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TREATMENT EFFECTIVENESS IN PATIENTS WITH TUBERCULOSIS AND DIABETES MELLITUS

Ergashov Behruz Komilovich

Assistant at Asia International University

Abstract

Tuberculosis (TB) and diabetes mellitus (DM) comorbidity represents a significant global health challenge. Diabetes increases the risk of developing active TB, worsens disease progression, delays sputum conversion, and negatively affects treatment outcomes. This study aims to evaluate treatment effectiveness in patients with TB-DM comorbidity based on current international evidence. According to the World Health Organization (WHO), approximately 10.7 million people developed TB in 2024, with 1.23 million deaths. Additionally, around 0.93 million incident TB cases were attributable to diabetes. The global burden of diabetes is also increasing, with 589 million adults affected worldwide in 2025 according to the International Diabetes Federation (IDF). Recent meta-analyses demonstrate that optimal glycemic control is associated with improved TB treatment outcomes, reduced sputum positivity, and fewer cavitary lesions. However, high-quality randomized evidence remains limited. Integrated screening, regular glycemic monitoring, and combined management strategies are essential to improve therapeutic effectiveness in TB-DM patients.

Keywords

tuberculosis, diabetes mellitus, comorbidity, treatment outcomes, glycemic control, sputum conversion, HbA1c

Introduction

Tuberculosis remains one of the leading infectious causes of morbidity and mortality worldwide. According to the WHO Global Tuberculosis Report 2025, approximately 10.7 million individuals developed TB in 2024, and 1.23 million deaths were recorded.

Diabetes mellitus has emerged as a major non-communicable epidemic. The International Diabetes Federation reported that 589 million adults were living with diabetes in 2025, with a substantial proportion remaining undiagnosed.

The coexistence of TB and DM significantly complicates disease management. Diabetes impairs innate and adaptive immune responses, particularly macrophage function, thereby increasing susceptibility to Mycobacterium tuberculosis infection. WHO estimates that diabetes increases the risk of developing TB by 2–3 times, doubles mortality risk, and increases relapse risk up to fourfold.

Given these interactions, assessing treatment effectiveness in TB patients with diabetes is critical for improving clinical outcomes and reducing global disease burden.

Aim

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To evaluate treatment effectiveness in patients with tuberculosis and diabetes mellitus based on current international evidence and to analyze clinical and prognostic factors influencing outcomes.

Materials and Methods

This study is a narrative review based on international scientific literature. Sources include:

- WHO Global Tuberculosis Report (2025)
- WHO TB-Diabetes guidelines
- IDF Diabetes Atlas (2025)
- Systematic reviews and meta-analyses (2019–2025)

The following outcomes were analyzed:

- Treatment success rate
- Mortality
- Relapse rate
- Sputum conversion
- Cavitary lung lesions
- Glycemic control (HbA1c, fasting glucose)

Results and Discussion

1. Diabetes Reduces TB Treatment Effectiveness

A systematic review (Huangfu et al., 2019) showed:

- Mortality risk: OR = 1.88
- Relapse risk: OR = 1.64
- MDR-TB risk: OR = 1.98

These findings indicate that diabetes significantly worsens TB treatment outcomes.

2. Optimal Glycemic Control Improves Outcomes

A 2024 meta-analysis (n = 6919 patients) demonstrated:

- Improved treatment success: RR = 1.13
- Reduced sputum positivity: RR = 0.23
- Reduced cavitary lesions: RR = 0.59

This confirms the importance of glycemic control in TB management.

3. Poor Glycemic Control is a Negative Prognostic Factor

A 2025 systematic review found:

- Treatment failure risk increased: RR = 1.91
- Persistent sputum positivity at 3 months: RR = 2.97

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Uncontrolled hyperglycemia significantly delays recovery.

4. Evidence Limitations

Despite promising associations, recent analyses (PLOS One, 2025) emphasize the lack of high-quality randomized controlled trials. Therefore, further research is needed to establish causality.

5. WHO Recommendations

WHO recommends:

- Bidirectional screening (TB patients for DM and vice versa)
- Regular monitoring of blood glucose and HbA1c
- Integrated management of TB and diabetes

Table 1. Global TB-DM Burden and Risk Indicators

Indicator Value	**Indicator Value**
Global TB cases (2024) 10.7 million	Global TB cases (2024) 10.7 million
TB deaths (2024) 1.23 million	TB deaths (2024) 1.23 million
TB cases attributable to diabetes 0.93 million	TB cases attributable to diabetes 0.93 million
Global diabetes prevalence (2025) 589 million	Global diabetes prevalence (2025) 589 million
Mortality risk in TB-DM OR 1.88	Mortality risk in TB-DM OR 1.88
Relapse risk OR 1.64	Relapse risk OR 1.64
MDR-TB risk OR 1.98	MDR-TB risk OR 1.98

Table 2. Impact of Glycemic Control on TB Outcomes

Outcome Relative Risk (RR)	**Outcome Relative Risk (RR)**
Treatment success improvement 1.13	Treatment success improvement 1.13
Reduction in sputum positivity 0.23	Reduction in sputum positivity 0.23
Reduction in cavitary lesions 0.59	Reduction in cavitary lesions 0.59
Treatment failure (poor control) 1.91	Treatment failure (poor control) 1.91
Persistent sputum positivity 2.97	Persistent sputum positivity 2.97

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Figure 1: Risk Increase in TB-DM Patients

- Mortality: 1.88
- Relapse: 1.64
- MDR-TB: 1.98
- Treatment failure: 1.91
- Sputum positivity (3 months): 2.97

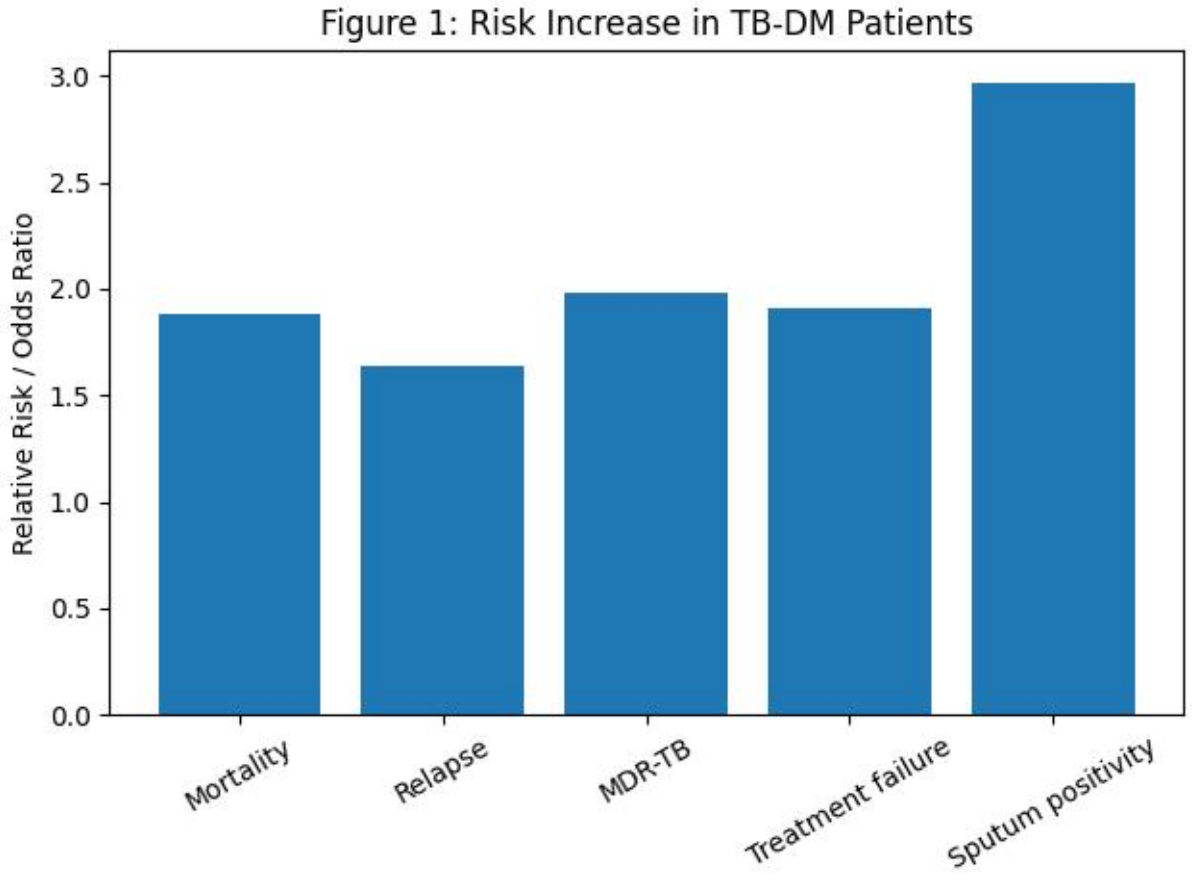

Figure 2: Benefits of Glycemic Control

- Treatment success: 1.13
- Sputum reduction: 0.23
- Cavitary reduction: 0.59

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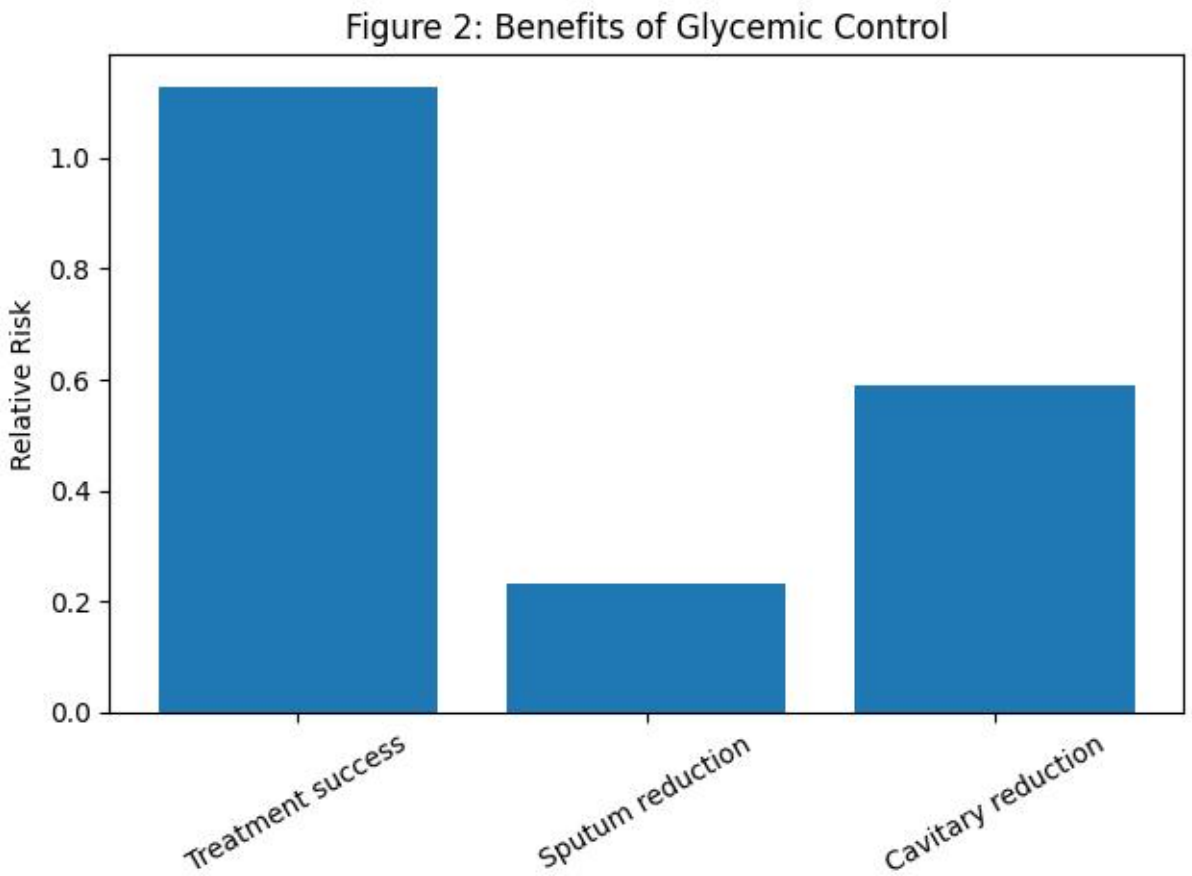

Clinical Implications

To improve treatment outcomes in TB-DM patients:

1. Implement routine diabetes screening in all TB patients
2. Screen diabetic patients for TB in high-risk settings
3. Monitor HbA1c and blood glucose regularly
4. Ensure early sputum conversion monitoring
5. Apply integrated care involving both endocrinologists and TB specialists

Conclusion

Tuberculosis and diabetes mellitus comorbidity significantly reduces treatment effectiveness and worsens clinical outcomes. Diabetes increases the risk of mortality, relapse, and drug-resistant TB. However, optimal glycemic control can improve treatment success, reduce sputum positivity, and decrease disease severity. Integrated management and early detection strategies are essential. Further high-quality studies are required to strengthen evidence-based guidelines.

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