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Exploring the Role of Fingerprint Registration in Reducing Loss to Follow-Up Among Clients of HIV Care and Treatment: Evidence from Chalinze District, Tanzania

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Abstract

Keeping track of and keeping people with HIV in care is not easy. It needs a united, creative strategy and tactics like fingerprint registration to keep an eye on patients and improve retention in HIV care programs. This study explores the role of fingerprint registration in decreasing the incidence of lost-to-follow-up (LTFU) among individuals living with HIV at Care and Treatment Centers (CTCs) in Chalinze District in Tanzania. Informed by Health Belief Model (HBM), the study specifically examined the benefits and obstacles of fingerprint registration systems for individuals living with HIV. A qualitative case study design was employed, utilizing in-depth interviews and focus group discussions for data collection. A total of n=22 participants, comprising health professionals and program coordinators, were purposively selected for key informant interviews. In addition, three Focus Group Discussions (FGDs) were conducted with HIV-positive clients, each consisting of an average of six participants. Data analysis was conducted thematically. Findings indicated that fingerprint registration was perceived as enhancing the simplification of identification of LTFU, reducing duplication, improving monitoring and recording, and ensuring timely registration. The study concluded that the fingerprint registration system is widely accepted and effective in improving retention of people living with HIV in CTCs despite a few challenges, such as stigma and long waiting hours. It is recommended that the fingerprint registration system be integrated with the national DHIS-2 database to address duplication and operational gaps.

Keywords: *Fingerprint registration system, client loss to follow-up, patient retention.*

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Introduction

This study investigates the effectiveness of client loss to follow-up (LTFU) in HIV Care and Treatment Services in Chalinze District, Tanzania, through the use of fingerprint registration. HIV/AIDS is still one of the biggest health problems in the world with millions of people suffering from the virus. In 2023, about 39.9 million individuals were living with HIV; 53% of whom were women and girls (UNAIDS, 2024).

The Tanzanian Impact Survey report of 2023-2024 revealed that in 2024 some 1,548,000 people were living with HIV (NBS, 2024). The number of females was 53% while the number of males was 47%. Out of all those infected with HIV, 77% were receiving antiretroviral therapy (ART) (ibid). Although great strides have been made in bringing the number of people living with HIV to 95% of those diagnosed with HIV and 95% of those on treatment and care (art), obstacles like poor adherence to antiretroviral therapy (ART) and the loss to follow-up persist. The failure to achieve 95-95-95 will mean the failure to realize the 2030 vision of becoming a HIV-free world (WHO, 2022; NBS, 2024).

Loss To Follow-Up (LTFU) relates to patients diagnosed with HIV that are not engaged in HIV services and this may result in interrupted care, poor health outcomes, and increased risk of HIV transmission (UNAIDS, 2022; WHO, 2023). Various factors have been identified as playing a role in the high rate of LTFU such as stigma,

extensive distances to clinics, poor tracking measures, and poor patient identification methods (Tesfaye, 2015; WHO, 2016).

In order to enhance patient identification and tracking, many countries have begun to use biometric fingerprint registration. For instance, Nigeria and Uganda have successfully adopted biometric systems to improve data quality, minimize missed visits and increase the length of time people remain in HIV care (Comulada et al*.,* 2017; Ojo et al., 2022; Owino et al., 2024). This is where biometric registration helps to avoid duplicate patient records and to make it easier to track adherence to ART.

Furthermore, the Biometric Identification System (BIS), which is in the form of fingerprints, has been used in Tanzania for many years. It has been extensively applied in government offices for passport applications, government workstations, driving license applications, phone registration and many more. Health systems have started implementing the registration of fingerprints to identify and monitor PLHIV in Zanzibar, Simiyu, Tanga and Mara in Tanzania (Amref Tanzania 2023). The programs were set up in 2021 and are currently being conducted in the coastal districts (Chalinze District).

Although the prevalence of HIV in Tanzania is still high at 4.4%, almost 1.5 million people are living with the virus (NBS, 2024). Despite the expansion of the number of ARTs and the establishment of Care and Treatment Centers (CTCs), a huge challenge in retaining clients remains. The reason for the introduction of Fingerprint Registration at the Tanzania's CTC centers is to ensure proper follow up and minimize lost customer records. There may be improvements in data management and data retention with fingerprint registration systems. However, their uptake, effectiveness, and acceptability by health workers and clients in Tanzania are still low, especially in Chalinze District (Amref Tanzania, 2023).

Statement of the Problem

There has been a significant progress in increasing access to Anti-Retroviral Therapy (ART), which has led to better survival and quality of life for people living with HIV (PLHIV). A total of about 77% of all PLHIV are already on ART in Tanzania, which is a significant progress towards meeting the 95-95-95 targets of UNAIDS (NBS, 2024). Despite this progress, loss to follow-up (LTFU) is a recurrent and serious problem in the provision of HIV care and treatment (CPT) services. Previous studies have shown that the reasons for deregistration from Care and Treatment Clinics (CTCs) include but are not limited to stigma, distance, lack of patient tracking systems and inefficiency in identification (Tesfaye, 2015). These difficulties are a threat to treatment continuity, to HIV transmission and to national and global HIV control.

Biometric fingerprint registration systems have been implemented in a number of low- and middle-income countries, including Tanzania, to solve patient identification and tracking issues. Pilot rollout of fingerprint registration in HIV care facilities, specifically in Zanzibar, Simiyu, Tanga, and Mara, in Tanzania, has shown promise of strengthening client monitoring and data management (Amref Tanzania, 2023). The interventions have also been rolled out in Chalinze District, as part of larger digital health innovations. Despite its increasing use, the effectiveness of the fingerprint registration system in reducing LTFU in the Tanzanian context is still little understood. The literature reviewed (Kumwenda et al., 2025; Bulsara et al., 2018 and Ramdas et al., 2025) mostly covered general issues related to LTFU, or the technical feasibility of biometric systems. There is a lack of empirical evidence on the direct effect of biometric systems on retention in routine healthcare settings. Furthermore, issues like system interoperability problems, inadequate infrastructure, non-uniform utilization by healthcare providers and acceptability concerns by clients can jeopardize the benefits of such systems.

The above discussion suggests that there is no clear evidence specifically for patient tracking and the reduction of LTFU among PLHIV with fingerprint registration. The actual extent to which these systems are implemented, used and integrated into routine HIV care services and their impact on retention is not clear in Chalinze District.

Literature and Theoretical Review

The Health Belief Model (HBM) was used in this study to explain the behavioral factors that contribute to attendance in Care and Treatment Centers (CTCs) and the acceptance of fingerprint registration as a patient tracking system of PLHIV. The Health Belief Model (HBM), developed by Hochbaum and Rosenstock in 1952 in the U.S. Public Health Service, is a psychological model that explains how people either engage in or fail to engage in

preventive health behaviors (Skinner et al., 2015). It claims that people's thoughts about vulnerability, susceptibility, severity, advantages, barriers and self-efficacy influence health-related behaviors, (Luquise & Kensinger, 2019).

For this study, each construct is directly related to the key variables being studied in the application of the HBM. Perceived susceptibility and perceived severity are the dimensions of PLHIV's understanding of the consequences of not attending appointments or failing to adhere to care, such as disease progression and viral load. Perceived benefits refer to how clients see that fingerprint registration can contribute to better service delivery through better identification of patients, minimization of duplication of patient records and continuity of care. On the other hand, the obstacles that can be perceived are privacy issues, stigma, distrust of technology, and fear of data misuse, which can all affect the acceptance of biometric systems. Self-efficacy is a patient and healthcare provider's beliefs in their capacity to effectively utilize fingerprint registration systems in their normal clinical practice. These constructs can be combined in the HBM to provide a structured approach for analyzing behavioral and technological factors that affect retention in HIV care and reduce LTFU.

Furthermore, the importance of the HBM for this study is that it offers a clear linkage between individual perceptions and observable health behaviors. Some prior research has shown that attitudes about health have a significant impact on adherence to antiretroviral therapy (ART) and HIV care retention programs (Champion & Skinner, 2008). Regarding this argument, the model can clarify clients' beliefs about the usefulness and reliability of fingerprint registration systems, which might influence their eagerness to participate in using fingerprintbased technologies in healthcare. Moreover, the approach of behavioral theory combined with digital health interventions provides a more robust and complete analytical framework as it takes into account that technological interventions are not enough without being accepted and adopted by end users. Hence the application of the HBM in this study gives a holistic approach in studying the human and system level determinants of patient retention in Chalinze District.

Furthermore, the HBM provides a conceptualization of a causal pathway whereby fingerprint registration could affect the outcomes of retention. Specifically, biometric systems can provide improved patient identification and achieve greater accuracy of patient identification, strengthening tracking and follow-up systems in HIV care programs (Odei-Lartey et al., 2016). That, in turn, helps to prevent missed appointments, and makes it easier to re-engage the client who may be lost to follow-up. The success of this pathway, however, relies on patients' perceptions of the benefits of this pathway and how willing they are to participate. As such, the model not only clarifies the intentions of those users but also identifies potential intervention points, such as tackling perceived obstacles, raising awareness, and improving the confidence of the users about the biometric technologies.

There is also empirical evidence that integration of biometric systems into HIV programs are relevant. For example, Abaasa et al. (2023) demonstrated that biometric fingerprinting was not only feasible, but also acceptable for tracking participant engagement in HIV prevention services, where it resulted in greater accuracy in attendance and more retention. Similarly, in their study on strengthening appointment and patient tracking systems for people receiving antiretroviral therapy (ART) in Tanzania, Mwatawala et al. (2022) found the retention of patients in the ART care cascade was inadequate at various points resulting in the need for better tracking systems. This finding is similar to previous studies conducted by scholars such as Awino et al. (2019), who identified structural and socio-economic factors such as transport costs, financial constraints and health system inefficiencies as major contributors to failure in follow-up among PLHIV in Tanzania.

Moreover, technological solutions like biometric fingerprint registration have been proven to increase the accuracy of data and better patient identification, thus minimizing the duplication and fragmentation of medical records (Odei-Lartey et al., 2016; Gelb & Clark, 2013). Other studies by scholars such as Marcus et al. (2016) and Katabaro et al. (2025) also show how fingerprint registration systems can improve patient tracking and facilitate continuity of care in resource-constrained environments. However, empirical evidence on how these systems are received, with patients' perceptions and behavioral responses in district level settings such as Chalinze, is still inadequate. This study, thus, adds to the body of knowledge by using the HBM to look at the behavioral determinants and HIV care retention outcomes of the biometric fingerprint registration in Chalinze District.

Methodology Research Design and Approach

This study used qualitative case study design which allows for exploring the context of Care and Treatment Centers (CTC) in Chalinze District where the fingerprint registration system was studied. A case study approach is

especially appropriate in real world situations where problems are complex, and an overall understanding of the practical value of patient tracking and retention can be gained (Creswell, 2019; Kothari, 2021). The researcher employed qualitative research methodology to collect in-depth information and gain insights into the subjective experiences of the respondents about the effectiveness of biometric interventions.

Study area and Population

The strategic research location was Chalinze district council in Pwani region, with high population mobility resulting from large scale sugar plantations such as Bagamoyo Sugar, rice fields at Ruvu, as well as being a major international transportation hub, increasing the risk of Loss to Follow-Up (LTFU) for PLHIV. The district's estimated HIV prevalence rate is 4.4% (THIS 2022/23) which translates to an estimated study population of 13,938 PLHIV. Some of the 20 CTCs in Chalinze are early adopters of the fingerprint registration but the district still has higher LTFU rates than neighboring districts, which was considered as a deliberate selection.

Sampling Technique and Sample Size

Purposive sampling was used to select "information-rich" cases which would provide an in-depth understanding of the research phenomenon (Kothari 2021). This technique was applied to recruit 12 health experts who deal with HIV clients (clinicians=5, nurses=4, and data clerks=3) and 10 program coordinators who lead and implement different HIV programs from eight selected healthcare facilities. The data saturation principle (Patton, 2002) was used to arrive at the final sample size of 22 participants. Further, 3 FGD were held in three health care facilities. Each group comprising 6 members who were selected based on gender balance and their HIV status meaning that all selected FGD members were HIV positive. The individuals picked for this group agreed to do so. The selection process was done by the health experts in collaboration with the researcher.

Data Collection Methods and Tools

The 22 experts and program coordinators at the health care facilities were interviewed in-depth for about 60 minutes. These sessions were devoted to the technical aspects and issues of the fingerprint system. Document Review: Secondary data was gathered by conducting a thorough systematic review of relevant documents such as national HIV/AIDS policies and guidelines: strategic plans, district health reports, program implementation reports, and health facility performance records. The goal of the review was to gauge the degree to which the implementation of HIV services is consistent with the stated policy goals and program targets, including patient identification, service continuity, and service retention.

In addition, selected and reviewed key facility level documents, such as HIV policy guidelines available at the health facility, program monitoring and evaluation reports, HIV service registers and HIV client registration databases were purposively selected and reviewed. In particular, records for HIV clients concerning the fingerprint registration system were given special attention. The document review aimed to develop a more in-depth knowledge of the use of biometric fingerprint registration in improving patient identification, tracking of clients across service points, strengthening the accuracy of the clients' data, preventing duplication of clients' records, and supporting the retention of clients in HIV care and treatment services. In addition, the review offered lessons learned on how the fingerprint technology can help to reduce the loss of client information, missed appointments, and continuity of care provision for people living with HIV.

Data Analysis Procedure

Thematic analysis was used to analyze the data, following the iterative steps described by Braun and Clarke (2019). The interviews and FGDs were transcribed word for word and then coded in NVivo 10 software. The process of analysis was to create an initial codebook to reflect the study objective and to allow emergent codes to arise in the process. The rigorous approach enabled the analysis of the responses by participant categories to look for any common themes in terms of system efficacy. In addition, documents relevant to this study such as HIV policy guidelines, reports, program records and HIV clients' registrar were purposively selected and reviewed to gain familiarity with the role of HIV client fingerprint registration and retention to reduce loss of information. The themes analyzed were data quality and patient tracking, program monitoring, and service efficiency and system implementation barriers.

Ethical Considerations

The District Administrative Office granted research clearance for the study with Ref: No.: HWC/A.11/18 VOLII/108. Participants gave verbal informed consent, and care was taken to ensure complete confidentiality of the findings, including not using any identifiers attached to them. The methodological triangulation was used to guarantee rigor and trustworthiness in the study.

Results

This section presents the findings for this study. The findings are organized into the following themes: simplified identification of LTFC, reduced duplication of records, enhanced monitoring and recording, timely registration, low privacy and stigma, long waiting hours, and transport challenges.

Simplified Identification of Lost to Follow-Up Cases

The results of the interviews and FGDs revealed that the fingerprinting process has dramatically made it easier to identify a client who has been lost to follow up (LTFU) in the healthcare industry. Informants reported that biometric data enabled them to immediately identify if a patient had missed scheduled appointments, even if they changed their name, went to a different CTC or paper records were missing. This enabled healthcare providers to respond in a timely manner to follow-up with clients for re-engagement in CTCs. Many respondents remarked that the biometric system has replaced manual records, which had previously caused inaccuracies and delays in tracking LTFU cases. One informant had this to say: *"Before fingerprint registration, it was difficult to know if a client was lost or attending another clinic under a different name. Now, the biometric system enables us track patients accurately across facilities"* (IDIInformant, 2025).

A similar observation was made by another informant who argued that:*"Before fingerprint registration, it was difficult to identify HIV clients with multiple care and treatment registrations within the district. However, the introduction of fingerprint registration helped to identify all clients with duplicate registrations within the district"* (IDI, Informant, 2025).Moreover, one FGD participant added: "*Finger print registration helps us to remain in one facility and follow routine uptake of our drugs instead of starting a fresh from other health care facilities. Health providers can easily find our information through finger print"* (FGD Participant, 2025).

Reduced Duplication of Records

The study results also showed that a lot of people said that fingerprint registration has greatly cut down on the number of duplicate patient data. In the past, people were registered multiple times, particularly at various clinics. In such contexts, it was difficult to remember and administer their treatments. The biometric technology allows each client to have a unique profile, ensuring that all their visits are associated with the same profile. This has helped to keep patients more easily tracked and it has reduced the working hours of the staff. One health specialist said: *"We used to have many duplicate records when patients gave different names or details. The fingerprint system prevents this by linking each patient to a single record"* (IDI Informant, 2025).

The above finding was supported by another healthcare provider who said that: *"The biometric system has helped to track patients and reduce multiple registrations with other facilities. The system keeps record of the clients and reduce possible duplication"* (IDI Informant, 2025).

Similar findings from FGD participants showed that before the introduction of the biomentric registration system, most HIV patients changed locations and centers for treatment without identification but they were easily identified after the introduction of biometric registration. .

One FGD participants had this to say:"*Before the introduction of the biometric registration, we used to register more than once, if you move away or transfer yourself to another location. Sometimes you may move away from your nearest clinic to look for better life, in that new place the health facility can identify you different from the old system because of lacking information"* (FGD Participant, 2025).

Enhanced Monitoring and Reporting

The study results also showed that the registration of fingerprints for PLHIV facilitated monitoring and reporting. The system facilitated more accurate attendance and follow-up information for patients. This information was utilized for internal activities of the facility and reporting to district health authorities. The system made it easier to identify trends, such as an abrupt rise in missed visits and allowed for necessary adjustments to programs. A healthcare expert said: "*Fingerprint registration has improved data accuracy. Now reports on retention, adherence, and treatment outcomes are more reliable because each patient has one unique digital profile"* (IDI Informant, 2025).

Another health care specialist added that:*"Through the biometric method, it has been very easy now to trace client's behavior in routine uptake of ARVs and other related services different from paper work which was used before biometric adoption and keeping records"* (IDI Informant, 2025).

A similar observation was made by another specialist who said:*"The biometric system has enabled us to store digital data which is easy to share and keep in multiple ways and to ensure close monitoring different from the old system which was difficult to transfer or share information"* (IDI Informant, 205).

Timely Registration

Healthcare providers also linked fingerprint registration to quicker and more accurate ways to register and verify patients. The study revealed that scanning the fingerprint enabled them to retrieve patients' record quickly, reducing time spent in files and questions to determine patients' identities. It was particularly helpful on clinic days when the clinic was very busy as it reduced delays and allowed staff to attend to more patients in a time-saving manner. Interviewed Healthcare providers said that: *"The system instantly displays patient records after a fingerprint scan, reducing the time we spend searching for files and speeding up patient flow"* (IDI Informant, 2025). However, not all respondents agree with timely registration. Some felt that the fingerprint registration takes much time, forcing them to switch to paperwork. This was illustrated by one of the FGD participants who said: *"Sometimes the fingerprint machine does not work, and we have to wait a long time or switch to paper, which wastes time"* (FGD Participant, 2025).

Another FGD member added:"*In general, the fingerprint registration is good but sometimes it does not work and this is when probably there is power failure. If you are in the facility and electricity goes off, it is difficult to get treatment and this takes time"* (FGD Participant 2025).

Although fingerprint registration is effective and has many benefits in maintaining information on HIV patients, it has its problems. Interview findings revealed these challenges as illustrated in the following themes.

Low Privacy and Stigma

Secrecy and privacy issues in clinics were identified as key issues contributing to LTFU among PLWHIV in CTCs. HIV clients voiced fears that they would be discovered by being seen in the CTC because of the lack of space, poor facility design, or lack of confidentiality by staff. Because of this factor, several people with HIV do not go to CTC services. One participant in FGD said: *"At the clinic, the waiting area is very open, and people might see me. I feel exposed. That is why I avoid going sometimes"* (FGD Participant, 2025).

Similarly, health workers acknowledged that privacy challenges deterred clients from attending CTCs and reduced trust in health services. One service provider stated: *"We receive complaints about the lack of privacy for our HIV clients. Some clients fear being seen or overheard and decide not to return to the CTC"* (IDI, Informant, 2025).

Moreover, one of the FGD participants added that: "*One of the challenges of finger print registration is overcrowding. If we are waiting for fingerprint registration, people directly know that we are HIV positive even if you don't tell them. Sometimes we do not feel good enough because of stigmatization when people know that we live with HIV*" (FGD Participant, 2025).

Long Waiting Hours in Ctcs

Similarly, the results indicated that too much waiting time at CTCs was one of the reasons for LTFU of HIV clients. Customers who had work, children to raise, or other obligations, were particularly frustrated by waiting in line, which made it difficult for them to make it to the clinic. The reason for the long waiting times demonstrated that

clients were not receiving timely care, and thus were angry. Long waiting periods were discouraging, particularly for people with other obligations, for both HIV clients and health care providers. One client said: *"We come early, but we sometimes spend four to five hours waiting. It takes too much time; I have to work to feed my children"* (FGD Participant, 2025).

Similar findings were revealed by one healthcare specialist who said: *"We receive a lot of complains from the clients who use fingerprint registration that sometimes it takes time. It may take time but not always, it depends on the number of clients on that day. It takes time if they are many but if they are few it doesn't"* (IDI Informant, 2025). A similar finding was observed by FGD participant who urged: *"The system used consumes a lot of hours. We may come here to take our drugs but unfortunately, we spend a lot of hours waiting for that. These people who operate the system do not bother about time at all"* (FGD Participants, 2026).

Transport and Financial Challenges

Most of those who responded indicated that the second highest reason for LTFU was transport and financial issues. Respondents reported being unable to cover transportation costs to the CTCs and the loss of income due to the time it takes to get there and waiting. Where there is a distance, it is even more difficult and fewer people from rural and distant areas will attend regularly. It was argued that *"We live far from the clinic, and sometimes I do not have money for transport. I have to choose between food and fare. That is why I miss some appointments"* (FGD Participants, 2025).

Program coordinators, CTC nurses, and doctors singled out transport as a significant barrier that drivers LTFU in the study area. One healthcare expert stated: *"Transport costs are a real barrier, especially for remote clients. Without support, we continue losing them"* (IDI Informant, 2025).

The above claim was supported by an FGD participant who said:*"We who come away from the health care facility face transport problems especially when we come for clinic. Not all facilities have fingerprint; some lack fingerprint registration and therefore present a challenge for us to attend especially those coming from rural areas"* (FGD Participant, 2025).

Discussion

The results of this study are discussed in this section. The fingerprint registration system within the study area has proven to be more convenient and accurate in finding at-risk clients with previously hard-to-find information. This function directly helps to achieve the goal of the national HIV program of reducing loss to follow-up (LTFU) and improving retention by allowing earlier interventions. This argument is in line with the study by Odhiambo et al., (2019), which showed that fingerprint identification system could be used for the rapid tracking of patients via association of their health records to a unique and non-changing identifier. Early detection of non-payment means that a community health worker or peer educator could follow-up with the individual who is behind on payments.

The data also indicates a decrease in duplicate records of people with HIV through the fingerprint registration programs. Duplicate records can have an enormous impact on patient safety and program monitoring. Getting rid of duplication ensures that treatment choices are based on complete and correct information, which lowers the chances of overdose, not getting enough treatment, or having to conduct unnecessary lab tests. It also contributes to the accuracy of HIV statistics reported at the institutional, district and national levels, which is essential for the informed decisions on HIV policies and resource allocation. The discovery has revealed that there is a direct systemic benefit in fingerprint registration. The study conducted by Wanyama et al. (2020) indicated that biometrics eliminate duplication by preventing duplication of names or identification numbers among individuals. Duplicate data can misrepresent patient numbers in HIV treatment, potentially resulting in the misallocation of resources and difficulty monitoring treatment. Marcus et al. (2016) also emphasized on the need for proper statistics for national HIV surveillance and ensuring uninterrupted treatment for patients.

Besides, the findings showed that the fingerprint registration system is a good tool to monitor and facilitate data informed decision making, which helps to improve service delivery and to achieve the desired performance, including the UNAIDS 95-95-95 targets. Nearly all respondents reported viewing this benefit, demonstrating frontline health professionals' familiarity with the importance of program accountability within the system. These

results are similar to those of Adebayo et al. (2019), who said that automated patient identification systems speed up the collection of clinical markers and improve the accuracy of program performance monitoring. Njuguna et al. (2018) also pointed out that reporting is essential for predicting medicine needs, staffing needs, and outreach programs if done correctly and on time.

In addition, the results showed that the fingerprint system could also improve patient satisfaction and reduce waiting times, which are factors that promote the attendance of patients. This observation is in line with the findings by Ouma and Okumu (2020), who observed that fingerprint registration reduces administrative time which involves manual searches of files and identification of ID. However, in areas with weak internet connections, the time-saving effect could be offset by technical setbacks (Asangansi et al., 2018). These findings highlight the need to address technological limitations in order to maximize the efficiency gains of biometric registration for PLHIV.

The Health Belief Model showed that most of the respondents were of the view that the fingerprint registration system had several advantages. They felt that the system minimized the loss of records, speed up services and maintained continuity of services. However, there were also some perceived impediments, such as wasting time due to slow internet connections and concerns about low privacy, stigma, long waiting hours, and transportation issues. This implies that, while the majority of people think the system is well suited to enhance service efficiency and to keep the services in place, there are still extensive issues regarding the infrastructure and confidence. This observation is consistent with the Health Belief Model, which states that the adoption depends on the perceived benefits and barriers (Champion&Skinner,2008).

The study revealed that all PLHIV, health care providers and program coordinators were generally receptive to the use of the fingerprint registration method. They all knew how it could improve patient tracking, data accuracy, monitoring and efficiency of service. The advantages of enhanced data quality, speed of service, reduced loss of records and continuity of care far outweigh the concerns of privacy and technical problems. Improving infrastructure and making communication more open may help to make the system more acceptable by addressing these concerns. The results highlight the importance of raising awareness in the community and adapting the work of clinics to reduce stigma. This argument is consistent with the observation by Layer et al. (2014), who observed that SSA individuals feeling their privacy was being violated were less likely to attend HIV care facilities. One solution to this problem is to create clinics where there are private waiting rooms, ensure that there are strict confidentiality protocols, and provide staff with training on client privacy. Without acting on the issue of privacy, LTFU in HIV clients in CTCs will likely remain. The study revealed that socioeconomic issues play a significant role in subsequent engagement in healthcare services among people with HIV. In rural programs, the location of the HIV clinic and transportation costs are among the factors associated with treatment discontinuations (Pascoe et al., 2019). Action measures that may help to significantly improve retention include decentralizing CTC services, deployment of mobile clinics, and provision of transport stipends. These findings suggest that beyond health education, interventions need to address factors that affect the functionality of the health education system, such as financial constraints, which can undermine the effectiveness of an effective fingerprint registration system.

Conclusion and Implication

From the results, it can be concluded that the fingerprint registration system is an effective method for reducing the number of clients who miss follow up appointments at their clients' care and treatment centers. This is because it is both operationally and clinically advantageous. The system provides a unique and secure identity for clients, reducing duplication of patient data and improving monitoring of patients. It also increases the accuracy of health data, making it easier to follow-up on time and receive HIV care. Furthermore, the overwhelmingly positive feedback from HIV clients, health care providers, and program coordinators, stemming from tangible improvements in retention, trust, and service efficiency underscores its importance as a tool to improve HIV program. The study, however, makes it very clear that there are problems that need to be addressed, such as poor system operation, privacy concerns, extent of coverage, and stigma. These problems need to be solved so that high levels of acceptance are maintained and the intended purpose of the system is maximized.

Recommendation

It is critical for people living with HIV to understand the role, benefits, and privacy protections of the fingerprint registration system on a frequent basis to build trust and dispel concerns about data security. PHEWs can be effective in supporting people to accept and engage in CTCs. Further, clients should be offered tailored support to

address barriers to attendance at the clinic, including but not limited to transportation vouchers, or home-based care programs. This will keep clients engaged in treatment, no matter where they are or what their finances are.

The government, especially the Ministry of Health, should prioritize and invest in fingerprint registration technologies for long-term sustainability, as these technologies have a positive impact on reducing LTFU, keeping people in care, and improving health data quality. The technical integration of the DHIS-2 and CTC-2 databases should also be the government's responsibility. This can be done with the help of middleware solutions, automating data pipelines, implementing unique patient identification and setting up synchronization protocols for institutions that are not online. Creating a single health dashboard using CTC-2 and DHIS-2 will enable people to make informed decisions based on facts and utilize resources more efficiently.

Healthcare practitioners such as doctors, nurses, and clerks should be trained regularly in the technical and ethical aspects of fingerprint registration. The training should cover problem-solving and coping skills for the system, patient delays, patient confidentiality and patient education about the system's potential benefits for patients with HIV. In addition, healthcare professionals can leverage fingerprint registration within their clinic processes to improve patient waiting times and boost the efficiency of clinical operations, thereby strengthening patient trust.

Limitations of the Study

There were specific challenges in the study such as gaining access to health-related information (health reports from clients who visited health institutions). Some of the facilities would not give the necessary statistics regarding their performance in fingerprint registration. Secondly, it was hard to find enough time for interviews with respondents and to acquire accurate information on HIV clients from respondents in the facilities. These challenges were addressed by obtaining official permission and adhering to ethical procedures to access the required information. Interviews were scheduled at convenient times to accommodate respondents' availability.

Areas for Further Studies

Further studies are needed to assess the effectiveness of biometric (fingerprint registration) and non-biometric patient tracking systems in different geographic, infrastructural and economic settings, and to help national policymakers make informed choices. Furthermore, to investigate barriers to country-wide implementation of fingerprint registration for PLHIV, including technological, logistical, cultural and policy challenges in order to inform policy development and help in the development of inclusive, sustainable, and solution-oriented patient tracking systems.

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