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The Role of Artificial Intelligence in Mobile Health-Based HIV/AIDS Management and Its Implementation Potential in DKI Jakarta: A Systematic Review

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Abstract

HIV/AIDS remains a global health challenge, impeding SDG 3. Treatment involves complex antiretroviral therapy with issues like side effects, drug resistance, cost, and stigma. Jakarta faces high HIV/AIDS rates, impacting the 20-49 age group, especially vulnerable populations. Despite potential technological progress, extending HIV/AIDS management to communities is vital for better care. Following PRISMA methodology, this study identifies articles via keyword searches, then applies inclusion/exclusion criteria. Among 46 articles, 8 meet Cochrane quality assessment. Data extraction examines study specifics, interventions, and outcomes. Variations in studies are acknowledged when assessing mobile health's efficacy for high-risk HIV/AIDS management. The study centers on tackling Jakarta's HIV/AIDS issues via the VITALIS AI-based app. Unhealthy behaviors and healthcare limitations drive HIV cases. The app merges therapy, risk screening, updates, counseling, and telemedicine, aiming to curb transmission, improve care, and enhance life quality. Designed with AI chatbot aid and stress monitoring, a field trial evaluates implementation, encompassing technology, social diversity, and regulations. Encryption and optimization address data security and internet access challenges. Feasibility analysis scrutinizes technological, social, and regulatory aspects. Technology-driven apps with personalized stress monitoring exhibit potential in enhancing HIV/AIDS therapy and life quality. Jakarta's implementation aligns with SDGs. Recommendations involve stakeholder collaboration, a sustainable model, adaptable features, and nationwide expansion for comprehensive HIV/AIDS management.

Introduction

HIV/AIDS (Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome) is one of the sexually transmitted diseases that continues to be a serious global health issue and poses a challenge to achieving Sustainable Development Goal (SDG) number three, "Good Health and Well-being" The treatment of HIV/AIDS involves antiretroviral therapy (ART), which consists of several

types of medications that need to be taken over an extended period (Menéndez-Arias & Delgado, 2021). The treatment of HIV/AIDS encounters several issues, including the presence of medication side effects that impact the patients' quality of life, viral resistance to drugs, and the high cost of treatment(Nakagawa et al., 2015; Vadra et al., 2022).

HIV/AIDS therapy management is a complex process encompassing medical care, social and psychological support, and mental well-being management. HIV/AIDS therapy involves intricate antiretroviral treatment (ART) regimens that demand strict adherence and monitoring, alongside various other interventions aimed at enhancing the quality of life for HIV/AIDS patients. Additionally, HIV/AIDS patients frequently encounter stigma and discrimination, further complicating the management process. Therefore, a holistic and integrated approach to HIV/AIDS management is essential to ensure the success of therapy and enhance patient quality of life.In this context, innovative solutions are needed to enhance the accessibility and quality of HIV/AIDS management and care for the community. (Regmi et al., 2020).

HIV/AIDS in Jakarta primarily affects the 20-49 age group, with higher infection rates among men than women(Lestari et al., 2013). HIV/AIDS transmission risk is higher in vulnerable populations such as sex workers, injecting drug users, and homosexuals(Dibble et al., 2022)

Jakarta holds the highest HIV/AIDS cases in Indonesia, with a rising trend annually (Nelwan, 2017). Approximately 12,775 HIV/AIDS cases exist in Jakarta. The HIV/AIDS prevalence in Jakarta for 2020 stood at 0.28%, indicating that 2.8 individuals per 1000 Jakarta residents live with HIV/AIDS (Ardani & Handayani, 2017).The social and economic conditions of Jakarta, a densely populated metropolis, contribute to HIV/AIDS spread (Lubis et al., 1994). Factors like urbanization, poverty, and shifts in social behavior drive HIV/AIDS transmission in Jakarta (Lubis et al., 1997). Effective prevention and management efforts are crucial to address this issue in Jakarta.

As Indonesia's capital, Jakarta boasts considerable potential for technological development and easy technology access (Puspitasari& Ishii, 2016). This is evident in the increased use of the internet and gadgets in Indonesia, particularly in Jakarta (Nugraha et al., 2021). According to the Indonesian Central Statistics Agency (BPS) 2021 report, there are 196.7 million internet users in Indonesia. Smartphone users reached 164.5 million, around 59.7% of Indonesia's total population (Central Statistics Agency, 2021).

The availability of HIV/AIDS management programs in Indonesia marks a positive initial step in mitigating the impact of the disease. However, challenges persist in expanding the coverage and reach of these services to a wider population in need, especially at the community level which requires distinct approaches from hospital-based care. This study aims to conduct an in-depth systematic review on the utilization of therapy management applications for HIV/AIDS in Indonesia, specifically focusing on community-level implementation beyond hospitals.

Methods

1. Study Selection

This article follows the PRISMA methodology. The first step is identification, involving keyword searches related to the research topic. Keywords include "mHealth," "HIV/AIDS," "intervention," "randomized controlled trial," "adherence," "MSM," "sex workers," "self-testing," "app," and "smartphone." Relevant articles are then selected based on inclusion and exclusion criteria.

Inclusion criteria encompass studies conducted on populations at high risk of HIV/AIDS, utilizing mobile health (mHealth) technology in interventions, and evaluating intervention effectiveness through randomized controlled trials or single-arm studies. Exclusion criteria involve studies not involving mHealth or interventions unrelated to HIV/AIDS management.

Searches were conducted on April 2, 2023, in PubMed and Google Scholar databases, yielding 46 relevant articles. After applying inclusion and exclusion criteria, 38 articles were excluded. Eight qualifying articles underwent quality assessment using Cochrane bias risk criteria.

Following the selection process, each study meeting the criteria underwent quality evaluation based on Cochrane bias risk criteria. Finally, data synthesis from each study culminated in conclusions regarding the effectiveness of mobile health technology in HIV/AIDS management.Utilizing the PRISMA framework, this article systematically and transparently provides insights into the effectiveness of mobile health technology in addressing HIV/AIDS among high-risk populations.

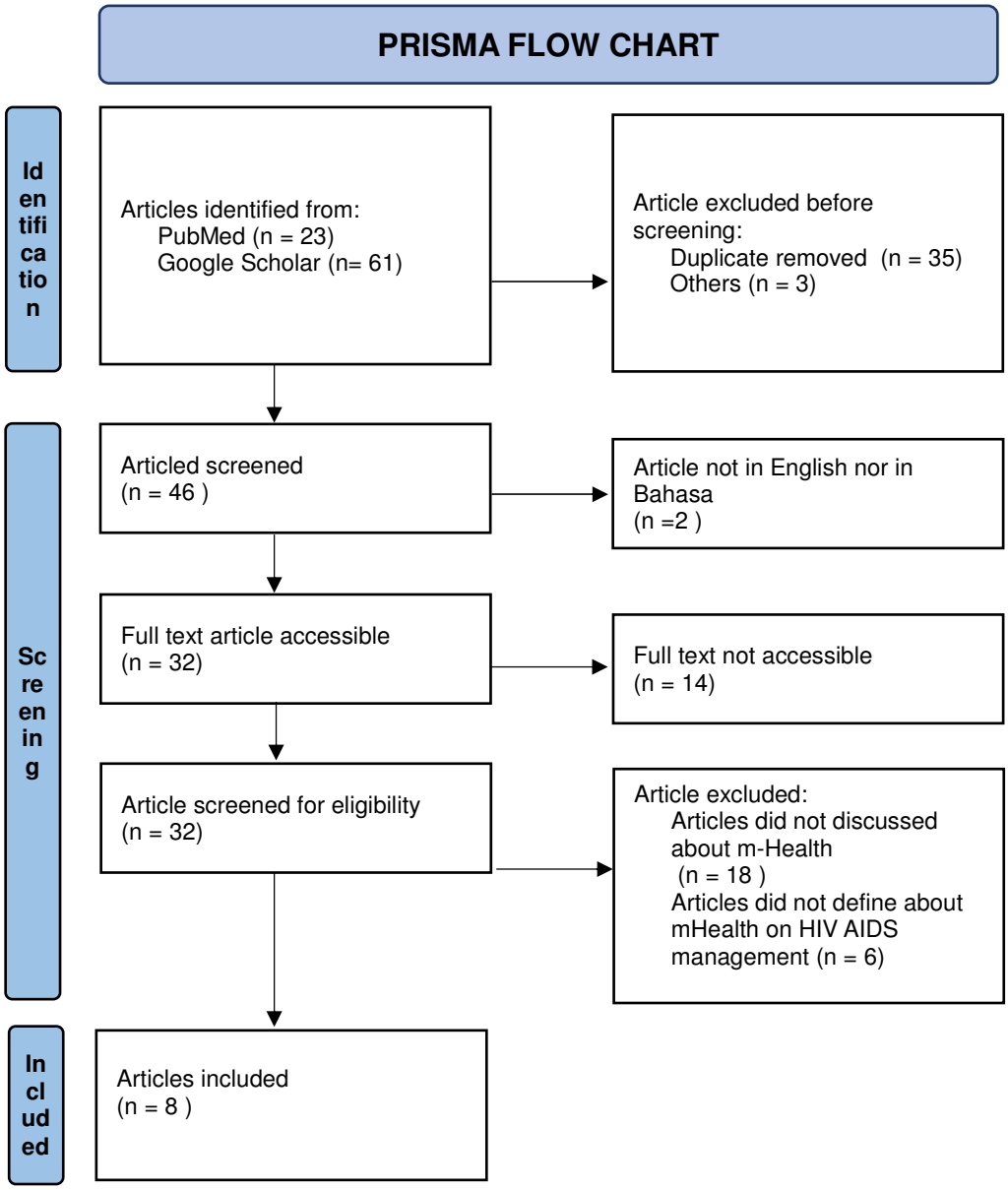

Figure1.PRISMA diagram

2. Data Extraction Result

For data extraction, the authors will meticulously review each article to identify pertinent information related to the research. Extracted data will encompass study characteristics, sample populations, interventions utilized, outcome measurements, and study results.

Upon data extraction, a synthesis of the data from each study will be conducted to derive conclusions about the effectiveness of mobile health technology in addressing HIV/AIDS among high-risk populations. This article acknowledges variations across studies, including study design, sample populations, intervention types, measured outcomes, and other factors that may influence research findings.

Table1. HIV/AIDSResult of Data Extraction on mHealth in HIV/AIDS Management

Author (Year)	Country	N	Age	Theoretical model	Intervention target
Pre-pilot randomized controlled trial					
Bauermeister et al. (2019)	USA	180	E = 18–24 M = 21.67 SD = 1.81	Cognitive-Emotional Decision-Making Framework with Dual-Processing System	Condom usage, ARV usage, HIV testing.
Zhu et al. (2019)	China	100	E ≥18 M 18–29 = 68% SD ≥30 = 32%	Information, Motivation, and Behavioral Skills Model.	Condom usage, HIV testing.
Single-arm trial with pre-post test					
Leluțiu-Weinberger et al. (2018)	Romania	43	E = 16–29 M = 23.4 SD = 3.6	Not reported	Condom usage, HIV testing.
Mitchell et al. (2018)	USA	10	E = 18–30 M = 24.1 SD = 2.38	Information, Motivation, and Behavioral Skills Model.	Adherence to ARV usage.
Sullivan et al. (2017)	AS	121	E ≥18 M = 28 IQR = 24–34	Information, Motivation, and Behavioral Skills Model.	Social Cognitive Therapy, Therapy Initiation.
Dworkin et al. (2019)	AS	43	E = 18–34 M = 29	Information, Motivation, and Behavioral Skills Adherence Model.	Adherence to ARV usage.
Hightow-Weidman et al. (2018)	USA	20	E = 16–24 M = 21.8 SD = 1.55	Social Cognitive Theory; Narrative Communication Theory; Fogg Behavior Model of Persuasive Technology	Adherence to ARV usage.
Crankshaw T et al. (2010)	South Africa	137	Not mentioned	Technology-based reminders for improving patient compliance.	Adherence to ARV usage.

(*USA = United State of America, N = Population E = age range , M = age mean , SD = standard deviation, ARV = Anti retroviral*)

In the synthesis analysis in this paper, a literature search was also conducted on the use of mobile health in healthcare services or facilities, and its impact on patient therapy management.

Table2. Extraction of articles on mobile health in healthcare services.

Author (year)	Study design	Subject	Data collection methods	Conclusion
Pimmer, C. et al. (2013)	Qualitative	Nurse	Semi-structured interview.	Social media can be used by nurses as a source of information, collaboration, emotional support, and to enhance communication and self-reflection.
Free, C. et al. (2013)	Systematic review	*Health care consumers*	Literature study	mHealth technology has been proven effective in changing health behaviors and disease management among healthcare service consumers.
Lupton, D. (2013)	Qualitative	Not mentioned	Text analysis	mHealth enables self-health monitoring, but privacy issues and access inequality need to be considered, as well as the technological risks posed by insurers and institutions to assess consumer health risks.
Abaza, H. A. et al. (2015)	Systematic review	Not mentioned	Literature study	mHealth is commonly used for chronic disease management, disease prevention, reproductive health, mental health, and nutrition. Popular technology combinations include sensors, mobile devices, cameras, GPS, and text messages.

Result and Discussion

Analysis of the HIV/AIDS Situation and Challenges in Jakarta

The primary issue targeted for mitigation by VITALIS is the escalating proliferation of HIV/AIDS risks in Jakarta. Based on an analysis of the HIV health situation in Jakarta, the number of HIV/AIDS cases has significantly risen in recent years. This trend is driven by various factors, including an increase in unhealthy sexual behaviors, drug abuse, and inadequate accessibility to healthcare services(Prabawanti, 2015).

In this context, the proposed AI-based application aims to provide an innovative solution to reduce the spread of HIV/AIDS in Jakarta through an integrated healthcare management service. This service offers therapy, risk factor screening, health updates, current health status, counseling, and telemedicine. By offering an integrated service powered by AI technology, the application seeks to enhance the effectiveness and efficiency of HIV/AIDS healthcare services in Jakarta while improving healthcare accessibility for the population.

The application is anticipated to contribute to HIV/AIDS risk reduction in Jakarta by enhancing public knowledge and awareness about HIV/AIDS. It aims to facilitate improved healthcare accessibility and enhance community adherence to HIV/AIDS treatment. As a result, the application aims to potentially decrease the incidence of HIV/AIDS transmission and improve the quality of life for people living with HIV/AIDS in Jakarta.

Basic Concept of AI-Based Health Management Application

This application provides a comprehensive one-stop service for PLHIV (People Living with HIV) and individuals at high risk of HIV/AIDS. The services offered encompass education, intervention management, HIV screening, health monitoring, CD4 status tracking, medication reminders, hospital referrals, telemedicine, teleconsultation, as well as artificial intelligence-based counseling through personalized stress monitoring and deep learning.

The application's concept utilizes artificial intelligence technology to process patient data, monitor health status, and deliver counseling based on personalized stress monitoring and deep learning. Data from personalized stress monitoring will be gathered from messages sent to an AI chatbot, forming a patient database.

Patient data, including profiles and health statuses, will be sourced from application users. This data will be employed to monitor health and provide personalized stress monitoring-based counseling. The AI chatbot will provide education, medication reminders, teleconsultations, and AI-based

counseling. If necessary, users can access telemedicine services for video consultations with doctors. In cases indicating further treatment, users can be referred to hospitals.

The Propose Features

The proposed features in an AI-based HIV/AIDS management, are as follows:

1. HIV/AIDS Education: This feature provides accurate information about HIV/AIDS and how to prevent its spread.

2. HIV Screening: Users can easily and quickly perform HIV tests through this feature.

3. Health Monitoring: Regularly monitors users' health and provides information about their health status.

4. CD4 Status Monitoring: Tracks users' CD4 cell count and offers information about infection risk.

5. Medication Reminders: Sends reminders to users to take their required ARV medications at the right time.

6. Telemedicine Services: Enables users to communicate with doctors and medical experts through telemedicine.

7. Hospital Referral Services: Grants users access to information about hospitals and medical services available in their vicinity.

8. AI for Counseling: Provides personalized AI-based counseling to assist users in managing stress and emotional issues related to HIV/AIDS.

In this application, there is an AI chatbot feature that aids users in various activities such as HIV screening, health monitoring, and medication reminders. This chatbot integrates with personalized stress monitoring, helping users manage stress and emotional concerns related to HIV/AIDS.

Personalized stress monitoring assesses users' stress levels through messages sent to the AI chatbot. It then uses deep learning to identify patterns and behaviors associated with stress. The outcomes of personalized stress monitoring inform the AI chatbot, which delivers personalized counseling to users.

In the integration scheme, messages sent by users to the AI chatbot are collected as a patient database for personalized stress monitoring. The AI chatbot continuously monitors users' stress levels

and emotions, sending monitoring results back to offer personalized counseling. Thus, the AI chatbot and personalized stress monitoring are effectively integrated into the AI-based HIV/AIDS management application.

Advantages and Innovations of the Application

This artificial intelligence (AI) based HIV/AIDS management application boasts distinct advantages and uniqueness that set it apart from other HIV/AIDS applications:

1. **Comprehensive One-Stop Platform:** The application offers a wide range of features, including education, intervention management, HIV screening, health monitoring, CD4 status tracking, medication reminders, hospital referrals, telemedicine, teleconsultation, and AI-based counseling through personalized stress monitoring and deep learning. With these features, users no longer need to search for separate apps to fulfill their healthcare needs.

2. **Artificial Intelligence Chatbot:** The AI-powered chatbot feature facilitates quick and accurate access to information about HIV/AIDS. The chatbot also provides emotional support through personalized stress monitoring, offering appropriate intervention recommendations based on the user's condition.

3. **Personalized Stress Monitoring:** This feature automatically monitors users' stress levels and psychological well-being. It aids HIV/AIDS patients in managing stress and potential mental challenges that may arise due to their health condition.

The integration of the AI chatbot and personalized stress monitoring adds a unique dimension to the application. With this integration, the application delivers more personalized and effective emotional support to HIV/AIDS patients. The integration scheme operates as follows:

Messages sent by users via the AI chatbot are collected and analyzed by the system to determine the user's stress level and psychological well-being. The analysis outcomes are then utilized to provide appropriate intervention suggestions, such as distraction techniques or meditation. Users can directly access teleconsultation or telemedicine services from the application, if needed, as a referral to doctors or specialists.

In summary, this AI-based HIV/AIDS management application stands out with its all-encompassing features, AI chatbot assistance, and personalized stress monitoring, combining to offer a unique and comprehensive solution for users' healthcare needs.

Design of Trials and Evaluation of Implementation

The design of trials and evaluation of the implementation of the AI-based Application Concept for HIV Management can be conducted through a field trial method involving a number of HIV/AIDS patients and medical personnel in DKI Jakarta.

The initial step in the trial is to select a group of HIV/AIDS patients and grant them access to use the AI-based HIV Management application. Subsequently, these patients will be asked to provide feedback on their experience using the application. Data from this feedback can then be analyzed to determine the effectiveness and utility of the AI-based HIV Management application. The trial design can be carried out in several stages, as follows:

1. Preparation Stage: Prepare and gather data from HIV/AIDS patients who will be the subjects of the study, install the AI-based HIV Management application and AI chatbot.

2. Implementation Stage: Utilize the AI-based HIV Management application and AI chatbot to receive messages from HIV/AIDS patients and input them into the database, as well as test the application's capability in providing assistance and support to HIV/AIDS patients.

3. Evaluation Stage: Evaluate the results of the trial of the AI-based HIV Management application, including data analysis, measuring the effectiveness and efficiency of the application, and identifying deficiencies and issues that need improvement.

Data from this evaluation can then be analyzed to identify the strengths and weaknesses of the AI-based HIV Management application, allowing for better improvements and developments in the future.The research design employed in the trial is a randomized controlled study with pre-post tests conducted among the application users.

Table3. Randomized Control pre-post test research design for the trial.

Group	Time	Intervention
Control Group (CG)	Pre-trial	No existent
Control Group (CG)	Pre-trial	No existent
Intervention Group (IG)	Pre-trial	No existent
Intervention Group (IG)	Post-trial	Implementation of Virtual Integrated Treatment and Assistance for Living with HIV/AIDS equipped with personalized stress monitoring, utilizing messages sent to an AI chatbot as a database for HIV/AIDS patients.

Assuming the control group does not use the AI-based mHealth application for their disease management, a randomized control trial will be conducted to evaluate the success of therapy for both the control and intervention groups, as shown in Table 3. The measured variables will include stress, medication adherence, and quality of life. The measurement tools and scales to be used in the trial are listed in Table 4. After the application development phase, the trial will be conducted with the aim of improving the application's service and ensuring its proper and targeted functionality for HIV/AIDS patients.

Table4. Variable and measurement for the test

Variable	Measurement	Scale
Stress	Quetionaire	PSS-10 (Lee, 2012)
Medication adherence	Medical record	Increase in medication adherence percentage
Quality of life	Questionaire	WHOQOL-HIV BREF (World Health Organization, 2002)

Current Challenges and Solution

Potential challenges that the development team of the AI-based mHealth application for HIV may encounter include issues related to patient data privacy and security. Since this application will collect and store sensitive information about HIV/AIDS patients, it is crucial to ensure that the data is secure and protected from unauthorized access. The solution to this problem is to implement stringent security protocols and appropriate data encryption when storing and transmitting the data.

Furthermore, another challenge that the team might face is limited internet access in certain areas. The solution to this problem is to optimize the application to function well even on slow internet connections. The development team can also collaborate with local internet service providers to improve internet access in remote areas. By doing so, users of the AI-based mHealth application across different regions can remain connected and benefit from the application without being hindered by limited internet access. However, for the creative idea presented in this scientific paper, the choice of the pilot project location is DKI Jakarta, where internet access for each user is deemed sufficient.

3.8 Feasibility and SWOT Analysis

The feasibility analysis of implementing the AI based m-Health application in DKI Jakarta Province is conducted by considering the following factors:

1. Technological Aspect

   DKI Jakarta is an area with relatively good technological access, characterized by high internet penetration and the rapid growth of technology startups. This facilitates the implementation of the AI-based mHealth application concept for HIV and integration with the national healthcare system.

2. Social Aspect

   The DKI Jakarta Province is a densely populated and multi-ethnic region, characterized by cultural diversity that needs to be considered in the development of the AI-based mHealth application concept for HIV. This can be addressed by involving a diverse team of medical professionals and providing appropriate education to the community..

3. Regulational Aspect

   The implementation of the AI-based mHealth application concept for HIV needs to consider the regulations and laws applicable in the DKI Jakarta Province, including personal data

protection and patient consent. This can be addressed by adhering to the existing rules and collaborating with relevant authorities.

Conclusion and Recommendation

Based on the synthesis analysis results from this systematic review, it can be concluded that the use of technology-based applications equipped with personalized stress monitoring has significant potential in enhancing HIV/AIDS therapy management and improving the quality of life for patients. The implementation of this application in the DKI Jakarta Province has shown positive outcomes and contributes to achieving several Sustainable Development Goals (SDGs) beyond SDG 3 "Good Health and Well-being", such as SDG 9 "Industry, Innovation, and Infrastructure" through the utilization of information technology, and SDG 17 "Partnerships for the Goals" through partnerships with NGOs and local government.

Based on the research findings, several recommendations can be proposed to enhance the effectiveness of implementation and development of the application as well as comprehensive HIV/AIDS management:

1. Close Collaboration with Stakeholders: It is crucial to establish closer collaboration with stakeholders and government entities, including NGOs and relevant healthcare institutions.
2. Sustainable Business Model: A sustainable business model needs to be developed to ensure the maintenance and continuous development of the application in the future. Integrating this application into the healthcare system comprehensively and considering its financial sustainability will be essential to ensure its continuity and effectiveness.
3. Adaptation of Additional Features: The application developers should consistently consider adding relevant and user-responsive features. Continuous monitoring of changing user needs and technological advancements will help enhance the sustained utility of this application.
4. Expansion of Reach: In addition to DKI Jakarta, this application should also be expanded to encompass HIV/AIDS patients residing outside the province. Developing and implementing this application in other regions will help improve the accessibility of HIV/AIDS services and therapy management throughout Indonesia.

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