



eISSN: 2281-7824

<https://www.pagepressjournals.org/index.php/hls/index>

Publisher's Disclaimer. E-publishing ahead of print is increasingly important for the rapid dissemination of science. The **Early Access** service lets users access peer-reviewed articles well before print / regular issue publication, significantly reducing the time it takes for critical findings to reach the research community. These articles are searchable and citable by their DOI (Digital Object Identifier).

The **Healthcare in Low-resource Settings** is, therefore, e-publishing PDF files of an early version of manuscripts that undergone a regular peer review and have been accepted for publication, but have not been through the typesetting, pagination and proofreading processes, which may lead to differences between this version and the final one. The final version of the manuscript will then appear on a regular issue of the journal.

E-publishing of this PDF file has been approved by the authors.

Healthc Low-resour S 2026 [Online ahead of print]

To cite this Article:

Setiyowati E, Wardani EM, Lutfauzia A. **E-learning health management on behavior to prevent tuberculosis transmission.** *Healthc Low-resour S* doi: 10.4081/hls.2026.14211



©The Author(s), 2026
Licensee [PAGEPress](#), Italy

Note: The publisher is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries should be directed to the corresponding author for the article.

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article or claim that may be made by its manufacturer is not guaranteed or endorsed by the publisher.



Submitted: 31 July 2025

Accepted: 14 April 2026

Early access: 14 July 2026

E-learning health management on behavior to prevent tuberculosis transmission

Eppy Setiyowati,¹ Erika Martining Wardani,¹ Asmaul Lutfauziah²

¹Departement of Nursing, Faculty of Nursing and Midwifery, Universitas Nahdlatul Ulama Surabaya; ²Departement of Primary Education, Faculty of Teacher Training and Education, Universitas Nahdlatul Ulama Surabaya, Indonesia

Correspondent Author: Eppy Setiyowati, Departement of Nursing, Faculty of Nursing and Midwifery, Universitas Nahdlatul Ulama Surabaya, Indonesia. E-mail: eppy@unusa.ac.id

Key words: preventive behavior, education level, pulmonary tuberculosis.

Abstract

Inadequate information of pulmonary tuberculosis prevention contributes to poor conduct in controlling its spread. E-learning health management education is an effective way to change individuals' attitudes toward improved health. This study sought to assess the effects of E-learning health management education on behaviors targeted at avoiding the spread of pulmonary tuberculosis. The research design used was pre-experimental, with a one-group pre-post-test procedure. The Wonokromo Community Health Center had a population of 37 patients with pulmonary tuberculosis, and the sample included all 37 respondents chosen using a non-probability sampling approach called total sampling. The independent variable is E-learning health management education, and the dependent variable is behavior aimed at limiting the spread of pulmonary tuberculosis. A Likert scale questionnaire was employed as the study tool. The data was analyzed using a T-test, with significance defined at $\alpha = < 0.05$. The consequence. The E-learning health management education intervention had a significant impact in preventing tuberculosis transmission ($p < 0.001$). This demonstrates a link between e-learning health management education and preventative behavior for pulmonary tuberculosis transmission. Prior to administering the E-learning health management education program among patients, the majority of participants had negative attitudes on limiting the spread of pulmonary tuberculosis.

Introduction

Tuberculosis (TB) is an illness caused by the *Mycobacterium Tuberculosis* bacteria, primarily affecting the lungs, but it can also impact other parts of the body, including the kidneys and bones.¹ Often referred to as "the great imitator," this disease shares many features with other conditions such as syphilis and lupus.² Common symptoms include general signs of illness like fever and fatigue.³ Additionally, tuberculosis presents other specific symptoms, including a lengthy cough lasting more than three weeks, expectoration of mucus (which may or may not contain blood), chest discomfort, night sweats, unintentional weight loss, and a sharp decrease in appetite.⁴

However, not all individuals experience the same symptoms, which can vary based on personal health conditions. If you notice any of these symptoms, it's advisable to see a healthcare professional or visit a local health facility for further evaluation, as delaying treatment could lead to spreading the disease, particularly among family members, since tuberculosis is contagious.⁵ Moreover, some individuals may trivialize these symptoms or think they are insignificant. Pulmonary tuberculosis, commonly referred to as TB, can transmit through the air when a person with the condition coughs, sneezes, or spits. It can be deemed cured if the affected individual completes the recommended treatment regimen.⁶ It's crucial that this treatment follows the prescribed dosage accurately; otherwise, drug resistance may emerge.⁷

Drug resistance occurs when microorganisms like bacteria, viruses, and fungi develop immunity to medications intended to eliminate them, thus necessitating adjustments in medication protocols to ensure effectiveness in treating TB.⁸ One of the simplest ways to prevent the illness is by practicing PHBS (*Perilaku Hidup Bersih dan Sehat*, Clean and Healthy Living Behavior).⁹ A low adherence to PHBS significantly increases the spread of disease, leading to many individuals suffering from pulmonary TB.¹⁰

A fundamental action within PHBS is handwashing with soap and clean water, ideally using running water. This practice not only benefits the individual but can also serve as a model for others, as PHBS offers numerous advantages, including the prevention of various infectious and non-infectious diseases while potentially lowering healthcare costs.¹¹ This could promote better health standards and an improved quality of life in the community.¹² It is critical to understand that isolating individuals with TB is unnecessary; such actions can lead to feelings of loneliness, despair, and hopelessness in those affected.

According to findings from a study¹ conducted in Surabaya in 2010, 23. 6% had adopted a clean and healthy living behavior. This figure rose to 45. 5% in 2014, and again increased to 68. 74% by 2018. In 50% of tuberculosis cases, patients live in homes with poor air circulation, and 66. 7% of these residences receive inadequate natural light, leading to musty conditions.

Several elements that impact the community's ability to prevent pulmonary TB include the understanding and application of PHBS. To assess public awareness of PHBS, we can utilize various methods such as direct observation, surveys, question and answer sessions, and similar approaches,¹⁴ then classify the findings from poor to excellent. A key approach to preventing the spread of pulmonary TB stems from the community's indifference towards maintaining a healthy lifestyle, particularly the neglect of clean and healthy living practices (PHBS) same as above.¹⁵

This includes behaviors like washing hands with soap and clean water, failing to consistently take prescribed medications, poor cough etiquette, and a lack of adherence to routine treatment protocols. Both knowledge and attitudes play a significant role in an individual's health status; when knowledge is lacking, the effects are generally unfavorable, and the reverse is also true. In this situation, while public awareness of tuberculosis symptoms is fairly good, there is still a notable lack of concern regarding the repercussions of TB transmission. This indifference is a contributing factor to the rising number of individuals suffering from pulmonary TB.¹⁶

Numerous initiatives have been undertaken by the community to halt the spread of pulmonary TB, focusing on disrupting the transmission cycle and managing infections.¹⁷ A crucial aspect of preventing and controlling pulmonary TB lies in the knowledge level and execution of public health behaviors for tuberculosis prevention include maintaining personal and environmental hygiene, wearing masks, cough etiquette, improving nutrition, early screening, and adherence to treatment. The greater the public's knowledge and awareness, the more effective TB prevention efforts will be, thus reducing morbidity and mortality from tuberculosis.²

Overcoming this challenge can be tough due to the shortage of healthcare professionals who can provide proper education, as well as a significant number of individuals who fail to practice PHBS, leading to a decline in their understanding of how to prevent pulmonary TB.¹⁹ To address this issue, the researcher is exploring solutions by implementing an intervention (action plan) that offers E-learning health management education aimed at improving behavior for preventing the transmission of pulmonary TB among patients. This intervention includes animated video resources and leaflets—colorful and engaging folded papers designed to capture readers' attention and prevent boredom.²⁰ Additionally, these leaflets are simple to produce and convenient to carry around.

The aim of this research was analyzing effectiveness of E-learning health management education on behaviors aimed at preventing the spread of implementing the E-learning health management education program among pulmonary TB patients at the Wonokromo Community Health Center in Surabaya. It will also involve delivering the E-learning health management education intervention to these patients at the same health facility. After the intervention was applied, the study will assess the actions taken to prevent pulmonary TB among patients at the Wonokromo

Community Health Center in Surabaya. Furthermore, the research will analyze the components to provide a thorough understanding of how E-learning health management education affects the behaviors that prevent the spread of pulmonary TB at the Wonokromo Community Health Center in Surabaya.

Materials and Methods

Description

The research conducted in this study employs a quantitative approach, specifically utilizing a Pre-Experimental design, which is recognized as the most straightforward form of experimental research, featuring a One group pre-posttest design. The total number of patients with pulmonary TB at the Wonokromo Community Health Center in Surabaya was 37, and all 37 individuals were selected as the sample using a non-probability sampling method called total sampling. The independent variable refers to the factor that the researcher alters to observe its effects on other variables, such as e-learning health management education in this study. In contrast, the dependent variable represents the outcome being assessed, which is influenced by the independent variable; here, it pertains to the behaviors related to preventing the spread of pulmonary TB. The research tool employed is a Likert scale questionnaire. This Likert scale serves as a common measurement tool to evaluate an individual's attitudes, opinions, or perceptions regarding specific statements or events. For data analysis, the Paired T-test was utilized, with significance determined at α .

Data collection procedures

The investigator sought an initial data collection letter from the Educational Institution of Universitas Nahdlatul Ulama Surabaya in Indonesia. In addition, the researcher sent a research permit letter to the Surabaya City Health Office to carry out a study at the Wonokromo Community Health Center in Surabaya. An ethical proposal was also submitted to assess the research's ethical standards, leading to the acquisition of an ethical certificate numbered No. 0503/EC/KEPK/UNUSA/2025.

The researcher requested a letter to gather data for the study at the Wonokromo Community Health Center, coordinating with authorized personnel there to obtain population information and arrange a schedule for the research. While working with the Wonokromo Community Health Center, the researcher prepared a list of tuberculosis patients who would serve as respondents, aiming to select a sample of 37 individuals. The researcher sought assistance from the administrator to gather contact addresses and phone numbers of the respondents and to inquire about the schedule for monitoring patients with Pulmonary TB at the health center. The researcher visited the Wonokromo Community Health Center in Surabaya to introduce themselves and clarify the research objectives,

alongside highlighting the role of potential respondents in the study. If individuals expressed interest in participating, they were asked to sign an informed consent form. Those who opted out were required to complete a resignation form. The researcher distributed pre-test questionnaires and provided instructions on how to fill them out.

The pre-test data collection spanned one week, focusing on TB patients at the Wonokromo Community Health Center in Surabaya. The researcher requested permission from the respondents to join a WhatsApp group designed for delivering E-learning Health Management Education interventions that promote the prevention of Pulmonary TB, lasting two weeks with sessions held four times on Mondays and Thursdays.

The e-learning intervention was provided to respondents for three weeks, with two meetings each week. In the first week, information was provided about pulmonary tuberculosis and the factors influencing its spread within the patient's environment. In the second week, the intervention covered preventive measures and actions necessary if transmission occurs within the respondent's environment. In the third week, information was provided about treatment and medication adherence for pulmonary tuberculosis patients.

Following this, the researcher returned to the health center to hand out post-test questionnaires and clarified the filling procedure. The post-test data collection also took place over the course of one week among TB patients at the center. After respondents completed the questionnaire, the researcher checked for the completeness of their responses to facilitate efficient data processing. The researcher then moved on to the data processing phase and expressed gratitude to the respondents for their participation in the study.

Data analysis

After the data is processed following the outlined steps, a subsequent analysis is conducted using the T-Test Results via SPSS for Windows. This statistical approach is employed to evaluate the averages between two sets of related data, such as comparing measurements taken before and after treatment within the same group. The statistical analysis will yield one of two potential outcomes, being considered significant if $\alpha = 0.05$. If the probability value is equal to α , then the alternative hypothesis H_1 is accepted, indicating that e-learning health management education does not significantly impact behaviors aimed at preventing the spread of pulmonary TB at the Wonokromo Community Health Center in Surabaya.

Results and Discussion

Table 1 indicates that out of the 37 participants, nearly half (45. 9%) were 17 individuals who were over 60 years old, 15 respondents aged between 41 and 60 years constituted 40. 5%, and the smallest group was made up of 5 respondents aged 18 to 40 years, which represented 13. 5%.

Table 2 indicates that among the 37 participants, a significant portion (54. 1%) consisted of 20 males, while the remaining (45. 9%) accounted for 17 females. This suggests that male participants exhibit considerable motivation and zeal towards education in order to enhance their knowledge, particularly since pulmonary TB predominantly affects men. Additionally, this might be attributed to the distinct lifestyles that men lead in comparison to women.²¹

Table 3 illustrates that out of 37 participants, a significant portion (64. 9%), which amounts to 24 individuals, experienced their illness for 2 months (beginning stage). Meanwhile, a smaller share (35. 1%), representing 13 individuals, was reported to have been ill for 4 to 12 months (later stage). The length of illness can be divided into two categories: the initial phase, referred to as acute, and the later phase, known as chronic; this distinction is based on the duration for which the individual has been unwell.²²

Table 4 indicates that among the 37 participants, most (67. 6%) or 25 individuals completed their high school education. A smaller percentage (5. 4%) or 2 individuals had an elementary school education. Additionally, 18. 9% or 7 respondents achieved a junior high school education, while a final percentage (8. 1%) or 3 respondents had attained a college or bachelor's degree.

Table 5 indicates that out of 37 participants, most of them, accounting for 62. 2%, or 23 individuals, are self-employed. A portion, marking 16. 2%, or 6 individuals, reported that they are unemployed. Moreover, 13. 5%, representing 5 respondents, are employed in government positions or as civil servants, and lastly, 8. 1%, which is 3 individuals, mentioned that they receive a pension or have been compensated for previous employment, noting that pensions are not available for every job.²³

Table 6 indicates that the actions related to stopping the spread of pulmonary TB among 37 participants prior to the E-learning health management education intervention revealed that most (59. 5%) of the 22 individuals had a negative attitude toward measures to prevent the transmission of pulmonary TB.²⁴ However, after the E-learning health management education intervention, the actions regarding the prevention of pulmonary TB transmission²⁵ improved, with the majority (73%) of the 27 respondents displaying a positive attitude toward these preventive measures.

E-learning health management education intervention toward behavior to prevent tuberculosis transmission²⁶ were significance $p = < 0,001$. This shows that there is a relationship between e-learning health management education and prevention behavior of pulmonary tuberculosis transmission.

Conclusions

The actions taken to stop pulmonary tuberculosis prior to implementing the E-learning health management education program among patients at the Wonokromo Community Health Center in Surabaya indicated that a majority of the participants exhibited negative attitudes towards preventing the spread of pulmonary tuberculosis.

References

- [1] Minsarnawati AAM. Pola Penyakit Tuberkulosis (TBC) di Provinsi Jawa Timur_ Analisis Spasial dan Determinannya 2023.
- [2] Dinas Kesehatan Provinsi Jawa Timur. Profil Kesehatan Provinsi Jawa Timur 2019. [East Java Province Health Profile 2019.] Dinas Kesehatan Provinsi Jawa Timur, 2020:tabel 53.
- [3] Dorjee K, Topgyal S, Tsewang T, et al. Risk of developing active tuberculosis following tuberculosis screening and preventive therapy for Tibetan refugee children and adolescents in India : An impact assessment. *PLoS Med* 2021;18:e1003502.
- [4] Huang S, Xiang H, Yang W, et al. Short-term effect of air pollution on tuberculosis based on kriged data: A time-series analysis. *Int J Environ Res Public Health* 2020;17:1522.
- [5] Id OO, Adepoju V, Emeka F, Id A. Treatment outcomes of drug susceptible Tuberculosis in private health facilities in. *PLoS One* 2021;16:e0244581.
- [6] Tan C, Kallon II, Colvin CJ, Grant AD. Barriers and facilitators of tuberculosis infection prevention and control in low- And middle-income countries from the perspective of healthcare workers: A systematic review. *PLoS One* 2020;15:e0241039.
- [7] Kinikar A, Chandanwale A, Kadam D, et al. High risk for latent tuberculosis infection among medical residents and nursing students in India. *PLoS One* 2019;14:e0219131.
- [8] Tesema T, Seyoum D, Ejeta E, Tsegaye R. Determinants of tuberculosis treatment outcome under directly observed treatment short courses in Adama City, Ethiopia. *PLoS One* 2020;15:e0232468.
- [9] Setiyowati E, Hanik U NP. An overview of lifestyle in communities during the second wave of Covid-19 pandemic. *J Health Sci* 2021;14:257–66.
- [10] Setiyowati E, Anggraeni R, Winoto PM, et al. Acceptance of the covid-19 vaccine based on health belief model. *Bali Med J* 2022;11:1319–24.
- [11] Setiyowati E, Soleha U, Mulyadi M, Basuni M. Benson's spiritual relaxation and lavender aromatherapy toward anxiety, sleep quality, and blood pressure. *Healthc Low-res S* 2025;13:13182.
- [12] Setiyowati E, Soleha U, Mulyadi M, Basuni M. Benson's spiritual relaxation and lavender aromatherapy toward anxiety, sleep quality, and blood pressure. *Healthc Low-res S* 2025;13:13182.
- [13] Setiyowati E, Khamidah N, Setianto B, et al. Preventive behaviors toward transmission of pulmonary tuberculosis. *Bali Med J* 2023;12:3376–81.
- [14] Aggarwal AN. Quality of life with tuberculosis. *J Clin Tuberc Other Mycobact Dis* 2019;17:121.

- [15] Mordekai Rangkoratat M, Melda Suhita B, Ana Anggraini N. Improving self-efficacy and behavior to prevent transmission in pulmonary tuberculosis patients through health coaching based on social cognitive theory. *J Appl Nurs Health* 2024;6:75–87.
- [16] Pérez LV, Díaz MJF. An immersive research activity for undergraduate nursing students: an educational innovation. *Teaching Learning Nurs* 2025;21:e411-5.
- [17] Waters VJ, Stanojevic S, Sonneveld N, et al. Factors associated with response to treatment of pulmonary exacerbations in cystic fibrosis patients. *J Cystic Fibrosis* 2015;14:755–62.
- [18] Karat AS, Gregg M, Barton HE, et al. Evidence for the use of triage, respiratory isolation, and effective treatment to reduce the transmission of mycobacterium tuberculosis in healthcare settings: a systematic review. *Clin Infect Dis* 2021;72:155-72.
- [19] Sabri A, Quistrebert J, Amrani HN, et al. Prevalence and risk factors for latent tuberculosis infection among healthcare workers in Morocco. *PLoS One* 2019;14:1081.
- [20] MacPherson P, Lebina L, Motsomi K, et al. Prevalence and risk factors for latent tuberculosis infection among household contacts of index cases in two South African provinces: Analysis of baseline data from a cluster-randomised trial. *PLoS One* 2020;15:23066.
- [21] Castro-Carrasco P, Cuadra-Martínez D, Gubbins V, et al. Subjective theories of the Chilean teachers' union about school climate and violence after the pandemic: a study of web news. *Front Educ (Lausanne)* 2024;9:1455837.
- [22] Citron K, Johnson M, Matheson BE, et al. Study protocol for training providers in private practice in family-based treatment for adolescents with anorexia nervosa: A randomized controlled feasibility trial. *Contemp Clin Trials* 2022;120:106889.
- [23] Melisse B, van den Berg E, de Beurs E. Effectiveness of web-based guided self-help cognitive behavioral therapy-enhanced for binge-eating disorder: An implementation study. *Int J Eating Dis* 2024;57:1379–89.
- [24] Chourasiya L, Lillohre UK, Pandey AK, et al. Enhancing healthcare classification with hybrid multimedia data processing and deep learning TNBO FCNN approach in IoT-enabled environments. *Sci Rep.* 2025;16:3286.
- [25] Purba C, Sinaga I, Rawung S, et al. Nurses' perceived knowledge, self-confidence, and attitudes in using telemedicine: A case study from West Indonesia. *Enferm Clin* 2023;33:S12–6.
- [26] Dai L, Xu H, Zhang Y. Automated classification of clinical diagnoses in electronic health records using transformer. *PLoS One* 2025;20:e0329963.

Table 1. Frequency distribution of respondents based on age.

No.	Age	Frequency (n)	Percentage (%)
1	18-40 years old	5	13,5
2	41-60 years old	15	40,5
3	> 60 years old	17	45,9
	Amount	37	100

Table 2. Frequency distribution of respondents based on gender.

No.	Gender	Frequency (n)	Percentage (%)
1	Male	20	54,1
2	Female	17	45,9
	Amount	37	100

Table 3. Frequency distribution of respondents based on length of illness.

No.	been sick for a long time	Frequency (n)	Percentage (%)
1	2 month (early stage)	24	64,9
2	4-12 month (advanced stage)	13	35,1
	Amount	37	100

Table 4. Frequency distribution of respondents based on education level.

No.	level of education	Frequency (n)	Percentage (%)
1	Elementary school	2	5,4
2	Junior High School	7	18,9
3	Senior High School	25	67,6
4	College/bachelor's	3	8,1
	Amount	37	100

Table 5. Frequency distribution of respondents based on occupation.

No.	Work	Frequency (n)	Percentage (%)
1	Doesn't work	6	16,2

2	Government employees/Civil servants	5	13,5
3	Self-Employed	23	62,2
4	Retired	3	8,1
Amount		37	100

Table 6. Distribution Frequency on their behavior in preventing pulmonary TB transmission before and after the E-learning health management education intervention.

E-Learning Health Management Education Intervention	Preventive Behavior			
	Behave Positively (n)	Percentage (%)	Negative Behavior (n)	Percentage (%)
<i>PRE-TEST</i>	15	40,5	22	59,5
<i>POST-TEST</i>	27	73,0	10	27,0
Amount	37	100	37	100
T-Test Results	< 0,001			

Contributions: Eppy Setiyowati, Erika Martining Wardani, Asmaul Lutfauziah, concepts, definition of intellectual content, experimental studies, manuscript preparation; Eppy Setiyowati, Erika Martining Wardani, design, data analysis; Eppy Setiyowati, literature search; Erika Martining Wardani, Asmaul Lutfauziah, clinical studies; Eppy Setiyowati, Asmaul Lutfauziah, data acquisition; Erika Martining Wardani, manuscript editing; Asmaul Lutfauziah, manuscript review.

Funding: funding of the study from Rector Universitas Nahdlatul Ulama Surabaya with number letter 819.39/UNUSA-LPPM/Adm.E/V/2025

Conflict of interest: the author declare no conflict of interest

Ethics approval: the Ethics Committee of Universitas Nahdlatul Ulama Surabaya approved this study No. 0503/EC/KEPK/UNUSA/2025 The study is conformed with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

Informed consent: all patients participating in this study signed a written informed consent form for participating in this study.

Patient consent for publication: written informed consent was obtained from a legally authorized representative(s) for anonymized patient information to be published in this article.

Availability of data and materials: all data generated or analyzed during this study are included in this published article.

Acknowledgments: the authirs thank the head of the Rector Universitas Nahdlatul Ulama Surabaya with number letter 819.39/UNUSA-LPPM/Adm.E/V/2025 and UPTD Wonokromo Surabaya Health Center for allowing, overseeing, and guiding this research until it was finished.