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Digital Health Education for Tuberculosis Patients: A Systematic Review of Self-Care Improvement *via* Mobile Applications

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ABSTRACT

Tuberculosis (TB) remains a significant global health challenge, ranking among the leading causes of mortality worldwide. Indonesia, as of 2023, has the second-highest number of TB infections globally, according to WHO. This study evaluates the effectiveness of mobile applications in enhancing self-care, particularly treatment adherence among TB patients. A systematic review was conducted using four databases which are PubMed, Google Scholar, ProQuest, and Dimensions—to analyze studies published between 2019 and 2023. A total of 51 articles were screened, and 7 met the inclusion criteria. Findings highlight that digital health education via mobile applications significantly improves self-care and treatment adherence among TB patients, offering a practical alternative to direct observation therapy. The review underscores the importance of such tools in supporting daily treatment regimens. Future research should examine diverse application features, focusing on intervention feasibility and cost-effectiveness.

1. Introduction

Tuberculosis (TB) is a deadly infectious disease, which mainly attacks the lung parenchyma caused by the bacteria mycobacterium tuberculosis. This problem is certainly a persistent and widespread chronic disease, representing a significant global health challenge and a leading cause of mortality worldwide. TB 2017 program team reports that one-third of the world's populace has been contaminated with pneumonic tuberculosis. This causes aspiratory tuberculosis to become the moment driving cause of passing from irresistible illnesses within the world after Human Immunodeficiency Infection (HIV)/AIDS. The number of unused cases of aspiratory tuberculosis in 2015 came to 10.4 million, an increment from the past 9.6 million [1]. According to the World Health Organization's (WHO) most recent data from 2023, Indonesia has the second-highest number of TB infections worldwide. Approximately 724,309 cases of tuberculosis had been discovered and reported by 2022. Significant obstacles still exist, though, since an estimated 335,691 cases have not been located or reported. An estimated 1,060,000 new cases of tuberculosis are reported worldwide

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each year, which translates to one new case every 30 seconds. This statistic emphasizes how critical the global tuberculosis situation is. The effects of tuberculosis are grave. The illness claimed 134,000 lives in 2022. This high fatality rate indicates that there are still numerous obstacles to controlling and curing this condition, despite the availability of medication [2].

Treatment or action is needed to end this deadly disease, as evidenced by some publications detailing cases of highly contagious tuberculosis. The length of treatment time is a challenge for patients and health workers in dealing with TB cases. Active TB patients require treatment for at least 6 months to 2 years or more in certain cases, depending on the doctor's instructions [3]. One of the strategies currently being developed is Digital Health Education for Tuberculosis Patients. Mobile applications work by actively participating in mobile health approaches to TB treatment adherence monitoring that are being tested, including indirect monitoring facilitated by patients or facilitated by software (e.g., self-reporting, medication bottles containing SIM cards, video-observed therapy, and direct monitoring *via* embedded sensors or drug metabolite testing) [4].

Applications such as mHealth and ERLINA exemplify how digital platforms can be leveraged to monitor treatment compliance, educate patients, and provide ongoing support. Monitoring through these processes simplifies effective access and enhances time efficiency in controlling the health status of TB patients. Furthermore, the use of mobile applications that incorporate behavioral change models into their products is expected to help improve treatment compliance. The proposed research is essential to explore the impact of the intervention and can be used to improve the implementation of the application in local settings [5]. The TB application on mobile phones, such as mHealth and ERLINA, is expected to help the community by improving self-care regarding adherence to treatment for TB sufferers, thereby contributing to the healing process.

Mobile Application interventions offer promising opportunities for enhancing TB treatment adherence and patient care. Mobile health applications like Ni-kshay SETU have demonstrated success in capacity building for healthcare workers, providing context-aware TB care information [6]. Various digital interventions, including SMS reminders, medicine reminders, and web-based direct observation therapy, have shown potential in improving TB treatment outcomes [7]. These technologies enable remote patient monitoring and medication adherence support [8]. However, challenges persist, including digital literacy, access to smartphones, data security and integration with traditional health systems [9]. To maximize the impact of digital health in TB care, future research should focus on developing bidirectional communication systems, encouraging patient participation and addressing implementation barriers [7]. Overall, digital health interventions present significant opportunities for enhancing TB treatment, but require careful consideration of challenges and evidence-based implementation strategies.

Self-care is an imperative concept in nursing, and could be a preparation in which individuals act on their possess sake to advance and keep up their well-being, distinguish any ailments they may have, and give or get treatment for their sicknesses [10]. Making strides in self-care in Tuberculosis (TB) patients plays a significant part in effective treatment and recuperation. For TB patients, self-care includes not as it were adherence to endorsed medication regimens but also overseeing a way of life that underpins the recuperating preparation. Vital mediations ought to center on understanding instruction with respect to malady administration and inspiration to experience treatment reliably can diminish drop-out rates and increment treatment victory. Mental back and adapting procedures have also appeared to be compelling in making a difference in patients adapting to the enthusiastic and physical challenges related to TB.

Subsequently, all-encompassing approach to self-care, counting instruction, enthusiastic back, and way of life changes, is fundamental to the progress of the well-being and clinical results of TB patients. One of the outputs of the self-care management aspect is TB treatment adherence, this

adherence is not caused by one factor alone, but is a combination of coordinated strategies that target knowledge, emotional status, treatment-related costs, and patient comfort through patient-centered care that simultaneously improves patient rights and equity [11]. All these coordinated strategies can be implemented easily through Digital Health Education via Mobile applications. Based on the theories and data outlined above, this study focuses on analyzing the effectiveness of mobile applications related to health promotion to improve self-care, especially medication adherence among TB patients.

2. Methodology

2.1 Literature Search Strategies and Databases

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The researcher searched four English-language databases: PubMed, Google Scholar, ProQuest and Dimensions (Table 1). The Joanna Briggs Institute (JBI) critical evaluation checklist was used to critically evaluate the included papers. The reviewed articles were published within the previous five years (January 2019-October 2023).

Table 1
Keywords and inclusion criteria used for searching in each database

Database	Main search	Limit	Search found (N)	Meet criteria (N)	Reasons for exclusion
PubMed	"Mobile Apps or Mobile Application" and "(Tuberculosis Or Tb Or Tbc)" and "Self Care Management"	English Year 2019-2023	102	15	The outcome is not matched
Google Scholar	"Mobile Apps or Mobile Application" and "(Tuberculosis Or Tb Or Tbc)" and "Self Care Management"	English Year 2019-2023	320	20	The outcome is not matched
ProQuest	"Mobile Apps or Mobile Application" and "(Tuberculosis Or Tb Or Tbc)" and "Self Care Management"	English Year 2019-2023	30	7	The outcome is not matched
Dimensions	"Mobile Apps or Mobile Application" and "(Tuberculosis Or Tb Or Tbc)" and "Self Care Management"	English Year 2019-2023 Article	230	9	The outcome is not matched

2.2 Eligibility Criteria

Studies that focused on self-care improvement on TB patients were considered. The inclusion criteria were:

i. Type of participants: TB patient with age more than 15 years old.
ii. Types of outcome measures: Self-care.
iii. Publication language and date of publication: publication in English between January 2019 to October 2023, to be current with the most recent literature.
iv. Study design: Cross sectional study, intervention.

Meanwhile, our exclusion criteria were studies that (1) literature review articles; (2) written in a language other than English; (3) focus on of self-care improvement among TB patient.

2.3 Study Selection

In the first step, we do search the article by software Harzing's Publish or Perish (window GUI edition) for Pubmed, Google Scholar and ProQuest. But for Dimention we search manually on the databased. After all the results of databases collected, the researcher put into Mendeley and removed all duplicate articles. Next, two examiners reviewed the titles and abstracts to determine studies that were eligible for inclusion in our review. Review studies and meta-analyses were removed. Moreover, studies that did not involve digital health education and self-care were not included in the study. Examiners obtained the complete text of the remaining papers and examined them for eligibility. The remaining papers were retained for next step; the literature review.

2.4. Data Extraction

Data were extracted from the seven articles following the PRISMA guidelines. Including authors, year of publication, country, study design, study setting, sample size, population, intervention, measurements, and funds. All the items were included in data extraction (Table 2).

2.5. Results

The researcher identified 682 articles with the search strategies. The researcher removed six hundred thirty-one duplicated articles and then selected 51 papers. After the title and abstract reading, the researcher decided on 51 articles for full reading because meet with the criteria of this study. Of those articles, 7 studies fulfilled the inclusion standards in the analysis, while 44 were excluded due to outcome not matched and not related self-care on TB (Figure 1). The researcher categorized for Study Synthesis Description article of Self Care in TB patient of each study in Table 2.

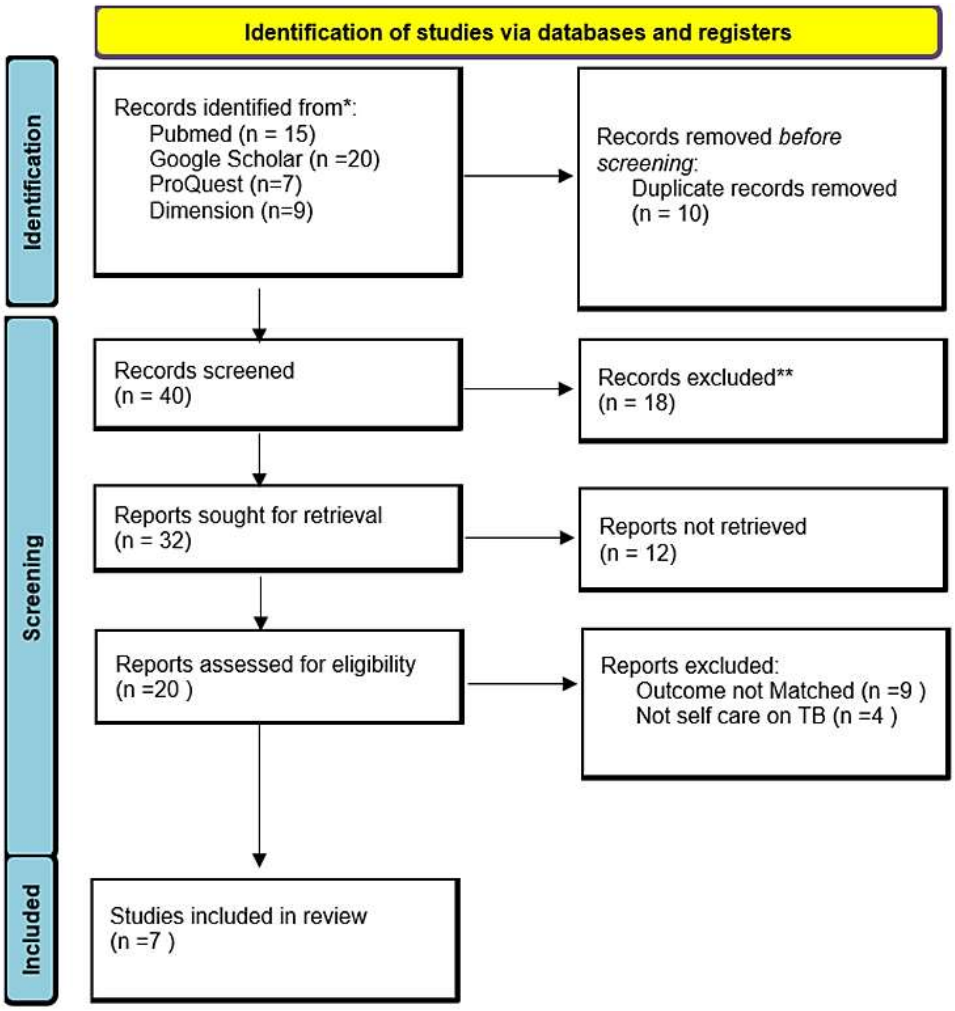

Fig. 1. PRISMA flow diagram

2.6. Characteristic Articles and Respondent

All the seven reviewed studies were conducted in Public Health Center area, Indonesia. The total number of participants in this study was 1265 respondents. Type of studies was 7 (article 1,2,3,4,5,6,7) quantitative. In this quantitative research, the research design is the cross-sectional method. The lowest number of participants in a single study was 33 participants while the highest was 324 participants. Seven studies explore about Digital Health Education for Self-Care Improvement of TB Patients *via* Mobile Applications [1,5,12-16].

3. Results

Digital education through mobile applications shows significant potential in improving self-care and self-improvement of TB patients. This study explores how the implementation of mobile applications for education can affect patients' knowledge, attitudes and behaviors in their self-care. The results indicate that mobile applications can effectively improve patients' understanding of TB disease, improve adherence to treatment regimens, and promote lifestyle changes that support healing. Respondents receive health education that focuses on respondents who effectively motivate behavioral change in a structured manner, through supportive relationships [17]. One key aspect of the effectiveness of mobile applications is their ability to provide personalized *via* smartphone,

Smartphones were created to make it easier for someone to communicate from anywhere and anytime. When smartphones are increasingly developing, the development of social media is also increasingly rapid. Smartphones are useful for accessing all types of social media anytime, anywhere and real-time information to patients [18].

In addition, the capabilities and features of mobile phones are a promising tool in improving public health and health literacy [19] TB treatment requires electronic monitors and automatic reminders attempting to improve the quality-of-care services as a form of supervision [20]. Cellular phone technology helps health services to provide health interventions to people who may be difficult to reach. Smartphones have several applications that have been used to support health services, including promoting TB treatment adherence. The use of smartphones as a reminder to take TB medicine has been carried out in India. Digital media enables individual development in understanding of health through the exchange of health information and current events related to health. These mobile apps are often equipped with features that allow patients to access relevant educational materials, monitor their health status and receive medication reminders.

Overall, despite some challenges, the use of mobile applications for digital education in the context of TB care offers significant opportunities to improve patient self-care. This is in line with the findings of the study stating that Internet-based media allows users to make patients adhere to treatment that must be done regularly for TB and can reduce time so that it is more effective and efficient [13]. In addition, research reported that the use of reminder applications and smart pill boxes has been shown to be well accepted and improve treatment outcomes compared to standard care in a programmed setting in Shanghai, China. Further high-level evidence is expected to confirm the positive effects of mHealth-based reminders on TB treatment outcomes, especially in self-improve [12]. In line with other theories stating that the development of mobile applications in TB provides broader contributions to patients, staff, policy makers and academics [15]. Another research also said that there are differences in knowledge, self-perception and adherence to taking TB drugs between pre-test and post-test 1 with the application of 'Ayo DOTS' (Directly Observed Treatment Short course) p value < 0.05 [1]. This is because Internet-based healthcare providers can remotely monitor patient conditions and adherence, and thus provide timely interventions.

Compared with paper-based approaches in usual care, the use of mHealth will facilitate and simplify patient access to clinical resources and self-management of patient. In addition, it will enable healthcare providers to actively engage with patients in care. In line with the research results which stated that the results of the review of home care documents in TB cases using the manual method, identified problems found in these documents include incomplete filling in of patient identity, incomplete filling in of the identity of the officer who made the visit including the date of the assessment, and the name or initials of the officer were not affixed, the accuracy of the diagnosis compared to the problems found in the assessment, and the writing of the nursing plan was mostly only in the form of education [21]. Different from many existing studies, our program is designed to include all core components. In addition, the program aims to improve patient self-management with the expectation that their interventions will primarily focus on supporting and motivating patients to adhere to the program through multiple automated messages and alerts will be provided through the mHealth system to support the intervention.

Subsequently, another use of this digital system is that there are other interventions that focus on providing education about TB, its treatment and prevention to help patients make the right decisions and the health care team to provide patient-centred care. The patient reminder and tracker system are targeted to help patients make appointments and take action when patients miss appointments [22]. Overall, the program study will provide a unique opportunity to help understand the potential use of mHealth innovations to improve patient self-management and health outcomes,

and thereby add to the evidence base for the effectiveness of using mHealth to improve self-care in the community [23]. This technology has also been developed in Thailand, digital adherence technology (DAT) has been used to monitor and ensure adherence to TB treatment using several functions, such as medication reminders, dose observation, dose history compilation, and triage and provision of differentiated care, which research has shown to be effective in preventing non-adherence in rural areas [24].

Further research is needed to explore strategies that can increase the adoption of this technology across different patient populations and to assess the long-term impact of this intervention on the health outcomes of TB patients. Poor adherence to TB medications is still a significant concern. The expansion of DOT using mobile applications incorporating the behavioural change model into their product is expected to help improve medication adherence [13]. TB continues to be a pressing global health threat and one of the deadliest infectious diseases in the world. Treatment non-adherence is a major known factor in poor outcomes for individuals and communities, including continued transmission, relapse, increased morbidity and mortality and the development of drug resistance. The prevalence of TB is further exacerbated by challenges faced by patients, such as long treatment duration, social stigma, fear, discrimination, poverty, lack of knowledge about the disease and its treatment, drug side effects and lack of support [4]. Some of these shortcomings can be alleviated by using digital-based media, but unfortunately this technology needs adequate smartphone specifications (e.g. picture resolution, memory), good connectivity and user capabilities. Smartphones with good connectivity are required because each video should be sent in an adequate video resolution and fairly large file size for proper drug monitoring.

The widespread use of smartphones will encourage providers to improve network quality [25]. Mobile applications show promise in improving treatment adherence among tuberculosis patients. Studies have found generally positive perceptions and acceptability of SMS and video-based directly observed therapy (vDOT) interventions [26,27]. Patients valued the potential for motivational texts, health education and reminders to increase adherence [26]. However, challenges include maintaining patient-provider relationships and accommodating low literacy levels [27]. A randomized trial protocol aims to evaluate the effectiveness of a mobile app in improving TB medication adherence and quality of life [5]. One study implementing a smartphone app for TB/HIV coinfected patients found improved antiretroviral therapy adherence and viral suppression, though TB cure rates were not significantly different [28]. These findings suggest that mobile health interventions can be valuable tools in TB treatment, particularly when tailored to patient needs and integrated with existing care systems.

There are obstacles are occurred in the study reported that what was carried out during the TB contact investigation activities included limited signals and data quotas owned by cadres, so that at the time of data collection it could not be done directly with the application, especially for filling in the GPS which was the location point of the suspected TB sufferer at that time [29]. In addition to the application of digital technology in educational media, there is a need for consensus that the diagnostic process must be improved, and more awareness of TB symptoms is needed in all types of health care facilities to increase the speed of diagnosis and initiation of treatment [4] This happens because the determination of important momentum is crucial in determining the initial process stage.

Self-care is a crucial aspect in the management of TB patients that is often overlooked but has a significant impact on treatment outcomes and quality of life, The more supporting factors and the fewer inhibiting factors that individuals feel they have to perform a behavior, the greater the control they feel over that behavior and vice versa [30]. Independence in TB patients tends to be lacking, this is because patients feel bored and fed up with taking medication, because it takes a long time [31].

TB is an infectious disease that requires a long-term treatment regimen and high adherence, so it is important for patients to manage their health well and maintain their motivation throughout the treatment period. Therefore, increasing knowledge and understanding through outreach is very important to support effective and sustainable health monitoring practices [32] only by addressing these factors will it have a significant impact on compliance with treatment [33] This is where online digital-based education becomes very relevant. By utilizing digital platforms, TB patients can access accurate and up-to-date information on effective ways to manage drug side effects, the importance of adherence to treatment and general health tips. These digital-based education programs allow patients to get the support and knowledge they need anytime and anywhere, without having to attend face-to-face sessions that may require additional time and costs.

In addition, online applications and platforms can provide interactive features such as medication reminders, discussion forums with fellow patients and virtual consultations with health professionals. By integrating digital-based education into self-care strategies, TB patients can more easily access important information, get emotional support, and improve adherence to treatment, ultimately supporting their treatment success and recovery. Access to TB information provided by digital media was considered very accurate and very helpful in terms of self-care improvement because the test strips provided confirmation, and having access to medication helped them stay on treatment. Interventions became easier after finding solutions, recognizing patient routines and their reporting patterns, and being able to help and build relationships with participants [4].

The reminder app and the smart pillbox interventions were acceptable and improved the treatment outcomes compared with the standard care under the programmatic setting in Shanghai, China. More high-level evidence is expected to confirm the effect of mHealth reminders on TB treatment outcomes [16]. Another digital apps like ERLINA also have been shown to be effective in improving self-care of TB patients in real-world treatment [15], adherence can be substandard and clinicians lack accurate methods to measure doses taken. Digital technologies offer promise in overcoming these barriers to care. WHO uses treatment success as an indicator of TB programme performance, although it is a poor indicator of care; patients who take less than 80% of doses may still have outcomes reported as treatment completion. Recently published trials have shown that digital adherence technologies can reduce loss to follow-up although it is important to understand the costs of implementing such interventions also how this translates into self-care improvement [34]. Another research said that the mHealth which is a digital platform intervention, which included text messages and weekly phone calls, was effective in improving medication adherence among TB patients on DOTS therapy, with adherence increasing from 85.5% at baseline to 96.4% at the end of the intervention period. This improvement in adherence was observed across different subgroups of patients [14].

Digital education about TB and self-care improvement are closely related, contributing significantly to treatment outcomes and patient well-being. Digitalization is increasingly developing today, including in the health sector, for this reason training activities to increase the knowledge of information technology users need to be carried out [35]. Through digital platforms, TB patients can obtain comprehensive and up-to-date information about their disease, including managing drug side effects, recovery strategies, and ways to maintain optimal health. In addition, digital platforms often offer emotional support and community, which can motivate patients to stay committed to their recovery process. Therefore, integrating digital education with self-care practices not only strengthens patients' knowledge but also enhances their ability to apply this knowledge in their daily lives, thereby improving the quality of self-care and supporting the overall success of TB treatment [10].

Digital health interventions (DHIs) show promise in enhancing TB management globally. Studies have explored various DHIs, including SMS reminders, video-observed therapy, and web-based direct observation therapy, to improve treatment adherence and patient care [7,36]. These technologies enable remote monitoring and medication reminders, offering opportunities for patient-centred care [9]. Research on DHIs for TB has primarily focused on diagnostic tools and treatment adherence technologies, with fewer studies addressing data services and health system management [36]. For latent TB infection, voice or textual reminders and synchronous video calls have shown promise in improving treatment adherence and screening retention [37]. While DHIs offer significant potential, challenges such as technology access, patient engagement, data security, and integration with traditional health systems must be addressed [9]. Overall, digital health technologies appear at least equivalent to current practices and may supplement TB care globally.

Mobile health applications (mHealth Apps) offer significant potential for improving tuberculosis (TB) care and control by enhancing patient monitoring, data collection, and treatment adherence [8]. However, integrating these apps with existing healthcare systems and electronic health records (EHRs) remains a challenge due to interoperability issues [38]. To address this, researchers have proposed standards-based architectures for integrating mHealth Apps with EHRs, such as using Clinical Document Architecture (CDA2) for bi-directional information exchange. This approach allows healthcare professionals to prescribe monitoring procedures and receive structured reports from patients, supporting patient engagement in self-management. Implementing semantic web technologies and ontologies can further enhance interoperability by enabling data retrieval with consistent meaning across different sources [38]. More rigorous studies are needed to establish an evidence base for informing policy and decision-making in mHealth integration for TB care [8]. Despite these advantages, challenges remain, particularly when implementing such technologies in diverse settings.

For instance, in rural areas, limited connectivity, inadequate smartphone specifications, and low digital literacy can impede the effectiveness of mHealth interventions. These limitations often exacerbate existing disparities in access to healthcare resources, creating barriers to the widespread adoption of digital health tools [29]. Socio-economic factors also play a crucial role in shaping the outcomes of digital health interventions. Patients in lower-income communities may lack access to smartphones or stable internet connections, which are critical for utilizing mHealth applications effectively. Moreover, cultural differences influence the receptiveness of patients to digital interventions, with some populations being less comfortable with technology due to privacy concerns or traditional beliefs about healthcare [4]. Healthcare infrastructure is another determinant of success. Urban healthcare facilities may have the resources and technical expertise to integrate mHealth technologies seamlessly, while rural clinics often face logistical and resource constraints. The availability of trained healthcare professionals to provide technical support and education about the use of digital tools is essential for ensuring patient engagement and adherence to treatment [25].

Additionally, variability in digital literacy among patients underscores the need for user-friendly application designs. Providing adequate training and ongoing technical support is crucial to bridge the digital divide and ensure equitable access to these technologies. For example, interventions like the "Ayo DOTS" application have shown significant improvements in patients' knowledge, self-perception, and adherence, but only when paired with robust educational support [1]. Despite these challenges, the potential of mHealth to transform TB care is undeniable. Research shows that features such as medication reminders, virtual consultations and discussion forums can effectively address key barriers to treatment adherence and self-care. In Shanghai, smart pillboxes and reminder applications improved treatment outcomes compared to standard care [39]. Similarly, the integration of DAT in Thailand demonstrated its effectiveness in preventing non-adherence in rural

settings [24]. To optimize the impact of digital health interventions, further research is needed to explore strategies that enhance their adoption across diverse patient populations. Addressing socio-economic disparities, strengthening healthcare infrastructure and fostering cultural acceptance will be critical in maximizing the benefits of mHealth.

Moreover, targeted efforts to improve digital literacy and provide technical support will help overcome existing barriers and ensure that these innovations can contribute meaningfully to TB care. By addressing these limitations and tailoring digital health solutions to meet the specific needs of different communities, the potential of mobile applications to improve self-care and treatment outcomes for TB patients can be fully realized. This aligns with broader global health goals to reduce the burden of TB and improve the quality of life for affected individuals. In addition, this study also identified several barriers that may affect the effectiveness of mobile applications, such as limited access to technology in some areas and technical difficulties in using the application. In addition, variability in digital literacy levels among patients may affect the extent to which they are able to effectively utilize the application. To address this, it is important to provide adequate training and technical support and ensure that applications are designed with different levels of user ability in mind [40].

Recent studies have demonstrated the cost-effectiveness and efficacy of mobile applications for TB treatment adherence and screening. A mobile app for TB risk assessment in Myanmar was found to be cost-effective, with an incremental cost-effectiveness ratio of US $1064 per disability-adjusted life year averted [40]. In Malaysia, a randomized trial is underway to evaluate the effectiveness of a mobile app in improving TB medication adherence [5]. A systematic review of economic evaluations revealed that shorter treatment regimens and decentralized care using mobile devices were cost-effective for active TB, particularly in low- and middle-income countries [39]. In India, a mobile app for TB medication reminders showed promising results, with lower loss to follow-up rates (2% vs 8%) and higher treatment success rates (89% vs 81%) compared to traditional methods [41]. These findings suggest that mobile applications can be valuable tools for improving TB treatment outcomes and cost-effectiveness. In addition, various theories are also explained in the following Table 2.

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
1.	Mohd Fazeli, Syed Sharizman, Syed Abdul Rahim, Richard Avoi, Nooralisa Mohd Tuah, Roddy Teo, Meryl Grace Lansing	Kota Kinabalu, Penampang, and Putatan districts of Sabah, Malaysia.	A randomized, controlled trial.	The purpose of the research in this paper is to determine the effectiveness of a mobile application in improving tuberculosis (TB) medication adherence compared to standard directly observed therapy (	The sample size for this study is 150 participants per arm, for a total of 300 participants.	Standard directly observed therapy (DOT) where patients receive their TB medication under the direct observation of healthcare staff or family members, with daily observation of medication consumption. Mobile application	Sociodemographic, behavioral, and clinical information collected through interviews and medical records.	Poor adherence to TB medications is still a significant concern. The expansion of DOT using mobile applications incorporating the behavioral change model into their product is expected to help improve

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No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
				(DOT), as well as to determine whether the mobile application can improve the patient's health-related quality of life, satisfaction, and income compared to standard DOT.		DOT where patients use a mobile app called "PatuhTB" to record and send videos of themselves taking their TB medication daily, which are then reviewed by researchers. Patients receive training on how to use the app and record the videos.		medication adherence.
2.	Saurav Purnama Sari Indah, Ayatun Fil Ilmi, Tri Okta Ratnaningtyas	Pamulang Health Center Center, Serpong 1 Health Center and Bambu Apus Health Center	A quantitative approach. This research is pre-experiment with one group pretest and posttest design.	To analyze the effectiveness of digital health intervention for enhancing self-perceived and compliance with anti-tuberculosis treatment	33 TB Patients	To find out the increase in knowledge, Self-perceived and adherence to taking TB drugs, a pretest and posttest were carried out. In this study, respondents were given treatment using the 'Ayo DOTS' application. Intervention was carried out within 4 (four) weeks. Every week the respondents were given twice intervention. Posttest 1 for knowledge, perception, and practice of adherence to taking TB drugs was	Self-perceived and compliance	There are differences in knowledge, self-perception and adherence to taking TB drugs between pretest and posttest 1 with the application of 'Ayo DOTS' (Directly Observed Treatment Short course) p value <0.05

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
						carried out after 2 weeks of intervention, while posttest 2 was carried out after 4 weeks of intervention.		
3.	Zheyuan Wu, Liping Lu, Yong Li, Jing Chen, Zurong Zhang, Chenxi Ning, Zheng'an Yuan, Qichao Pan, Xin Shen and Wenhong Zhang	Songjiang CDC (Shanghai)	cohort study with the standard care group	to evaluate the real world effect of two mHealth reminders, i.e., the reminder app and the smart pillbox, on TB treatment outcomes compared with the standard care in Shanghai, China.	324 patients who eligible	All eligible patients were invited to choose the standard care, the reminder app, or the smart pillbox to support their treatment. Cox proportional hazard model was fitted to assess the effect of mHealth reminders on treatment success.	Tuberculosis treatment outcomes	The reminder app and the smart pillbox interventions were acceptable and improved the treatment outcomes compared with the standard care under the programmatic setting in Shanghai, China. More high-level evidence is expected to confirm the effect of mHealth reminders on TB treatment outcomes.
4.	Erlina Wijayanti, Adang Bachtiar, Anhari Achadi, Ummi Azizah, Amal Chalik Sjaaf, Tris Eryando, Trihono, Kemal N Siregar, Dhanasari	Jakarta, Indonesia	A quasi-experimental study protocol with a post-test group control design. It involves an intervention group that receives a mobile application in addition to standard	The purpose of the research is to assess the effects of a mobile application on tuberculosis medication safety, by developing a predictive model of medication	114 participants in the 2nd phase of the quantitative research	intervention in this study was the use of the ERLINA mobile application by the intervention group, in addition to standard monitoring, for 2 months following the start of tuberculosis	Sputum examination, medication adherence, and side effects - measured through interviews	Identifying predictors of medication safety for primary-care tuberculosis patients, including patient, staff, healthcare facility, organizational, external, drug, and process

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
			monitoring, and a control group that receives only standard monitoring. The study has both quantitative (cross-sectional and quasi-experimental) and qualitative research phases, and measures the effect of the intervention over a 2-month period.			treatment. The ERLINA application was designed to monitor medication safety through features like tracking sputum examination, medication adherence, and side effects.		factors. Developing a decision support system algorithm to identify at-risk patients and provide interventions. Evaluating the impact of a mobile application called ERLINA on medication safety, which involved a wide range of patients and had cadres help ensure safety in limited-equipment conditions. ERLINA has been shown to be effective in improving self-care of tuberculosis (TB) patients help improve.
5.	Saurav Basu, Sahadev Santra, Suneela Garg, Nandini Sharma, Mongjam Meghachandra Singh, Ashwani Khanna, Junior Resident.	Delhi, India	A quasi-experimental study with an intervention group and a control group, conducted at multiple DOTS centers in Delhi, India over an 8-month period.	The purpose of the research was to evaluate the effectiveness of a mHealth package on the medication adherence of patients with tuberculosis (TB) on antitubercular (directly observed	The total sample size for the study was 220 participants, with 110 in the intervention group and 110 in the control group. However, the final sample size after	The Interventions are 30 unique text messages in the local language (Hindi) sent once daily for 90 days (total of 90 text messages). A weekly real-time two-way phone call that lasted approximately 10 minutes, for a total of	medication adherence, which was assessed using the 4-item Morisky-Green-Levene adherence scale (MGLS). Non-adherence was defined as a score less than 4 on the MGLS, with a recall period of the previous 15 days.	the mHealth intervention, which included text messages and weekly phone calls, was effective in improving medication adherence among TB patients on DOTS therapy, with adherence increasing

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
			The assignment to the intervention and control groups was not randomized.	treatment short-course [DOTS]) treatment.	excluding 10 illiterate patients, 7 patients without mobile phones, and 68 patients who refused to participate was 135 participants.	12 calls over the 90-day intervention period.		from 85.5% at baseline to 96.4% at the end of the intervention period. This improvement in adherence was observed across different subgroups of patients.
6.	Byonanebye Dathan Mirembe, Hope Mackline, Christine Sekaggya Wiltshire, Agnes N. Kiragga, Mohammed Lamorde, Elizabeth Oseku, Rachel King and Rosalind Parkes-Ratanshi	Uganda	An open-label, multicenter RCT in volving adult patients with drug-susceptible TB randomized (1:1 ratio)	To determine the impact of an IVRT software (CFLU-TB) on treatment success in patients receiving treatment at public facilities in Uganda. To compare TB cure rates (six months) in patients with microbiologically diagnosed TB in the intervention and control arms. To compare treatment completion (six months) in patients clinically diagnosed with TB in the intervention and control arms. To determine the effect of	274 Patients	The intervention (adherence and appointment reminders, health messages, and 24-h health care worker call service) or control arm. The study will have nested qualitative and economic evaluation sub-studies and a process evaluation to determine the uptake and use of the intervention.	Secondary outcomes included TB cure rates in participants with pulmonary TB, timeliness of appointments, adherence to treatment, and dropout from care.	The CFL-UTB study seeks to determine the impact of IVRT-based MHI on TB treatment outcomes. The software aims to address key operational barriers to optimizing TB care by leveraging aging technology with greater reach regardless of literacy levels. Study enrollment has begun, and initial study results are expected in late 2022. As with any MHI, we anticipate several challenges that can be overcome. The changing mobile technology

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
				enhanced TB treatment support with CFLU-TB on retention at 2 and 6 months in patients receiving TB treatment. To assess the perception of patients' care providers (treatment buddies) and other stakeholders about CFLU-TB. To determine the cost-effectiveness of the intervention. To compare adherence rates between patients in the intervention arm and control arms. To determine the effect of CFLU-TB on adherence to clinic appointments. To compare knowledge about TB/HIV in patient enrolled in the intervention and control				ecosystem and increasing mobile phone penetration have become possible solutions to health system challenges in most low- and middle-income countries. However, the impact of such technology remains to be determined. Despite design and implementation limitations, this study addresses a significant public health issue using a novel, previously used MHI.

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
				arms. To determine Drug-resistant TB rates in the intervention and control arms. To determine the uptake of the CFLU-TB tool in patients and their care providers (treatment buddies).				
7	Kassahun Dessie Gashu, Kassahun Alemu Gelaye, Richard Lester, Binyam Tilahun, Kassahun Dessie	the Central Gondar Zone and Gondar town administration in Northwest Ethiopia, specifically in 22 health facilities (15 health centers and 7 hospitals)	A two-arm, randomized controlled trial (RCT) with a covariate adaptive randomization (minimization) technique to balance covariates across the two study arms. It was a superiority trial design.	The purpose of this study was to evaluate the effect of a phone reminder system on patient-centered tuberculosis (TB) treatment adherence during the continuation phase, where patients are responsible for taking medication at home. The study also aimed to evaluate the effect of the intervention on provider-patient relationships and treatment outcomes as secondary outcomes.	The sample size of the study is 306 participants, with 152 in the intervention group and 154 in the control group.	Weekly pill refilling reminders using graphics-based and text messages in the local language. Daily medication reminders using graphics-based and text messages in the local language. The reminders were sent daily from 7:30-8:00 AM for daily medication and the day before the appointment for weekly pill refilling The intervention was provided for the 4-month continuation phase of TB treatment	Adherence to patient-centered TB treatment during the continuation phase, using the 11-item Adherence to Refill and Medication Scale (ARMS). Treatment success rate (TSR), defined as the sum of patients cured and/or completed treatment Provider-patient relationship, assessed through questions on patient trust, communication, and satisfaction with care	The mobile phone-based reminder system improved adherence to patient-centered TB treatment during the continuation phase compared to the control group. The mobile phone-based reminder system improved the provider-patient relationship compared to the control group. The treatment success rate was higher in the intervention group compared to the control group, but the difference

Table 2
Study synthesis description articles self-care in TB patient

No.	Author	Setting or place	Research design	Purpose	Sample size	Intervention	Type of aspects measured and instruments	Finding
								was not statistically significant.

4. Conclusions

Online education through mobile applications has been shown to be effective in improving self-care of tuberculosis (TB) patients. The use of these applications offers an easily accessible platform to provide educational information, treatment guidance and ongoing support to patients. By leveraging digital technology, TB care systems can be strengthened, making online-based education an essential component of modern TB control and prevention strategies.

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