



Pulmonary Tuberculosis Management in Primary Care: The Added Value of a Holistic Assessment Approach

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Abstract

Pulmonary tuberculosis (TB) remains a major global public health problem, particularly in developing countries with high population density, limited socioeconomic resources, and constrained healthcare access. Indonesia continues to rank among the countries with the highest TB burden worldwide, emphasizing the need for effective early detection and comprehensive patient-centered management at the primary healthcare level. Although pharmacological treatment through the Directly Observed Treatment Short-course (DOTS) strategy has significantly improved TB control, treatment success is often influenced by psychosocial, behavioral, economic, and environmental determinants that are insufficiently addressed in conventional clinical management. This case report aims to describe the implementation and clinical value of a holistic biopsychosocial assessment approach in the management of pulmonary TB at a primary healthcare facility. A 34-year-old male presented to the Simpur Community Health Center, Bandar Lampung, Indonesia, with a productive cough lasting more than four weeks, weight loss, night sweats, intermittent fever, and decreased appetite. Clinical examination, sputum acid-fast bacilli (AFB) testing, rapid molecular testing, and chest radiography confirmed a diagnosis of drug-sensitive active pulmonary TB. A comprehensive holistic assessment revealed multiple interrelated determinants influencing disease progression and treatment adherence, including malnutrition, psychological anxiety, fear of social stigma, unstable income, smoking habits, overcrowded living conditions, and inadequate household ventilation. The patient underwent integrated management consisting of standard anti-tuberculosis drug therapy, family-based medication supervision, nutritional intervention, psychosocial counseling, infection prevention education, smoking cessation counseling, and environmental modification strategies aimed at improving household ventilation and reducing transmission risk. Follow-up evaluation demonstrated substantial clinical improvement characterized by reduced respiratory symptoms, weight gain, improved treatment adherence, enhanced psychological well-being, and stronger family support. This case highlights the importance of integrating biological, psychological, social, economic, behavioral, and environmental assessments into pulmonary TB management at the primary care level. A holistic approach not only supports successful pharmacological treatment but also improves patient adherence, quality of life, and community-based TB prevention efforts. The findings emphasize that comprehensive patient-centered care should become an essential component of TB management strategies in high-burden settings.



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1. Introduction

Tuberculosis (TB) remains one of the oldest yet most persistent infectious diseases affecting global populations and continues to represent a major public health challenge, particularly in developing countries. Pulmonary tuberculosis, caused by *Mycobacterium tuberculosis*, primarily affects the lungs and spreads through airborne droplets expelled during coughing, sneezing, or speaking. The disease is strongly associated with poverty, overcrowding, malnutrition, limited healthcare access, and poor environmental conditions, making TB not only a biomedical problem but also a social and economic issue. Despite major advancements in diagnostic technologies and anti-tuberculosis therapy over recent decades, TB continues to contribute substantially to global morbidity and mortality. According to the World Health Organization (WHO), approximately 10.6 million people developed tuberculosis and approximately 1.3 million people died from TB-related causes in 2022, making TB one of the leading infectious causes of death worldwide (Egan et al., 2024; Ulpathakumbura et al., 2026; Zhao et al., 2026).

The burden of TB remains disproportionately concentrated in low- and middle-income countries, particularly in densely populated urban settings where healthcare disparities, socioeconomic instability, and environmental deterioration are prevalent. Indonesia continues to

rank among the countries with the highest TB burden globally, following India and China. The WHO estimated approximately 969,000 new TB cases in Indonesia in 2022, indicating that the disease remains a critical national health priority. The high incidence of TB in Indonesia is associated with several interconnected determinants, including high smoking prevalence, inadequate nutrition, crowded living conditions, delayed diagnosis, limited health literacy, and insufficient disease surveillance systems (Zhou et al., 2026).

In addition to biomedical risk factors, psychological, social, behavioral, and environmental determinants substantially influence disease progression, treatment adherence, and long-term recovery among TB patients. Many individuals diagnosed with TB experience significant psychological distress, anxiety, social stigma, and fear of discrimination (Ayadi et al., 2026; Blaney et al., 2025; Condorí-fern & Gando-y-crego, 2026). These psychosocial burdens often lead to delayed healthcare-seeking behavior, social isolation, reduced self-esteem, and poor adherence to long-term treatment regimens. Previous studies have shown that TB patients frequently experience depression, stress, and financial insecurity due to prolonged treatment duration and reduced work productivity (Slee et al., 2026; W. Wang et al., 2026). Consequently, TB management requires approaches that extend beyond pharmacological treatment alone.

Socioeconomic factors also play a major role in the persistence and transmission of tuberculosis. Individuals from low-income households often face barriers to healthcare access, transportation difficulties, nutritional deficiencies, and unstable employment conditions, all of which may compromise treatment success. Furthermore, environmental determinants such as poor household ventilation, overcrowding, limited sunlight exposure, and unhealthy occupational settings significantly increase the risk of airborne transmission within families and communities. Research has demonstrated that inadequate ventilation and densely populated living environments facilitate prolonged survival and circulation of *Mycobacterium tuberculosis* particles in indoor air (Lin et al., 2025; Tsai et al., 2025). These findings emphasize the importance of integrating environmental health considerations into TB prevention and management programs.

Primary healthcare facilities have a strategic role in controlling TB transmission and improving treatment outcomes, particularly in resource-limited settings. In Indonesia, community health centers (Puskesmas) serve as the frontline institutions responsible for early case detection, diagnosis, treatment initiation, monitoring, and health education (Borah et al., 2023; Khandelwal et al., 2024; Suralaga & Usman, 2025). The Directly Observed Treatment Short-course (DOTS) strategy has become the cornerstone of the National Tuberculosis Control Program and aims to improve treatment adherence while reducing treatment failure, relapse, and drug resistance. However, although the DOTS strategy has significantly improved TB control outcomes, successful treatment is often influenced by non-medical factors that are not fully addressed through conventional clinical approaches alone (Chen et al., 2025; Lien et al., 2025).

Increasing evidence suggests that holistic and patient-centered approaches may substantially improve the quality and effectiveness of TB management. A holistic assessment approach integrates biological, psychological, social, economic, behavioral, nutritional, and environmental dimensions into patient evaluation and intervention planning (Garcia-cabello et al., 2026; Ko et al., 2026; Li et al., 2025; Patel et al., 2020). Through comprehensive assessment, healthcare providers can identify hidden barriers to treatment adherence, including emotional stress, social stigma, financial limitations, unhealthy lifestyles, poor nutrition, and inadequate housing conditions. This approach enables more individualized and multidisciplinary interventions aimed not only at eliminating bacterial infection but also at improving patients' overall well-being and quality of life (Cannizzaro & Spessotto, 2025; Ding et al., 2025; Garg et al., 2025).

The importance of holistic care is particularly relevant in urban communities with high population density and socioeconomic vulnerability, such as Bandar Lampung City. The Simpuri Community Health Center serves a densely populated urban area characterized by high mobility, limited residential space, poor environmental sanitation, and substantial socioeconomic disparities. These conditions contribute significantly to the risk of TB transmission and complicate long-term treatment adherence among patients (Fischman et al., 2025; Peng et al., 2025; Terin et al., 2025). Consequently, early identification and integrated management strategies are essential to reduce disease burden and prevent further community transmission (Al et al., 2025; Hoyek et al., 2025).

Although many studies have discussed the biomedical management of tuberculosis, relatively few reports have comprehensively described the implementation of holistic biopsychosocial assessment approaches in primary healthcare settings, particularly within Indonesian community health centers (Mandolesi et al., 2025). Most conventional case reports primarily focus on diagnostic findings and pharmacological treatment outcomes without sufficiently addressing the broader psychosocial and environmental determinants influencing recovery. Therefore, there remains a need for practical evidence demonstrating how holistic patient-centered care can be effectively implemented within routine primary healthcare services (J. Wang et al., 2025).

This case report aims to describe the identification, diagnosis, and comprehensive management of a pulmonary TB patient at the Simpuri Community Health Center in Bandar Lampung using a holistic assessment approach. This report highlights the added value of integrating biological, psychological, social, economic, behavioral, nutritional, and environmental evaluations into TB management at the primary care level. Furthermore, this study emphasizes how multidisciplinary and patient-centered interventions can improve treatment adherence, enhance patient well-being, strengthen family support systems, and reduce the risk of disease transmission within the community. The findings are expected to contribute to the growing evidence supporting holistic and integrated approaches in TB control programs, particularly in high-burden urban settings in developing countries.

2. Materials and Methods

2.1. Study Design and Setting

This study was conducted as a descriptive clinical case report using a holistic patient-centered assessment approach to evaluate the identification, diagnosis, management, and follow-up of a pulmonary tuberculosis (TB) patient at the primary healthcare level. The case report was prepared in accordance with the CARE (CAse REport) guidelines to ensure systematic clinical documentation and comprehensive reporting of patient management. The study emphasized the integration of biological, psychological, social, economic, behavioral, nutritional, and environmental assessments in the management of pulmonary TB.

The study was conducted at the Simpura Community Health Center, Bandar Lampung City, Indonesia. Bandar Lampung is a densely populated urban area characterized by high population mobility, heterogeneous socioeconomic conditions, and increasing environmental health challenges. The Simpura area is recognized as one of the urban communities with relatively high pulmonary TB incidence due to overcrowded housing conditions, limited ventilation systems, suboptimal sanitation, and socioeconomic vulnerability. The Simpura Community Health Center serves as a frontline primary healthcare facility responsible for implementing the National Tuberculosis Control Program using the Directly Observed Treatment Short-course (DOTS) strategy. The healthcare center provides TB screening, diagnosis, treatment, patient education, contact tracing, and long-term therapeutic monitoring for the surrounding population.

2.2. Patient Information and Clinical Assessment

The subject of this case report was a 34-year-old male patient who presented to the Simpura Community Health Center with respiratory complaints suggestive of pulmonary tuberculosis. Comprehensive clinical evaluation was performed through detailed history taking, physical examination, laboratory testing, radiological assessment, psychosocial evaluation, and environmental assessment. Patient history included:

- Duration and characteristics of respiratory symptoms,
- Constitutional symptoms,
- Previous medical history,
- History of close contact with TB patients,
- Smoking habits,
- Occupational exposure,
- Family conditions,
- Nutritional status,
- Socioeconomic background,
- Living environment characteristics.

Physical examination included:

- General appearance,
- Nutritional assessment,
- Body mass index (BMI),
- Body temperature,
- Respiratory rate,
- Pulse rate,
- Blood pressure,
- Chest inspection,
- Palpation,
- Percussion,
- Lung auscultation.

2.3. Diagnostic Procedures

The diagnosis of pulmonary tuberculosis was established based on clinical, microbiological, and radiological findings according to the Indonesian National Tuberculosis Management Guidelines and World Health Organization recommendations (Fig. 1).

2.3.1. Sputum Examination

Sputum samples were collected using the Moring-time-morning (MTM) method:

- First spot specimen,
- Early morning specimen,
- Second spot specimen.

Microscopic examination for Acid-Fast Bacilli (AFB) staining was performed to identify the presence of *Mycobacterium tuberculosis*. The AFB smear grading system was used according to national laboratory standards.

2.3.2. Rapid Molecular Test

A Rapid Molecular Test (RMT) was performed to confirm the presence of *Mycobacterium tuberculosis* and evaluate rifampicin resistance status. This examination was conducted using sputum specimens collected during the diagnostic process.

2.3.3. Radiological Examination

Chest radiography was performed to evaluate pulmonary involvement, infiltrative lesions, cavitory abnormalities, and other radiological features consistent with active pulmonary tuberculosis.

2.3.4. Holistic Assessment Approach

A comprehensive holistic assessment was conducted to identify multidimensional factors influencing disease severity, treatment adherence, and recovery potential. The assessment included the following domains:

2.3.5. Biological, Psychological, Social, Economic, and Environmental Assessment

A comprehensive holistic assessment was conducted to identify multidimensional factors influencing disease severity, treatment adherence, and recovery outcomes. The biological assessment included evaluation of respiratory symptoms, nutritional status, comorbid diseases, smoking history, and overall infection severity. In addition, psychological assessment focused on identifying anxiety, emotional stress, fear of social stigma, treatment-related concerns, and patient motivation toward long-term therapy adherence. Social assessment was also performed to evaluate family support systems, social interaction, healthcare accessibility, community stigma, and the availability of medication supervision during treatment.

Economic assessment included evaluation of the patient's occupational status, family income, treatment affordability, transportation barriers, and nutritional limitations that could potentially interfere with treatment adherence and clinical recovery. Furthermore, environmental assessment examined housing density, household ventilation quality, lighting exposure, sanitation conditions, occupational environment, and potential risks of tuberculosis transmission within the household and surrounding community.

Therapeutic intervention was implemented according to the National Tuberculosis Control Program using the DOTS (Directly Observed Treatment Short-course) strategy for new drug-sensitive pulmonary tuberculosis cases. The patient received a standardized anti-tuberculosis treatment regimen consisting of a two-month intensive phase using HRZE therapy (Isoniazid, Rifampicin, Pyrazinamide, and Ethambutol), followed by a four-month continuation phase using HR therapy (Isoniazid and Rifampicin). In addition to pharmacological treatment, the patient also received education regarding medication adherence, infection prevention, nutritional improvement, psychosocial support, and environmental modification to support comprehensive recovery and reduce the risk of disease transmission. Additional non-pharmacological interventions included nutritional counseling, smoking cessation education, infection prevention education, psychosocial counseling, environmental modification recommendations, and family education regarding TB transmission prevention.

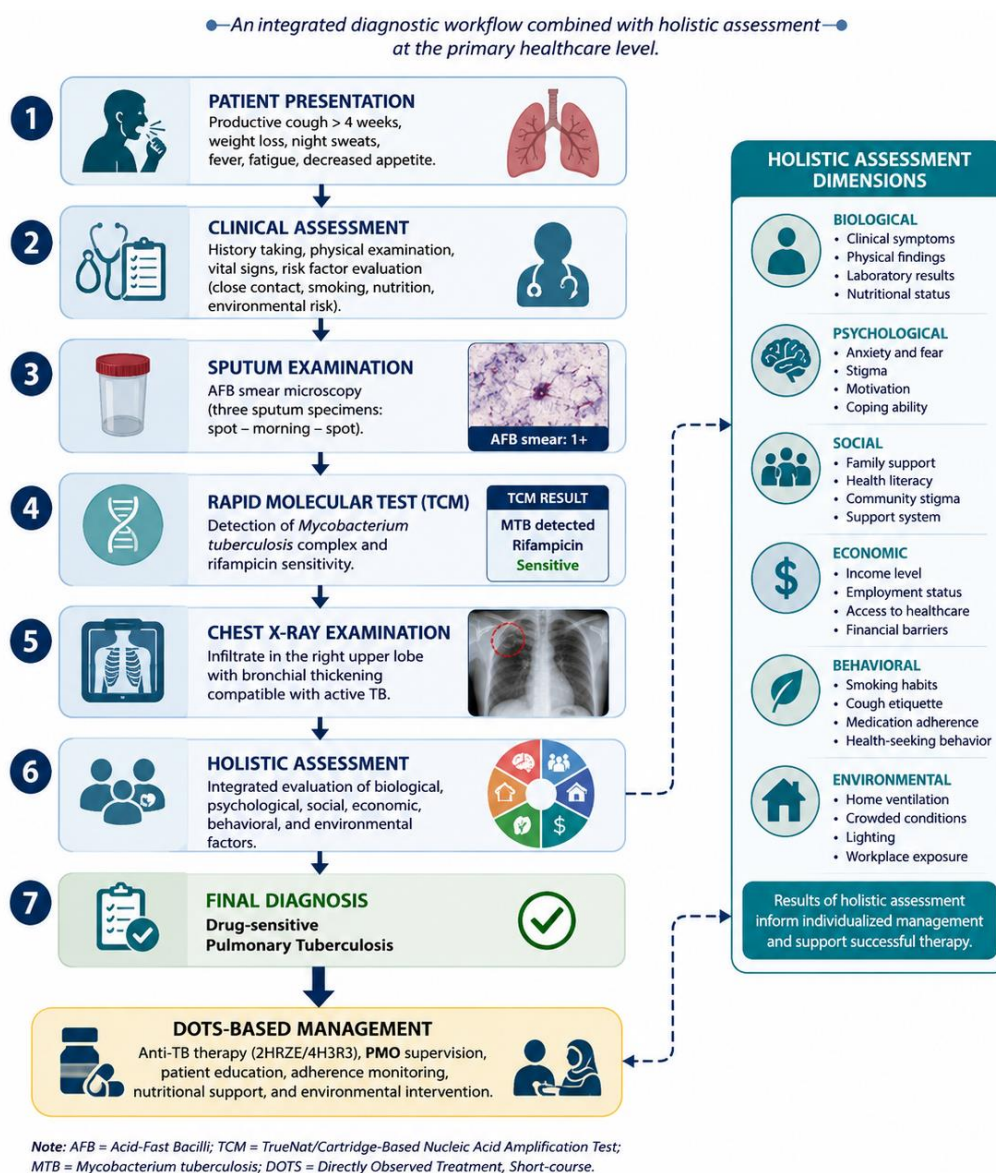


Fig. 1. Diagnostic procedures and integrated holistic assessment workflow for pulmonary tuberculosis management at the primary healthcare level.

2.4. Therapeutic Intervention

The patient received standard anti-tuberculosis therapy for new drug-sensitive pulmonary TB cases according to the national DOTS program. The treatment regimen consisted of intensive phase: 2 months of HRZE (Isoniazid, Rifampicin, Pyrazinamide, Ethambutol), and continuation phase: 4 months of HR (Isoniazid and Rifampicin). Medication adherence was supervised through a family-based Directly Observed Treatment (DOT) system, in which the patient's wife served as the Treatment Supervisor. Additional non-pharmacological interventions included:

- Nutritional counseling,
- Smoking cessation education,
- Infection prevention education,
- Psychosocial counseling,
- Environmental modification recommendations,
- Family education regarding TB transmission prevention.

Follow-up and outcome evaluation in the clinical follow-up was conducted periodically during the intensive treatment phase to evaluate symptom improvement, body weight changes, medication adherence, treatment side effects, psychological condition, and environmental improvements.

Repeat sputum examination was performed at the end of the intensive phase to assess bacteriological conversion status. Final holistic evaluation was conducted to assess overall improvement in biological, psychological, social, nutritional, and environmental conditions following integrated management. Written informed consent was obtained from the patient for publication of this case report and associated clinical information. Patient confidentiality and anonymity were maintained throughout the study by excluding identifiable personal information from the manuscript.

3. Results and Discussion

The patient presented to the Simpung Community Health Center with clinical manifestations strongly suggestive of active pulmonary tuberculosis, including a productive cough persisting for more than four weeks, progressive weight loss, intermittent low-grade fever, night sweats, fatigue, and reduced appetite. These symptoms are considered classic constitutional and respiratory manifestations of pulmonary TB and remain important indicators for early case identification at the primary healthcare level. The prolonged duration of symptoms before seeking medical attention reflected delayed healthcare-seeking behavior, which is commonly observed among economically productive adults in developing countries. Delayed diagnosis remains one of the major contributors to ongoing community transmission and worsening disease severity (Egan et al., 2024; Ullathakumbura et al., 2026).

Physical examination demonstrated signs consistent with chronic infectious disease and nutritional impairment. The patient appeared thin and weak with a Body Mass Index (BMI) of 17.5 kg/m², indicating mild malnutrition. Respiratory examination revealed fine crackles predominantly in the right upper lung field, which is a common auscultatory finding in pulmonary TB due to inflammatory infiltrates and alveolar involvement. No significant cardiovascular or gastrointestinal abnormalities were identified, suggesting that the disease remained primarily localized to the pulmonary system without major systemic complications at the time of diagnosis (Slee et al., 2026; W. Wang et al., 2026; Zhou et al., 2026).

Microbiological examination confirmed the diagnosis of pulmonary tuberculosis. Acid-Fast Bacilli (AFB) smear microscopy demonstrated positive results, indicating active bacterial shedding and infectiousness. Furthermore, Rapid Molecular Testing (TCM) identified *Mycobacterium tuberculosis* with rifampicin sensitivity, confirming drug-sensitive pulmonary TB. The use of molecular diagnostic testing significantly improved diagnostic accuracy and reduced delays in therapeutic initiation compared with conventional culture-based methods. These findings support previous studies emphasizing the importance of integrating rapid molecular diagnostics into primary healthcare TB programs to improve early case detection and reduce disease transmission (Garcia-cabello et al., 2026; Ko et al., 2026; Li et al., 2025; Patel et al., 2020).

Radiological examination further strengthened the diagnosis. Chest X-ray findings revealed infiltrative lesions within the right upper lobe accompanied by diffuse fine nodules and bronchial thickening, which are characteristic radiographic features of active pulmonary tuberculosis. Upper lobe involvement is commonly associated with higher oxygen tension environments that favor *Mycobacterium tuberculosis* proliferation. Although cavitory lesions were absent, the infiltrative pattern strongly indicated active pulmonary infection requiring immediate intervention (Chen et al., 2025; Lin et al., 2025; Tsai et al., 2025).

One of the most important findings in this study was the identification of multiple interconnected non-biological determinants influencing disease progression and treatment adherence. Holistic assessment revealed that the patient experienced considerable psychological distress related to anxiety, fear of social stigma, and concern regarding long-term treatment duration. The patient was particularly worried about transmitting the disease to family members and losing occupational productivity due to prolonged therapy. Psychological burden among TB patients is frequently underestimated in routine clinical management despite evidence demonstrating its strong association with treatment non-adherence and poor therapeutic outcomes (Cannizzaro & Spessotto, 2025; Lien et al., 2025).

Social assessment demonstrated that the patient lived within a densely populated household with limited ventilation and poor air circulation, significantly increasing household transmission risk. Nevertheless, strong family support became a critical positive determinant in therapeutic success. The patient's wife agreed to serve as a medication supervisor (Pengawas Menelan Obat / PMO), thereby improving treatment monitoring and emotional support. Family-based supervision has been widely recognized as an effective strategy for improving medication adherence in TB management programs, particularly in resource-limited settings (Ding et al., 2025; Garg et al., 2025; Hoyek et al., 2025).

Economic evaluation also revealed several barriers potentially affecting treatment continuity. The patient worked as a daily laborer with unstable income and limited financial resources. Although anti-tuberculosis medication was provided free of charge through the national

TB program, indirect costs such as transportation, nutritional support, and temporary loss of income remained significant concerns. Previous studies have consistently demonstrated that economic vulnerability may negatively affect long-term treatment adherence and increase the risk of treatment interruption (Al et al., 2025; Mandolesi et al., 2025; J. Wang et al., 2025).

Environmental assessment identified several important risk factors contributing to disease transmission and progression. The patient resided in a crowded rental house with inadequate natural lighting and poor ventilation. In addition, his occupational environment exposed him to dust and poorly ventilated indoor conditions, which may worsen respiratory symptoms and pulmonary inflammation. Poor household ventilation has been recognized as one of the most important environmental determinants of TB transmission because airborne bacilli remain suspended longer in enclosed spaces with limited airflow (Terrin et al., 2025).

Following comprehensive assessment, the patient was enrolled in the DOTS-based tuberculosis management program and received standardized anti-tuberculosis therapy consisting of a two-month intensive phase with HRZE followed by a four-month continuation phase with HR therapy. The implementation of pharmacological treatment was combined with multiple supportive interventions, including nutritional counseling, psychosocial support, environmental modification education, smoking cessation counseling, and family-centered adherence monitoring. This integrated intervention strategy represented one of the major strengths and novelties of the present case report because conventional TB management in primary care frequently focuses primarily on pharmacological treatment without systematically addressing psychosocial and environmental determinants (Garcia-cabello et al., 2026; Ko et al., 2026; Li et al., 2025; Patel et al., 2020).

Clinical follow-up demonstrated significant improvement after four weeks of therapy. Respiratory symptoms progressively decreased, appetite improved, and the patient experienced gradual weight gain, indicating improved nutritional and metabolic status. Psychological condition also improved substantially as the patient became more confident and less anxious regarding his disease. Family support strengthened during the treatment period, further improving treatment adherence and emotional stability. Importantly, environmental modifications such as improving household ventilation and implementing infection prevention measures contributed to reducing household transmission risk. The positive treatment response observed in this case highlights the importance of integrating holistic biopsychosocial assessment into routine TB management at the primary healthcare level. The novelty of this study lies not only in documenting successful pulmonary TB treatment but also in demonstrating how biological, psychological, social, economic, and environmental factors interact dynamically throughout the disease course and recovery process. Unlike conventional case reports that mainly emphasize microbiological confirmation and pharmacological intervention, this study illustrates that successful TB management requires multidimensional patient-centered strategies.

The holistic approach applied in this case provides several important implications for primary healthcare practice. First, early psychosocial assessment allows healthcare providers to identify anxiety, stigma, and emotional stress that may interfere with adherence. Second, family involvement substantially enhances supervision and emotional support during long-term therapy. Third, environmental assessment enables healthcare providers to identify modifiable household transmission risks. Finally, integrating socioeconomic considerations into patient management may improve healthcare accessibility and continuity of care among vulnerable populations.

These findings are consistent with growing international evidence supporting integrated and patient-centered TB care models. The World Health Organization increasingly emphasizes that TB elimination strategies must address social determinants of health in addition to biomedical treatment. Therefore, implementation of holistic assessment frameworks at community health centers may contribute significantly to improving treatment outcomes, reducing transmission risk, and enhancing quality of life among pulmonary TB patients in high-burden urban communities. Overall, this case demonstrates that pulmonary tuberculosis management at the primary healthcare level becomes substantially more effective when comprehensive biopsychosocial and environmental assessments are integrated into clinical decision-making and long-term therapeutic planning.

4. Conclusions

This case report demonstrates that successful pulmonary tuberculosis management in primary healthcare requires more than microbiological confirmation and pharmacological therapy alone. The integration of biological, psychological, social, economic, behavioral, nutritional, and environmental assessments provided a more comprehensive understanding of the patient's condition and enabled the development of individualized interventions that addressed both medical and non-medical determinants of health. The implementation of a holistic assessment approach at the Simpura Community Health Center contributed significantly to early diagnosis, improved treatment adherence, enhanced psychological well-being, strengthened family support, and reduced environmental transmission risks. The patient showed substantial clinical improvement following integrated DOTS-based therapy combined with psychosocial counseling, nutritional support, adherence monitoring, and environmental modification strategies. This study highlights the added value of holistic and patient-centered approaches in pulmonary tuberculosis management, particularly in densely populated urban communities with socioeconomic vulnerability. The findings suggest that integrating multidimensional assessment into routine primary healthcare services may improve therapeutic outcomes, reduce treatment interruption, and strengthen community-based TB control efforts. Therefore, holistic management frameworks should be considered an essential component of future tuberculosis control strategies in primary healthcare settings, especially in high-burden developing countries.

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Informed Consent Statement: Written informed consent has been obtained from the patient's guardian to publish this case report, including clinical details and images.

Data Availability Statement: All data supporting the findings of this study are contained within the article. No additional datasets were generated or analyzed.

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