

Characteristics of *Mycobacterium tuberculosis* Infection and its Medications

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DESCRIPTION

Mycobacterium tuberculosis (*M. tuberculosis*) is the causative agent of Tuberculosis (TB), a disease that has plagued humanity for thousands of years. Despite advances in medical science, TB remains a significant global health challenge, particularly in developing countries. *M. tuberculosis* is a slow-growing, acid-fast bacterium. Its complex cell wall, rich in lipids, makes it resistant to many common antibiotics and gives it the ability to survive within host macrophages. This ability to evade the host's immune system contributes to the chronic nature of TB infections.

Transmission and infection

TB is primarily transmitted through airborne droplets when an infected person coughs or sneezes. Once inhaled, the bacteria can settle in the lungs, where they may remain dormant for years. This latent infection can reactivate, leading to active TB, which can be fatal if not treated properly. Diagnosing TB can be challenging due to its nonspecific symptoms and the limitations of diagnostic tools. The standard treatment for TB is a combination of antibiotics taken over several months. However, the emergence of Multidrug-Resistant (MDR) and Extensively Drug-Resistant (XDR) strains of *M. tuberculosis* has complicated treatment and control efforts. TB is a leading cause of death worldwide, particularly in low- and middle-income countries. The World Health Organization (WHO) estimates that approximately 10 million people fell ill with TB in 2020 alone. The disease disproportionately affects vulnerable populations, including those with HIV/AIDS, malnourished individuals, and those living in crowded conditions.

Challenges and future directions

Efforts to control TB face several challenges, including:

Drug resistance: Strains of *Mycobacterium tuberculosis* have emerged that are resistant to the drugs commonly used to treat TB. Multi-Drug Resistant TB (MDR-TB) and Extensively Drug-Resistant TB (XDR-TB) are significant public health concerns.

Diagnosis: Accurate and early diagnosis remains a challenge, particularly in resource-poor settings.

Vaccination: The only available vaccine, BCG, has limited effectiveness, and new vaccines are urgently needed.

Social and economic factors: Poverty, lack of access to healthcare, and stigma associated with TB hinder prevention and treatment efforts.

Despite these challenges, there is confidence for future generations. Increased funding, research, and international collaboration are essential to developing new diagnostic tools, treatments, and vaccines. Public health initiatives that address the social determinants of TB are also crucial for controlling this ancient disease. *Mycobacterium tuberculosis* is the causative agent of Tuberculosis (TB), a disease that primarily affects the lungs but can also target other parts of the body.

Applications of *Mycobacterium tuberculosis*

Gram-positive bacteria: Though it is a Gram-positive bacterium, it doesn't stain well with the Gram stain due to its unique cell wall. Instead, it's detected using the acid-fast stain because of its waxy cell wall.

Rod-shaped: It is a bacillus, meaning it has a rod-like shape.

Slow growing: *Mycobacterium tuberculosis* is a slow-growing bacterium, which can make laboratory culture and diagnosis time-consuming.

Aerobic: It requires oxygen to survive and is thus an obligate aerobe.

Cell wall composition: The cell wall of *Mycobacterium tuberculosis* is rich in mycolic acid, a complex lipid. This waxy coat makes the bacterium resistant to many common antibacterial agents and also to drying out.

Pathogenicity: It has the ability to survive and multiply within macrophages, the very cells that are supposed to destroy pathogens. This characteristic contributes to its virulence and ability to cause disease.

Transmission: It is primarily transmitted from person to person through airborne droplets when an infected person coughs, sneezes, or talks.

Latent infection: After inhalation, many people don't immediately develop active TB. Instead, they have a latent TB infection where the bacteria remain dormant but alive in the body and can become active later.

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CONCLUSION

Mycobacterium tuberculosis is a complex and resilient pathogen that continues to pose a significant global health threat. The battle against TB requires a multifaceted approach that combines

scientific innovation with social and economic interventions. The lessons learned from the ongoing fight against TB will undoubtedly inform future efforts to control other infectious diseases, reflecting the enduring importance of understanding this remarkable bacterium.