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CHALLENGES OF USING TELEHEALTH IN TRACKING TUBERCULOSIS HIV AIDs PATIENTS: A SYSTEMATIC REVIEW

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ABSTRACT

Lost to follow-up (LTFU) in the treatment process for HIV AIDS patients suffering from Tuberculosis is a serious problem that is a challenge for health services. This condition needs to be managed well so it must be treated immediately because the problem of Tuberculosis will have an impact not only on the sufferer himself but also cause an increase in the spread and transmission to other people. Handling the problems of HIV AIDS with tuberculosis infection needs to be managed well to ensure the implementation of the treatment process, to minimize the risk of dropping out. It is hoped that the use of digital applications in the form of telehealth will be able to have an effective function in controlling and integrating the treatment process being undertaken by HIV AIDS sufferers with tuberculosis infection. This systematic review aims to identify and provide a critical assessment. It is also to find evidence based on published articles, and carry out a synthesis of the articles obtained. This method uses a search process carried out through 5 databases (Ebsco Host, Proquest, Medline, PubMed, Cochrane), articles in English, published in 2014-2024 which were assessed by using JBI (Joanna Briggs Institute) as a guide in synthesizing the results searched and reviewed using PRISMA For Systematic reviews. The results obtained were 10 studies that described the use of digital or telehealth applications to combine adherence and loss to follow-up cases in tuberculosis treatment. The use of telehealth can contribute to overcoming the problem of patients who are lost to follow-up and increasing adherence to HIV AIDS treatment with tuberculosis infection.

Keywords: telehealth, loss to follow-up, HIV AIDS, TB, adherence

ABSTRAK

Lost to follow up (LTFU) pada proses pengobatan pasien HIV AIDS yang mengalami Tuberculosis merupakan masalah serius yang menjadi tantangan bagi pelayanan Kesehatan. Kondisi ini perlu dikelola dengan baik sehingga harus disegera di Atasi karena masalah Tuberculosis akan berdampak tidak hanya pada diri penderita itu sendiri namun juga beresiko menyebabkan terjadinya peningkatan penyebaran dan penularan pada orang lain. Penanganan masalah HIV AIDS dengan infeksi tuberculosis perlu dilakukan pengelolaan dengan baik untuk meningkatkan kepatuhan proses pengobatan yang dijalani, sehingga mampu meminimalisir resiko terjadinya drop out. Pemanfaatan digital application dalam bentuk telehealth diharapkan mampu memiliki fungsi efektif dalam mengontrol maupun memantau proses pengobatan yang sedang dijalani penderita HIV AIDS dengan infeksi tuberculosis. Systematic review ini bertujuan untuk mengidentifikasi, memberikan penilaian secara kritis serta menemukan bukti berdasarkan artikel yang telah dipublikasi dengan serta melakukan sintesa mensintesis artikel yang diperoleh tersebut. Metode ini melalui proses pencarian dilakukan melalui 5 database (Ebsco Host, Proquest, Medline, PubMed, Cochrane), artikel menggunakan bahasa Inggris, diterbitkan pada tahun 2014-2024 yang di appraisal research menggunakan JBI (Joanna Briggs Institute) sebagai pedoman dalam mensintesis hasil pencarian serta di review menggunakan PRISMA For Systematic review. Hasilnya diperoleh 10 penelitian yang menggambarkan penggnaan digital application atau telehealth yang digunakan untuk memantau adherence dan kasus lost to follow up pada pengobatan tuberculosis. Pemanfaatan telehealth mampu memberikan kontribusi dalam penanggulangan masalah lost to follow up pasien dan meningkatkan kepatuhan pada pengobatan HIV AIDS dengan infeksi tuberculosis.

Keywords: telehealth, lost to follow-up, HIV AIDS, Tuberculosis, adherence

INTRODUCTION

Tuberculosis (TB) is an infectious disease that is contagious and closely related to someone who has HIV (Human Immunodeficiency Virus), especially those who are in the AIDS (Acquired Immuno Deficiency Syndrome) phase. The WHO Global Tuberculosis Report 2020 highlighted that 44% of PLHIV with TB globally were undiagnosed in 2019. Therefore, increasing TB detection among people living with HIV is critical. Tuberculosis preventive treatment (TPT) for PLHIV has been shown to reduce TB deaths significantly. Although only 50% of PLHIV who started ART started TPT globally in 2019, expansion and improvement of TPT coverage have begun in many countries. Indonesia ranks second in the world for the number of TB cases with 845,000 TB cases and 19,000 TB-HIV co-infected patients in 2019.

Meanwhile, out of 271 million people, an estimated 543,100 people are living with HIV and an estimated 4,700 TB-HIV patients have died out of around 96,000 deaths with TB (WHO, 2021).

The Indonesian government has made various efforts to make breakthroughs in controlling TB, especially DR TB in HIV-infected patients, which can include various efforts to prevent the spread of tuberculosis, provide effective treatment and support to clients. In fact, the government, through cadres and community health workers (Community Health Nurses), takes a persuasive approach to TB HIV-AIDS sufferers who are undergoing treatment. The things that are done, such as visiting sufferers' homes and controlling the orderly process of taking medicine by sending photos to health workers, are still not effective in ensuring that sufferers are orderly in taking medicine until the end of treatment. Some sufferers think that the TB DR they suffer from has been cured when they feel physically healthier but the long process of treatment has not been completed, coupled with HIV-AIDS which is attached to them. Apart from that, many sufferers also change their domicile, causing loss of follow-up in the treatment process.

The problem of "lost to follow-up" in patients suffering from drug-resistant tuberculosis (DR-TB) and HIV-AIDS is a serious problem in controlling these two diseases. When DR TB patients who are also infected with HIV-AIDS are enrolled in a treatment program, their loss from monitoring can result in serious complications. When DR TB HIV-AIDS patients are lost from monitoring, they may not receive appropriate treatment, including DR TB drugs and antiretroviral therapy (ARV). This can cause a deterioration in their health and increase the risk of death. When this condition is treated or not treated properly it can become a source of transmission of DR TB to other people, including people who are also susceptible to HIV-AIDS. This can trigger the spread of DR TB in the community.

The existence of Medication Monitoring Supervisors (PMO), which in fact is not sufficient for the number of sufferers who must be supervised because the adequate number is around 30%, with most of the PMO being their own families, is a problem that must be resolved immediately (Murtiwi, 2016). So it is necessary to utilize technology and developments in the digital world to accommodate various needs to improve health services, especially overcoming infectious disease problems and controlling compliance in taking medication such as telehealth or other digital applications. Various studies have been conducted showing the efficiency and effectiveness of using telehealth or digital applications. This research is used to synthesize existing research using the systematic review method.

Research Objectives

This systematic review aims to identify, critically assess, and find evidence based on published articles. It is to synthesize the use of telehealth and to improve the efficiency of TB HIV-AIDS patient treatment.

Method

This literature review uses a systematic review method in mapping and identifying gaps or problem gaps in the research area conducted in a study. This systematic review uses PRISMA For Systematic Review as a reference for its preparation. This is done because it can present the results of the systematic review in detail. The steps taken in conducting a systematic review are:

1. Identifying article search results

2. Selecting articles based on title, abstract
3. Full text
4. Conducting critical appraisal based on JBI
5. Combining, summarizing, and presenting results

Result

Study Selection

In this systematic review study, the article search uses the PICO framework (Population, Intervention, Compare, Outcomes). This framework can help to identify aspects that include situations and populations with special conditions and expected results based on the interventions carried out. The following is an explanation of the PICO framework:

Framework	Description
Population/causes	TB HIV-AIDS patients
Intervention	*Digital Application* (*telehealth*)
Comparison	Conventional
Outcomes	LTFU/Adherence Decreased

Inclusion and Exclusion Criteria

The articles obtained were adjusted to the criteria and specified using inclusion and exclusion criteria. The inclusion criteria used were Abstract, Full-text article, Intervention, Quasy experiment, COHORT, RCT, English, Publication Year 2018 - 2024, MDR TB, HIV-AIDS Lost to Follow-Up, and Original Research. The exclusion criteria were Abstract in English but full-text in languages other than English and Indonesian, Research using Qualitative methods, Systematic review - Meta-analysis publication, and Review article.

Search Strategy and Data Source

The first strategy was carried out, namely searching for articles using 5 databases, namely PubMed, Cochrane, Ebscho Host, Proquest, and Medline. Articles identified during the search were based on the title and, abstract then continued to a comprehensive search with the Joanna Briggs Institute (JBI) guidelines, this search was with keywords and booleans *'Lost to follow-up* or *drop out*" and "HIV AIDA or Tuberculosis or TB MDR" and Adherence.

Appraisal of Risk Bias

Independent reviewers were involved to assess bias using the JBI guidelines for cohort, cross-sectional, randomized controlled trials, and quasi-experimental studies (Aromataris, 2023). Reviewers categorized the quality based on Mostafaei et al. (2020). The total score was calculated based on the percentage of “yes” answers to the critical appraisal results using the

JBI: > 80% is classified as high quality, 60%-80% is moderate quality, and < 60% is low quality.

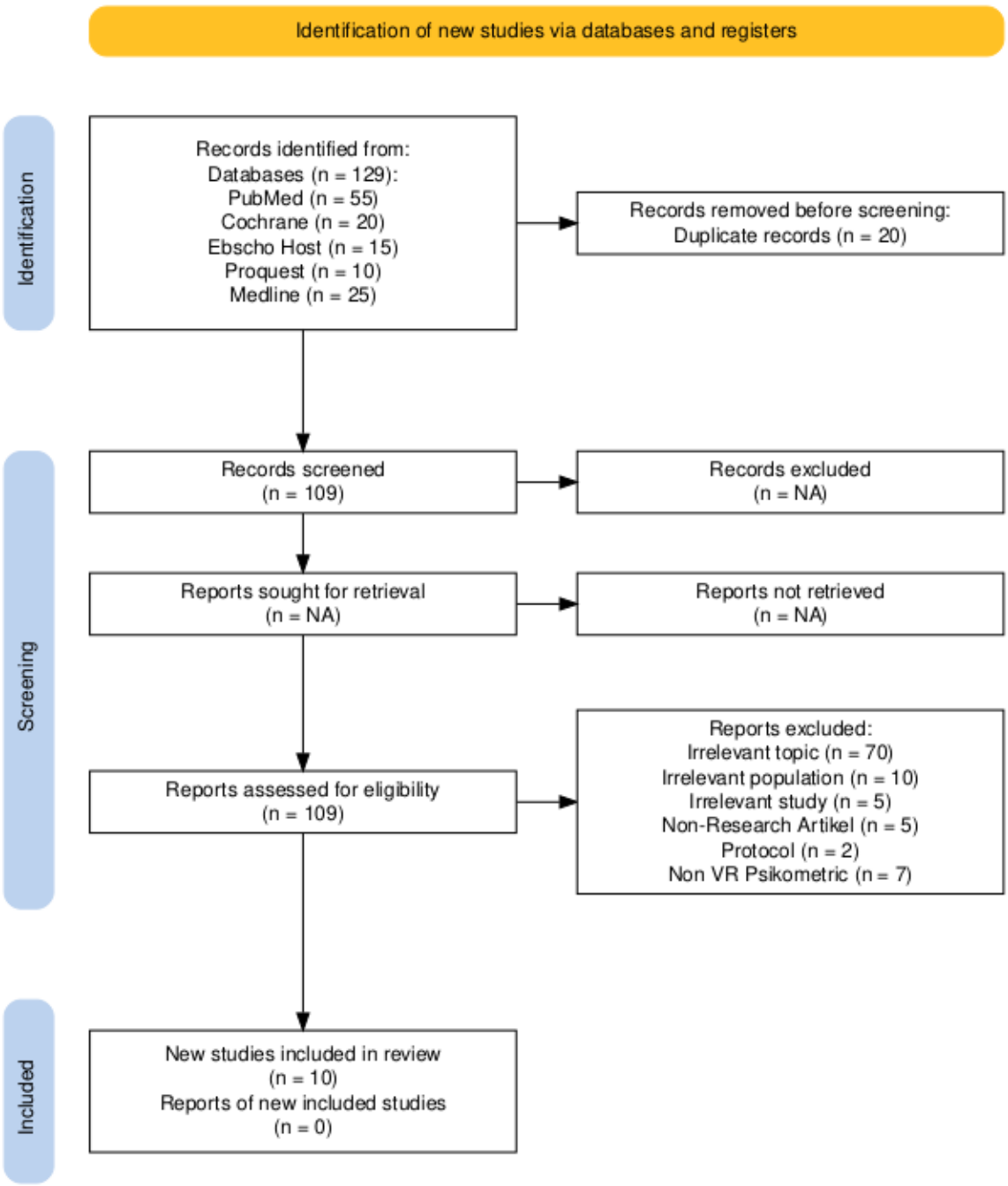

Figure 1: ***Preferred reporting*** **items for systematic review and meta-analyses (PRISMA) flow diagram.**

Table 1 Study Characteristics

No	Database	Authors,	Article title	Journal title	Objectives	Design/ variable/instrument	Sample/location	Results
1	Ebscho Host	(Bateman et al., 2022)	Adherence Measured Using Electronic Dose Monitoring is Associated with Emergent Antiretroviral Resistance and Poor Outcomes in People with Human Immunodeficiency Virus/AIDS and Multidrug-Resistant Tuberculosis	Clinical Infectious Diseases by Oxford University Press of America	To find the threshold of awareness of electronic drug use associated with emerging antiretroviral resistance and treatment outcomes in patients with MDR-TB and HIV receiving bedaquiline-containing treatment regimens.	Prospective Cohort Study	HIV patients with MDR TB in Kenya, South Africa	November 2016–February 2018, 198 people with MDR-TB and HIV were enrolled and followed up (median, 17.2 months; interquartile range, 12.2–19.6). Eleven percent had baseline ART resistance mutations, and 7.5% developed ART-emergent resistance after 6 months. ART adherence was independently associated with ART resistance and mortality. Modeling

								identified a significant linear association (P < .001) between ART adherence and emerging resistance, indicating a robust association with no threshold.
2	Ebscho Host	(Bateman et al., 2022; Kiwanuka et al., 2020)	Determinants of loss to follow-up among HIV-positive patients receiving antiretroviral therapy in a test and treat setting: A Retrospective cohort study in Masaka, Uganda	PLoS ONE 15(4): e0217606.	To identify determinants of LTFU in this context, specifically, factors associated with the risk of LTFU among patients receiving ART in routine health care delivery settings.	Retrospective Cohort Study	HIV patients aged > 18 years who have taken ARVs between 1 January 2012-4 July 2016 Location: Masaka Region, Uganda	Of the 7,553 patients included in the sample, 3,231 (42.8%) initiated ART within seven days of HIV diagnosis. There were 1,180 cases of LTFU observed over 15,807.7 person-years at risk. The overall incidence rate (IR) of LTFU was 7.5 (95% CI, 7.1–7.9) per 100 person-years of observation (PYO). The cumulative incidence of LTFU increased with

	follow-up duration from 8.9% (95% CI, 8.2–9.6%) at 6 months to 20.2% (95% CI, 19.0–21.4%) at 48 months. High-risk predictive factors for LTFU were: initiating ART within 7 days of HIV diagnosis ((aHR) = 1.69, 95% CI, 1.50–1.91), not having a telephone (aHR = 1.52, 95% CI, 1.35–1.71), CD4 cell count 200–350µ/ml (aHR = 1.21, 95% CI, 1.01–1.45) and baseline WHO clinical stage 3 or 4 (aHR = 1.35, 95% CI, 1.10–1.65). Factors associated with reduced risk of LTFU were: baseline age ≥25 years (aHR ranged from 0.62, 95% CI,

								0.47–0.81 for the 25–29 age group to 0.24, 95% CI, 0.13–0.44 for the ≥50 age group), at least primary education (aHR ranged from aHR = 0.77, 95% CI, 0.62–0.94 for primary education to 0.50, 95% CI, 0.34–0.75 for post-secondary education), and having a BMI ≥30 (aHR = 0.28, 95% CI, 0.15–0.51).
3	PubMed	(Manyazewal et al., 2022)	Effectiveness of a digital medication event reminder and monitoring device for patients with tuberculosis (SELFTB): a multicenter randomized controlled trial	BMC Medicine	to determine the effectiveness of the use of digital medication reminder and event monitor (MERM) devices for tuberculosis (TB) patients in	a multicenter randomized controlled trial	Aged ≥ 18 years who have recently or previously been treated, bacteriologically confirmed drug-sensitive TB, and are eligible to start standard 6-month anti-TB treatment.	Participants were enrolled in the study between June 2, 2020, and June 15, 2021, with the last participant completing follow-up on August 15, 2021. A total of 337 patients were screened for eligibility, of whom 114 were

	Ethiopia. MERM is used as an alternative to observed self-administered therapy to improve treatment awareness and TB treatment outcomes. This study aims to determine whether the use of MERM provides non-inferior treatment awareness compared to directly observed therapy (standard in-person DOT)	Location: Ethiopia	randomly assigned and included in the final analysis [57 control and 57 intervention participants]. Participants were 64.9% male, 15% living with HIV, 10.5% retreatment, and 5.3% homeless. TB treatment adherence was comparable between the intervention group [geometric mean (GM%) 99.01%, geometric standard deviation (GSD) 1.02] and the control group [GM% 98.97%, GSD 1.04] and was within the prespecified margin for non-inferiority [ratio of means (MR) 1.00 (95% CI 0.99–1.01); p = 0.954].

					The intervention arm was significantly superior to the control arm in a secondary analysis considering all take-home doses in controls not swallowed [control GM% 77.71 (GSD 1.57), MR 1.27 (95% CI 1.33–1.43)]. Urinary isoniazid testing was performed on 443 (97%) samples from 114 participants; 13 participants had at least one negative result; negative tests were significantly more common in the control group compared with the intervention group [11/57 (19.3%) vs 2/57 (3.5%); p = 0.008]. There were no significant

								differences between the control and intervention arms for smear conversion [55 (98.2%) vs 52 (100%); p > 0.999], adverse treatment outcomes [0 vs 1 (1.9%); p = 0.48], and self-reported nonadherence [5 (8.9%) vs 1 (1.9%); p = 0.008]. p = 0.21].
4	PubMed	(Manyazewal et al., 2020)	Electronic pillbox-enabled self-administered therapy versus standard directly observed therapy for tuberculosis medication adherence and treatment outcomes in Ethiopia (SELFTB): protocol for a multicenter	BMC Medicine	To increase awareness and implementation of TB treatment in Ethiopia, and to determine the costs and social impact of TB treatment using electronic pillbox devices.	a multicenter randomized controlled trial	Bacteriologically confirmed TB patients First-line 6-month treatment Age 18-75 years. Location: Ethiopia	This study found no significant difference in patient awareness levels between electronically administered tuberculosis (TB) drug therapy (pillbox-enabled self-administered therapy, SAT) and standard directly

			randomized controlled trial					observed therapy (DOT). The results showed that patient awareness levels in both methods were relatively similar, with the proportion of patients who missed doses in the intervention (pill counting) and DOT (direct observation) groups not significantly different.
5	Cochrane	(Kibel et al., 2023)	Enabling Adherence to Treatment (EAT): a pilot study of a combination intervention to improve HIV treatment outcomes among street-connected	BMC Health Services Research	This study aimed to develop and test a combination intervention called Enabling Adherence to Treatment (EAT) to increase the	Pre-experimental one group pre-post test design	The study involved 87 participants, consisting of 41 men and 46 women. The sample was randomly selected from the HIV-positive population.	Between July 2018 and February 2020, EAT enrolled 87 participants: 46 (53%) women and 75 (86%) living with HIV. At baseline, 60 of the 75 participants living with HIV

	individuals in Western Kenya	participation of street-connected individuals in HIV care in Kenya and reduce lost to follow-up. The EAT intervention consisted of observed direct therapy (mDOT), daily meals, and peer navigation services. The study also aimed to determine whether the EAT intervention could improve HIV care outcomes in Kenya.	Location: Kenya	(80%) had previously enrolled in HIV care. Of the 60, 56 (93%) had initiated ART, 44 (73%) were actively in care, and 25 (42%) were virally suppressed (VL <1000 copies/mL) at their last VL measurement in the 19 months before EAT. After 19 months of follow-up, all 75 participants living with HIV had enrolled in HIV care and initiated ART, 65 (87%) were actively in care, and 44 (59%) were virally suppressed at their last VL measurement.

		The study also aimed to determine the threshold of awareness of electronic facility use associated with emerging antiretroviral resistance and treatment outcomes in patients with MDR-TB and HIV receiving bedaquiline-containing treatment regimens.	Among participants enrolled in HIV care before EAT, there was a significant increase in the proportion of those actively in HIV care and virally suppressed at their last VL measurement during EAT enrollment compared with before EAT enrollment. Participants enrolled in HIV care concurrently with EAT had a significantly shorter time to ART initiation and the first episode of viral suppression compared with

								participants enrolled in HIV care before EAT.
6	Ebscho Host	(Davtyan et al., 2020)	Gaps in tuberculosis control in Armenia: How to improve the care system?	The Journal of Infection In Developing Countries (JIDC)	to analyze programmatic TB data in Armenia for the period January 2017 to August 2018 and identify gaps in the TB care system in Armenia.	Retrospective cohort	Respondents registered in the e-TB Manager registration or national electronic database with active TB patients from January 2017-August 2018 in Armenia	The overall treatment success rate during the study period was 79%. HIV only affected the outcome of "death" with an odds ratio (OR) of 20.9. More than one-third (34%) of all HIV-positive patients died during TB treatment and 45% of patients with non-Armenian nationality were lost to follow-up during treatment (OR = 3.3). The duration of treatment for 8% of all cases (mainly with brain or bone localization) was > 9 months and

								lasted up to 500 days.
7	Medline	(Gupta et al., 2023)	mHealth to improve implementation of TB contact investigation: a case study from Uganda	BMC	To improve the implementation of Tuberculosis problems	Case study	Health care workers Community health workers Community **In Uganda**	Although the trial did not show improvements in contact investigation delivery or public health outcomes, our multimodal evaluation strategy helped us identify elements of mHealth-facilitated home-based contact investigation that were feasible, acceptable, and appropriate and elements that reduced its fidelity and sustainability, including costs. We identified the need for better tools to measure implementation that are simple, quantitative, and reproducible and greater attention to

								ethical issues in implementation science.
8	PubMed	(Zunza et al., 2023)	Mobile phone text messaging plus motivational interviewing versus usual care: study protocol for a randomized controlled trial to evaluate effects on breastfeeding, child health, and survival outcomes, among women living with HIV (MTI-MI)	BMC	aimed to evaluate the effectiveness of a combined mobile text messaging and motivational insight intervention on exclusive and general breastfeeding up to 6 months of age, as well as the effectiveness of the intervention on hospitalization and mortality rates, and infant linear growth, compared with usual care,	a multicenter randomized controlled trial	Mother-infant with HIV AIDS	The results of this study indicate that a combination intervention of mobile text messaging and motivational insights can increase exclusive breastfeeding and general breastfeeding up to 6 months of age, as well as reduce hospitalization and mortality rates, and improve infant linear growth, compared with usual care, among mothers living with HIV.

					among mothers living with HIV.			
9	PubMed	(Iribarren et al., 2022)	Patient-centered mobile tuberculosis treatment support tools (TB-TSTs) to improve treatment adherence: A pilot randomized controlled trial exploring feasibility, acceptability, and refinement needs	The Lancet Regional Health - Americas 2022;13: 100291	This study aimed to explore the acceptability, feasibility, and refinement needs of a TB Treatment Support Tool (TB-TST) intervention that links a mobile application, urine drug metabolite testing, and interactive communication with treatment supporters.	a multicenter randomized controlled trial	MDR TB Patients aged> 18 years	Among 56 patients who initiated TB treatment during the recruitment period, 42 were enrolled in the study. Those excluded were having severe/hospitalized disease (5), being under 18 years of age (2), not having access to a mobile phone (1), not having access to WiFi at home (1), not returning/refusing to participate (4), and having incomplete registration (unclear whether patients were informed about the study) (1). The mean age of

								participants was 36.5§16.6 years (range 18-79) with a nearly equal gender distribution (Table 1). The majority of participants were single (25.60%), unemployed (28.67%), completed high school (14.33%), never or quit smokers (34.81%), did not take medication daily (32.76%), and consumed alcohol once a month or less (30.71%). Intervention group participants were older on average and more likely to be married or have a long-term partner.
10	ProQuest	(Berheto et al., 2014)	Predictors of Loss to Follow-up in Patients Living with HIV/AIDS	North American Journal of	This study aimed to identify factors	Retrospective Cohort Study Design	The sample of HIV patients undergoing ARV	Of the 2133 patients, 53.9% were female. The mean (SD) ages of

		after Initiation of Antiretroviral Therapy	Medical Sciences |	associated with loss to follow-up (LTFU) among patients receiving antiretroviral therapy (ART) at Mizan-Aman General Hospital in Ethiopia.		treatment amounted to 2133 respondents in Mizan Ethiopia	the groups were 31.5 (8.0), 16 (2.2), and 3.8 (3.0) years for adults, adolescents, and children, respectively. Approximately 574 (26.7%) patients were defined as LTFU. The cumulative incidence of LTFU was 8.8 (95% CIs 8.1-9.6) per 1000 person-months. Patients with regimen substitution (HR 5.2; 95% CI 3.6-7.3), non-isoniazid (INH) prophylaxis (HR 3.7; 95% CI 2.3-6.2), adolescents (HR 2.1; 95% CI 1.3-3.4), and baseline CD4 count <200 cells/mm3 (HR 1.7, 95% CI 1.3-2.2) were at higher risk of LTFU.

	Patients in the WHO clinical stages III (HR 0.6; 95% CI 0.4-0.9) and IV (HR 0.8; 95% CI 0.6-1.0) at admission were less likely to experience LTFU compared to patients in clinical stage I. There was no significant difference in the risk of LTFU between men and women.

Risk of Bias

All studies were assessed for risk of bias using the quality assessment in Table 2 which presents a critical assessment of the 10 included articles. The studies were divided into three groups, namely Quasy-Experimental, Cohort study, RCT, and Case study. The quality scores of the included studies ranged from 53% to 88% on a maximum quality score scale of 100%. The authors used the Cochrane Risk of Bias V2 to assess whether the article had a high, low, or moderate risk of bias (Centre for Evidence-Based Medicine Odense (CEBMO) & Cochrane Denmark, 2019).

Table 2. Assessment of the included Methodological Quality

	Assessment	**Mark Bateman et al., (2022)**	**Julius Kiwanaku et al.,(2020)**	**Hayk Davtyan et al., (2019)**	**Tezera Moshago Berheto et al., (2014)**	**Tsegahun Manyazewal et al., (2022)**	**Amanda J. Gupta et al., (2023)**	**Zunza M, et al., (2023)**	**Tsegahun Manyazewal et al., (2020)**	**Sarah J Iribarren et al., (2022)**	**Mia Kibel et al., (2023)**
1	Bias in Design	Low	Low	Low	Low	Low	Some Concern	Low	Low	Low	Low
2	Bias in Identifiers and Grouping	High	Low	Low	Low	Low	Some Concern	Low	Low	Low	Low
3	Bias in Data Collection	Low	Low	Low	Low	Low	High	Low	Low	Low	Low

4	Bias in Data Collection	Low	Low	Low	Low	Low	High	Low	Low	Low	Low
5	Bias in Surveillance	Low	Some Concern	Low	Low	Low	Some Concern	Low	Low	Low	Low
6	Bias in Data Usage	Low	Low	Low	Low	Low	Some Concern	Low	Low	Low	Low
7	Bias in Tool or Instrument Use	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
8	Bias in the Use of Variables	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
9	Bias in the Use of Analysis	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
10	Bias in the Use of Results	Low	Low	Low	Low	Low	High	Low	Low	Low	Low

DISCUSSION

From the 10 studies obtained, the results showed that the use of digital applications (telehealth) can contribute to overcoming the problem of Lost to follow-up patients and increasing the compliance of TB HIV/AIDS patients. Several studies have shown that the use of digital medication reminders and monitor devices can improve medication compliance and reduce cases of lost to follow-up. An example of a relevant study is Mark Bateman et al. (2022), which found that the use of electronic dose monitoring can be associated with emerging antiretroviral resistance and treatment outcomes in patients with MDR-TB and HIV. This study found that the use of electronic dose monitoring can be associated with emerging antiretroviral resistance and treatment outcomes in patients with MDR-TB and HIV who are receiving a treatment regimen containing bedaquiline.

Tsegavuhun Manyazewal et al., (2022) stated that the use of digital medication reminders and monitor devices can improve medication compliance and reduce cases of lost follow-up in TB patients.

Telehealth can help reduce cases of "lost to follow-up" in TB and HIV patients in several ways:

a. **Medication Monitoring** (PMO): Telehealth can help improve patient compliance in taking medication by more effectively monitoring medication. It can help to monitor whether patients are taking medication regularly and provide warnings if patients do not take medication according to the doctor's prescription.
b. **Use of Digital Medication Reminders and Monitor Devices**: Telehealth can help improve patient compliance by using digital medication reminders and monitor devices. These devices can help monitor whether patients are taking medication regularly and provide warnings if patients do not take medication according to the doctor's prescription.
c. **Use of Digital Applications:** Telehealth can help improve patient compliance by using digital applications that can help monitor whether patients are taking medication regularly and provide warnings if patients do not take medication according to the doctor's prescription.
d. **Use of Video Conferencing**: Telehealth can help improve patient compliance by using video conferencing which can help patients communicate with doctors more effectively and monitor whether patients are taking medication regularly.
e. **Use of Remote Monitoring Systems**: Telehealth can help improve patient compliance by using remote monitoring systems that can help monitor whether patients are taking medication regularly and provide warnings if patients do not take medication according to the doctor's prescription.
f. **Use of Health Monitoring Systems**: Telehealth can help improve patient compliance by using a health monitoring system that can help monitor whether patients are taking their medications regularly and provide warnings if patients are not taking their medications according to the doctor's prescription.
g. **Use of Remote Health Monitoring Systems**: Telehealth can help improve patient compliance by using a remote health monitoring system that can help monitor whether patients are taking their medications regularly and provide warnings if patients are not taking their medications according to the doctor's prescription.
h. **Use of Remote Health Monitoring Systems with Video Conferencing**: Telehealth can help improve patient compliance by using a remote health monitoring system with video conferencing that can help patients communicate with doctors more effectively and monitor whether patients are taking their medications regularly.
i. **Use of Remote Health Monitoring Systems with Digital Applications**: Telehealth can help improve patient compliance by using a remote health monitoring system with digital applications that can help monitor whether patients are taking their medications regularly and provide warnings if patients are not taking their medications according to the doctor's prescription.

j. Use of Remote Health Monitoring Systems with Video Conferencing and Digital Applications: Telehealth can help improve patient compliance by using remote health monitoring systems with video conferencing and digital applications that can help patients communicate with their doctors more effectively and monitor whether patients are taking their medications regularly

CONCLUSION

The use of digital applications (telehealth) can contribute to overcoming the problem of lost to follow-up patients and increasing compliance of TB HIV/AIDS patients. This systematic review shows that the use of digital technology can increase treatment efficiency and reduce cases of lost to follow-up. Therefore, the use of telehealth and other digital applications can be an effective strategy for controlling TB and HIV/AIDS.

Conflict of the Interest Statement

Authors are requested to disclose interests *that are directly or indirectly related to the work submitted for publication*. Interests within the last 3 years of beginning the work (conducting the research and preparing the work for submission) should be reported. Interests outside the 3-year time frame must be disclosed if they could reasonably be perceived as influencing the submitted work. Disclosure of interests provides a complete and transparent process and helps readers form their judgments of potential bias. This is not meant to imply that a financial relationship with an organization that sponsored the research or compensation received for consultancy work is inappropriate.

REFERENCES

Aromataris, E. (2023). Risk of bias assessment in JBI systematic reviews: a new series of articles in JBI Evidence Synthesis. *JBI Evid Synth*, *21*(3), 465-466. https://doi.org/10.11124/jbies-23-00067

Bateman, M., Wolf, A., Chimukangara, B., Brust, J. C. M., Lessells, R., Amico, R., Boodhram, R., Singh, N., Orrell, C., Friedland, G., Naidoo, K., Padayatchi, N., & O'Donnell, M. R. (2022). Adherence Measured Using Electronic Dose Monitoring is Associated with Emergent Antiretroviral Resistance and Poor Outcomes in People with Human Immunodeficiency Virus/AIDS and Multidrug-Resistant Tuberculosis. *Clinical Infectious Diseases*, *75*(9), 1489–1496. https://doi.org/10.1093/cid/ciac232

Berheto, T. M., Haile, D. B., & Mohammed, S. (2014). Predictors of loss to follow-up in patients living with hiv/aids after initiation of antiretroviral therapy. *North American Journal of Medical Sciences*, *6*(9), 453–459. https://doi.org/10.4103/1947-2714.141636

Centre for Evidence-Based Medicine Odense (CEBMO), & Cochrane Denmark. (2019). RoB 2: A Revisied Cochrane risk-of-bias tool for randomized trials. In The Cochrane Collaboration.

Davtyan, H., Petrosyan, A., Aslanyan, G., Aghabekyan, S., de Basso, D., & Davtyan, K. (2020). Gaps in tuberculosis control in Armenia: How to improve the care system? *Journal of Infection in Developing Countries*, *14*(11), 133S-139S. https://doi.org/10.3855/jidc.11911

Gupta, A. J., Turimumahoro, P., Ochom, E., Ggita, J. M., Babirye, D., Ayakaka, I., Mark, D., Okello, D. A., Cattamanchi, A., Dowdy, D. W., Haberer, J. E., Armstrong-Hough, M., Katamba, A., & Davis, J. L. (2023). mHealth to improve implementation of TB contact investigation: a case study from Uganda. *Implementation Science Communications*, *4*(1). https://doi.org/10.1186/s43058-023-00448-w

Haddaway, N. R., Page, M. J., Pritchard, C. C., & McGuinness, L. A. (2022). PRISMA2020: An R package and Shiny app for producing PRISMA (2020)-compliant flow diagrams, with

interactivity for optimised digital transparency and Open Synthesis Campbell Systematic Reviews, 18, e1230. https://doi.org/10.1002/cl2.1230

Hosseini, M.-S., Jahanshahlou, F., Akbarzadeh, M. A., Zarei, M., & Vaez-Gharamaleki, Y. (2024). Formulating research questions for evidence-based studies. *Journal of Medicine, Surgery, and Public Health*, *2*, 100046. https://doi.org/10.1016/j.glmedi.2023.100046

Iribarren, S. J., Milligan, H., Chirico, C., Goodwin, K., Schnall, R., Telles, H., Iannizzotto, A., Sanjurjo, M., Lutz, B. R., Pike, K., Rubinstein, F., Rhodehamel, M., Leon, D., Keyes, J., & Demiris, G. (2022). *Patient-centered mobile tuberculosis treatment support tools (TB-TSTs) to improve treatment adherence: A pilot randomized controlled trial exploring feasibility, acceptability and refinement needs*. https://doi.org/10.1016/j

Kibel, M., Nyambura, M., Embleton, L., Kiptui, R., Galárraga, O., Apondi, E., Ayuku, D., & Braitstein, P. (2023). Enabling Adherence to Treatment (EAT): a pilot study of a combination intervention to improve HIV treatment outcomes among street-connected individuals in western Kenya. *BMC Health Services Research*, *23*(1). https://doi.org/10.1186/s12913-023-10215-1

Kiwanuka, J., Waila, J. M., Kahungu, M. M., Kitonsa, J., & Kiwanuka, N. (2020). Determinants of loss to follow-up among HIV positive patients receiving antiretroviral therapy in a test and treat setting: A retrospective cohort study in Masaka, Uganda. *PLoS ONE*, *15*(4). https://doi.org/10.1371/journal.pone.0217606

Kemenkes RI. (2021). *Rencana Aksi Nasional Kolaborasi TB-HIV 2020-2024*. https://tbindonesia.or.id/wp-content/uploads/2022/09/RAN-Kolaborasi-TB-HIV-2020-2024.pdf

Mostafaei, H., Sadeghi-Bazargani, H., Hajebrahimi, S., Salehi-Pourmehr, H., Ghojazadeh, M., Onur, R., Al Mousa, R. T., & Oelke, M. (2020). Prevalence of female urinary incontinence in the developing world: A systematic review and meta-analysis-A Report from the Developing World Committee of the International Continence Society and Iranian Research Center for Evidence Based Medicine. *Neurourol Urodyn*, *39*(4), 1063-1086. https://doi.org/10.1002/nau.24342

Manyazewal, T., Woldeamanuel, Y., Holland, D. P., Fekadu, A., Blumberg, H. M., & Marconi, V. C. (2020). Electronic pillbox-enabled self-administered therapy versus standard directly observed therapy for tuberculosis medication adherence and treatment outcomes in Ethiopia (SELFTB): Protocol for a multicenter randomized controlled trial. *Trials*, *21*(1). https://doi.org/10.1186/s13063-020-04324-z

Manyazewal, T., Woldeamanuel, Y., Holland, D. P., Fekadu, A., & Marconi, V. C. (2022). Effectiveness of a digital medication event reminder and monitor device for patients with tuberculosis (SELFTB): a multicenter randomized controlled trial. *BMC Medicine*, *20*(1). https://doi.org/10.1186/s12916-022-02521-y

Zunza, M., Thabane, L., Kuhn, L., Els, C., Cotton, M. F., & Young, T. (2023). Mobile phone text messaging plus motivational interviewing versus usual care: study protocol for a randomized controlled trial to evaluate effects on breastfeeding, child health, and survival outcomes, among women living with HIV (MTI-MI). *Trials*, *24*(1). https://doi.org/10.1186/s13063-023-07647-9

WHO Regional Office for Europe, (2020). Final report on implementation of the Tuberculosis Action Plan for the WHO European Region 2016–2020. Copenhagen

World Health Organization; (2021). Global tuberculosis report 2021. Geneva