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Review Article

Treatment Adherence in Patients with Tuberculosis: An Integrative Review

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Abstract

Introduction: Tuberculosis (TB), caused by a single infectious agent, is the second leading cause of death worldwide, following coronavirus disease 2019, resulting in almost twice as many deaths as HIV/AIDS. Over 10 million people continue to develop TB annually. Thus, this review aimed to explore the treatment adherence in patients with TB and identify the key barriers affecting their adherence to therapy.

Methods: This integrative review utilized Joanna Briggs Institute reporting guidelines for scoping reviews. Researchers completed literature searches across PubMed, ProQuest, Scopus, CINAHL, Cochrane, and Garuda databases to find English and Bahasa Indonesian full texts published from 2013 to 2023. In addition, the review followed the Whittemore and Knafl framework and employed the Critical Appraisal Prospective Study Instrument for quality control.

Results: The results of 13 studies examining treatment adherence, barriers, and the role of health workers in TB revealed that individuals, service policies, and comorbidities affect TB treatment adherence. Moreover, treatment barriers were primarily caused by a lack of social support, drug side effects, economic factors, and low levels of knowledge. Nonetheless, health workers contributed to improving TB treatment adherence through supervising medication intake, providing education and counseling, and collaborating with their coworkers.

Conclusion: Our findings demonstrated the importance of understanding medication adherence, barriers, and the role of health workers in integrative care of TB patients.

Keywords: Tuberculosis, Treatment Adherence, Review

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Introduction

Tuberculosis (TB) is the world's second leading cause of death from a single infectious agent, following coronavirus disease 2019 and accounts for nearly twice as many deaths as human immunodeficiency virus/acquired immunodeficiency syndrome. More than 10 million people continue to fall ill with TB each year. In addition, TB was projected to account for 75% of global deaths by 2022 (1). In 2018, there were 9,073 cases of resistant TB in Indonesia due to non-compliance, resulting in suboptimal treatment and increasing the risk of morbidity and mortality (2). Therefore, special attention is needed to reduce morbidity and mortality rates, especially in terms of TB integrative care.

TB is a primary infectious disease caused by the bacterium *Mycobacterium tuberculosis*, which invades the host, is transmitted through the air and is considered highly preventable and treatable (1, 3). As recommended by the World Health Organization (WHO), the first-line treatment for new cases of pulmonary TB involves a six-month regimen of a combination of four drugs: isoniazid, rifampicin, pyrazinamide, and ethambutol. Likewise, the WHO suggests that health workers supervise TB treatment (4). However, family support is crucial for effectively monitoring medication adherence (MA) in the home setting.

As with other chronic diseases that need long-term treatment and medication, health workers play an essential role in improving patients' conditions (5, 6), including in the area of treatment adherence in patients with TB (7). They supervise and ensure that patients with TB take their medication. Additionally, health workers substantially contribute to case management, including conducting bacteriological evaluation, managing drug side effects, and implementing TB infection control measures (8). It is vital for various health programs and service facilities to collaborate to ensure that patients receive continuous treatment (9). It should be noted that

non-adherence to TB medication can lead to relapse with more severe side effects, drug resistance, extended treatment duration, increased disease severity, economic loss and even death (10). On the other hand, successfully adhering to medication is another sign of patients' better self-care management and increased quality of life (11-13). Therefore, it is crucial to optimize TB treatment adherence.

Many reviews have explored how patients with TB and other chronic conditions adhere to their medication. Alipanah et al, Syahrul et al, and Zuraida et al (14-16) demonstrated that increased adherence to TB treatment can be achieved through diverse approaches, including education, counseling, incentives, facility support, psychological interventions, reminders, monitoring, and digital technology. A review by Ridho et al (17) also identified several factors, such as poor communication, social status, health services, mental health and the nature of therapy, as contributors to TB treatment failure despite the availability of TB medications. Moreover, another review by Nezenega et al (18) highlighted individual characteristics, social environment, economy, health system, type of therapy, lifestyle and geographical access as factors that may influence TB treatment adherence. A similar review conducted by Chimeh et al (19) discussed the economic consequences of non-adherence to TB treatment, including increased costs and socioeconomic burdens. More recent studies by Li et al and Jerene et al (20, 21) emphasize the growing role of integrated digital adherence tools, community-based support networks, and patient-centered care models in addressing these barriers. However, no analysis of barriers, the role of health workers, and MA was included in the mentioned reviews.

Accordingly, this integrative review aims to explore facilitators of treatment adherence in TB patients based on the latest evidence and analyze the role of health workers in improving TB treatment adherence. Additionally, the study examines the definitions and factors that influence adherence to taking medications for TB and provides a comprehensive overview of barriers to TB treatment adherence. This review will further describe the important role of health workers in improving adherence. It is expected to inform the development of more effective interventions to improve TB treatment adherence and success.

Our research has focused on gaining a better understanding of MA, identifying possible barriers, and examining the role of health workers in ensuring patient adherence. In particular, attempts are made to explore the following research questions:

a. *What are the facilitators of MA in patients with TB?*

b. *What are the barriers to MA in patients with TB?*

What is the role of health workers in improving treatment adherence in patients with TB?

Materials and Methods

Search Strategy

The integrative review method was selected to improve the accuracy of this review. Integrative reviews allow various study designs to be brought together to provide a more comprehensive picture of a health phenomenon. This integrative review followed the guidelines for improving accuracy in article searches.

The literature search was conducted in seven online databases: PubMed, ProQuest, Scopus, Science Direct, Cochrane, CINAHL, and Garuda, an Indonesian Ministry of Education, Culture, Research, and Technology's portal that serves as a national index for Indonesian scientific journals and publications. Several keywords were used, including "Tuberculosis Patient" OR "TB Patient" OR "Tuberculous Patient" OR "TB Diagnosis" OR "Pulmonary TB Patient" AND "Adherence" OR "Compliance" OR "Conformity" OR "Observance" OR "Consistency" AND "Treatment" OR "Therapy" OR "Intervention" OR "Medical Intervention" OR "Health Regimen" OR "Medical Treatment" OR "Healthcare Plan". The search was performed in December 2023 and was limited to studies published from January 1st 2013, to December 31st , 2023. In addition, the publication year range of 2013–2023 was selected to ensure the inclusion of recent and relevant evidence in the context of TB treatment adherence. It is noteworthy that this ten-year window allowed the researchers to capture current trends, strategies, challenges and outcomes aligned with the latest WHO guidelines, technological advancements and policy developments in TB control. Older studies were excluded to avoid outdated data that may no longer reflect the present clinical, social and technological contexts in TB management. Further, duplicate checking was automatically in Mendeley and verified manually.

Inclusion Criteria

The inclusion criteria were articles that were published in English or Bahasa Indonesia, contained original research, and published between 2013-2023. Furthermore, articles were selected for review if they focused on treatment adherence, barriers, or the role of health workers in TB patients' treatment adherence and included adults aged > 18 years who were diagnosed with TB.

Exclusion Criteria

The exclusion criteria were reviews studies instrument development studies, and unpublished studies.

Data Extraction and Quality Assessment

Researchers used the Preferred Reporting Items for Systematic Review and Meta-Analysis Extension for Scoping Review Checklist (PRISMA-ScR) to screen articles for inclusion. The study selection process is illustrated in Figure 1. After the initial search by the established inclusion and exclusion criteria, the procedure, screening outcomes, and extraction criteria for the included studies were outlined using PRISMA-ScR reporting guidelines. In total, 2,649 relevant abstracts were gathered from the

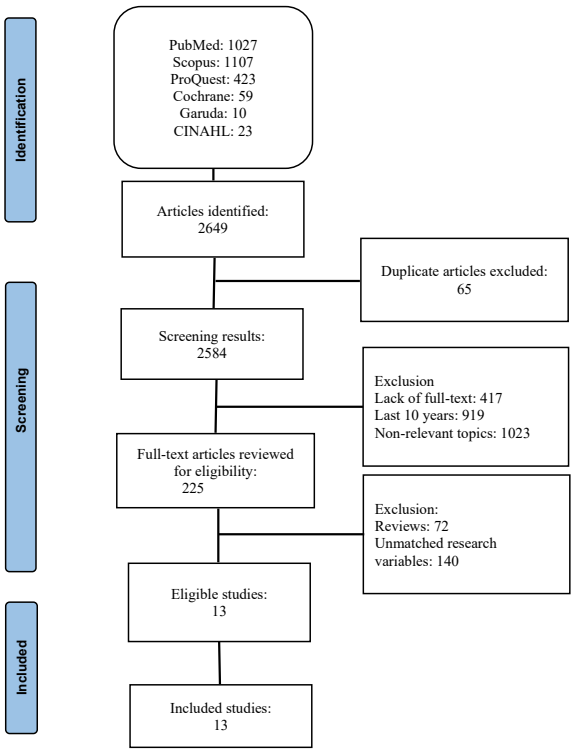

Figure 1. PRISMA Flowchart
Note. PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

six aforementioned databases. After removing duplicates, 2,584 abstracts remained. The titles were then assessed for relevance, narrowing the list to 225 articles for full text evaluation. Of these, 13 articles were identified as directly related to the research question. Next, all articles retrieved from the search were imported into Mendeley. Following removing duplicates, they were exported to the Rayyan program, a web-based tool designed to facilitate screening and collaboration in systematic reviews by enabling blinding, tagging, and resolving conflicts efficiently to ensure inter-rater reliability during the screening process based on the inclusion and exclusion criteria (22). All stages of screening and selection were independently conducted by two reviewers (Gabriella Delfie Natalia and Andi Masyitha Irwan) with blinding activated in Rayyan to minimize bias. Moreover, any disagreements were resolved through discussion until a mutual agreement was reached to ensure the accuracy and reliability of the synthesis.

The included articles were subjected to integrative review. Although quality assessment is not required in an integrative review, it can assist researchers in interpretating study results. Thus, two reviewers critically appraised the 13 selected studies for quality using Bowling's instrument, with a scale of "Yes", "Not Reported", and "Poor". The quality assessment of the included articles is presented in Table 1. Based on the quality assessment, all 13 studies were deemed to be of high quality and eligible for inclusion in the review. Data extraction was based on research objectives, methods, sample size, instruments, MA, barriers to MA, and the role of health workers (Table 2).

Results

Characteristics of Studies

Researchers found that 4 and 3 studies were conducted in China (20, 23, 27, 28) and Indonesia (24, 28, 30), respectively. In addition, the remaining studies (23, 25, 27, 31, 32, 35) were performed in Ukraine (n = 1), Mozambique (n = 1), Australia (n = 1), England (n = 1), Ethiopia (n = 1), and Uganda (n = 1). Detailed characteristics of the included studies are presented in Table 1.

Based on our findings, the studies included quasi-experimental (24), cross-sectional (26, 28, 29, 30), qualitative (23, 25, 27, 31, 33), retrospective cohort (32), phenomenological (33), and cluster randomized (34, 35) designs. A summary of qualitative, mixed-method, and quantitative study designs is provided in Table 2. The sample sizes for mixed-method studies ranged from 17 to 67,944 participants, combining both primary and secondary data. The study with the largest sample size (67,944) was conducted by Lolong et al (28).

Medication Adherence

Of the 13 articles analyzed, nine discussed TB treatment adherence (24-26, 29-32, 34, 35). Of these nine articles, five examined TB treatment adherence rates of more than 50% (24, 30, 32, 34, 35), two demonstrated TB non-adherence rates of more than 50%, and two other articles stated that factors affecting the level of treatment adherence are influenced by the individual, health service

Table 1. Quality Appraisal

Authors	Goals Are Clearly Explained	Study Design Explained	Appropriate Research Method	Adequate Description, Sample, And Exclusion Criteria	Ethics Are Presented	Results Are Reported	Results Are in Accordance With the Study Questions and literature	Limitations Are Presented	Implications Are Discussed	Value/ Level
Aibana et al (23)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Ni'mah et al (24)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
De Schacht et al (25)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Du et al (26)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Ting et al (27)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Lolong et al (28)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Chen et al (29)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Tampubolon et al (30)	Yes	Yes	Yes	Poor	Yes	Yes	Yes	Yes	Yes	8/9 High
Craig et al (31)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Tesfahunegyn et al (32)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Zhang et al (33)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Lewis et al (34)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High
Cattamanchi et al (35)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/9 High

policies, institutional aspects, comorbidities, and the quality of counselling for patients (26, 34). Several articles emphasized that adherence is shaped not only by a matter of patient behavior but also by systematic factors, such as counseling quality (25), social influences (31), and medication reminders (34). The analysis exemplified the need for a comprehensive approach and continuous efforts from various relevant constituents to effectively improve treatment adherence throughout respective regions.

Barriers to Taking Medicine

Twelve articles delineated barriers to MA (23, 25-35). Based on the analysis of these 12 articles, various factors were identified as barriers to TB MA. The most frequently mentioned barrier was a lack of health literacy regarding the disease and its treatment, which was highlighted in seven articles (23, 24, 26, 28, 30, 31, 33). In addition, the absence of social support was considered a major barrier to MA in five articles (23, 25, 26, 28, 31). Additionally, another barrier elucidated from five articles was the side effects of TB medications (25, 27, 29, 32, 33). Socio-economic factors (e.g., low income and poverty) were also found to be barriers to MA in five articles (23, 26, 28-30). An inadequate healthcare system was described as a barrier to adherence to TB medication in five articles (23, 25, 29, 31, 35). Furhermore demographic factors were regarded as barriers to MA and were specified in two articles (26, 28). Likewise, patient behaviors, such as smoking and alcohol consumption, were identified as barriers in two articles (26, 28). Similarly, psychological distress (e.g., stress and depression) were mentioned as barriers to MA in two articles (23, 26). Eventually, a lack of family support was reported in only one article as a factor hindering MA (30). Accordingly, there is a need for a multidisciplinary and comprehensive approach that involves all relevant parties in MA management to effectively overcome this problem.

The Role of Health Workers

Eleven articles discussed the role of health workers (24-32, 34, 35). Based on the analysis of these articles, health workers play a pivotal and manifold role in improving TB treatment adherence. Medication supervision was the most frequently mentioned role of the health workers (24, 26, 29, 31, 34, 35). In addition, patient education, which is considered quite important in improving TB treatment adherence, was discussed in four articles (24, 26, 29, 32). Further, four articles highlighted the role of health workers in treatment counseling to improve MA (25, 26, 30, 32). The availability of adequate health services as a supportive factor for treatment adherence was emphasized in four articles (23, 28, 29, 31). Moreover, collaboration among health workers to improve TB treatment adherence was mentioned in three articles (24, 31, 34). In addition, three article indicated the importance of psychological support from health workers for patients to improve TB treatment adherence (23, 25, 26). Briefly, health workers significantly contribute to improving TB treatment adherence through medication administration supervision, patient education and counseling, social support, availability of services, collaboration among health workers, and psychological support, which all require a comprehensive and collaborative approach to TB MA.

Table 2. Extraction Data

Author	Year/ Country	Research Purposes	Method	Sample/Setting	Instrument	Medication Adherence	Barrier to Medication Adherence	Roles of Health Professionals
Aibana et al (23)	2020/Ukraine	To understand the challenges faced by TB patients and factors influencing TB treatment adherence in Ukraine	Qualitative with in-depth interview approach	60/ TB treatment in Kyiv Oblast, Ukraine	Interview sheet		- Psychological distress - Unsupportive interactions with service providers - High pill burden - Financial - Transportation costs - Rigid facilities - Lack of psychological support	-
Ni'mah et al (24)	2018/ Indonesia	To improve pulmonary TB treatment adherence	Quantitative quasi-experimental design	36/Clampis Community Health Centre, Bangkalan	Observation sheet TB forms 01 and 02 and the medication adherence questionnaire	- Compliant control group 39% - Compliant intervention group 83%	-	- Utilizing peer group support - Assisting the program to increase knowledge and positive attitudes.
De Schacht et al (25)	2019/ Mozambique	To understand and assess the quality of existing TB health services in Mozambique, specifically for the management of the 3 types of patients: drug-sensitive TB, TB/HIV, and multidrug-resistant TB	Qualitative with focus group discussion	51 patients/health centers in Sofala and Manica Province, Mozambique	Descriptive with guidelines	- Individual factors - Social - Institutional - Need for community-based adherence counseling session	- Shame/stigma - Lack of prioritization of treatment - A better feeling and lack of completing therapy, - Side effects	- Counseling to help patients adhere - Prioritizing interaction and empathy with patients to encourage medication adherence
Du et al (26)	2020/China	To explore medication adherence rates among pulmonary TB outpatients and predictive factors based on the bio-psycho-social medical model	Quantitative cross sectional design	564 patients/Dalian TB hospital, Pulandian TB hospital, and Zhuanghe and Lvshun TB dispensaries	Questionnaire Morisky Medication Adherence Scale (MMAS-8)	- High: 41,84% - Medium: 32,45% - Low: 25,71%	- Socio-demographic characteristics, - Treatment factors - TB knowledge - Mental health - Behavioral characteristics	- Counseling comprehensively - Addressing the financial burden of unemployed patients - Ensuring adherence to additional medication - Implementing social support, education, counseling, alcohol control, and medication monitoring interventions
Ting et al (27)	2020/ Australia	To explore the burden of TB treatment Qualitative semi-structured interviews	Qualitative with semi-structured interviews	20 participants/Hospital in Sydney, Australia	Interview sheet	-	- Number of pills - Bad taste - Difficult to swallow - Side effects, such as	- Having quick access to doctor consultation. - Guiding when to take medication - Using a community treatment model to minimize treatment burden
Lolong et al (28)	2023/ Indonesia	To assess the proportion, reasons, and factors associated with anti-TB treatment non-adherence	Quantitative cross sectional design	67,944/ 136 cities in Indonesia	Demographic questionnaire	-	- Demographic factors - Socio-economic - Lack of social support - Knowledge of treatment duration - Access to health services - Smoking - Side effects of medication - Impact of education - Gender	- Utilizing the Directly Observed Treatment, Short-Term Strategy (DOTS) - Involving community health centers
Chen et al (29)	2020/China	To evaluate treatment adherence among newly diagnosed TB patients	Quantitative cross sectional design	481 patients/ Dalian tuberculosis hospital	Morisky Medication Adherence Scale (MMAS-8)	- Good adherence: 45.7% - Moderate adherence: 24.7% - Low adherence: 26.8%	- Adverse drug reactions - Transportation - Financial burden - Ineffective communication between doctors and patients	- Monitoring patients via phone - Providing health education

Table 1. Continued

Author	Year/ Country	Research Purposes	Method	Sample/Setting	Instrument	Medication Adherence	Barrier to Medication Adherence	Roles of Health Professionals
Tampubolon et al (30)	2023/ Indonesia	To determine the factors associated with TB treatment adherence	Quantitative cross-sectional design	32 patients/ Kepanjen Community Health Center	Questionnaire Morisky Medication Adherence Scale (MMAS)	- Compliant: 68.8% - Non-compliant: 31.3 %	- Improper drug dosage and intake - Concomitant medical conditions - Socio-economic status - Family support - Regimen complexity - Waiting time for identification	Counseling patients to influence medication adherence
Craig et al (31)	2015/United Kingdom	To describe the social context of treatment adherence in marginalized treatment groups in London TB service centers	Qualitative	17/London, England, Birmingham, Brussels and Rotterdam	Interview sheet	- Influenced by social location - Comorbidities - Policies and services - Integrated care pathways to address clinical and social risks	- Social and institutional factors - Risky lifestyle - Homelessness - Policy and service gaps	- Implementing DOT - Providing support - Collaborating with other sectors to address clinical and social risks
Tesfahuneygn et al (32)	2015/Ethiopia	To assess adherence rates and assess treatment outcomes and factors associated with poor TB treatment outcomes	Retrospective cohort study	200 patients/Health facilities of Alamata District	Questionnaire	- Adherent: 88.5% - Non-adherent: 11.5%	- Unintentional non-adherence (forgetting) to medicine - Limited access - Side effects of medication - Hospitalization	- Educating - Counseling - Closely monitoring patients with comorbidities such as HIV
Zhang et al (33)	2020/China	To explore the factors that influence patient non-adherence to pulmonary TB treatment, from the perspective of the patients themselves	Qualitative with a phenomenological approach	17 patients/Tibet, China	Interview sheet	-	- Lack of knowledge about TB treatment - Poor self-management skills - Misperception of health condition - Drug side effects - Discrimination	-
Lewis et al (34)	2023/China	To assess the impact of daily medication reminder monitors and monthly review of adherence data by healthcare providers on patients' TB treatment adherence and outcomes.	Quantitative cluster-randomized superiority trial approach	485 patients/24 counties/district in three provinces in China	Medication event reminder questionnaire	- Compliant: 52% - Non-compliant: 46%	- Lack of a change in patient management despite non-compliance - Inaccurate and untimely data on non-adherence.	- Providing training to patients on medication - Providing support and motivation - Monitoring the patient's adherence to medication
Cattamanchi et al (35)	2021/ Uganda	To evaluate the effectiveness of a 99DOTS-based TB treatment supervision strategy in Uganda	Quantitative Cluster-randomized trial	1,913 patients/18 facilities health in Uganda	Not specifically stated. Data were taken from digital adherence platform based on 99 DOTS	-Adherent: 86.6% -Non-adherent: 70.5%	-Time -Cost -Inconsistency	- Good adherence: 45.7% - Moderate adherence: 24.7% - Low adherence: 26.8%

Note. TB: Tuberculosis; HIV: Human immunodeficiency virus; AIDS: Acquired immunodeficiency syndrome.

Discussion

This review determined the best approaches to TB MA, barriers to taking TB medication, and the role of health workers in treatment adherence for patients with TB.

Patient Adherence to Tuberculosis Treatment

Based on the results of this integrative review, researchers determined that TB treatment adherence is different. TB treatment adherence was affected by individual factors (e.g., age and knowledge about TB), health service policy factors (e.g., access and family support), organizational aspects (e.g., effective collaboration), and other factors (e.g., medication side effects). These finding are consistent with previous concepts, including the ideology that TB treatment adherence is influenced by diverse and complex factors, such as sociodemographic characteristics, mental health, behavioral characteristics, knowledge about TB, and treatment factors (36). However, several studies reported differing patterns of adherence depending on the regional and cultural context. Studies indicate that although the barriers are similar, their relative importance is different. For example, stigma plays a dominant role in Southeast Asia, while transportation costs are described as the primary barrier in Sub-Saharan Africa (37). Moreover, the quality of counseling and education for patients is considered to be crucial in improving TB treatment adherence. In particular, counseling approaches tailored to patient literacy levels and sociocultural background have shown better outcomes in previous studies, which aligns with our findings (38). Therefore, varying rates of TB treatment adherence across geographic regions may indicate the need for tailored efforts to improve adherence based on the specific sociocultural factors in each respective region. Consequently, it is necessary that further research focuses on factors affecting adherence in each region in order to design targeted interventions.

In addition, the development of a comprehensive intervention program involving various stakeholders, including health workers, policymakers, and communities, is imperative to effectively address factors contributing to TB treatment adherence. Community capacity building and culturally-relevant training for health workers in providing quality education and counseling to patients with TB should be prioritized as well. A practical implication for policymakers is the integration of TB adherence interventions into existing primary healthcare services in regions with the federal oversight of healthcare delivery, thus enabling more efficient resource allocation. Additionally, strong collaboration and coordination among the health, social, and economic sectors are essential for addressing factors influencing adherence holistically. With sustained efforts and a comprehensive approach, it is expected that TB treatment adherence be effectively improved across the respective regions.

Barriers to Taking Medication in Patients With Tuberculosis Treatment

Based on the results of this integrative review, researchers identified that various programs and strategies are effective in promoting MA, including patient education, support, and counseling (1), the Directly Observed Treatment Short-Course (DOTS) strategy (2), and the involvement of local health facilities (3). Other methods encompassed community-based treatment models (4) close monitoring, especially for patients with comorbidities (5), strategies for overcoming financial burdens (6), and treatment supervision (7). These finding align with those of the study by Muller (39), emphasizing that various interventions, including the DOTS strategy implemented by trained community health workers, significantly improved MA and increased cure rates while reducing treatment failure among TB patients.

The Health Belief Model indicates the importance of individual perceptions of the benefits and barriers to taking health actions, influenced by factors such as social support and education (40). Furthermore, the Social Cognitive Theory explains how personal, behavioral, and environmental factors interact to influence health behavior, including MA (41). However, it is argued that the DOTS strategy alone is insufficient without a theoretical approach involving social support and counselling. Our findings support this argument, as studies included in this review repeatedly demonstrated that the absence of family or community support undermines DOTS effectiveness, even when implemented correctly. Moreover, family and community involvement is crucial while not solely relying on health workers. A multidisciplinary approach involving the health, social, and economic sectors is necessary to comprehensively address the factors affecting TB treatment adherence. Therefore, the integration of education, counseling, peer support groups, and family involvement into TB control programs is essential for the sustainability of TB treatment adherence. For instance, a case study in Indonesia revealed that integrating peer support groups into TB programs could increase adherence rates by 20% within a year. Such context-specific examples strengthen the practical relevance of our review findings. Additionally, more flexible and community-based approaches, such as community treatment models or supervision by health brigades, are required to achieve TB treatment adherence. Likewise, collaboration among health and other sectors is important to assist patients in overcoming social and financial barriers. Accordingly, further research is needed to explore effective intervention models for patients with TB with specific barriers. A potential research direction is to evaluate the long-term sustainability of community-based adherence models in low-resource settings.

The Role of Health Workers in Tuberculosis Treatment

This integrative review confirmed that health workers play a critical role in ensuring MA for TB patients. In addition, the implementation of DOT strategies with direct supervision by health workers has been proven to be effective. Similarly, emotional support and motivation provided by health workers can assist patients in

improving TB treatment adherence (42). Additionally, comprehensive counseling by trained health workers can influence adherence by simultaneously addressing barriers while providing support (43). Health workers also contribute to ensuring adherence to additional treatment modalities for comorbidities and mechanisms to address drug side effects (44). They are involved in educating, counseling and mitigating other factors that may affect TB treatment adherence (e.g., alcohol consumption habits). Moreover, health workers can be part of the enabling environment through patient education, support and counselling. They play a central role in these efforts, not only through direct supervision but also through the facilitation of holistic approaches. It is essential for health workers to establish desirable relationships with patients, express empathy and assist patients in addressing the challenges that they may face.

Collaboration with other sectors (e.g., social and economic services) can also help address clinical and social risk factors that may affect TB treatment adherence. Notably, our findings are consistent with those of Smith et al (45), indicating that health workers' communication skills significantly predicted TB treatment adherence, independent of patients sociodemographic characteristics. This suggests that improving interpersonal communication may be as important as logistical support in TB care.

There is a need for capacity building and training for health workers to deliver collaborative education, support, and counseling to patients with TB. Strengthening surveillance and monitoring systems (e.g., DOTS and medication reminders for patients), developing adequate policies, and allocating resources to support the role of health workers in mitigating TB are some of the important actions that can be taken in this respect. Moreover, increased collaboration and coordination among health workers and other sectors is needed to address risk factors affecting patients' treatment adherence. In practice, this can involve establishing multidisciplinary TB care teams within community health centers, combining clinical expertise with social and psychological support services.

Implications

Improving adherence and recovery of patients with TB requires a multidimensional approach that includes education, improved access to health services, family support, and effective counseling and therapeutic relationships between health workers and patients. It is noteworthy that proper education can enhance patient and community awareness of the importance of TB treatment adherence. In addition, access to TB health services needs to be expanded, with the availability of adequate facilities and resources. Furthermore, family involvement and support in accompanying patients during the treatment process plays a crucial role in improving adherence.

Further implications to improve TB adherence include government efforts to reduce stigma, increase public awareness and strengthen health workers' capacity to provide effective counseling and patient assistance through training. The availability of adequate health services, including the facilities and resources needed for comprehensive TB treatment, is also a key factor. Likewise, collaboration between various health workers is required to treat TB cases in an integrated and holistic manner. This multidimensional approach involving various sectors is expected to significantly improve TB treatment adherence in patients with TB.

Limitations

Although this integrative review included a more comprehensive range of studies, there was a limited body of research that could explicitly address treatment adherence, barriers and the role of health workers in TB treatment. Hence, future original studies are needed in this area. In addition, this integrative review only included English and Bahasa Indonesian studies while excluding relevant studies in other languages. The limited number of articles reduces the breadth of insights gained on this globally complex topic, as most are from the Asian region, particularly China and Indonesia, and may not represent the diversity of sociocultural characteristics and situations in other countries and continents. In addition, most of the studies lacked longitudinal data, thereby limiting the ability to assess the long-term effectiveness of the intended interventions. These limitations underscore the need for broader, multilingual and geographically diverse primary research using more varied methodological approaches to better inform geospatial TB control efforts. Further, variations in healthcare infrastructure and sociocultural factors were not thoroughly explored in this review study. While these findings can serve as a foundation for more integrated TB control programs and policies, future research should focus on longitudinal community-based studies to assess the real-world effectiveness of these interventions.

Conclusion

This integrative review underscores that treatment adherence in TB patients is a multifaceted issue that is shaped by individual behaviors, social dynamics, economic conditions, and health system challenges. Major barriers, such as inadequate social support, adverse drug effects, limited knowledge, and restricted access to care, significantly hinder TB treatment adherence. Health workers serve a pivotal role in addressing these barriers through supervision, education, support, counseling, and interprofessional collaboration. Finally, enhancing adherence requires a coordinated, interprofessional effort involving patients, families, healthcare providers, and policymakers. Therefore, future interventions must holistically target these interconnected factors to strengthen treatment outcomes and advance TB control efforts.

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All authors contributed to the writing of this integrative review article.

Authors' Contribution

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Competing Interests

The authors declares that there is no conflict of interests.

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