The Use of N-Smsin (Nurse -Short Message Service Information) Telenursing Application Technology on Compliance With Treatment and Care of Tuberculosis Patients in Preventing Transmission and the Occurrence of Multi Drug Resistant Tuberculosis

Indra Rahmad[1], Muhtar[2], Maruni Wiwin Diarti[3], Julhana[4], Ahmad[5]

[1,2,3,4,5]Department of Nursing, Mataram Ministry of Health Polytechnic, Mataram, Indonesia

Abstract
Tuberculosis is a chronic, infectious disease caused by the bacterium Mycobacterium tuberculosis and remains a global health problem, including in Indonesia. Worldwide, TB is one of the 10 leading causes of death. Poor adherence to treatment is a major obstacle to efficient TB control. Innovative strategies are needed to improve access and adherence to treatment, one of which is the use of the Telenursing N-SMSIn (Nurse-Short Message Service Information) application. The purpose of this study was to determine the effectiveness of the Telenursing N-SMSIn (Nurse-Short Message Service Information) application on adherence to treatment and care for tuberculosis patients, preventing transmission and the occurrence of multidrug-resistant tuberculosis. The research method used a quasi-experimental pretest-posttest with a control group design. The sampling technique used accidental sampling, with a sample of 168 respondents with pulmonary TB in the Woha Community Health Center working area in 2025. The research instrument used the 8-item Morisky Medication Scale. The analysis used the Wilcoxon test and obtained a p-value of 0.001 < 0.05. Therefore, it can be concluded that the implementation of the N-SMSIn telenursing application technology significantly impacts adherence to treatment and care in tuberculosis patients, preventing transmission and the occurrence of multidrug-resistant tuberculosis in the Woha Community Health Center Work Area, Bima Regency.

Keywords: N-SMSIn Telenursing, Adherence, Tuberculosis

Introduction

In 2019, the total number of TB patients (all types) in West Nusa Tenggara Province was reported to have reached 6,509, while in 2020, the total number of TB patients was 5,430. Compared to 2019, TB cases in 2020 decreased by 16.58%. TB is often found in densely populated areas with poor sanitation.(1)The prevalence of pulmonary tuberculosis is one of the diseases that must be paid attention to because the number tends to increase in Bima City. This can be seen from the disease register data, the number of TB cases has increased, from 2016 the number of cases found was 0.13% of cases, increasing in 2017 to 0.17% of cases, and in 2018 it decreased to 0.10% of cases.(2). Challenges that need to be addressed are the increasing cases of MDR-TB, TB-HIV, TB with Diabetes Mellitus, TB in children and other vulnerable communities. In Indonesia, the notification rate (Case Notification Rate/CNR) for all tuberculosis cases in 2017 was 162 per 100,000 population, an increase compared to 2016 of 139 per 100,000 population (Ministry of Health of the Republic of Indonesia, 2017). In Bima City, the case detection rate (CDR) for pulmonary TB is still low at 29.6%, still below the national CDR of 42.8%. In 2017, the number of TB sufferers reported was 282 cases, an increase from 2016 of 206 cases, with a complete treatment rate of 47.81% and a cure rate of 47.81%.(3). Bima City in reducing TB disease carried out a pulmonary TB eradication program by implementing the

DOTS strategy with passive case finding through active promotion. The results of interviews with TB officers at the Bima City Health Office in March 2019 showed that several problems that became obstacles in the eradication of pulmonary TB included the still strong stigma in the community who viewed TB as a shameful disease and concealed the disease suffered, lack of knowledge about pulmonary TB disease as well as family economic constraints and the habits of people on the outskirts of Bima City who work as corn farmers living in the fields during the planting season until harvest so that it is difficult for health workers to reach them. This has an impact on low case finding, treatment and self-care for pulmonary TB sufferers.(4)Poor adherence to treatment is a major obstacle to TB control, requiring innovative strategies to improve access and adherence to treatment. Some TB patients do not come to health services to take OAT for reasons such as forgetting, being bored with the long treatment, feeling cured, or being far from the health service. The role of the PMO is crucial. During the course of treatment, patient saturation with OAT will increase, so a reliable documentation system is needed by medical personnel. In this case, continuous monitoring is essential to support the recovery of TB patients. Active management of outpatient TB care can be done through telenursing. Telenursing is the use of telecommunications and information technology to provide nursing services remotely using information, communication, and computer technology.(5). The formulation of the problem in this study is how to create and implement the use of N-SMSIn telenursing application technology on adherence to treatment and care of tuberculosis patients in preventing transmission and the occurrence of multi-drug resistant tuberculosis. The purpose of this study is to analyze the use of N-SMSIn Telenursing Application Technology on adherence to treatment and care of tuberculosis patients in preventing transmission and the occurrence of multi-drug resistant tuberculosis.

Method

The research method used a quasi-experimental pretest-posttest with a control group design. The sampling technique used was accidental sampling, with a sample of 168 respondents of pulmonary TB patients in the Woha Community Health Center Working Area in 2025. The types of data used were primary and secondary. The treatment given to the intervention group used the N-SMSIn (Nurse-Short Message Service Information) telenursing application technology. The telenursing technology development model used in this study is N-SMSIn, where the model is developed through sending short messages via Android. This application is based on a responsive website, accessible via mobile phones and computers. Where nurses can enter patient data and contact who can be contacted for monitoring or as a reminder to take medication. In the application, nurses can map the medication schedule based on the TB patient's OAT schedule. The SMS is built based on a website, affiliated with a single email provider. Then, the control group was given media in the form of a leaflet containing a column for the scheduled dates for taking medication.

The research instrument used the standard Indonesian version of the MMAS-8 (Morisky Medication Adherence Scale-8) questionnaire, with a score of 6-8 categorized as compliant and a score of <6 as non-compliant. Data were analyzed using the non-parametric Wilcoxon test and Pearson Chi-square test. This study has received ethical approval from the Research Ethics Committee under the following number:

Results And Discussion

Results

1. Normality Test of Respondent Characteristics in the Intervention Group and Control GroupIn the Working Area of Woha Health Center, Bima Regency in 2025

a. Normality Test

Table 1. Normality Test of Respondent Characteristics of the Intervention Group and Control Group Research in the Woha Community Health Center Work Area, Bima Regency 2025

	Intervention Group	Control Group
	Kolmogorov-Smirnova	Kolmogorov-Smirnova

	Statistics	df	Sig.	Statistics	df	Sig.
Age	.164	84	.000	.160	84	.000
Gender	.373	84	.000	.381	84	.000
Education	.182	84	.000	.175	84	.000
DM History	.468	84	.000	.468	84	.000
Smoking History	.482	84	.000	.475	84	.000
Family Support	.381	84	.000	.388	84	.000
a. Lilliefors Significance Correction						

Based on Table 1, it shows that the results of the normality test on the variables of age, gender, education, history of DM, history of smoking, and family support in the intervention group and the control group produced a p value <0.05, so it can be concluded that the data is not normally distributed and uses the non-parametric Chi Square test.

b. Distribution DataFrequency of Respondent Characteristics Based on Age, Gender, Education, History of DM, History of Smoking, and Family Support In the Working Area of Woha Health Center, Bima Regency in 2025

Table 2 Frequency Distribution of Respondent Characteristics Based on Age, Gender, Education, History of Diabetes, History of Smoking, and Family Support in the Working Area of Woha Community Health Center, Bima Regency in 2025

Variables	Medication Compliance in Pulmonary TB Patients		OR	CI 95%	*P value*
	Intervention	**Control**			
Age					
Productive (15-59 Years)	68 (81%)	72 (86%)	2,592	1,355-4,718	*0.005*
Unproductive (> 60 Years)	16 (19%)	12 (14%)			
Gender					
Man	50 (59.5%)	48 (57.1%)	3,500	1,842-6,651	*0.000*
Woman	34 (40.5%)	36 (42.9%%)			
Education					
Elementary - Middle School	47 (56%)	51 (60.7%)	1,962	1,063-3,628	*0.045*
High School – College	37 (44%)	33 (39.3%)			
DM History					
Positive	43 (51.2%)	55 (65.5%)	1,967	1,063-3,639	*0.046*
Negative	41 (48.8%)	29 (34.5%)			
Smoking History					
Yes	50 (59.5%)	44 (52.4%)	3,500	**1.842-6.651**	*0.000*
No	34 (40.5%)	40 (47.6%)			
Family Support					
Support	67	48	2,956	**1,489-**	*0.003*

	(79.8%)	(57.1%)		5,867	
Does not support	17 (20.2%)	36 (42.9%)			

Table 2 shows that the percentage of respondents in productive age (15-59 years) is equally high, namely (81%) in the intervention group and (86%) in the control group. The test results obtained a p value of 0.005 (p <0.05) meaning that there is a significant relationship between age and adherence to treatment and care. The percentage of gender is mostly male, namely (59.5%) in the intervention group and (57.1%) in the control group. The test results obtained a p value of 0.000 (p <0.05) meaning that there is a significant relationship between gender and adherence to treatment and care. The percentage of education is mostly elementary-junior high school, namely (56%) in the intervention group and (60.7%) in the control group. The test results obtained a p value of 0.045 (p <0.05) meaning that there is no significant relationship between education and adherence to treatment and care. The percentage of TB respondents with a history of DM is (51.2%) in the intervention group and (65.5%) in the control group. The test results obtained a p value of 0.046 (p <0.05) meaning there is no significant relationship between the history of DM and adherence to treatment and care. The percentage of respondents who have a history of smoking is (59.5%) in the intervention group and (52.4%) in the control group. The test results obtained a p value of 0.000 (p <0.05) meaning there is a significant relationship between smoking and adherence to treatment and care. Then the percentage of respondents received family support is (79.8%) in the intervention group and (57.1%) in the control group. The test results obtained a p value of 0.003 (p <0.05) meaning there is a significant relationship between family support and adherence to treatment and care.

2. **Analysis of the Use of N-SMSIn Telenursing Application Technology on Compliance with Treatment and Care of Tuberculosis Patients in Preventing Transmission and Occurrence of Multi Drug Resistant Tuberculosis in the Intervention Group**

Table 3 Analysis of the Use of N-SMSIn Telenursing Application Technology on Treatment and Care Compliance of Tuberculosis Patients in the Intervention Group in the Woha Community Health Center Work Area, Bima Regency in 2025

Medication Compliance	Pre				Post			
	F (%)	M (SD)	Mean (SE Mean)	p	F (%)	M (SD)	Mean (SE Mean)	p
Obedient	9 (10.7)	4.38 (1.581)	4.38 (0.280)	0.008	83 (98.8)	5.66 (1.125)	5.66 (0.199)	0.039
Not obey	75 (89.3)				1 (1,2)			
pWilcoxon	0.001							

Based on table 3, it shows that adherence to treatment and care of pulmonary TB patients has increased after being given an intervention in the form of using the N-SMSIn telenursing application technology. The

Wilcoxon-test statistical test obtained for the variable of adherence to treatment and care of pulmonary TB patients p value 0.001 <0.05 means that there is a significant influence of the application of N-SMSIn on adherence to treatment and care in pulmonary TB patients at the Woha Community Health Center, Bima Regency.

3. Analysis of Leaflet Use on Treatment and Care Compliance of Tuberculosis Patients in Preventing Transmission and Occurrence of Multi Drug Resistant Tuberculosis in the Control Group

Table 4. Analysis of Leaflet Use on Treatment and Care Compliance of Tuberculosis Patients in the Control Group in the Woha Community Health Center Work Area, Bima Regency in 2025

Medication Compliance	Pre				Post			
	F (%)	M (SD)	Mean (SE Mean)	p	F (%)	M (SD)	Mean (SE Mean)	p
Obedient	10 (11.9)	4.28 (1.573)	4.28 (0.380)	0.009	56 (66.7)	4.88 (1.151)	4.88 (0.219)	0.042
Not obey	74 (88.1)				28 (33.3)			
pWilcoxon	0.05							

[*]$P< 0.05$ indicates that the data is not normal, the results of the Shapiro-Wilk normality test
[**]$P< 0.05$ there is a significant influence of the use of leaflets on compliance with treatment and care results of the Wilcoxon test

Based on table 4, it shows that adherence to treatment and care of pulmonary TB patients has increased after being given leaflet media. The Wilcoxon-test statistical test obtained for the variable of adherence to treatment and care of pulmonary TB patients with a p value of 0.05 means that there is an effect of the use of leaflets on adherence to treatment and care in pulmonary TB patients at the Woha Community Health Center, Bima Regency.

Discussion
a. Analyzing the Characteristics of Respondents with TB Regarding Compliance with Treatment and Care of Tuberculosis Patients in Preventing Transmission and the Occurrence of Multi Drug Resistant Tuberculosis in the Intervention Group and Control Group.

Based on table 2, the frequency distribution of respondents based on age shows that the majority of respondents were in the productive age group of 15–59 years, as many as 68 people (81%) in the intervention group and as many as 72 people (86%) in the control group, and a p value of 0.005 (p < 0.05) was obtained with an OR value of 2,592, which means there is a relationship between age and compliance and productive age.have a chance2,592times to comply. Where productive age groups are often active outside, they have the highest risk of positive pulmonary TB cases. This is in line with research conducted by Devi et al. 2018, which found that MDR-TB patients are often found in productive age groups because they are highly susceptible to TB transmission due to easy interaction with others, high mobility, and the possibility of transmission to others and the surrounding environment.(6). The age at which pulmonary TB is most often found is in the productive age group, namely 15-50 years.(7). In addition, based on research by Maelani (2019), patients of productive age are more susceptible to contracting pulmonary TB because activities at productive age are more active than those of older age.(8)Age and education are also sociodemographic characteristics that have a significant correlation with medication adherence (p < 0.05). Patients of productive age, i.e., those under 60 years old, generally have better memories than older patients, making it easier to find and receive information.(9)This is in line with Wiyati's research (2024), where age characteristics have a significant relationship with the level of knowledge and compliance (p <

0.05).(10)The average level of compliance in those aged <60 years is higher than in those aged ≥60 years. At age <60 years, a person is still able to carry out all normal activities, tends to have a strong desire to recover from their illness, and is highly motivated to participate in the treatment provided.(11).

The gender of respondents in this study was mostly male, 50 people (59.5%) in the intervention group and 48 people (57.1%) in the control group, and a p value of 0.000 (p < 0.05) was obtained with an OR value of3,500, which means there is a relationshipgenderwith compliance andgender has a chance3,500times to comply. Then, most respondents had a history of smoking, as many as 50 people (59.5%) in the intervention group and 44 people (52.4%) in the control group, and a p value of 0.000 (p < 0.05) was obtained with an OR value of 0.000.3,500, which means there is a relationshipsmoking historywith compliance andsmoking history has a chance3,500times to comply. Males have a significantly higher prevalence of smoking than females. This suggests that smoking is more common among males, likely influenced by social and cultural factors that support this behavior in this group.(12)This study found that men have a higher risk of contracting pulmonary TB than women. This is because the harmful substances in cigarettes can weaken the immune system and damage the cilia in the respiratory tract, which function to expel germs, bacteria, and viruses.(13)Cigarette smoke damages the lung's defense mechanisms, affects lung function, damages the airway mucosa, increases airway resistance, and causes pulmonary blood vessels to leak easily. Exposure to cigarette smoke plays a significant role in bacterial colonization.(14)This makes the body more susceptible to infection and worsens the severity of TB disease.(15). Nicotine has been shown to inhibit the production of tumor necrosis factor-alpha (TNF-α) by macrophages, a critical cytokine involved in the immune response to Mycobacterium tuberculosis.(16)This is in line with research conducted by Yasni et al. (2024) and Febriza et al. (2025) that there is a significant relationship between the risk factor of smoking and the incidence of pulmonary tuberculosis.(17)(18)Gender is a factor related to adherence to taking anti-TB medication, but men and women differ in several ways, such as social relationships, environmental influences, lifestyle habits, and biological and physiological differences. Equal opportunities to access all information, including information about pulmonary TB treatment, are essential.(19)Based on the researcher's assumption, productive-age men are physically fit and assume significant family responsibilities, particularly as primary breadwinners, protectors, and educators of their children and spouses, thus encouraging adherence to treatment. Gender can indicate a person's level of productivity. Universally, men's productivity is higher than women's.(20). In addition, compliance depends on an understanding of pulmonary tuberculosis itself, family or PMO support, health facilities, information and education for pulmonary TB patients, one of which is through the use of N-SMSIn Telenursing Application Technology.

Based on the research results, it shows that the majority of respondents received family support, as many as 67 people (79.8%) in the intervention group and 48 people (57.1%) in the control group, with a p value of 0.003 (p <0.05) with an OR value of2.956, which means there is a relationshipfamily supportwith compliance andfamily support has the opportunity2,956times to adhere to TB treatment. Most respondents who attended treatment visits were accompanied by their families. This positive family support is evident in the ability of the family to assist with the respondents' daily needs and the time available to assist with their activities. This provides emotional support for respondents in maintaining their health.

Families play a role in motivating and supporting their TB family members to take their medication regularly. Good support can influence the patient's medication-taking behavior, ensuring consistent treatment until the patient is declared cured by healthcare providers. However, some family members may not pay enough attention to this, or even ignore it, thus under-supporting the treatment process.(21). Family support includes encouraging sufferers to comply with taking their medication, showing sympathy and concern, and not avoiding sufferers from their illness.(22)Meldawaty (2023) stated that family is an influential factor in determining patient compliance and motivation in choosing an acceptable treatment

program. The family approach is one of the Community Health Center's strategies in improving health services for the community.(23)This is because family support makes sufferers more confident, with sufferers receiving support, attention, and assistance so that sufferers feel comfortable and not burdened alone.(24). The form of family support in managing and supervising compliance in taking medication will increase the patient's motivation to take medication, so that indicators in achieving successful treatment and recovery will increase.(25).

b. Analyzing the Use of N-SMSIn Telenursing Application Technology on Compliance with Treatment and Care of Tuberculosis Patients in Preventing Transmission and Occurrence of Multi Drug Resistant Tuberculosis

Based on table 3, the results of the Wilcoxon test p value 0.001 (p <0.05) showed that adherence to taking medication for pulmonary TB patients increased after being given the N-SMSIn telenursing application technology intervention, meaning there was a significant influence of the application of the N-SMSIn telenursing application on adherence to taking medication for pulmonary TB patients in the Woha Health Center work area. Then in table 4, a p value of 0.05 was obtained indicating that adherence to taking medication for pulmonary TB patients increased after being given leaflets, meaning there was an influence of leaflets on adherence to taking medication for pulmonary TB patients in the Woha Health Center work area. However, the p value of 0.001 <0.05 means that the provision of the N-SMSIn telenursing application is more effective than leaflets. The use of telenursing is very effective, the results of this study are supported by Sari's research (2024), where researchers combined the provision of Leaflet Media and Whatsapp Reminder interventions, showing that there was an influence of leaflet media and whatsapp reminders on increasing adherence to taking medication. Leaflet media and WhatsApp reminders can provide information and guidelines in developing health services to increase compliance in patients undergoing treatment.(26)A different thing happened in Rusdiaman's (2024) study, which stated that the leaflet combination pill count method showed a p-value of 0.149 (> 0.05) from the Chi-Square test, which means there was no difference in the level of compliance of tuberculosis patients who were given the leaflet combination pill count intervention compared to the pill count method alone. The leaflet did not significantly affect the compliance of tuberculosis patients taking medication.(27).

Chinese research suggests a daily SMS reminder system can significantly improve medication adherence in pulmonary TB patients.(28). The results of research in Jember, Indonesia also proved that mobile phone reminder applications have a significant influence on adherence to pulmonary TB treatment.(29). Along with the development of technology, information, and modern communication, there are various technologies that can facilitate and support people in carrying out activities and interacting with others without having to meet face to face.(30).

In this study, the use of mobile phones became a medium used as a medium between researchers and pulmonary TB patients, as a communication tool to remind medication taking times to improve medication adherence through the Telenursing N-SMSIn (Nurse-Short Message Service Information) application technology that has been designed and developed, where this application is based on a responsive website, accessible via mobile phones and computers. Nurses can enter patient data and contactable contacts to monitor or as a reminder to take medication. In the application, nurses can map the medication taking schedule based on the TB patient's OAT taking schedule. The SMS is built based on a website, under one email provider. Sending short messages as a medication reminder is not only an alarm or containing an invitation to take medication but also contains health information related to TB disease, cough etiquette, and how to prevent transmission to others. Providing health information education related to TB that is carried out continuously can improve memory, knowledge, behavioral changes, self-awareness of TB disease. This results in increased compliance of TB patients to visit and take TB medication. Similar research was conducted by Ni Putu Ayu Sumertini (2022) where the researcher provided short message service (SMS)-

based health education and found an impact on self-care management in tuberculosis patients in Klungkung Regency.(31).

Text messages sent by mobile phones are important and have strong potential to change behavior, promote health activities, and support the availability of widespread, cheap, and fast health services.(32) (33)Sending reminder messages specifically to TB patients using mobile phones is said to be effective because it can act as a reminder to take medication, make patients feel cared for, and build trust in healthcare providers and the healthcare system in general.(34)(35)The use of electronic information and communication technology greatly assists both health workers and patients in improving their health status and ensuring that government programs are implemented effectively, efficiently, and appropriately.(36)(37)(38)Telenursing is part of the utilization of technological developments in the world of nursing.(39) (40)(41)Telenursing via SMS is an important feature in supporting the successful treatment of pulmonary TB patients, to monitor adherence to taking OAT to prevent dropout cases that can lead to MDR-TB cases.(42)(43)(44)(45).

N-SMSIn is a concrete example of the use of telenursing technology through its responsive website-based application, accessible via mobile phones and computers. The website-based messaging is managed by a single email provider, from nurses to patients. Telenursing itself is implemented through the use of a web-based email provider, containing short medication reminders sent daily at a frequency consistent with the patient's medication schedule. Other researchers have also discussed N-SMSIn, arguing that SMS messages are more likely to be read than other media such as email and video.(43). In addition, interventions in the form of SMS reminders can also be an effective health service intervention medium for pulmonary TB patients.(46) (47)The results of this study received several positive responses from patients. Therefore, the N-SMSIn feature for pulmonary TB patients is considered effective in supporting successful TB treatment and can be implemented by health services, both community health centers and hospitals.

Closing
Conclusion

The implementation of the N-SMSIn (Nurse-Short Message Service Information) telenursing application technology has proven effective in improving adherence to treatment and care for tuberculosis patients, preventing transmission and the occurrence of multidrug-resistant tuberculosis. With the reminder program through this feature, implemented for 6 months, adherence to taking medication in pulmonary TB patients can be properly monitored and feel more cared for, thus minimizing prevention for families.

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