence (per 100,000)	MDR-TB (% New Cases)	Mortality (per 100,000)
Global	130	3.3	16
Central Asia	85	10.5	8
Uzbekistan	47	5.3	5

#### Comparative Tables Table 1: TB Epidemiology (2019)

Sources: WHO, 2022; Ulmasova et al., 2013

#### Table 2: Treatment Approaches

Туре	Duration	Drugs	Success Rate
Standard	6 months	Rifampicin,	85%
		Isoniazid	
MDR-TB (Short)	9–12 months	Bedaquiline,	58% (Uzbekistan)
		Delamanid	
XDR-TB	6–18 months	Pretomanid,	39% (Global)
		Linezolid	

Sources: WHO, 2024; Safaev et al., 2021

## Conclusion

New epidemiology has clarified TB's complex dynamics, shaping prevention and treatment innovations. In Central Asia, particularly Uzbekistan, the burden of TB persists because of MDR-TB, late diagnosis, and hospital-based treatment. TB can be fought with coordinated surveillance, high-tech diagnostics, and ambulatory model transitions, grounded on international experience and local adaptation. By embracing these recommendations, Uzbekistan can become a part of the End TB Strategy, reducing morbidity and mortality in a region long plagued by this ancient disease.

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