TEXTO & CONTEXTO ENFERMAGEM
TEXT & CONTEXT NURSING TEXTO & CONTEXTO ENFERMERÍA

EVALUATION OF THE USE OF THE TB-ONLINE MOBILE APP BY PRIMARY HEALTH CARE NURSES

Sibele Naiara Ferreira Germano[1]
Alacoque Lorenzini Erdmann[1]

[1]Universidade Federal de Santa Catarina. Programa de Pós-Graduação em Gestão do Cuidado em Enfermagem. Florianópolis, Santa Catarina, Brasil.

ABSTRACT

Objective: to evaluate the clinical acceptability of the TB-Online mobile application in the care of individuals with drug-resistant tuberculosis by primary health care nurses.
Method: this methodological study of technology evaluation was conducted in Manaus, the capital of the state of Amazonas, Brazil. Data collection occurred in person with 20 primary care nurses from August to September 2023. It utilized the Technology Acceptance Model, which comprises 15 items related to the constructs of perceived ease of use, perceived usefulness, attitude toward use, intention to use, and actual system usage. The items were evaluated using a Likert scale. The responses were statistically analyzed using the Agreement Index among evaluators.
Results: the majority of the participants in the technology evaluation were female (80%). Among these, 16 were clinical nurses and 4 were managerial nurses, all managing individuals with drug-resistant tuberculosis. All items achieved 100% agreement (CI=1.0) on the ease of use and usefulness of the TB-Online mobile application.
Conclusion: the use of the TB-Online mobile application for caring for individuals with drug-resistant tuberculosis was satisfactorily evaluated, demonstrating 100% clinical acceptability by primary health care nurses. These results suggest that professionals will likely continue using this technology as a tool for ongoing education, thereby increasing their knowledge and enabling comprehensive and continuous care.

DESCRIPTORS: Mobile Applications. Nursing Informatics. Information Technology. Biomedical Technology Assessment. Health Impact Assessment. Tuberculosis Multidrug-Resistant. Primary Health Care.

HOW CITED: Germano SNF, Erdmann AL. Evaluation of the use of the tb-online mobile app by primary health care nurses. Texto Contexto Enferm [Internet]. 2025 [cited YEAR MONTH DAY];34:e20230295. Available from: https://doi.org/10.1590/1980-265X-TCE-2023-0295en

AVALIAÇÃO DO USO DO APLICATIVO MÓVEL TB-ONLINE POR ENFERMEIROS DA ATENÇÃO PRIMÁRIA À SAÚDE

RESUMO

Objetivo: avaliar a aceitabilidade clínica do aplicativo móvel TB-online no cuidado a pessoas com tuberculose drogarresistente, por parte de enfermeiros da atenção primária à saúde.
Método: este é um estudo metodológico de avaliação de tecnologia, realizado no município de Manaus, capital do estado do Amazonas. A coleta de dados foi presencial no campo prático com 20 enfermeiros da atenção primária, no período de agosto a setembro de 2023, por meio do instrumento Modelo de Aceitação de Tecnologia, que contém 15 itens referentes aos construtos: facilidade de uso percebida, utilidade percebida, atitude em relação ao uso, intenção de uso e uso real do sistema, utilizando-se a escala Likert. Aplicou-se a análise estatística das respostas pelo Índice de Concordância entre os avaliadores.
Resultados: os participantes da avaliação da tecnologia eram, em sua maioria, do sexo feminino (80%). Dentre estes, 16 eram enfermeiros assistenciais e 4, enfermeiros gestores que lidavam com pessoas com tuberculose drogarresistente. Todos os itens alcançaram 100% de concordância (IC=1,0) quanto à facilidade e utilidade do uso do aplicativo móvel TB-Online.
Conclusão: o uso do aplicativo móvel TB-Online para cuidados a pessoas com tuberculose drogarresistente foi avaliado satisfatoriamente, demonstrando 100% de aceitabilidade clínica por parte dos enfermeiros da atenção primária. Esses resultados evidenciam a perspectiva de que os profissionais continuarão utilizando a tecnologia como uma ferramenta de educação permanente, gerando impacto no aumento do conhecimento desses profissionais para um cuidado integral e contínuo.

DESCRITORES: Aplicativos Móveis. Informática em Enfermagem. Tecnologia da Informação. Avaliação da Tecnologia Biomédica. Avaliação do Impacto na Saúde. Tuberculose Resistente a Múltiplos Medicamentos. Atenção Primária à Saúde.

EVALUACIÓN DEL USO DE LA APLICACIÓN MÓVIL TB-ONLINE POR ENFERMEROS DE ATENCIÓN PRIMARIA DE SALUD

RESUMÉN

Objetivo: evaluar la aceptabilidad clínica de la aplicación móvil TB-online en el cuidado de personas con tuberculosis resistente a medicamentos, por parte de enfermeros de atención primaria de salud.
Método: este es un estudio metodológico de evaluación de tecnología, realizado en el municipio de Manaus, capital del estado de Amazonas. La recolección de datos fue presencial en el campo práctico con 20 enfermeros de atención primaria, en el período de agosto a septiembre de 2023, mediante el instrumento Modelo de Aceptación de Tecnología, que contiene 15 ítems referentes a los constructos: facilidad de uso percibida, utilidad percibida, actitud respecto al uso, intención de uso y uso real del sistema, utilizando la escala Likert. Se aplicó el análisis estadístico de las respuestas por el Índice de Concordancia entre los evaluadores.
Resultados: los participantes en la evaluación de la tecnología eran, en su mayoría, mujeres (80%). De estos, 16 eran enfermeros asistenciales y 4, enfermeros gestores que trataban con personas con tuberculosis resistente a medicamentos. Todos los ítems alcanzaron el 100% de concordancia (IC=1.0) en cuanto a la facilidad y utilidad del uso de la aplicación móvil TB-Online.
Conclusión: el uso de la aplicación móvil TB-Online para el cuidado de personas con tuberculosis resistente a medicamentos fue evaluado satisfactoriamente, demostrando un 100% de aceptabilidad clínica por parte de los enfermeros de atención primaria. Estos resultados destacan la perspectiva de que los profesionales continuarán utilizando la tecnología como una herramienta de educación permanente, generando un impacto en el aumento del conocimiento de estos profesionales para un cuidado integral y continuo.

DESCRIPTORES: Aplicaciones Móviles. Informática Aplicada a la Enfermería. Tecnología de la Información. Evaluación de la Tecnología Biomédica. Evaluación del Impacto en la Salud. Tuberculosis Resistente a Múltiples Medicamentos. Atención Primaria de Salud.

INTRODUCTION

Cases of people with tuberculosis (TB) and its severe drug-resistant form, Drug-Resistant TB (DR-TB), are increasing worldwide. The World Health Organization (WHO) estimates that 10.6 million people became ill with TB in 2021, presenting 450,000 new cases of DR-TB[1]. The Brazilian Ministry of Health reported in 2023 that the TB incidence rate in 2022 was 36.3 cases per 100 thousand inhabitants, warning of the need to implement strategies to combat this serious public health problem[2–3].

Technological tools to support clinical decision-making used in Permanent Health Education (PHE) stand out among the essential strategies in combating this disease, as they guide care practices. These technologies are recommended by the WHO to help eliminate TB as a public health problem. They are used in the continued guidance of health professionals to improve clinical decision-making and the quality of care for people with the disease[3–4].

The evolution of mobile internet access devices such as smartphones, ultrabooks, laptops and tablets demonstrates that the mobile application for smartphones is one step ahead of other technologies used in the educational process. This results from the adaptation of educational content to this portable device and its increasing evolution, increasingly offering opportunities for new educational models to break from conventional teaching methods[4].

Mobile applications for smartphones are currently recognized as an accessible innovation which can provide high-quality health services to sick people through qualified care based on up-to-date scientific knowledge[5]. Therefore, the use of this technology becomes essential for the PHE of nursing professionals, who are recognized by the WHO as essential in the fight to end TB and DR-TB. It is recognized that they face several challenges to be overcome in a typical day of work in Primary Health Care (PHC), dealing with different health situations[3,6].

Mobile devices can be applied in different ways in this scenario, such as in remote monitoring of people with TB and DR-TB in the territory, diagnostic support and assistance in decision-making during nursing consultations. It is an auxiliary tool in the practice of these professionals, especially due to the absence of time and space barriers for its use, and can even be used during home visits[6–7].

However, in order to achieve this, the applications installed on these devices must be based on scientific knowledge and be created dynamically, easily accessible and associated with the reality of the professional's practical context. Furthermore, they must have updated scientific content, informative alerts, direct contact with the team for discussions, care flows and guidance for sick people and their families[4,6].

Thus, the TB-Online mobile application was developed to meet all of these requirements with the participation of PHC nurses as an PHE technology to support decision-making in care practices for people with DR-TB. The application's content was validated by a committee of experts on the topic after adjustments were made as per their request. It was registered at the National Institute of Industrial Property (INPI) with process number BR512023002396-5. However, it is necessary to evaluate the software use in practice to ensure that it meets the necessary quality requirements. It is essential to ensure that it meets its objective, offering agility in carrying out processes and bringing acceptability and a positive impact on use[8–9].

This study is justified considering this need to evaluate the use and impact of the mobile application in clinical practice, which aimed to evaluate the clinical acceptability of the TB-Online mobile application on care for people with drug-resistant tuberculosis among PHC nurses.

METHOD

This is a methodological study[10] regarding a technology assessment with a quantitative approach based on the Technology Acceptance Model (TAM)[11]. It focuses on usability, as well as satisfaction, usefulness and ease of use, as suggested by the Brazilian standard ABNT ISO/IEC 25062:2011.[12] This type of study deals with the development, validation and evaluation of tools, focusing on the development of new instruments[10].

The software evaluated in this study is a mobile application for PHE of PHC nurses on DR-TB, which was named TB-Online. It was developed after applying action research[13] and a literature review. It was validated by experts on the subject to perform the current stage of evaluating use in the practical context of technology users[14].

The data collection location was the municipality of Manaus, capital of the state of Amazonas in Brazil, with an area of 11,401.092 km², equivalent to 0.7312% of the state's territory, and an estimated population of 2,130,264 inhabitants, with a population density of 158.06 inhabitants per km²[15]. Manaus has its Health Care Network (*Rede de Atenção à Saúde - RAS*) organized into five Health Districts (*Distritos de Saúde - DISA*): North, South, East, West and Rural. When checking the proportion of DR-TB by territory, *DISA*-Sul currently ranks first in cases of the disease, making it the ideal district for evaluating the TB-Online application[16].

The selection of the study population was based on intentional sampling by applying inclusion and exclusion criteria to enable the researcher to select the participants for this study[17]. The inclusion criteria included: being a PHC nurse, holding a care and/or management position for at least 6 months of contract or being a member of the institution's staff, dealing with people with DR-TB at *DISA*-Sul. Nurses who were on leave for any reason during the data collection period were excluded.

Data collection took place in person in the practical field of PHC nurses, from July to September 2023, after approval of the Research Project by the Research Ethics Committee of the Federal University of Santa Catarina. The number of participants followed what is recommended in the literature for an intentional sample of at least 20 people[17].

The questionnaire applied to evaluate usability which measures effectiveness, efficiency and satisfaction in the use of technology was the TAM, with 15 items referring to the following constructs: perceived ease of use, perceived usefulness, attitude towards using, intention to use and actual use of the system[11].

The scoring levels and criteria for judgment used a Likert scale with four levels of agreement: 1 - Completely agree, 2 - Agree, 3 - Partially agree, and 4 - Disagree, to analyze the perceptions of the responding nurses regarding the use of the TB-Online application for PHE in the care of people with DR-TB in PHC. For options 3 and 4, respondents could describe why they considered these items and make suggestions for improving the technology. Acronyms and numbers were used when identifying suggestions to maintain the anonymity of participants.

After evaluating the professionals, the questionnaires were collected and statistical analysis of the responses was applied using the Concordance Index (CI). With this procedure, we sought to evaluate the proportion of participants who agreed on a certain aspect of the TB-Online application. The CI calculation consists of calculating the number of times the evaluators agree and dividing by the total number of evaluations (varies between 0 and 100%). The technology is considered adequate when a minimum of 80% agreement is reached between participants[18–19].

Calculation of the CI:

$$CI = \frac{\textit{Number of responses "completely agree" or "agree"}}{\textit{Total number of evaluations}}$$

The response data from the evaluation of each of the questionnaire items were organized in an Excel® Electronic Spreadsheet to present the results through tables and descriptively. The results also considered the opinions and comments of the participants, generating discussion and support of effectiveness, efficiency and satisfaction in the use of the TB-online application by PHC nurses regarding care for people with DR-TB. The Concordance Index (CI) presented was 100%, with a confidence interval of 95% and a sampling error of 25% (the highest acceptable) for the number of participants[18–19].

RESULTS

The TB-Online software is a technology in the format of a mobile application, which presents nine icons on the main screen (information access items): TB+DR, Diagnosis, Treatment, Patient Flow, Guidelines for Patients and Families, News, Contacts, Bibliographic References and Creators. When accessed, these items open subscreens with subitems, keeping nursing professionals updated in real time in their work environment, according to their PHE needs, as can be seen in (Figure 1).

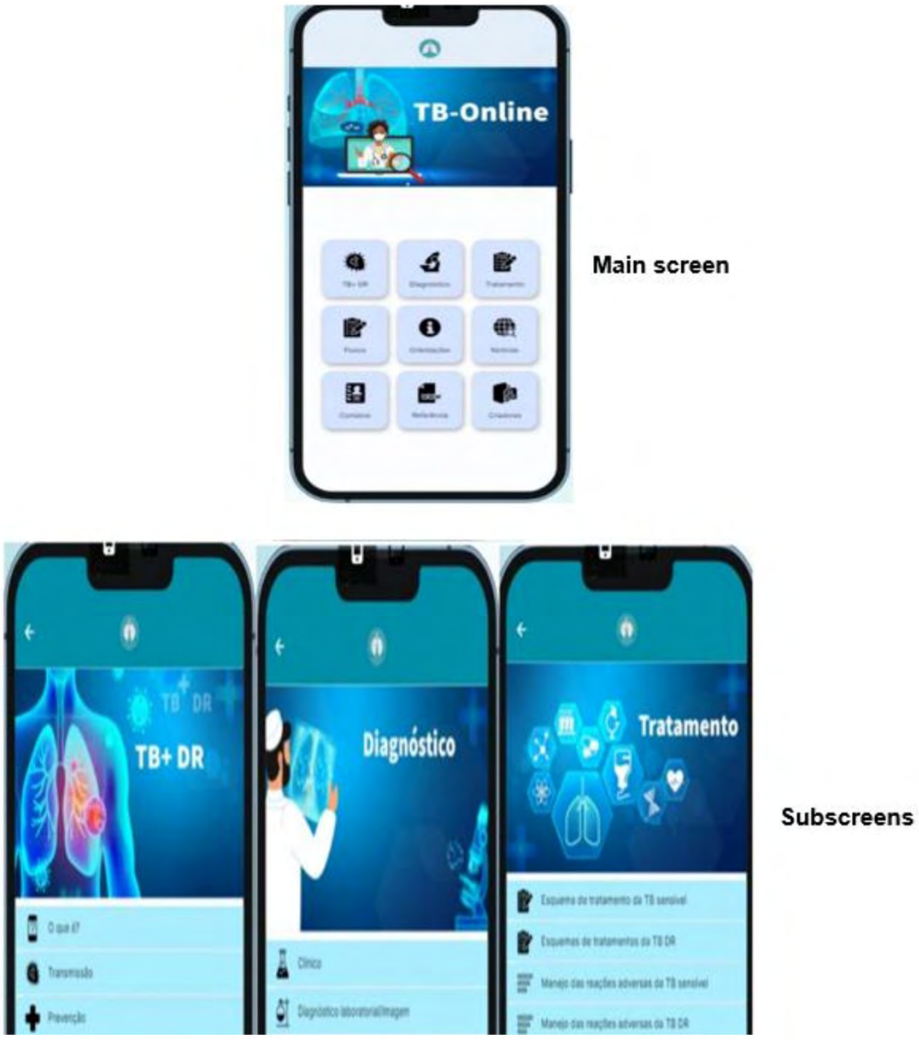

Figure 1 – Main screen of the TB-Online mobile application and some open TB+DR, diagnosis and treatment subscreens.

The TB-Online application can be accessed in any browser and on any operating system, such as Android and iOS. It was made available via the AppMachine platform and can be accessed via the link: https://8305ef.myinstant.app/. Access is free for all nursing professionals participating in the application evaluation. These professionals received the access link via WhatsApp and participated in prior training through the Google Meet platform to learn how to access all of the application's features in order to evaluate its use in the work context.

The nurses participating in the technology evaluation were mostly female (80%), with 16 being clinical nurses and 4 managers, all dealing with people with DR-TB in the PHC territory. The majority of participants (60%) were specialists in family and community health; 20% had publications in the thematic area. The age of the participants ranged between 25 and 56 years, and the time working in the area ranged from 3 to 36 years. Moreover, nine nurses used Android and six used iOS for the operating system.

When evaluating the instrument items, they all surpassed the minimum approval criteria (CI ≥ 80%), reaching 100% agreement (CI=1.0) regarding the ease and usefulness of using the TB-Online mobile application (Table 1).

Table 1 – Evaluation of the use of the TB-Online mobile application in the practical context of primary health care nurses. Florianópolis, SC, Brazil, 2023. (n=20).

Constructs	Items	Concordance		CI*
		Yes n(%)	No n(%)	
Perceived ease of use	1. PHE† DR-TB Education technology is easy to use in your work context.	100	0	1.0
	2. Learning to use technology was easy for you.	100	0	1.0
	3. It is easy to become skilled in using PHE technology for DR-TB.	100	0	1.0
Perceived usefulness	4. Using PHE technology for DR-TB improves the quality of your work with people affected by the disease.	100	0	1.0
	5. Using PHE technology for DR-TB increases your productivity at work.	100	0	1.0
	6. Using PHE technology for DR-TB is important for carrying out nursing care for people with the disease.	100	0	1.0
Attitude towards using	7. Carrying out your activities using PHE technology for DR-TB is an innovative idea.	100	0	1.0
	8. You consider PHE technology for DR-TB a positive, efficient and effective information tool.	100	0	1.0
	9. PHE technology for DR-TB is compatible with other information systems that you use in your daily life.	100	0	1.0

Table 1 – Cont.

Constructs	Items	Concordance		CI*
		Yes n(%)	No n(%)	
Intention to use	10. You intend to make the most of the information contained in the PHE technology for DR-TB and become a professional who is knowledgeable about its content.	100	0	1.0
	11. Even when there are other information options, PHE technology for DR-TB will always be your information option when working as a nurse facing a person with the disease.	100	0	1.0
	12. You always seek to resolve doubts with PHE technology for DR-TB when they arise.	100	0	1.0
Actual use of the system	13. You update your knowledge with PHE technology for DR-TB in the work context whenever you care for a person with the disease.	100	0	1.0
	14. You always use PHE technology for DR-TB in the scope of work when talking about the disease.	100	0	1.0
	15. You use some information from PHE technology for DR-TB to fill out the patient's medical record.	100	0	1.0

Legend: CI* = Concordance Index; PHE† = Permanent Health Education; DR-TB‡ = Drug-Resistant Tuberculosis.

PHC nurses highlighted the ease of use, design and layout of the material, which made it easy to read and understand the information, such as: *the illustrations are very beautiful and not only contribute to beautify the material, but also to highlight the important aspects of the content* (M.E.2). *Congratulations on the application. It is a great achievement for us nurses, very attractive and motivating. It makes you want to use it* (S.E.1). *Congratulations on the application. I liked it so much that I already said at a meeting of ours with the STI coordination team that they could make one like this to care for people and pregnant women with syphilis. It would greatly facilitate our access to updated content* (A.E.3).

The professionals also highlighted the content, organization, flows and contacts in real time to answer questions with coordination and direct access to websites of the health department and the Ministry of Health on TB: *The use of topics and flowcharts makes for easier understanding, generating dynamism in what is presented* (E.E.5). *In addition to providing all the current information according to the literature, the application also allows us direct access to clarify doubts via WhatsApp from the coordinators and direct access websites for updates, which promotes, in addition to understanding the topic in an up-to-date way, the possibility of clarify doubts when faced with something new or that we have doubts about* (A.E.4).

All nurses (100%) reported a positive impact on the use of the TB-Online mobile application, highlighting that it contributes to increasing up-to-date knowledge on the subject, provides quality systematic care, guarantees the correct treatment schedule and appropriate follow-up, avoiding complications and greater resistance. All participants (100%) also stated that the application is very complete, as it covers everything from the correct management of TB to prevent DR-TB to all the necessary guidance in guiding sick people to becoming cured. Furthermore, they emphasize welcoming and important guidance not only for patients, but also for their families.

DISCUSSION

The evaluation of the TB-Online mobile application achieved excellent acceptance in the practical field of PHC nurses, indicating that it is suitable for the objectives for which it was proposed. There are current studies on the evaluation of mobile applications for TB by the target audience in the literature. The use of different instruments to assess the quality and impact that the use of this tool brings in assisting people with the disease is reported, demonstrating that they are acceptable, satisfactory and easy to use[3,5,20–24].

While there is a vast current literature on mobile applications for TB, there is a paucity of studies focused on the severe form of the disease, DR-TB. In the context of PHE, it is clear that there is still little use of technologies as educational tools, especially in the daily lives of nurses. This result may reflect the resistance of some nurses regarding its use in clinical practice, as was seen in the questionnaires of a survey carried out on permanent education in nursing mediated by educational technologies in the care of people with oncological wounds[6].

However, some studies highlight that the development of a technology driven by action research with literature review brings greater acceptability in its use in clinical practice by professional nurses. It is considered that this way of conducting research provides opportunities for study, discussion, exchange of experiences and knowledge between professionals and the researcher, strengthening understanding on the importance of using technology as tools to support clinical decision-making through PHE, anchored in theoretical and methodological references and focused on the needs of each local reality[25–26].

Therefore, the use of action research is perhaps the main factor associated with the excellent acceptance in using the TB-Online application in the clinical practice of nursing professionals. All items were evaluated above the minimum approval criteria (CI≥80%), with 100% agreement (CI=1.0) regarding ease and usefulness of use, highlighting the positive impact on increasing knowledge for care for people with DR-TB in PHC.

When carrying out a non-systematized search in databases that index articles published in national and international journals, it was not possible to identify studies that had applied the TAM instrument to evaluate mobile PHE technologies on DR-TB or TB. However, with regard to verifying the acceptance of digital technologies in the context of teaching, the TAM model appears as the dominant one in the literature to investigate the antecedents which affect users' decision to accept this[8,27–28]. This instrument stood out as the most suitable for evaluating the TB-Online mobile application as an educational tool for PHE.

In the systemic evaluation of the use of the TB-Online application by TAM, it was possible to verify the following variables: perceived ease of use, perceived usefulness, attitude towards use, intention to use and actual use of the system. This evaluation demonstrated that the attitude variable influences the intention to use the technology, which is positively affected by the perceived usefulness and ease of use. Intention to use was determined by both attitude and perceived usefulness, which in

turn positively affected actual use of the system. Furthermore, ease of use also influenced usefulness and actual usage. Thus, it is observed that the technology achieved its PHE objective in the practical context of the professionals involved.

In the context of TAM, attitude represents the user's desire to use the system, and can significantly influence the intention to use certain technologies, although it is affected by the perceived usefulness and ease of use. One study highlighted that perceived ease may not have a direct effect on attitude, but it has a significant impact on perceived usefulness, suggesting that technology can be considered useful due to its ease of use, as the attitude towards using it will depend on how useful it is considered. This result reinforces that the adoption of a technology is not only because of its ease of use, but because of how much it can add a positive result to professional practice[8].

National and international studies reveal that a usability assessment measures effectiveness, efficiency and satisfaction, being able to detect difficulties in use and contribute to improving the user experience[3–5,8,29]. A national study with nurses from several states in Brazil evaluated the use of the Neonatal Skin Safe mobile application using the Product Quality Model, which identifies quality characteristics, including "quality in use", with requirements such as effectiveness, efficiency, satisfaction, freedom from risk and context coverage, demonstrating that the application met the needs of nurses in the care and prevention of skin injuries in newborns[4].

Another national study with 100 health professionals used the Computer System Usability Questionnaire (CSUQ) to assess satisfaction with the use of the TB+ application, also applying the Likert scale to verify the answers "completely agree" and "completely disagree". It was evident that ease influenced usefulness and satisfaction in use, considering the technology efficient and effective[3].

An international study carried out in Indonesia used a Systems Usability Scale (SUS) questionnaire with professionals to evaluate the usability of SIKRIBO, a TB screening application. The result indicated that the application was highly usable, and perceived ease of use strongly influenced usefulness. A similar result occurred in another methodological study that evaluated the acceptability, feasibility and impact of the miLINC mobile health application aimed at reducing the time from diagnosis to initiating treatment for people with DR-TB, demonstrating satisfactory results when combining mobile technology with appropriate human resources[30].

The use of TAM in a study carried out in the state of Rio de Janeiro to evaluate the use of WhatsApp by university professors as a tool for the teaching and learning process using the Likert scale also presented satisfactory results. It was identified that the compatibility construct had great influence on the perceived ease of use and usefulness, as well as on the attitude towards use. This in turn strongly influenced the intention to use WhatsApp, which was considered accepted by teachers in the teaching-learning process[8].

It is well known that the learning process using mobile devices is instantaneous, occurs interactively and presents itself as a potential source of transformation in the methods of offering PHE. It becomes more accepted when developed in the professional's practical context, with their participation in a knowledge and experience exchanging process, meeting their educational needs[31].

From this perspective, the TB-Online mobile application emerged developed for PHE, becoming useful in the clinical decision support process. It contains complete information on how to deal with a person with DR-TB, including correct management of TB, timely diagnosis, treatment scheme depending on resistance, management when dealing with adverse reactions, flows of suspected people with the disease, guidelines for patients and their families, contacts for discussing questions and bibliographical references. The application therefore provides an expansion of professional knowledge based on scientific evidence.

With its vast content, the application can encourage nurses' critical sense, impact on increasing knowledge on the subject, direct actions, support care, and reduce the risks of drug resistance through correct and systematic healthcare, promoting comprehensive care for people with DR-TB in PHC until the disease is cured.

This study has limitations related to the scarcity of mobile applications for PHE that cover care for people with DR-TB in PHC, which prevents comparisons with other models for possible inferences. Furthermore, the evaluation of the application was limited to nurses, which could reduce the quality of suggestions for improvement, as it did not include the perspective of other professionals in the practical context. The inclusion of these professionals could bring different perspectives for improvement and use.

It is worth mentioning that this is the first PHE mobile application built by and for PHC nurses, validated by a committee of experts on the subject, recognized as an unprecedented and innovative technology, registered with the National Institute of Industrial Property (INPI) under the number process BR512023002396-5. Its use in the practical field of professionals was satisfactorily evaluated, serving as an updated tool for PHE and clinical decision support in the care of people with DR-TB. This study could also serve as a model for evaluating other developed mobile applications.

CONCLUSION

The use of the TB-Online mobile application in caring for people with DR-TB was satisfactorily evaluated, demonstrating 100% clinical acceptability by PHC nurses. Through its constructs of perceived ease of use, perceived usefulness, attitude towards use, intention to use and actual use of the system, the TAM revealed that professionals tend to continue using this technology as an PHE tool based on scientific knowledge updated in real time, which has a significant impact on increasing the knowledge of these professionals for comprehensive and continuous care.

The use of this application breaks time and spatial barriers and can be used at any time during care, both in offices and during home visits by PHC nurses. This application can be applied and evaluated beyond the local context in which this study was developed, presenting potential for adaptations and verification of barriers for use in other similar contexts. The instrument used to evaluate technology enabled achieving the proposed objective, pointing out the relevance of its use in future research to evaluate educational technologies.

REFERENCES

1. World Health Organization – WHO. Global Tuberculosis Report 2022 [Internet]. 2022 [cited 2022 Dec 12]. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022
2. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde e Ambiente. Boletim Epidemiológico Tuberculose 2023 [Internet]. 2023 [cited 2023 Aug 12]. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/boletins/epidemiologicos/especiais/2023/boletim-epidemiologico-de-tuberculose-numero-especial-mar.2023/view
3. Reis M, Bernardi F, Lima V, Alves D. Development of a Mobile Application with Health Guidelines for TB Patients Care. Stud Health Technol Inform [Internet]. 2021 [cited 2023 Aug 12];305:373-6. Available from: https://doi.org/10.3233/SHTI230509

4. Santos SV, Ramos FRS, Costa R, Batalha LMC. Assessment of the quality of a software application for the prevention of skin lesions in newborns. Rev Latino-Am Enferm [Internet]. 2020 [cited 2023 Aug 12];28:e335. Available from: https://doi.org/10.1590/1518-8345.3711.3352

5. Rahayu SR, Zainafree I, Merzistya ANA, Cahyati WH, Farida E, Wandastuti AD, et al. Development of the SIKRIBO Mobile Health Application for Active Tuberculosis Case Detection in Semarang, Indonesia. Health Inform Res [Internet]. 2022 [cited 2023 Aug 22];28(4):297-306. Available from: https://doi.org/10.4258/hir.2022.28.4.297

6. Vicente C, Amante LN, Santos MJ, Alvarez AG, Salum NC. Care for the person with oncological wound: Permanent education in nursing mediated by educational technologies. Rev Gaúcha Enferm [Internet]. 2019 [cited 2023 Sep 2];40:e20180483. Available from: https://doi.org/10.1590/1983-1447.2019.20180483

7. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Doenças de Condições Crônicas e Infecções Sexualmente Transmissíveis Tuberculose na atenção primária: protocolo de enfermagem [Internet]. 2022 [cited 2023 Jul 28]. Available from: https://www.gov.br/saude/pt-br/centrais-de-conteudo/publicacoes/svsa/tuberculose/tuberculose-na-atencao-primaria-a-saude-protocolo-de-enfermagem.pdf

8. Santos LC, Freitas AS, Ferreira JB. WhatsApp como ferramenta de ensino e aprendizagem por professores do ensino superior: uma avaliação utilizando o modelo de aceitação de tecnologia TAM. RECADM [Internet]. 2020 [cited 2023 Jul 28];19(2):257-79. Available from: https://doi.org/10.21529/RECADM.2020011

9. World Health Organization – WHO. Monitoring and evaluating digital health interventions: A practical guide to conducting research and assessment [Internet]. 2016 [cited 2023 Jul 28]. Available from: https://apps.who.int/iris/bitstream/hand le/10665/252183/9789241511766-eng.pdf

10. Polit DF, Beck CT. Fundamentos de Pesquisa em Enfermagem: Avaliação de Evidências para a Prática da Enfermagem. 7th ed. Porto Alegre, RS(BR): Artmed; 2011.

11. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly [Internet]. 1989 [cited 2023 Jul 28];13(3):319-339.

12. International Organization for Standardization – ISO/ IEC 25010. System and Software engineering - System and software Quality Requirements and Evaluation (SQuaRE) - System and software quality models. [Internet]. 2011 [cited 2024 Apr 09]. Available from: https:// www.iso.org/standard/35733.html

13. Thiollent M. Metodologia da pesquisa-ação. 18th ed. São Paulo: Cortez; 2011.

14. Lacerda MR, Ribeiro RP, Costenaro RGS. Metodologias da pesquisa para a enfermagem e saúde: da teoria à prática. Porto Alegre, RS(BR): Moriá; 2018.

15. Instituto Brasileiro de Geografia e Estatística – IBGE. Cidades e Estados - Manaus. Estimativa 2017 [Internet]. 2017 [cited 2021 Mar 4]. Available from: https://www.ibge.gov.br/cidades-e-estados/am/manaus.html

16. Prefeitura Municipal de Manaus. Secretaria Municipal de Saúde. Plano Municipal de Saúde 2018-2021 [Internet]. 2018 [cited 2021 Mar 2]. Available from: https://semsa.manaus.am.gov.br/wp-content/uploads/2019/04/Plano-Municipal-de-Sa%C3%BAde-de-Manaus-2018-2021.pdf

17. Gil AC. Como elaborar projetos de Pesquisa. 5th ed. São Paulo, SP(BR): Atlas; 2010.

18. Pasquali L. Instrumentos psicológicos: manual prático de elaboração. Brasília, DF(BR): LabPAM/IBAPP; 1999.

19. Teixeira E. Desenvolvimento de tecnologias cuidativo-educacionais. Porto Alegre, RS(BR): Moriá; 2020.

20. Wu Z, Lu L, Li Y, Chen J, Zhang Z, Ning C, et al. Effect of mobile health reminders on tuberculosis treatment outcomes in Shanghai, China: A prospective cohort study. Front Public Health [Internet]. 2023 [cited 2023 Sep 10];11:923319. Available from: https://doi.org/10.3389/fpubh.2023.923319

21. Katende KK, Amiyo MR, Nabukeera S, Mugisa I, Kaggwa P, Namatovu S, et al. Design, development, and testing of a voice-text mobile health application to support Tuberculosis medication adherence in Uganda. *PLoS One* [Internet]. 2022 [cited 2023 Sep 10];17(9):e0274112. Available from: https://doi.org/10.1371/journal.pone.0274112

22. Novaes MT, Prado TN, Delcarro JCS, Rissino SD, Crepaldi NY, Sanches TLM, et al. Development and content validation of a mobile application for monitoring latent tuberculosis treatment. J Braz Soc Trop Med [Internet]. 2021 [cited 2023 Sep 10];55:e0465. Available from: https://doi.org/10.1590/0037-8682-0465-2021

23. Li X, Pang X, Zhang F. Evaluation of Mobile Application for the Management of Tuberculosis Patients in Tianjin During 2019-2020. Patient Preference and Adherence [Internet]. 2022 [cited 2023 Sep 10];16:321-329. Available from: https://doi.org/10.2147/PPA.S321289

24. Wijayanti E, Bachtiar A, Achadi A, Rachmawati UA, Sjaaf AC, Eryando T, et al. Mobile application development for improving medication safety in tuberculosis patients: A quase-experimental study protocol. *PLoS One* [Internet]. 2022 [cited 2023 Sep 12];17(9):e0272616. Available from: https://doi.org/10.1371/journal. pone.0272616

25. Zanatta EA, Hanzen IP, Siega CK, Portaluppi DM, Zocche DAA. Pesquisa-ação como método para construção de instrumento de Consulta de Enfermagem à criança. Investigação Qualitativa em Saúde: Avanços e Desafios. New Trends Qual Res [Internet]. 2021 [cited 2023 Sep 5];8:1-8. Available from: https://doi.org/10.36367/ntqr.8.2021.1-8

26. Almeida EIA, Silva E, Araujo MGS, Silva YKC, Silva DCOL. Fighting visceral leishmaniasis using innovative technology: Construction of an educational game based on action research. Res Soc Develop [Internet]. 2023 [cited 2023 Sep 5];12(8):e3312842880. Available from: https://doi.org/10.33448/rsd-v12i8.42880

27. Scherer R, Siddiq F, Tondeur J. The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Compu Educ [Internet]. 2018 [cited 2023 Sep 5];128(Spec):13-35. Available from: https://doi.org/10.1016/j.compedu.2018.09.009

28. Vasconcelos GMC, Silva JCS, Silva LS. Avaliação da aceitação de Tecnologias Educacionais Digitais aplicadas ao ensino-aprendizagem de matemática. RENOTE [Internet]. 2021 [cited 2023 Sep 8];19:118393. Available from: https://doi.org/10.22456/1679-1916.118393

29. Tonel JZ, Vieira ACG, Rodrigues AP, Bolzan GP, Padoin SMM, Paula CC. Video clip for learning the physiology of lactation: Evaluation by the family support network for breastfeeding women. Texto Contexto Enferm [Internet]. 2023 [cited 2023 Sep 8];32:e20230048. Available from: https://doi.org/10.1590/1980-265X-TCE-2023-0048en

30. Farley JE, McKenzie-White J, Bollinge R, Hong H, Lowensen K, Chang LW, Stamper P, et al. Evaluation of miLINC to shorten time to treatment for rifampicinresistant Mycobacterium tuberculosis. Int J Tuberc Lung Dis [Internet]. 2019 [cited 2023 Sep 5];23(9):980-8. Available from: https://doi.org/10.5588/ijtld.18.0503

31. Domingo MG, Garganté AB. Exploring the use of educational technology in primary education: Teachers' perception of mobile technology learning impacts and applications' use in the classroom. Comput Hum Behav [Internet]. 2016 [cited 2023 Sep 5];56:21-8. Available from: https://doi.org/10.1016/j.chb.2015.11.023

NOTES

ORIGIN OF THE ARTICLE

Extracted from the thesis – *Tecnologia para educação permanente dos enfermeiros da atenção primária à saúde sobre tuberculose drogarresistente num distrito de saúde de Manaus, Amazonas*, in a pandemic course, presented to the Postgraduate Program in Nursing Care Management of the Universidade Federal de Santa Catarina, in 2023.

CONTRIBUTION OF AUTHORITY

Study design: Germano SNF, Erdmann AL.
Data collection: Germano SNF
Data analysis and interpretation: Germano SNF, Erdmann AL.
Discussion of results: Germano SNF, Erdmann AL.
Writing and/or critical review of content: Germano SNF, Erdmann AL.
Review and final approval of the final version: Germano SNF, Erdmann AL.

APPROVAL OF ETHICS COMMITTEE IN RESEARCH

Approved by the Ethics Committee in Research with Human Beings of the Universidade Federal de Santa Catarina, opinion no.5,699,395, Certificate of Presentation for Ethical Review 62820022.4.0000.0121.

CONFLICT OF INTEREST

There are no conflicts of interest to declare.

EDITORS

TRANSLATED BY

Christopher James Quinn.

HISTORICAL

Received: September 29, 2024.
Approved: April 25, 2025.

CORRESPONDING AUTHOR

Sibele Naiara Ferreira Germano.
sibelenaiaraferreiragermano@gmail.com