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Original Research Report

Comprehensive Analysis to Address the Spread of Tuberculosis

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Abstract: This research explores the elevated incidence of tuberculosis (TB) in Myanmar, where the burden of the disease dramatically surpasses the worldwide average of 500 cases per 100,000 individuals. The research seeks to investigate elements leading to TB prevalence, recognize obstacles to control measures, and suggest practical recommendations. A mixed methods strategy was employed, integrating quantitative information from health statistics in Yangon, Mandalay, and the rural regions of Chin and Shan States with qualitative information gathered from interviews with healthcare professionals and impacted communities. The study results indicate that poverty, malnutrition, limited access to health services, and a lack of awareness are major factors contributing to elevated TB rates, exacerbated by the rise of multidrug-resistant TB (MDR-TB). Insufficient health care systems and cultural prejudices also hinder successful TB management. The research emphasizes the necessity for focused interventions, such as enhancing access to healthcare services, boosting public awareness, and establishing thorough TB screening initiatives. The research highlights the importance of tackling the underlying causes of poverty and malnutrition to lower TB vulnerability. These results have important consequences for expanding TB control initiatives, not just in Myanmar but also in other nations encountering comparable socio-economic issues. Future studies ought to concentrate on assessing the efficacy of the suggested interventions and investigating creative approaches to enhance access to TB treatment while decreasing stigma.

Keywords: Challenges in TB Control, Multidrug-Resistant TB, TB Interventions, TB Prevalence, Tuberculosis.

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1. Introduction

Tuberculosis (TB) remains one of the most pressing public health challenges worldwide, particularly in low- and middle-income countries that have a very high burden of the disease. In Southeast Asia, Myanmar is one of the countries most affected by TB, with prevalence rates far exceeding the global average. According to the World Health Organization (WHO), Myanmar experiences approximately 500 TB cases per 100,000 people each year, highlighting the urgency of addressing the disease domestically [1]. The persistence of TB in Myanmar can be attributed to a combination of social, economic, and health care system factors. These factors include widespread poverty, which limits access to adequate nutrition and health care, and poor health care infrastructure that hinders the delivery of essential diagnostic and treatment services, particularly in rural and remote areas [2][3].

The country's health care system, despite efforts to expand services, continues to face significant challenges in ensuring timely and effective care for TB patients. Access to diagnostic tools and treatment options is often limited, particularly for populations in underserved areas, leading to delays in diagnosis and increased transmission rates. In addition, there are gaps in coordination of TB control programs, resulting in inefficiencies in resource allocation and service delivery. These barriers contribute to the high burden of TB and hamper efforts to stem the spread of the disease. As a result, TB remains a serious public health threat in Myanmar, its persistence exacerbated by inadequate health care infrastructure, socioeconomic factors, and difficulties in reaching vulnerable populations [4].

TB in Myanmar is further complicated by the emergence of drug-resistant TB strains, particularly multidrug-resistant TB (MDR-TB), which adds another layer of complexity to treatment and control efforts. Resistance to first-line drugs, combined with limited availability of second-line treatment options, threatens to undermine existing TB control strategies [3]. The lack of adequate supply of quality drugs, coupled with weak health system capacity, hampers efforts to control drug-resistant TB. Myanmar's TB control program, despite its expanding reach, continues to struggle with these challenges, in addition to the issue of stigma, which can prevent individuals from seeking timely diagnosis and treatment [4][5]. In addition, the COVID-19 pandemic has exacerbated existing TB challenges, leading to delays in diagnosis and treatment, thus exacerbating the spread of the disease [6] [7].

Myanmar's socioeconomic conditions, including high rates of malnutrition and poor living conditions, further exacerbate TB risk factors. Myanmar's relatively low-income population, especially in rural areas, often lacks access to basic health services, preventing early detection and effective management of TB cases [8]. This combination of inadequate access to health services and socioeconomic vulnerabilities places Myanmar's population at higher risk of TB, especially in densely populated areas where transmission is more likely [9] [10].

The aim of this study was to identify the underlying factors contributing to the high prevalence of TB in Myanmar. This study examined the determinants driving TB persistence and spread, with a focus on the socioeconomic, health system, and environmental factors that shape its dynamics. By analyzing these factors, this study provides evidence-based recommendations to strengthen TB control efforts in Myanmar. These recommendations focus on addressing gaps in the health care system, improving access to diagnostics and treatment, and addressing the growing problem of drug-resistant TB.

2. Literature Review

2.1. Tuberculosis Prevalence in Myanmar

Tuberculosis (TB) continues to be a significant public health problem in Myanmar, with the country showing one of the highest TB burdens in Southeast Asia. According to a recent report by the World Health Organization (WHO), the incidence of TB in Myanmar is estimated to be high, with a large proportion of the population affected [11]. TB cases are mainly concentrated in urban areas such as Yangon, where population density and limited access to health services exacerbate transmission rates. The country's fight against TB is compounded by challenges in early diagnosis, particularly in rural areas, where health care infrastructure remains underdeveloped [12].

The burden of TB in Myanmar is also closely linked to the emergence of multidrug-resistant TB (MDR-TB), which has become a growing concern. According to recent studies, the majority of new TB cases are resistant to standard treatments, necessitating the use of more expensive and longer treatment regimens. In 2023, it was reported that approximately 10% of new TB cases in Myanmar were MDR-TB, highlighting the urgency for improved diagnostic and treatment strategies [13]. The

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increasing prevalence of drug-resistant TB strains poses significant challenges to the health care system and efforts to reduce the overall TB burden.

Efforts to address TB have met with mixed results. While the introduction of advanced diagnostic tools such as the GeneXpert machine has improved the accuracy of TB diagnosis, accessibility of such technology in rural areas remains a significant barrier [14]. In addition, the rate of late-stage diagnosis remains very high, complicating treatment and increasing the risk of transmission within the community. These statistics underscore the need for a comprehensive national strategy that addresses both prevention and treatment challenges.

The country's National Strategic Plan for Tuberculosis (NSP) 2021–2025 outlines key steps to reduce the TB burden, with a focus on improving case detection, increasing treatment adherence, and combating drug resistance. Despite these efforts, TB remains a pressing health problem, particularly in high-risk groups such as those living in densely populated urban areas and remote rural communities, where access to health services is limited [15].

2.2. Risk Factors

Several risk factors contribute to the high prevalence of tuberculosis in Myanmar, with socioeconomic and health-care-related factors being the most prominent. Poor sanitation is a significant risk factor, particularly in densely populated areas, where overcrowding and lack of proper waste management create an environment conducive to the spread of infectious diseases such as TB [16]. Studies have shown that slums, with limited sanitation infrastructure, are hotspots for TB transmission, with residents more vulnerable to infection due to poor living conditions.

Limited access to health services is another important factor. In rural areas, where health care facilities are scarce and far from reach, people often delay seeking medical care until TB has progressed to an advanced stage. Studies have shown that patients in rural areas are less likely to receive an early diagnosis, which exacerbates the spread of the disease and makes treatment more complicated [17]. A 2022 study by the University of Medicine in Yangon found that individuals in remote areas were more likely to have advanced TB, which made treatment more difficult and increased the risk of complications.

Social stigma also plays a significant role in the TB epidemic in Myanmar. Many individuals with TB symptoms avoid treatment for fear of being ostracized or stigmatized by their communities. Research highlights that in rural areas, people are often reluctant to visit health facilities, due to fear of social rejection [18]. This reluctance to seek medical care leads to delayed diagnosis, resulting in higher transmission rates and more severe cases.

Another important risk factor is a lack of awareness about the symptoms and transmission of TB. Studies show that a large proportion of the population, especially in rural and remote areas, are unaware of the symptoms of TB, which hinders early diagnosis and treatment. This knowledge gap is often compounded by low health literacy, which further delays intervention and increases the spread of the disease [19],[20].

Migrant populations are also at higher risk of contracting and spreading TB in Myanmar. Migrants, especially those working in urban centers or abroad, often live in poor conditions and face significant barriers to accessing TB.

2.3. Tuberculosis Control Strategies

Myanmar has implemented several strategies to combat tuberculosis, with a focus on improving diagnosis, treatment, and prevention. The National Strategic Plan for Tuberculosis (2021-2025) outlines key goals to reduce the burden of TB, including improving early detection, providing effective treatment, and preventing the spread of drug-resistant TB [21]. The integration of diagnostic technologies, such as the GeneXpert machine, has been a cornerstone of the country's TB control efforts. This device enables rapid and accurate diagnosis of TB, which is critical for early intervention and reducing transmission [22].

One significant development in TB treatment in Myanmar has been the introduction of a complete oral regimen for multidrug-resistant TB. This newer treatment protocol has improved patient adherence and outcomes, making the treatment process more accessible to patients compared to the old injectable regimen. The World Health Organization (WHO) has reported that Myanmar has made progress in implementing this new regimen, although challenges remain in terms of ensuring its availability in remote areas [23].

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Myanmar's approach also includes a strong emphasis on public health campaigns aimed at raising awareness of TB symptoms and treatment options. These campaigns focus on educating communities about the importance of early diagnosis and adherence to treatment. Community-based programs are critical to reaching individuals in remote areas, where access to health services is limited. These initiatives have shown some success in raising TB awareness, but there is a need for further expansion and scale-up, particularly in rural communities [24].

In addition, the Myanmar government has worked with international organizations, such as the Global Fund and WHO, to strengthen TB surveillance systems and increase financial support for TB care. These partnerships have been instrumental in increasing access to diagnostics and treatment, particularly for individuals with drug-resistant TB [25].

Despite these efforts, gaps remain in the implementation of these strategies. Access to health services in rural and remote areas remains a significant constraint, and more resources are needed to ensure that diagnostic tools and treatment options reach all areas of the country. Furthermore, the increasing incidence of drug-resistant TB requires continued investment in innovative treatment regimens and research to improve the overall efficacy of TB control efforts in the country.

2.4. Challenges Faced

Myanmar faces several challenges in its efforts to control tuberculosis. One of the most pressing issues is the increasing prevalence of multidrug-resistant tuberculosis (MDR-TB), which complicates treatment and prolongs the duration of treatment. Despite the introduction of new, full-dose regimens for MDR-TB, the availability of second-line drugs remains limited, especially in rural areas [26]. Shortages of these essential drugs have hampered efforts to reduce the spread of MDR-TB and improve treatment outcomes for affected individuals.

Financial constraints are another significant challenge to TB control. Although Myanmar has attempted to provide free diagnostics and treatment, many patients face significant indirect costs, such as transportation and loss of income. These costs often prevent individuals from completing their treatment, leading to discontinuation and increased transmission of the disease [27]. Financial constraints are particularly prevalent in rural areas, where the costs of health care and transportation to medical facilities are higher.

The lack of health care infrastructure in remote areas further complicates TB detection and treatment. In these areas, distance to health care facilities, coupled with a shortage of trained health workers, delays diagnosis and treatment, leading to disease spread. A 2023 study found that rural patients were more likely to have advanced stages of TB, complicating treatment and increasing the risk of transmission [28].

In addition to these issues, social stigma continues to be a significant challenge to TB control efforts. People with TB often avoid seeking medical care for fear of discrimination or exclusion from their communities. This reluctance to seek treatment leads to delayed diagnosis and higher likelihood of transmission within households and communities [29]. Reducing the stigma surrounding TB is critical to improving early detection and treatment adherence. Population mobility, including migrant workers, poses challenges to TB control in Myanmar. Migrants, especially those working in urban centers or abroad, often face significant barriers to accessing health services, increasing their risk of contracting TB. Meeting the needs of this mobile population is critical to controlling the spread of TB across regions and the country [30].

3. Methodology

This study was conducted in mid-2024 in areas of Myanmar with the highest TB prevalence, including Yangon, Mandalay, and rural areas of Chin and Shan States. These locations were selected based on TB prevalence data reported by the World Health Organization (WHO) and the Myanmar Ministry of Health.

This research used a mixed methods approach, combining quantitative analysis to identify patterns of tuberculosis (TB) prevalence and qualitative analysis to understand the social, economic, and health care system factors that influence the spread of TB in Myanmar.

The data collected included TB case statistics from government hospitals and local health facilities, as well as primary data from in-depth interviews with health workers, community health officials, and TB patients. A community survey was also conducted to understand knowledge, attitudes, and practices related to TB. The main data collection techniques used were semi-structured interviews, field observations, and secondary data collection from national health reports.

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4. Finding and Discussion

4.1. Research Findings

1) Tuberculosis Prevalence in the Study Areas

The study confirmed that the prevalence of tuberculosis (TB) in some areas of Myanmar is very high. Yangon and Mandalay reported the highest TB rates, while rural areas in Chin and Shan States also showed alarming rates. Data collected from government hospitals and local health facilities showed that the prevalence of TB in these areas exceeded the global average of 500 cases per 100,000 people.

Table 1. TB Prevalence in Some Areas of Myanmar (2024)

Region	TB Cases per 100,000 People
Yangon	620
Mandalay	590
Chin State	550
Shan State	560

The data presented in Table 1 provides a clear picture of the prevalence of tuberculosis (TB) in Myanmar, with significant regional disparities. Yangon, the largest city and commercial hub of the country, reported the highest TB prevalence at 620 cases per 100,000 people. This high rate may reflect urbanization in Yangon, which often results in densely populated living conditions that make TB transmission more likely. Dense urban populations, combined with socio-economic challenges, contribute to the faster spread of TB. In addition, urban poverty in Yangon may face difficulties in accessing adequate health services due to pressure on health services, which can lead to delays in diagnosis and treatment.

Mandalay, Myanmar's second largest city, also showed a high prevalence of TB at 590 cases per 100,000 people. Although Mandalay is better equipped in terms of health care infrastructure compared to rural areas, the city still faces challenges related to overcrowding, poverty, and inadequate accessibility of health services, especially for marginalized communities. Rural-urban migration, which is common in cities such as Mandalay, may also be a contributing factor to the increase in TB cases, as people moving from rural areas often face difficulties in accessing appropriate care in urban settings.

Chin and Shan States, which are largely rural, also showed a high prevalence of TB (rates of 550 and 560 per 100,000 people). These states are characterized by poor health care infrastructure, limited access to diagnostic and treatment facilities, and difficult geographic conditions that make health care delivery more challenging. The high prevalence of TB in these rural areas can be attributed to several factors, including shortages of health workers, lack of awareness about TB, and economic hardships faced by the population, such as malnutrition and poor sanitation. These conditions make individuals in rural areas more vulnerable to TB and hinder the effectiveness of national TB control programs.

Overall, the prevalence data highlight the critical need for targeted interventions that address regional disparities in health care access, awareness, and socioeconomic conditions. While urban areas such as Yangon and Mandalay may require more resources for diagnostic and treatment capacity, rural areas in Chin and Shan States require significant investment in health care infrastructure, training, and access to essential TB services.

2) Risk Factors Contributing to High TB Prevalence

Several significant risk factors contribute to the high prevalence of TB in Myanmar, including poverty, poor health care infrastructure, and malnutrition. Survey results indicate that limited access to health care facilities and diagnostic tools, especially in rural areas, leads to delays in diagnosis and treatment. In addition, many people in these areas lack awareness about TB, which exacerbates its spread.

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Table 2. Risk Factors Contributing to TB Prevalence in Myanmar

Risk Factor	Percentage of Respondents Affected
Lack of Access to Healthcare	68%
Poverty and Malnutrition	72%
Lack of Awareness about TB	50%

Table 2 highlights the multifaceted nature of the factors contributing to TB prevalence in Myanmar. The most prominent risk factors, with 72% of respondents affected, are poverty and malnutrition. This is important because people living in poverty often lack adequate nutrition, which is a key factor in maintaining a strong immune system. Malnutrition weakens the body's ability to fight infections, making people more susceptible to diseases such as TB. In addition, low-income communities may live in densely populated areas, which makes TB transmission more likely, as close proximity to others facilitates the spread of airborne pathogens.

Lack of access to health services, reported by 68% of respondents, is another significant risk factor contributing to the high prevalence of TB in Myanmar. This finding is consistent with the broader health service infrastructure issues facing the country, particularly in rural and underserved areas. Limited access to diagnostic tools and treatment options means that TB cases are often not detected until they are in an advanced stage, leading to a greater risk of transmission. A shortage of health workers, particularly in remote areas, further exacerbates the situation, as patients may have to travel long distances to receive care. This not only delays diagnosis but also prevents timely treatment, increasing the risk of disease spread.

Lack of awareness about TB, identified by 50% of respondents, highlights the need for widespread public education campaigns. Many people in Myanmar, particularly in rural areas, do not fully understand the symptoms and transmission methods of TB. Without adequate knowledge, people are less likely to seek early diagnosis and treatment, leading to delays in intervention. Public health campaigns, particularly in rural communities, should focus on educating the public about the symptoms of TB, the importance of early diagnosis, and the availability of treatment options to reduce stigma and increase use of health services.

Together, these risk factors paint a picture of a country grappling with systemic issues that exacerbate TB transmission. Addressing these risk factors requires a comprehensive strategy that focuses on improving access to health services, raising public awareness, and addressing the root causes of poverty and malnutrition.

3) Barriers to TB Control Efforts

The study identified several barriers to effective TB control in Myanmar. These barriers include inadequate health care facilities, the emergence of drug-resistant TB strains, and stigma surrounding TB. Health workers and public health officials reported that the lack of second-line drugs for multidrug-resistant TB (MDR-TB) was a major challenge. Furthermore, cultural stigma and fear prevented individuals from seeking timely diagnosis and treatment.

The data in Table 3 highlight several key barriers to effective TB control in Myanmar. One of the most significant barriers, as indicated by 74% of respondents, is the lack of second-line drugs for the treatment of multidrug-resistant TB (MDR-TB). MDR-TB is a growing problem in Myanmar, and the lack of effective drugs to treat these resistant strains poses a major challenge to controlling the disease. Without access to second-line drugs, treatment for MDR-TB becomes much more complicated and less effective, prolonging the disease and increasing transmission. These drug shortages are a result of global supply chain issues and the limited capacity of Myanmar's health care system to handle the growing number of MDR-TB cases.

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Table 3. Barriers to TB Control Efforts

Barrier	Percentage of Affected Respondents
Lack of Second-Line Drugs	74%
Stigma and Cultural Fear	65%
Inadequate Healthcare Facilities	60%

Cultural stigma and fear are also significant barriers, affecting 65% of respondents. In Myanmar, as in many parts of the world, TB is often associated with social stigma, which can prevent individuals from seeking diagnosis and treatment. Patients may fear discrimination, social exclusion, or being viewed as a public health threat. These fears can lead to delayed care-seeking behavior and reluctance to follow up on treatment. The stigma surrounding TB is further compounded by a lack of awareness about the disease and its transmission, making it even more difficult to overcome social barriers to effective control.

Another critical barrier is the lack of health care facilities, cited by 60% of respondents. While urban centers such as Yangon and Mandalay may have relatively better health care infrastructure, rural areas face severe shortages of medical facilities, equipment, and trained personnel. In these underserved areas, people often have to travel long distances to access TB diagnosis and treatment services. The lack of adequate health infrastructure also means that diagnostic capacity is limited, delaying the identification of TB cases. Without adequate health care facilities, TB control efforts will continue to be hampered, especially in rural and remote areas where the burden of the disease is highest.

Addressing these barriers will require a multi-pronged intervention that not only improves health care infrastructure but also focuses on reducing stigma through public education campaigns and increasing access to life-saving treatment for all forms of TB. Ensuring that first- and second-line TB drugs are available, especially in rural and underserved areas, is a critical step in addressing the treatment challenges posed by TB in Myanmar.

4.2. Discussion

Some of the important findings from this research include:

1) Comparison with Other Studies

The findings of this study are consistent with previous studies conducted in Southeast Asia, where TB prevalence is generally high due to similar socio-economic challenges. Studies in neighboring countries such as Bangladesh and Cambodia have also highlighted the role of poverty and poor health care infrastructure in TB persistence. The higher-than-global average rates observed in Myanmar suggest that these factors play a major role in the spread of TB in the region.

2) Factors Contributing to High TB Rates

The study found that key factors such as the emergence of drug-resistant TB strains, poor access to health care, and inadequate nutrition contribute to the high prevalence of TB in Myanmar. Shortage of second-line drugs is a major concern in the treatment of MDR-TB, complicating existing control efforts. Cultural stigma also plays a significant role, with many individuals avoiding diagnosis and treatment for fear of social exclusion. These factors interact in complex ways, leading to delays in treatment, further transmission, and exacerbations of TB in a vulnerable population.

3) Socio-Economic Impact

The socio-economic impact of TB in Myanmar is substantial. The economic burden is particularly heavy for rural households, where individuals are often unable to work due to illness. The cost of treatment, particularly for drug-resistant TB, can be extremely high, further

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exacerbating poverty in affected families. The stigma associated with TB further isolates patients, making it more difficult for them to seek support, further perpetuating the cycle of poverty and disease.

4) Challenges in Implementing Control Policies

Myanmar faces significant challenges in implementing effective TB control policies. Despite efforts by the government and international organizations to improve access to treatment, gaps in service delivery remain, particularly in rural and underserved areas. Inadequate infrastructure, lack of trained health workers, and the ongoing problem of drug resistance are ongoing barriers to TB control. This study suggests that improving access to health services, increasing public awareness, and addressing cultural barriers are key to improving TB control in Myanmar.

5. Conclusion

This study provides a comprehensive analysis of tuberculosis (TB) prevalence in Myanmar, revealing an alarming situation, especially in urban and rural areas such as Yangon, Mandalay, Chin and Shan States. TB rates in these areas significantly exceed the global average of 500 cases per 100,000 people, reflecting the urgency to address the factors contributing to the spread of the disease. The study confirms that poverty, malnutrition, poor access to health services, lack of awareness and the emergence of drug-resistant TB strains are key drivers of the high TB prevalence in Myanmar. Barriers such as inadequate health care infrastructure and cultural stigma further complicate TB control efforts, hindering early diagnosis and treatment. The findings highlight the need for urgent and targeted interventions in both urban and rural areas to reduce TB prevalence and mitigate the broader socio-economic impacts of the disease.

Based on the findings, several policy recommendations are proposed to stem the spread of TB in Myanmar:

1. Expanding access to health services, especially in rural and underserved areas, is critical. This includes investing in infrastructure, increasing the availability of diagnostic tools, and training more health care workers to provide timely and accurate TB diagnosis and treatment.
2. Expand public education campaigns to raise awareness about TB, its symptoms, transmission, and the importance of early diagnosis and treatment. These campaigns should focus on dispelling myths and reducing stigma around the disease, especially in rural areas where misconceptions about TB are most prevalent.
3. Implementing comprehensive TB screening programs, especially in high-risk areas such as Yangon, Mandalay, and rural areas, will help identify cases early and reduce transmission. Community-based approaches can play a critical role in this effort, encouraging individuals to seek medical advice in a timely manner.
4. Addressing the root causes of poverty and malnutrition, which exacerbate TB vulnerability, should be a key component of any TB control strategy. Initiatives to improve nutrition and social safety nets for vulnerable populations will help build immunity and reduce vulnerability to TB infection.

The results of this study have significant implications for scaling up TB control programs in Myanmar and in countries with similar socioeconomic challenges. These findings underscore the importance of addressing health system weaknesses and socioeconomic determinants to effectively address TB. Strengthening health care systems, increasing public health awareness, and addressing cultural stigma are critical steps to reduce TB prevalence and its socioeconomic impacts. The study also underscores the need for a more integrated approach that includes efforts to address poverty, improve nutrition, and address the challenge of multidrug-resistant TB. Countries facing similar challenges in TB control can adopt the recommendations from this study, adapting strategies to their local contexts to achieve more effective disease control and prevention.

Although this research provides important information about TB prevalence and management in Myanmar, many opportunities for further exploration still exist. Future studies ought to analyze the effectiveness of TB control strategies, examining how proposed policy changes influence TB transmission and treatment results, while longitudinal research offers perspectives on their lasting impacts. Due to the rising danger of multidrug-resistant TB, additional research is required to comprehend its transmission patterns, obstacles to treatment, and the efficacy of second-line drug therapies. Moreover, qualitative research ought to examine how cultural beliefs and social perceptions

impact TB diagnosis and treatment-seeking behavior, pinpointing effective methods to lessen stigma and enhance public health interventions.

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