


Telenursing Intervention for Pulmonary Tuberculosis Patients - A Scoping Review

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Abstract: Management of care for people with Pulmonary TB at home using Information and Communication Technology (ICT) tools and innovative approaches, such as tools for telecommunications online education. In the nursing sector, the use of telecommunications is called telenursing. The purpose of this study is to determine the types of telecommunications-based interventions, especially telenursing, in monitoring the level of treatment adherence in patients with pulmonary TB. This study used a scoping review method approach to determine the type of telecommunications-based interventions, especially telenursing, in monitoring the level of treatment adherence in patients with pulmonary TB. Literature distribution using several sources, namely EBSCOhost, Scopus (Elsevier), and PubMed. To facilitate obtaining appropriate literature, PICO techniques are used in conducting literature searches, P (population/problem/patient), I (intervention, prognostic factor, exposure), C (comparison, control), and O (outcome). Keywords used in English “Tuberculosis OR Pulmonary Tuberculosis AND Telehealth OR Telehealth Nursing AND Medication Adherence OR Medication Compliance OR Behavior”. In total from the 13 articles obtained, the articles used several telehealth to pulmonary TB patients with various implementations, such as the Directly Observed Therapy, Short Course (DOTS) (n = 7). These four implementations have the same goal and support adherence to taking medication and daily recovery in pulmonary TB patients. Overall characteristics of pulmonary TB patients in the reviewed articles are pediatric TB patients (0–14 years), adult TB (18–30 years). A total of 9 studies used a sample population of adult TB patients (18–30 years), TB undergoing Directly Observed Treatment Short-course (DOTS), TB receiving medical care and TB patients actively receiving treatment. The most influential effectiveness of telehealth in helping the treatment process of Pulmonary TB patients is Directly Observed Treatment Short-course (DOTS) because the main focus of the DOTS strategy is patient discovery and cure, priority is given to infectious TB patients without ruling out other types of TB.

Keywords: effectiveness, intervention, pulmonary tuberculosis, telenursing, DOTS

Introduction

Pulmonary TB is an infectious disease caused by *Mycobacterium tuberculosis*. The Ministry of Health of the Republic of Indonesia (2022) states that as many as 91% of TB cases in Indonesia are pulmonary tuberculosis which has the potential to transmit to healthy people around them.¹ As of June 2, 2022, the Ministry of Health of the Republic of Indonesia has released official data that Pulmonary TB patients in Indonesia exceeded 406,936. One of the health problems spread throughout the world today, especially in developing countries with high morbidity and mortality rates is Pulmonary TB.²

Tuberculosis is the second leading cause of death from infectious diseases, accounting for around 1.3 million deaths worldwide. There are 6.3 million cases of pulmonary tuberculosis worldwide. Indonesia has the third highest number of TB cases in the world, with 446,732 cases. In 2013–2018, the prevalence of pulmonary tuberculosis was 245 per 100,000 people based on doctor's diagnosis data per province. In 2017, 42.8% of TB patients in Indonesia received complete treatment. The percentage of tuberculosis treatment success is 85.7%, with 5.4% of patients losing surveillance, 2.7% not being examined, 2.5% dying, and 0.4% failing therapy. In Indonesia, the estimated incidence of RO TB is 2.4%

of all new TB patients and 13% of cured TB patients, for a total estimated incidence of RO TB cases of 24,000, or 8.8/100,000 population. In 2019, around 11,500 Rifampicin-Resistant TB patients were identified and reported, accounting for roughly 48% of patients who began second-line TB therapy and resulting in a treatment success rate of 45% (WHO Global TB Report 2020), which is lower than the global treatment success rate of 57%. Based on these findings, it is clear that there is still a significant disparity between confirmed instances of RO TB and patients treated. This can be due to a variety of factors, such as patients refusing to be treated, patients not returning after being diagnosed, and challenges in accessing health facilities due to the fact that not all districts / cities in Indonesia have TB RO.

According to ² the target of the Pulmonary TB control program is to achieve the discovery of new patients with positive BTA at least 70% of the estimated and cure 85% of all these patients, and maintain it. However, until now the results have not been satisfactory. Skin test or Mantoux tuberculin skin test (TST); Interferon Gamma Release Assays (IGRA); sputum smear microscopy; and chest X-ray (thorax) are common medical diagnostic procedures used in Indonesia to diagnose tuberculosis. High drop-out rates, inadequate treatment, and resistance to Anti-Tuberculosis Drugs (OAT) are still obstacles in the treatment of Pulmonary TB.

According to the Ministry of Health of the Republic of Indonesia (2009), the failure of the TB program so far has mainly been caused by inadequate case management, including TB services that are not accessible to the community, non-standard case findings, not monitoring during treatment, so that it fails to cure cases that have been diagnosed. TB is transmitted by airborne contact when the person with active TB is coughing or sneezing. The activity spreads respiratory fluids into the air and is inhaled by others. A person is more likely to develop TB from contact with people who live or work together in one room than from strangers. Groups of people who are more susceptible to tuberculosis infection, namely: Elderly; People infected with HIV or AIDS; Baby; People with cancer, diabetes, kidney disease, or autoimmune diseases; Malnourished patients.

In addition, community poverty and low political commitment, as well as funding contributed to the failure. Based on this, care management of patients with Pulmonary TB at home plays an important role in increasing BTA sputum conversion and nutritional status, especially in the intensive care phase, so that the recovery rate of patients increases. So far, the monitoring process of Pulmonary TB patients in the community is carried out passively by health workers, namely when control patients go to the health center. Treatment of patients with pulmonary TB must be the right type, schedule, and dose to be able to work optimally and prevent drug resistance. Patients with Pulmonary TB and their families also need information support about nutritional management, because nutrition is a supporting factor in accelerating healing. Therefore, the active role of community nurses in the management of TB care at home is very necessary.

In the healthcare sector, the practice of telehealth or telemedicine grew rapidly during the pandemic and continues to grow. Requiring people with TB to visit facilities daily or weekly to receive essential treatment during a pandemic is unrealistic, especially in low-resource settings. The ongoing COVID-19 pandemic has reinforced the urgent need to move away from facility-based DOT towards a person-centered, human rights-based model of care. Looking at the change, the shift in health paradigms among them, Inequality in access to health facilities is one of the key problems for some groups of people when it comes to health services. People in the suburbs, where health care is insufficient and biased, are portrayed as an unhealthy segment of the population. However, as a result of the epidemic, tele-health practices are expanding, barriers are being removed, and access to public health institutions is improving. Increased digitalization in healthcare improves efficiency, patient engagement, and health customisation. Because of technological advancements, multiple interventions like as telenursing, teleappointment, real-time interaction, telediagnosis, remote patient monitoring, and others are now possible.

These alternative models are important for integrating the biomedical aspects of treatment with the empowerment of people affected by TB through information, capacity building, coordination, and access to inclusive and comprehensive social protection systems to create an enabling environment for effective treatment and care needed to save lives and end TB Using Directly Observed Therapy Short Course (DOTS) as a government plan to combat the rise in pulmonary tuberculosis incidence in Indonesia.

Management of care for people with Pulmonary TB at home using Information and Communication Technology (ICT) tools and innovative approaches, such as tools for telecommunications online education. This telecommunications

was developed before the pandemic and became more popular during the pandemic because people were looking for creative solutions to reduce the impact of the pandemic. In the nursing sector, the use of telecommunications is called telenursing. Telenursing is defined as a process of providing management and coordination of care and delivery of health services through information and telecommunications technology.³ According to,^{4,5} the use of telenursing can improve patient behavior in preventing transmission of Pulmonary TB. However, this telenursing method is quite expensive. The formulation of the problem that the author sets is: "The effectiveness of telecommunications-based interventions, especially telenursing, in monitoring the level of treatment adherence in patients with pulmonary TB.

Telenursing-related research limitations, such as a lack of evidence on the effect of digital technology on TB care, necessitate more research with higher evidence quality and a sole focus on evaluating the feasibility of telenursing use, user convenience, and acceptability in digital health interventions. According to Indonesia, smartphone-based telenursing should be created in Indonesia to optimize the DOTS program for TB patient treatment adherence, which is backed by the vast number of Indonesians who own smartphone-based mobile phones. Special considerations must be made for one-way or two-way communication in Smartphone features in TB patients.

Based on the foregoing, the study question is, "What telecommunications-based interventions are most effective for monitoring treatment compliance of pulmonary TB patients?". The goal of this scoping review study is to establish the efficacy of telecommunications-based interventions, particularly telenursing, in monitoring medication adherence in patients with pulmonary tuberculosis.

Materials and Methods

Design

This study was designed using Arksey and O'Malley's scoping review framework. Scoping review is a methodological technique to explore new topics that are currently being developed.⁵ Scoping review aims to explore a topic and usually aims to answer broad questions.⁶ The researcher conducted a scoping review to assess the extent of available evidence, to organize them into groups according to similarity.⁷ Scoping reviews can also be used as a basis for conducting systematic reviews and meta-analysis. This research framework has a wide conceptual range so that it is able to explain various relevant studies.⁸ The framework used consists of five core stages, namely identification of research questions, identification of relevant study results, study selection, mapping data, compiling, summarizing and reporting results.⁹

This literature review used PRISMA Extension for Scoping Reviews (PRISMA-ScR) to determine telecommunications-based interventions, especially telenursing, in monitoring treatment adherence rates in patients with pulmonary TB to be implemented in the community (Figure 1). The research question in this study is to determine what type of telenursing-based telenursing intervention in monitoring treatment adherence rates in patients with pulmonary TB?

Search Strategy and Eligibility Criteria

For publication searches, three databases were used: Scopus (Elsevier), PUBMED, dan EBSCO. Kata kunci yang digunakan untuk mencari artikel jurnal yaitu (((Tuberculosis)) OR (Tuberculosis Pulmonary)) AND (Telehealth)) OR (Telehealth Nursing)) AND (Medication Adherence)) OR (Medication Compliance)) OR (Behavior)). The criteria in this study based on the PICO (Patients, Interventions, Comparison, Outcome) criteria framework were:

Problems/Patients: Pulmonary TB with a general adult age range (no age limit).

Interventions: Treatment of pulmonary TB in the post-pandemic era through telehealth.

Comparison: No comparison.

Outcomes: Treatment adherence rate for pulmonary TB patients (PMO), pulmonary TB patient education, non-pharmacological treatment, and measuring quality of life for pulmonary TB patients.

The sources considered in this scoping review based on inclusion criteria consist of all types of quantitative and qualitative studies that focus on the use of telehealth as an intervention in patients with pulmonary tuberculosis in general in the general adult age range (without age limit). We limit the literature search period to the last 10 years (2013–2023) which are articles in English and Indonesian and available in full text. While the exclusion criteria in conducting

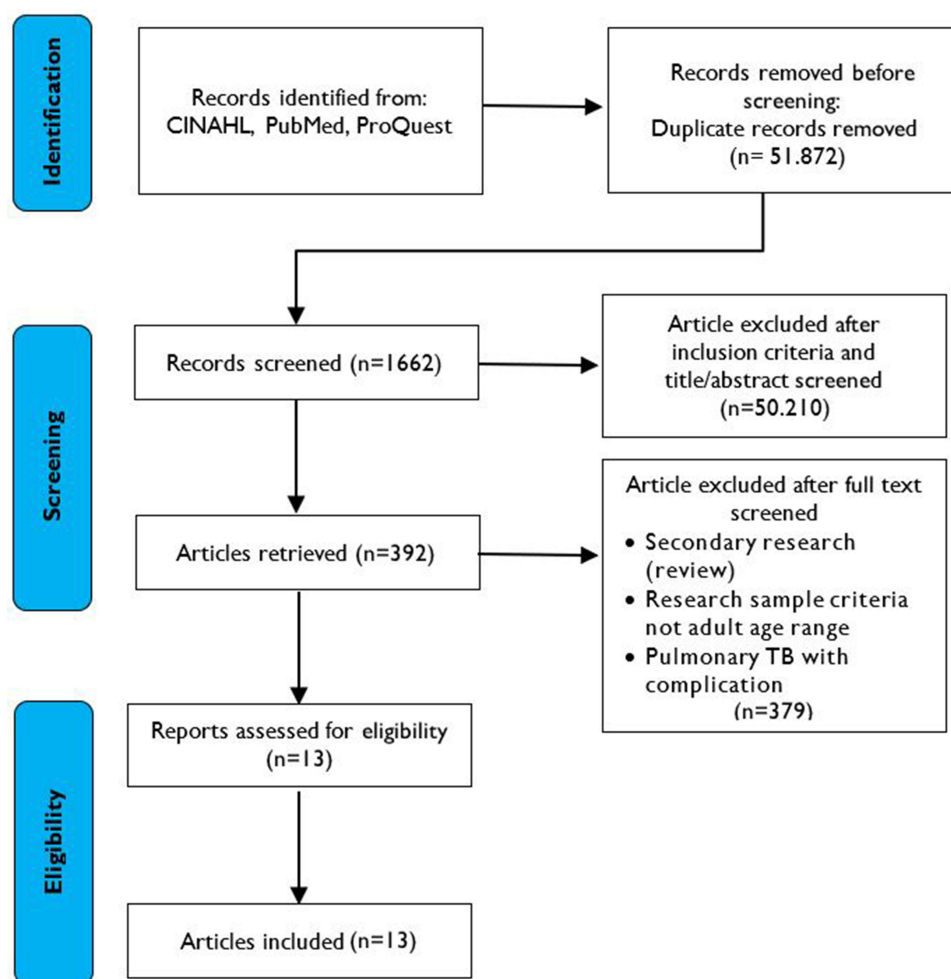


Figure 1 PRISMA Flow Diagram.

Notes: PRISMA figure adapted from Page MJ, McKenzie JE, Bossuyt PM, et al. J. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. Creative Commons.¹⁰

literature searches are research with secondary data (review results), studies with sample criteria outside the adult age range, diagnosed pulmonary TB with complications, and research articles in Chinese, German, and Brazilian.

Data Collection

Journal articles selected based on inclusion and exclusion criteria are then extracted and analyzed by taking into account the title, citation, country, population, sample and sampling techniques, theories or concepts, variables, instruments, results, and strengths and weaknesses of journal articles.

Data Analysis

Data analysis used in this study is a quantitative approach. All authors read the entire article then made a summary and entered it into the data extraction table. After that, the authors discussed the findings of the article and compile research results. After that, the authors classified digital therapy according to similar methods. After that, the authors made a narrative description of digital therapy. All authors completed the study selection process and included studies followed the PRISMA flowchart: (1) identifying duplicates; (2) filtering of titles and abstracts; and (3) availability of full text.

Results

There were 13 articles reviewed with characteristics of research publications in Moldova ($n = 1$), India ($n = 1$), China ($n = 2$), Malaysia ($n = 2$), the United States ($n = 5$), Bima City ($n = 1$), and Korea ($n = 1$). The overall sample population is TB patients, adult TB patients undergoing Directly Observed Treatment Short-course (DOTS), TB patients receiving routine medical care in the clinic, patients undergoing drug-sensitive TB treatment, patients undergoing MDR-TB treatment, HIV-infected and HIV-infected TB patients, TB patients actively receiving treatment and aged 18 years and over, regional referral center patients for children, adult TB patients in the advanced phase of treatment who are BTA-negative and taking isoniazid plus rifampicin.

The results of the identification of the objectives of this study are the effectiveness and difference in patient costs from VOT, evaluating the effectiveness of mHealth on the treatment of TB patients, conducting mHealth interventions based on the Integrated Theory of Health Behavior Change (ITHBC) in pulmonary TB patients, improving treatment adherence, testing TB management delivery models, and monitoring drug consumption in tuberculosis patients with remote technology. Authors identified the five methods by providing an explanation of the impacts and activities carried out. The results of the analysis of the article are presented in tabular form as follows (Table 1).

Characteristics of Pulmonary Tuberculosis Patients

Overall characteristics of pulmonary TB patients in the reviewed articles are pediatric TB patients (0–14 years) and adult TB patients (18–30 years). A total of 9 studies used a sample population of adult TB patients (18–30 years), TB resistant to many drugs removed, TB undergoing Directly Observed Treatment Short-course (DOTS), TB receiving medical care, TB patients actively receiving treatment. 4 studies used pediatric TB patients (0–14 years), patients on MDR-TB treatment, and patients requiring therapy either for TBI or for active TB disease.

Implementation Telehealth for Pulmonary Tuberculosis Patients

Overall from 13 articles that have been reviewed, the article uses several telehealth to pulmonary TB patients with various implementations, such as the implementation of Video-observed therapy (VOT) ($n = 4$), Directly Observed Therapy, Short Course (DOTS) ($n = 7$), Short Message Service (SMS) ($n = 1$), and Wirelessly Observed Therapy (WOT) ($n = 1$). These four implementations have the same goal and support adherence to taking medication and daily recovery in pulmonary TB patients. VOT is a procedure that asks patients to use a mobile device and app to record and is sent to a case worker who will view and document each event.

The type of VOT itself is divided into 2, namely direct conferencing (synchronous) and uploading video to the system (asynchronous). DOTS implementation is the highest standard for confirming the use of oral medications in the treatment of pulmonary TB. DOTS is divided into 2 types, namely electronic and face-to-face. From the article that has been reviewed, it is stated that patients prefer to use and continue treatment with electronic DOT. Implementation that utilizes SMS (Short Message Service) as a reminder of the time to take medicine containing an appeal to take medicine immediately. Meanwhile, WOT is a wirelessly observed therapy that can detect and record drug consumption digitally. The use of WOT has been confirmed to be safe, although there are limited side effects to skin irritation associated with wearing the patch and is easy to use.

The application of DOTS, according to the researchers, has the highest standard in certifying the usage of oral TB medications when compared to others. This is because it is simple and well-liked by patients, who can use it as a reminder to take medication via the SMS application.

Effect Implementation Telehealth for Pulmonary Tuberculosis Patients

Overall from 13 journal articles that have been reviewed, the most influential effectiveness in helping the treatment process of Pulmonary TB patients is Directly Observed Treatment Short-course (DOTS) because the main focus of the DOTS strategy is patient discovery and cure, priority is given to infectious TB patients without ruling out other types of TB. A form of direct supervision is also applied in this strategy, each patient treated with TB, must be accompanied by a PMO or Drug Swallowing Supervisor. By combining technical and managerial components gained from best practices,

Table 1 Results of Article Analysis

No	Article Title, Author & Year	Research Objectives	Population, Sample & Sampling Techniques	Types of Research	Result
1.	[11]	To analyze the effectiveness and cost difference of patients from VOT compared to clinic-based direct observation therapy (DOT) in improving treatment adherence in Moldova, an LMIC in Eastern Europe.	Population: TB patients Sample: 197 TB patients (n=99 DOT control group; n=98 VOT treatment group; multidrug-resistant TB cases excluded). Sample technique <i>Random Sampling</i>	<i>Randomized Controlled Trial.</i>	VOT Significantly decreased Non-compliance for 4 days (95% CI 3.35–4.67 days, $p<0.01$) per 2-week period: 5.24 missed days per 2-week period for DOT and 1.29 days for VOT. VOT patients spent 504 (EUR 25) MDL 504 (95% CI MDL 277–730, $p<0.01$) and 58 hours (95% CI 48–68 hours, $p<0.01$) less on their treatment. In addition, VOT increased self-reported satisfaction with treatment. We found no significant results with regard to treatment success, patient well-being or patient employment status and some evidence of increased mHealth side effects was effective in improving TB patient adherence rates in directly observed treatment short-course (DOTS) treatment.
2.	[12]	To evaluate the effectiveness of mHealth on treatment adherence of TB patients with short-term treatment of antituberculosis directly	Population: Adult TB patients who undergo Directly observed treatment short-course (DOTS) for a period of at least 30 days and a maximum of 90 days, have access to a mobile phone and can read messages and receive calls via mobile phone. Sample: There were 130 male patients and 90 female patients, so the total was 220 patients with an average age of 45.7 years. Sample technique <i>The Consecutive Sampling Method</i>	Quasi experiment al study	mHealth interventions are a useful mechanism to provide adherence support to TB patients
3.	[13]	To explore and conduct mHealth interventions based on the Integrated Theory of Health Behavior Change (ITHBC) in pulmonary TB patients to improve self-care management capabilities.	Population: TB patients who received routine medical care at the TB clinic of Harbin Chest Hospital, China from May 2020 to August 2020 and received a 3-month intervention. Sample: Conducted on 114 male patients, divided into two groups, namely the intervention group and the control group received medical care. Patients aged 18–30 years Sample technique <i>convenience sampling</i>	Randomized Controlled Trial.	Total scores of all 13 self-management behaviors were calculated. Both groups scored greater than baseline ($P<0.001$ vs $P=0.04$, respectively), but the intervention group's total score was higher than that of the control group ($P<0.001$). After the intervention, scores from 3 dimensions improved significantly in the intervention group ($P<0.001$) and significantly higher compared to the control group ($P<0.001$). There were no significant changes in the control group's scores before and after the intervention. ITHBC-based mHealth interventions can be a promising new therapeutic strategy for TB management to improve patient subjective initiative and self-management behavior, which is beneficial for improving adherence and quality of pulmonary TB prevention and control. In addition, mHealth provides effective solutions for outpatients without nursing care.

4	[14]	To assess the percentage difference in drug doses actually consumed by patients observed by participants by comparing electronic and face-to-face DOT	<p>Population: A total of 216 people with a range, 16–86 years of age with a doctor's suspicion or bacteriologically confirmed tuberculosis 9 in 4 clinics operated by the New York City Department of Health.</p> <p>Sample: Conducted on 173 participants, of which five participants (2%) withdrew and 38 (18%) withdrew during crossover period I</p> <p>Sample technique a randomized sampling</p>	A Randomized Noninferiority Trial	Seventy-three (42%) of the 173 participants who completed the crossover period reported that they preferred continuing treatment with a live video electronic DOT, 73 (42%) preferred recorded video electronic DOT, 9 (5%) chose a community-based face-to-face DOT, 1 (0.6%) chose a clinic-based direct DOT, and 6 (4%) chose to self-medicate. Electronic DOT is not inferior to face-to-face DOT. Furthermore, the magnitude of the bootstrap percentage difference showed that electronic DOT outperformed face-to-face DOT by 1.9% to 4.9%
5.	[15]	To find out the effectiveness of educational videos through whatsapp groups to increase knowledge related to tuberculosis prevention.	<p>Population: Two pretest-posttest design groups were the intervention group (given educational videos via whatsapp group) and the control group (given leaflets via whatsapp group)</p> <p>Sample: Conducted on 30 respondents participating in the study consisting of 15 intervention group people and 15 control group people</p> <p>Sample technique: a randomized sampling</p>	Quasi experimental design	The mean and min-max values in the intervention group (2.93) were higher and significantly higher than in the control group (1.27). Furthermore, the results of the Mann Whitney test in the pre-post intervention group showed a p value of 0.001 and the pre-post control group showed a p value of 0.003 which means a significant effect after being given educational actions through videos or through leaflets in whatsapp groups. Multivariate analysis revealed that tuberculosis intervention modules using WhatsApp are effective at improving and promoting treatment success among tuberculosis patients.
6.	[16]	Evaluate the use and effectiveness of vDOT in program settings, including Verified compliance comparisons between those who receive vDOT and DOT directly. And also seek to understand the impact of COVID-19 on TB treatment adherence and technology adoption.	<p>Population: TB patients who are actively receiving treatment and aged 18 years or older.</p> <p>Sample: 49 patients (51%) of the 96 patients receiving active TB care Signed availability for study; n=23 receives vDOT and n=26 does not receive vDOT</p> <p>Sample technique: Random Sampling</p>	Prospective Observational Cohort Study	<p>Among 49 TB patients (mean age 41, SD 19; n=27, 55% female and n=47, 96% non-US born), 18 (36.7%) received treatment during the post-COVID-19 period. Overall, verified adherence (proportion of observed doses) was significantly higher when using vDOT (mean 81%, SD 17.4) compared to face-to-face DOT (mean 54.5%, SD 10.9; P=0.001). vDOT adoption increased significantly from 35% (11/31) of TB patients in the pre-COVID-19 period to 67% (12/18) in the post-COVID-19 period (P=0.04).</p> <p>As a result, overall verified adherence (ie, observed) among all patients with TB in clinics increased over the study period (56%, 67%, and 79%, P=0.001 for pre-, early, and intra-COVID-19 periods, respectively). Verify true adherence above 80%, include weekend dosing and; offer a more comprehensive categorization of all treatment doses. It has been found that vDOT can reduce stigma and; improve logistical convenience, while also allowing TB programs to reduce costs and; reallocate resources more efficiently. In particular, compliance</p>

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Table 1 (Continued).

No	Article Title, Author & Year	Research Objectives	Population, Sample & Sampling Techniques	Types of Research	Result
7	[17]	The study used SMS (Short Message Service) as a reminder of TB treatment adherence and cure but the success rate was 63.5% in the intervention group and 62% in the control group due to withdrawal by the sixth month of treatment	Population: All Puskesmas per quarter = 60 patients. Sample: The number of samples is equal to the population Sample technique: Total sampling.	Research method: experimental. Research design: One group Pretest-Posttest Design without using a control group.	The distribution of the frequency of compliance of respondents taking anti-TB drugs at the Bima City health center in 2019 showed that respondents with pulmonary TB before being treated by telenursing who were in the medium adherence category were 14 respondents (23.3%), while in the less category, compliance was 46 respondents (76.7%). Then all respondents were treated with telenursing and the results showed that respondents who were included in the high compliance category were 60 respondents (100%).
8	[18]	The aim of this study was to identify what factors are associated with higher rates leading to incomplete therapy in pediatric TBI patients. The second objective is to study the impact of telehealth introduced during the COVID-19 pandemic	Population: patients of the regional referral center for children, Haven Children's Hospital Winchester Chest Pediatric Tuberculosis Clinic in the Northeastern United States who require therapy either for TBI or for active TB disease Sample: pediatric patients aged 0–18 referred to Yale Pediatric Winchester Chest Tuberculosis Clinic Sample technique: A randomized sampling	<i>Randomized Controlled Trial</i>	The number of missed appointments for in-person visits decreased in 2021 compared to 2016–2019. The study showed that missed appointments before the COVID-19 pandemic were higher in patients who spoke languages other than Spanish and English. The introduction of telehealth reduced the rate of absenteeism for both video and in-person visits. In this small sample, it is a valuable tool for follow-up TBI and is preferred by patients living further away from the clinic
9	[19]	This study aimed to examine TB management delivery models and outcomes from integrated patient management systems using patient-centered and community-based approaches, along with health technology	Sample Population: A total of 3605 TB patients were enrolled in the program in five Moroccan prefectures (Rabat, Salé, Kénitra, Khemisset, Skhirat-Témara) from January 2018 to December 2019. Sample technique: A randomize sampling	Retrospektif studi dengan tes chi-square	Integrated patient management in the form of short message service (SMS) technology, and electronic pillboxes results in higher treatment success rates than existing programs in Morocco. This comprehensive approach provides an opportunity to overcome hurdles in TB patient management. However, there are still challenges in the human resources and technological infrastructure needed to run this program

10	[20]	To assess the clinical benefits and costs of observed live video therapy (VDOT), compared to DOT services.	Sample Population: 405 participants from each study group of patients with TB Sample technique: Sampling survey	This prospective randomized controlled	When analyzing the results of 405 participants from each study group, we found a very high treatment completion rate with VDOT vs DOT. The two methods of treatment observed have no statistical differences, and all of them can complete the task well. The mean time per dose observed was 16.5 min (standard deviation [SD] 12.1) for VDOT, while 44.1 min (SD 3.7) for DOT (including travel time), $p < 0.01$. And the cost incurred on VDOT was 34.3 (SD 3.8) manmo, which is statistically lower compared to 71.6 (SD 49.7) manmo in the DOT group, $p < 0.01$. Most patients in both groups believed that the observed treatment (VDOT/DOT) helped them not to miss a dose. Patients in the VDOT group had a better experience compared to those in the DOT group. They think the way is convenient and convenient and will choose the original way if necessary, and will recommend this method to other patients.
11	[21]	To monitor drug consumption in tuberculosis patients with remote technology and support treatment adherence	Population: Adult TB patients in the advanced phase of treatment who are BTA negative and taking isoniazid plus rifampicin, without evidence of drug-resistant TB, who have a complete blood count (CBC) and comprehensive panel value (CMP), can understand written or oral information about WOT, and can use mobile devices Sample: 61 participants with TB Sample technique: Random sampling	Randomized Control Trial (RCT) dan bersifat open-label dan prospektif	The results of this study provide evidence that WOT is able to support daily medication adherence in TB treatment. The research trial also confirmed that WOT is safe, with limited side effects on skin irritation associated with wearing the patch and being easy to use. These studies determined the accuracy of ingestion detection in clinical and home settings using WOT and were then compared, in randomized control trials (RCTs), confirming daily adherence to treatment in people taking WOT or directly observed therapy (DOT) during TB treatment.
12	[22]	To evaluate the effectiveness of multicomponent interventions based on the Health Action Process Approach (HAPA) model to improve self-management precursors of older adults with tuberculosis (TB).	Population: TB Patients Sampled: Of the 348 TB patients in 21 communities, 63 (18.1%) were ineligible, 23 (6.6%) were eligible but	Multicomponent interventions targeting self-management precursors Using the HAPA model and investigating its effectiveness for older adults with TB.	Among the 262 randomized patients, 244 (93%) completed the trial. Compared with the control group, self-management precursor scores for the intervention group improved significantly over time ($\beta_{\text{group*time}} = 2.92, p < 0.001$) in the following 3 precursors: behavioral beliefs ($\beta_{\text{group*time}} = 0.35, p < 0.001$), behavior plan ($\beta_{\text{group*time}} = 0.72, p < 0.001$), and self-efficacy ($\beta_{\text{group*time}} = 1.85, p < 0.001$). Education was significantly associated with behavioral beliefs ($\beta = 0.18, p < 0.05$). Chronic comorbidity was significantly associated with planned behavior ($\beta = -0.26, p < 0.05$).

(Continued)

Table 1 (Continued).

No	Article Title, Author & Year	Research Objectives	Population, Sample & Sampling Techniques	Types of Research	Result
13	[23]	The purpose of this study was to investigate whether adult drug-sensitive adult pulmonary TB patients whose treatment strategies include medication monitoring for daily medication dose reminders and monitoring	Population: Adult pulmonary TB patients in 24 counties in 3 provinces of China Sample: The study population consisted of successive samples of adults (≥ 18 years) with new episodes of pulmonary TB sensitive to rifampicin and Genexpert positive. Sample technique: Randomized advantage trial of open group, pragmatic, with 24 districts in three provinces in China, randomized 1:1 to implement interventions or standards of care.	Cluster Randomized Control Trial	Poor combined outcomes measured for 18 months from the start of TB treatment, defined as poor outcomes at the end of treatment (death, treatment failure, or absenteeism) or subsequent recurrence (positive culture for TB) at 12 or 18 months or restarting TB treatment in the follow-up period).

Note: Table Results from the review of articles selected according to the criteria.

clinical studies, and the administration of TB control programs, this technique is considered cost-effective. DOTS focuses on locating and treating patients because this is the most effective strategy to reduce TB transmission. DOTS, as defined by WHO, consists of five major components: 1) government commitment, 2) case detection, 3) standard treatment, 4) regular and uninterrupted supply of OAT, and 5) a recording and reporting system capable of providing an assessment of patient treatment outcomes and program performance.

The Pulmonary TB control program with the DOTS strategy consists of five parts, namely political commitment, case detection, drug distribution, drug supervision and recording and reporting. From 13 journal articles that have been reviewed, the effectiveness of DOTS can be felt if the treatment is carried out for 3–6 months. With DOTS we are able to achieve a better quality of life and avoid TB disease. In this case, DOTS can also achieve a high cure rate and is able to expand services. The program is open to all patients who have been suspected of having the potential to develop TB disease.

Discussion

Various theories discuss the adherence of TB patients to take drugs such as Lawrence Green's Precede and Proceed theory, Anderson's theory, Health Belief Model theory. We used the behavioral theory model Precede and Proceed by Lawrence Green (1980) where the factors influencing compliance are predisposing, enabling, and reinforcing. Adherence is the degree to which the patient follows the clinical advice of the treating physician.⁴ According²⁴ to compliance is the extent to which the patient's behavior is in accordance with the provisions given by health professionals.

This theory is based on a person's actions that affect behavior related to medication adherence influenced by 3 factors, namely: Predisposing factors; Enabling factors and reinforce factors.²⁵ Directly Observed Treatment Short Course DOTS is a pulmonary TB treatment strategy with OAT that prioritizes monitoring drug taking during the treatment period, preventing patients from dropping out of treatment and searching and finding new cases in the community. In this program, there is a PMO drug supervisor who has the task of PMO supervising TB patients to swallow drugs regularly until the end of treatment, giving encouragement and encouragement to patients, reminding patients to recheck sputum at a predetermined time and providing counseling to patients (Ministry of Health of the Republic of Indonesia. Integrated management of drug-resistant TB control (MPTOP)).²⁵

Directly Observed Therapy Short Course (DOTS) is one of the government's strategies in overcoming the increase in pulmonary TB cases in Indonesia.²⁶ The DOTS strategy was developed by the World Health Organization (WHO) and the International Union Against Tuberculosis and Lung Disease (IUATL) from 1990 and has now become the standard of care for tuberculosis compliance.²⁷

According to WHO, DOTS has a major role in preventing, treating OAT-resistant TB (MDR-TB) and reducing the impact of TB. In achieving this goal, five strategies for the application of DOTS are used, including: Political commitment to TB control. The Government has made a commitment by establishing the National Strategy for Tuberculosis Control 2011–2014 in providing references for the government, local governments, communities, health service facilities, educational/research institutions, and non-governmental organizations in the implementation of tuberculosis control programs, one of which is implemented through health facilities and TB partners as implementers.²⁸ Playing a role in direct supervision of short-term treatment with the obligation of every tuberculosis program manager to focus attention (direct attention) in trying to find patients.²⁹

Establish the diagnosis of TB through microscopic sputum examination. This microscopic examination is a passive method of finding cases but is also the most effective in finding TB cases. However, under certain conditions, the type of examination for tuberculosis can be done through thoracic photo examination.³⁰

TB treatment uses a combination of OAT (Anti-Tuberculosis Drugs) monitored by PMO (Drug Taking Supervisor). TB treatment goes through 2 stages, namely intensive and advanced stages. In the intensive (early) stage, patients get medication every day and need to be monitored directly. Most people with BTA positive TB become BTA negative (conversion) within 2 months.³⁰

Become non-contagious within 2 weeks. Furthermore, the advanced stage of the patient gets fewer types of drugs, but in a longer period of time. This stage is important to kill persister germs (dormant) so as to prevent recurrence. The provisions for PMO are an employee who is an expert in the field of TB, it can also be like a Midwife in the Village,

a Nurse, a Worker, a Sanitarian, an Immunization implementer, and others. However, if there is no employee in the health sector who can be used as a PMO, it can also be a cadre in the health sector, a teacher, a member of PPTI, PKK, to other community leaders or family members.³¹

Continuity of OAT supply with each patient must receive treatment that is organized in the management system, distribution with sufficient drug supply, then each patient must receive good medicine, meaning standard short-course treatment that has been clinically proven effective. Recording and reporting using books to facilitate monitoring and evaluation of pulmonary TB control programs so that support from the government is absolutely needed to make tuberculosis control programs a high priority in health services. (Ministry of Health. 2014).³²

The implementation of DOTS in Indonesia currently still has several challenges and obstacles, including increasing the need for DOTS strategy training as well as the need for training with new topics such as the management of MDR-TB, PAL, PPI TB, and others.⁽³⁴⁾ This DOTS strategy training is important considering the expansion of the DOTS strategy by expanding the type and number of health care facilities and various innovations to strengthen the implementation of the DOTS strategy (eg new diagnostic tools, electronic TB, ACSM, logistics management).³³ In addition, the factors of limited number of staff, staff rotation in health care facilities and health offices as well as continuity between trainings are also challenges in human resource development in the era of decentralization.³⁴

Overcoming the limitations of the above obstacles and maintaining treatment compliance of TB patients can be applied DOTS strategy via WhatsApp. This is in line with H. Noor's (2019) research on the use of DOTS by utilizing WhatsApp to improve and promote treatment success among tuberculosis patients which has been widely carried out in several health services. This is based on the use of WhatsApp which is easy to understand and easily accessible among the public. The use of DOTS strategies carried out electronically increases the efficiency of health systems in areas where resources and limited trained medical personnel are scarce in Malaysia.³⁵

In addition, the Directly Observed Therapy Short Course (DOTS) conducted electronically in Morocco can increase the success of treatment by more than 90% by developing protocols to provide education, smart pillboxes, and psychological support according to the characteristics of the region of residence, socioeconomic status of each TB patient, level of health literacy, and the presence of caregivers (S, Park, 2021).³⁶ DOT reduces stigma and increases client convenience in terms of transportation as well as reduces costs and reallocates resources more efficiently (Bachina, 2022).¹⁶ Innovation in implementing electronic DOTS through WhatsApp can be implemented in Indonesia, this is based on BPS data reports (2016), based on the 2021 Susenas Survey, 62.10% of the Indonesian population has accessed the internet in 2021 with the number of active social media users in Indonesia as many as 191 million people in January 2022 with 88.7% WhatsApp users, so this data can be used as a supporting basis in the application of this innovation.⁽³²⁾ SMS Gateway allows patients to get information when to go to health services and can be a reminder to take medicine independently.³⁷

Overall, the findings of the conversation, researchers can draw conclusions from the results of the discussion is to claim that implementation through DOTS is a very high implementation in demand due to the convenience of reminding the schedule of taking pharmaceuticals through the SMS application. Furthermore, DOTS applications can reduce stigma and increase client convenience in terms of transportation, as well as reduce costs and reallocate resources more efficiently, and ultimately improve health system efficiency in areas where resources and trained medical personnel are scarce.

Limitations

The limitation in this study is that research on telenursing monitoring of pulmonary TB disease is still limited so that it cannot discuss telenursing in an effort to improve compliance, especially adherence to taking medication. In addition, telenursing can only be done in countries that are already advanced in terms of technology. This causes the application of digital telenursing to be adjusted to the conditions of each country. Another limitation of the study was that it explored only a few telenursing methods to improve adherence, but could not analyze the effectiveness of implementing digital telenursing.

Conclusion

Directly Observed Therapy Short Course (DOTS) is one of the government's strategies in overcoming the increase in pulmonary TB cases in Indonesia. The most influential effectiveness of telehealth in helping the treatment process of Pulmonary TB patients is Directly Observed Treatment Short-course (DOTS) because the main focus of the DOTS strategy is patient discovery and cure, priority is given to infectious TB patients without ruling out other types of TB. A form of direct supervision is also applied in this strategy, each patient treated with TB, must be accompanied by a PMO or Drug Swallowing Supervisor.

Acknowledgments

All authors thank you to Universitas Padjadjaran who has facilitating us to make this study.

Funding

This research has not external funding.

Disclosure

The authors declare that no conflicts of interest in this study.

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