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The Impact of Self Reminder Interactive (SRI) Application on Quality of Life, Compliance of anti-TB Drug, and Self Efficacy Among TB Patients

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ABSTRACT
The impact of technology plays a significant role in health, including prevention and rehabilitation of Tuberculosis patients. One of the breakthroughs made to reduce pulmonary tuberculosis sufferers is through telenursing to improve patient behavior in preventing transmission of pulmonary tuberculosis. This study aimed to identify the influence of the Community Resources-based SRI (Self Reminder Interaction) Application on improving the quality of life, anti-TB drug Compliance, and Self-Efficacy among Pulmonary Tuberculosis patients. This study is a quasi-experiment research type with a nonequivalent control pre-test and post-test design. The sample in this study was selected using simple random sampling with a total of 50 respondents. The independent variables of this study were SRI application implementation, then the dependent variables included quality of life, self-efficacy, and anti-TB drug adherence. The results of this study consist of the majority of respondents were aged 35 to 39 years old, female, and working as private laborers. The bivariate results found the significant impact of SRI application to increase quality of life, self-efficacy, and anti-TB drug adherence after. Among case groups, there is found significant improvement between pre and post-test after giving intervention. It can be concluded that the SRI application is significant in improving TB patient life. Future studies could add more predictors related to the accessibility of technology such as education level, income, and place of residence to explore the impact of such application in multivariate analysis.

Keywords: SRI (Self Reminder Interactive) Application, Anti-TB drug adherence, Self-Efficacy, Quality of Life, Pulmonary TB

ABSTRAK
Dampak teknologi memegang peranan penting terhadap kesehatan, termasuk pencegahan dan rehabilitasi pasien Tuberkulosis. Salah satu terobosan yang dilakukan untuk menurunkan penderita tuberkulosis paru adalah melalui telenursing untuk meningkatkan perilaku pasien dalam mencegah penularan tuberkulosis paru. Tujuan penelitian ini untuk mengetahui pengaruh Aplikasi SRI (Self Reminder Interactive) Berbasis Sumber Daya Komunitas terhadap peningkatan kualitas hidup, Kepatuhan obat anti TBC dan efikasi diri pada pasien Tuberkulosis Paru. Metodologi: Jenis penelitian adalah quasy eksperimen dengan rancangan nonequivalent control pre-test and post-test design. Sampel dalam penelitian ini dipilih menggunakan simple random sampling dengan jumlah 50 responden. Variabel independen penelitian ini adalah penerapan penerapan SRI, kemudian variabel dependennya meliputi kualitas hidup, efikasi diri, dan kepatuhan obat anti tuberkulosis. Hasil penelitian ini menunjukkan mayoritas responden berusia 35 hingga 39 tahun, berjenis kelamin perempuan, dan bekerja sebagai pekerja swasta. Hasil bivariat menemukan adanya pengaruh signifikan penerapan SRI terhadap peningkatan kualitas hidup, efikasi diri, dan kepatuhan obat anti tuberkulosis setelahnya. Di antara kelompok kasus, ditemukan peningkatan yang signifikan antara pre dan post-test setelah pemberian intervensi. Kesimpulannya yaitu penerapan SRI signifikan dalam meningkatkan kehidupan pasien TBC. Penelitian di masa depan dapat menambahkan lebih banyak prediktor terkait aksesibilitas teknologi seperti tingkat pendidikan, pendapatan, dan tempat tinggal untuk mengeksplorasi dampak penerapan teknologi tersebut dalam analisis multivariat.

Kata Kunci: Aplikasi SRI (Self Reminder Interactive), Kepatuhan minum OAT, Efikasi Diri, Kualitas Hidup, TB Paru

INTRODUCTION

Pulmonary Tuberculosis remains a global issue, especially in developing countries. Indonesia was at the second rank of highest people with TB after India. The prevalence of TB in 2021 was 969,000 cases which increased by 17% from 2020 which was 824,000. The incidence rate of TB was 354 per 100,000 cases (Bagcchi, 2023). The accurate data on individuals with tuberculosis (TB) globally need a comprehensive approach involving multiple sources and studies is essential. The global burden of TB, with approximately 10.6 million people affected by TB and 1.6 million deaths worldwide in 2021 (Samanta et al., 2023; Xie et al., 2022). The prevalence and incidence rate of TB among HIV-infected patients in mainland Tanzania, emphasizes the intersection of TB with other health conditions (Majigo et al., 2020). In the Indonesian context, the implementation of TB prevention faced some challenges such as geographical, diversity of ethnic groups, language, customs, and other sociocultural aspects.

The risk factors associated with TB, include multidrug-resistant TB (MDR-TB), smoking, diabetes, alcohol consumption, and low body mass index (Baya et al., 2019; Elduma et al., 2019; Maja & Maposa, 2022). Understanding these risk factors is crucial for developing targeted interventions and prevention strategies. Explore health-related quality of life (HRQoL) among TB patients and predictors of HRQoL in multidrug-resistant TB patients (Izhar et al., 2021). Improving HRQoL is essential for comprehensive TB care and patient well-being. The epidemiology of TB in different regions, such as China, Germany, and Canada, highlights the global impact of TB and the challenges posed by drug-resistant TB (Couvin et al., 2019; Kersten et al., 2020).

Indonesia faces a significant burden of tuberculosis (TB) cases. Previous studies estimated that around 120 million people in Indonesia were infected with Mycobacterium tuberculosis in 2014, making it the third-highest burden country in the world after China and India (Apriani et al., 2022). Around 33,336 cases of TB were reported in Indonesia, with an incidence rate of 2.52 cases per 1,000 population by the year 2021 (Putri et al., 2023). Indonesia is one of the six countries with a high burden of TB and HIV, emphasizing the dual challenge of infectious diseases in the country (Noviyani et al., 2021; Parwati et al., 2020). The estimation of the subnational TB burden in Indonesia indicates the importance of localized data to inform TB policymaking at the district level (Parwati et al., 2020). Spatial variation in TB risk in Indonesia from 2010 to 2019, indicating the need for targeted interventions in specific regions (Puspita et al., 2021). The TB cases rank third in the world in Indonesia, underscoring the significant impact of TB on the population (Priyandani et al., 2019).

The implementation of TB prevention and rehabilitation is impacted by many factors, such as technology. Implementing technology for tuberculosis (TB) management in developing countries involves overcoming various challenges related to resources, infrastructure, and healthcare systems. According to the integration of previous research, digital health technologies, such as mobile applications, electronic monitoring systems, and telemedicine solutions, can potentially improve TB treatment outcomes and support adherence among patients (Ngwatu et al., 2018). However, the effectiveness and impact of these technologies are often shaped by the context in which they are implemented (Veronese et al., 2023). Apart from establishing the new technology, there is also a need the behavior change that the mechanism guided by the Social Determinant of Health and Social Cognitive Theory (Schunk & DiBenedetto, 2020; WHO, 2017). This study aimed to examine the impact of SRI (self-reminder interactive) application on quality of life, anti-TB drug adherence, and self-efficacy among TB patients.

METHODS

This study is a quasi-experiment with a case and control group of samples. This study was done from December 2023 to January 2024 at Kalibobo Primary Health Care, Nabire Sub-district, Papua Province.

The population of this study was derived from all people with Tuberculosis in the Kalibobo Primary Health Care, Nabire Sub-district, a total of 127 patients in 2022. This study used simple random sampling to select the respondents. The inclusion criteria to select the sample included a TB patient who got the anti-TB drug during the intensive phase, aged 17 years or older, being able to write and read, be able to operate the smartphone. Moreover, the exclusion criteria to select the sample include, TB patients with other chronic diseases, changing the phone number before the study finished, and those with psychological disorders. The sample size in this study

was defined using the Cochran formula with the final minimum sample size was 50 respondents who categorized 25 respondents as a case group and 25 respondents as a control group.

The main independent variable in this study was the SRI application. It provides the health service for Android users with features, such as characteristics of the patients, automatic alarm, detection of anti-TB drug compliance, detection of quality of life, and health education for patients with TB. The dependent variables in this study include medication compliance for people with TB by using the MMAS-8 (*Morisky Medication Adherence Scale-8)* questionnaire from the Guttman scale to ask about the time, dose, and frequency of TB medication. Furthermore, self-efficacy in this study was followed GSE questionnaire (*General Self-Efficacy)* using the Likert scale which consists of action self-efficacy and coping self-efficacy. Quality of life in this study uses the WHOQOL BREF (*World Health Organization Quality of Life-BREF)* questionnaire to explore daily activity, dependency on the TB drug, mobility, painlessness, sleep, workload, etc.

The data was collected before the intervention for both case and control groups. The case group was given the SRI (Self Reminder Interactive) application, and the control group was given the common education by primary health care. The authors were helped by health professionals from primary health care and enumerators. The intervention was given four times a month by direct visit to TB patient home. The data analysis in this study consists of univariate by presenting the result in frequency and percentage. The bivariate analysis was done to examine the normality test using the *Kolmogorov-Smirnov test* and the homogeneity test using the *Levene test.* The normal data was continued to test using *paired t-test* and abnormal data was continued to test using *Wilcoxon* and *Mann Whitney.* The analysis used SPSS version 24.0 software.

This study was approved to collect the data by the University of Karya Husada with numbers: 139-140/BAAK/S2KEP/SA/VI/2023. All the ethical considerations including informed consent procedures, confidentiality measures, and potential conflict of interest have been ensured ethically.

RESULTS

The results of this study consist of univariate and bivariate results. However, the general characteristics of the sample are provided in Table 1 below.

Table 1. Distribution of frequency and characteristics of samples

Characteristics	Case group	Control group
Age		
40 years or older	5 (20%)	5 (20%)
20 – 24 years	3 (12%)	2 (8%)
25 – 29 years	3 (12%)	1 (4%)
30 – 34 years	5 (20%)	5 (20%)
35 – 39 years	9 (36%)	12 (48%)
Sex		
Male	9 (36%)	15 (60%)
Female	16 (64%)	10 (40%)
Employment		
Labor	4 (16%)	1 (4%)
Teacher/ lecture	3 (12%)	1 (4%)
Housewife	3 (12%)	0 (0%)
State-owned company labor	2 (8%)	2 (8%)
Private labour	6 (24%)	13 (52%)
Student	2 (8%)	2 (8%)
Civil servant	1 (4%)	2 (8%)
Self-employed	1 (4%)	1 (4%)
Security	1 (4%)	0 (0%)
Army/ police	1 (4%)	3 (12%)
Signs and symptoms		
Body weak	3 (12%)	4 (16%)
Cough with phlegm	5 (20%)	2 (8%)

Dry cough	2 (8%)	2 (8%)
Night sweats	2 (8%)	4 (16%)
Phlegm mixed with blood	4 (16%)	2 (8%)
Fever/chills	2(8%)	5 (20%)
Decreased appetite	3 (12%)	5 (20%)
Out of breath	4 (16%)	1 (4%)

Table 1 describes that most TB patients were aged 35 to 39 years old for both case and control groups (64% and 48%, respectively). According to age, for the case group, most of them were female, and for the control group were male. In terms of employment, the majority of the sample was from private labor (24%) and 52, for both groups. Related to signs and symptoms, most of them felt cough with phlegm (20%) for the case group and fever and decreased appetite for the control group (20%).

Table 2. Paired t-test results before and after given intervention

Variables intervention group	**Mean pre**	**Mean post**	**Sig. (2-tailed)**
Quality of life before and after	82.12	113.88	0.00
Self-efficacy before and after	31.92	44.04	0.00
Anti-TB drugs adhere before and after	2.88	5.52	0.00

Table 2 describes the paired t-test result for the intervention group to examine the significance of intervention to increase the variables of interest. It revealed that quality of life was increased after given SRI application from 82.12 to 113.88. Moreover, self-efficacy was increased from 31.92 to 44.04. Then, the anti-TB drug was also changed from 2.88 to 5.52.

Table 3. Independent t-test results for case and control group after given intervention

Variables	**Case group**	**Control group**	**Sig. (2-tailed)**
Quality of life	113.88	89.56	0.00
Self-efficacy	44.04	33.20	0.00
Anti-TB drugs adherence	5.52	3.12	0.00

Table 3 only focuses on the intervention group, Table 3 tested the significance of all predictors. It showed the score of the case and control after the intervention with significance for both. Quality of life was significantly higher after the intervention. Moreover, other significance also showed significance for variables of self-efficacy and anti-TB drug adherence. In the general findings, it can be concluded that the quality of life of those with TB as the case group was higher than control group. It also revealed self-efficacy and anti-TB drugs.

Based on the findings above, it was revealed that SRI application significantly improved quality of life, self-efficacy, and anti-TB drug adherence among the intervented group as well as the pre-test and post-test.

DISCUSSION

The findings of this study revealed that using the SRI (*Self-reminder Interactive*) application effectively increases the quality of life, self-efficacy, and anti-TB drug adherence among patients with TB patient. In countries with high TB burden, like India, operational research and programmatic implementation are crucial for combating TB infection and contributing to global knowledge (Moonan et al., 2018). However, challenges such as high healthcare costs, economic development levels, transportation availability, and patient privacy issues can hinder the full implementation of technologies like directly observed therapy (DOT) management for TB treatment (H. Li et al., 2021). In low- and middle-income countries, the implementation of robust TB resistance diagnostic programs using molecular tools remains a challenge (Assiana et al., 2021). Additionally, transitioning out of support from global health organizations like the Global Fund can pose funding challenges for TB control programs in developing countries (England et al., 2019). Addressing TB-related stigma and improving community awareness while enhancing adherence to TB medications are essential in developing countries (Faraade et al., 2022). Implementing effective child contact management strategies to prevent childhood TB is crucial but often not prioritized or fully implemented in low- and middle-income countries (Hirsch-Moverman et al., 2020).

Based on the provided references, various technologies have been explored to support tuberculosis (TB) patients in managing their treatment effectively. Digital adherence technologies (DATs) have emerged as promising tools to enhance treatment adherence and monitoring among TB patients (Subbaraman et al., 2018). These technologies include feature phone-based and smartphone-based solutions, digital pillboxes, ingestible sensors, and mobile applications, offering patient-centric approaches for monitoring adherence (X. Li et al., 2022; Subbaraman et al., 2018). Electronic medication monitoring (EMM) has been recommended by the World Health Organization (WHO) as a digital technology to guide the management of TB patients at the community level (Zhang et al., 2019). EMM, along with other digital health technologies, has the potential to improve treatment outcomes and support adherence among TB patients (Nsengiyumva et al., 2018). Studies have shown that digital technologies, such as text messaging, telemedicine, and electronic monitoring, can effectively support TB treatment and improve patient outcomes (Ngwatu et al., 2018; Thomas et al., 2020). Mobile health applications, voice-text messages, and video-directly observed therapy (VDOT) have been developed to enhance medication adherence and support TB patients in various settings (Travedi, 2023; Katende et al., 2022)(Travedi, 2023). These technologies offer patient-centered tools to improve adherence and treatment outcomes, especially in resource-limited settings (Tadesse et al., 2021; Thomas et al., 2021). Additionally, ingestible biosensors and electronic pillbox-enabled self-administered therapy have shown promise in improving medication adherence and treatment outcomes among TB patients (Manyazewal et al., 2020; Vaz et al., 2022).

Factors associated with the quality of life among people with TB encompass various individual-level and health-related aspects. Studies have highlighted various elements that influence the quality of life of TB patients, including self-efficacy, medication adherence, physical health, emotional state, social support, spirituality, and mental health.

Self-end medication adherence has been identified as a risk factor for quality of life among TB patients (Isnainy, 2021). Individual-level factors such as physical health, emotional state, social support, and spirituality play crucial roles in determining the quality of life of TB patients (Rachmawati et al., 2021). Health-related Quality of Life (HRQoL) is influenced by physical, social, environmental, and mental factors, which are essential for treatment success among TB patients (Touré et al., 2022). Moreover, the relationship between self-efficacy and the quality of life of patients with pulmonary tuberculosis has been established (Sofiana et al., 2022). Social functioning significantly differs in the quality of life before and after anti-TB drug administration, indicating the impact of treatment on patient's daily interactions and activities (Ksatriaputra et al., 2020). Additionally, the presence of depressive symptoms among TB patients is associated with adverse health outcomes, functional impairment, increased medical costs, and poor health-related quality of life (Yohannes et al., 2020). Co-morbid depression can lead to delays in diagnosis and treatment, treatment failure, disability, and even death, affecting the overall quality of life (Bifftu et al., 2019).

Furthermore, the quality of TB care, public trust in TB services, and bypassing of formal health systems are indicators that can impact the quality of life of TB patients (Arsenault et al., 2019). The presence of anemia among TB patients has been linked to poor prognosis, increased risk of death, and complications during treatment, affecting their overall well-being (Abaynew et al., 2023).

The use of technology, such as loop-mediated isothermal amplification and next-generation sequencing, has revolutionized the diagnosis of TB, enabling early detection compared to traditional methods (H. Li et al., 2021). Furthermore, mobile health technologies have been explored to provide social support to TB patients in rural areas, highlighting the potential of technology in activating social support systems for improved patients (Musiimenta et al., 2020). Factors associated with anti-TB drugs among individuals with TB encompass a wide range of elements that influence treatment outcomes and drug resistance. Studies have highlighted various factors that play a crucial role in the effectiveness of anti-TB drugs and the development of drug resistance in Mycobacterium tuberculosis. Drug-resistant TB poses a significant challenge to TB therapy and control programs, emphasizing the importance of understanding the factors contributing to drug resistance (Singh et al., 2019). The occurrence of multidrug-resistant TB (MDR-TB) has been strongly associated with previous treatment with anti-TB drugs, indicating a link between treatment history and drug resistance (Desissa et al., 2018). Risk factors for

developing anti-TB drug resistance have been identified, including factors such as previous treatment with anti-tumor necrosis factor agents, which can impact the effectiveness of TB treatment (Park et al., 2023). Patients with TB and diabetes mellitus are more likely to have risk factors for delayed or reduced absorption of anti-TB medications, highlighting the importance of considering comorbidities in treatment (Alkabab et al., 2023).

Factors associated with self-efficacy among people with TB play a crucial role in their ability to manage the disease effectively. Studies have shown that self-efficacy is significantly associated with adherence to self-care activities and treatment outcomes in various health conditions, such as diabetes mellitus (Amer et al., 2018). In the context of TB, factors such as knowledge about the disease, access to healthcare, and social support can influence self-efficacy levels. Understanding the spatial patterns of TB and HIV co-infection can shed light on the factors influencing self-efficacy among TB patients. Access to healthcare services, proximity to international borders, and demographic factors like literacy and wealth index have been linked to the prevalence of TB/HIV co-infection (Alene et al., 2019). These factors can impact individuals' confidence in managing their TB treatment effectively.

The findings of this study support the positive impact of technology, especially the Android application to remind, educate, and inform patients of TB pulmonary to on-time consume drugs and conduct preventive and rehabilitation. However, the result of this study cannot be generalized to other places and time of settings. Future studies might consider the sustainability and scalability of the SRI application, adding qualitative studies for a better understanding of patient experience.

CONCLUSION

The majority of respondents in this study are in the age range of 35 to 39 years old. It was found a significant impact of using the SRI (Self-Reminder Interactive) application to increase the quality of life of TB patients, self-efficacy, and anti-TB drug adherence. Future studies could add more predictors to examine the impact of technology by educational level, place of residence, and other potential factors related to accessibility to technology.

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