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PREVENTION OF PULMONARY TUBERCULOSIS: CHALLENGES, SOLUTIONS, AND MODERN APPROACHES

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Annotation: This article provides a comprehensive overview of the preventive measures aimed at reducing the incidence and spread of pulmonary tuberculosis. The epidemiological aspects of tuberculosis, its transmission mechanisms, and the influence of social, medical, and biological factors are discussed in detail. Various levels of prevention—including primary, secondary, and tertiary—are examined, along with the importance of BCG immunization, early detection of infectious sources, adoption of a healthy lifestyle, and adherence to sanitation and hygiene practices. Additionally, strategies to prevent drug-resistant tuberculosis, the role of the internationally recognized DOTS approach, public awareness campaigns, and rehabilitation measures for affected patients are analyzed. The article emphasizes the necessity of a multidisciplinary and systematic prevention program to effectively combat tuberculosis and underscores the importance of prioritizing preventive healthcare approaches within modern public health systems.

Keywords: Pulmonary tuberculosis, TB prevention, BCG vaccination, immunization, epidemiology, sanitation and hygiene, DOTS strategy, multidrug-resistant tuberculosis (MDR-TB), early detection, public health, healthy lifestyle, infection control, rehabilitation.

Introduction

Pulmonary tuberculosis (TB), caused by *Mycobacterium tuberculosis*, is an infectious disease primarily affecting the lungs and is transmitted through airborne droplets. Although global TB incidence has shown a gradual decline, the disease remains one of the most pressing challenges for public health. Millions of people worldwide are affected each year. Despite significant progress, socioeconomic disparities, limited access to healthcare, HIV co-infection, and the emergence of drug-resistant TB forms continue to complicate TB control efforts.

Uzbekistan has implemented extensive prevention and control programs to reduce TB incidence, and notable progress has been achieved. However, comprehensive preventive measures must remain a priority to maintain and enhance these achievements.

This article explores key preventive measures, including immunization, screening, sanitation and hygiene, healthy lifestyle promotion, social support, the DOTS strategy, and rehabilitation.

1. Epidemiology and Factors Contributing to TB Transmission

1.1. Epidemiological Situation

Tuberculosis remains widespread, especially in low- and middle-income countries. Its prevalence is influenced by:

- high population density,
- poor sanitation conditions,
- limited access to medical services,
- poverty and malnutrition.

1.2. Mechanism of Transmission

TB is transmitted primarily via airborne droplets expelled when an infected person talks, coughs, or sneezes. These droplets may be inhaled by individuals nearby, leading to infection.

1.3. Personal Risk Factors

Individuals at increased risk include:

- people living with HIV,
- individuals with weakened immune systems,
- smokers,
- patients with chronic illnesses such as diabetes or chronic lung diseases.

2. Major Directions of Tuberculosis Prevention

Tuberculosis prevention is typically categorized into three levels:

1. **Primary prevention** — preventing the disease before it occurs.
2. **Secondary prevention** — early detection and timely treatment.
3. **Tertiary prevention** — reducing complications and disability after illness.

3. Importance of BCG Vaccination

3.1. Role of the Vaccine

BCG vaccination is primarily intended to:

- prevent severe forms of TB in children,
- reduce the risk of TB meningitis,
- stimulate immunological resistance to TB infection.

3.2. Vaccination Schedule

In Uzbekistan, BCG vaccination is administered to newborns within the first days of life.

4. Early Detection of Infectious Sources

4.1. Screening Methods

Early identification of TB cases is a key factor in breaking the chain of transmission. Screening includes:

- annual fluorography,
- sputum smear microscopy,
- molecular tests such as GeneXpert.

4.2. High-Risk Groups

Screening is particularly important for:

- healthcare workers,
- individuals living with HIV,
- prison populations,
- those who have had close contact with TB patients.

5. Healthy Lifestyle as a Protective Factor

5.1. Strengthening Immunity

A balanced diet rich in proteins, vitamins, and minerals supports immune function.

5.2. Avoidance of Smoking and Alcohol

Smoking increases TB susceptibility severalfold, while excessive alcohol intake weakens immunity.

5.3. Stress Management

Chronic stress negatively affects immune defense responses, increasing vulnerability to infections.

6. Sanitation and Hygiene Measures

6.1. Ventilation

Regular ventilation of indoor spaces significantly reduces the risk of TB transmission.

6.2. Use of Protective Masks

Masks are essential for infected individuals and those in close contact with them to prevent droplet spread.

7. Addressing Social Determinants of TB

7.1. Housing Conditions

Cramped living spaces and unsanitary environments promote TB transmission.

7.2. Nutritional Support Programs

Adequate nutrition helps strengthen the immune system and reduces susceptibility to infection.

7.3. Public Awareness

Educational programs and public health campaigns help increase awareness and encourage early medical consultation.

8. Multidrug-Resistant Tuberculosis (MDR/XDR-TB)

8.1. Causes of Drug Resistance

Drug resistance often develops as a result of:

- incomplete treatment,
- irregular medication intake,
- improper or inadequate therapy.

8.2. Prevention of MDR-TB

The DOTS strategy aims to ensure patients take medications under direct supervision, preventing treatment failure and resistance.

9. DOTS Strategy

The DOTS (Directly Observed Treatment, Short-course) strategy includes:

1. political commitment,
2. early diagnosis,
3. supervised drug administration,
4. consistent drug supply,
5. Proper monitoring and reporting.

10. Rehabilitation and Tertiary Prevention

TB may cause lasting complications, including lung scarring and respiratory insufficiency. Rehabilitation measures include:

- breathing exercises,
- physiotherapy,
- psychological support,
- balanced nutrition,
- Physical rehabilitation programs.

Conclusion

Pulmonary tuberculosis is a serious yet preventable disease. Effective prevention relies on a combination of immunization, screening, healthy lifestyle promotion, sanitation and hygiene compliance, DOTS-based treatment supervision, and social support. A comprehensive preventive strategy plays a crucial role in reducing TB incidence and protecting community health.

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