



Enhancing Performance of HIV/AIDS Projects through Digital Health Interventions for Client Appointments in Kisumu County, Kenya

Collins Mudogo 

University of Nairobi, Kenya

Angeline Mulwa 

University of Nairobi, Kenya

Dorothy Kyalo 

University of Nairobi, Kenya

Cathy Mwangi 

University of Maryland, Baltimore, USA

Suggested Citation

Mudogo, C., Mulwa, A., Kyalo, D. & Mwangi, C. (2023). Enhancing Performance of HIV/AIDS Projects through Digital Health Interventions for Client Appointments in Kisumu County, Kenya. *European Journal of Theoretical and Applied Sciences*, 1(4), 618-629.
DOI: [10.59324/ejtas.2023.1\(4\).57](https://doi.org/10.59324/ejtas.2023.1(4).57)

Abstract:

This study examined the perceptions of health service providers on the relationship between utilization of digital health intervention (DHI) for clients' adherence to appointments and performance of HIV/AIDS projects in Kisumu County using an ex-post facto cross-sectional descriptive survey design. A census approach was used to recruit 191 participants who were at work during the data collection period across eight health facilities where the DHI was being used. Quantitative data was collected electronically using a questionnaire built a 5-point Likert scale and analyzed using SPSS version 26.

Descriptive analysis involved generating the means and standard deviations while inferential analysis involved determining correlations and linear regression modelling. Results for both descriptive and inferential statistics are presented using tables. Qualitative data was collected using a key informant interview guide and analyzed thematically. Data were collected in January 2022. Results show a high level of utilization of DHI for clients' appointments adherence (composite mean =4.28; SD=0.77; CI=95%). Performance of HIV/AIDS projects was scored highly with a composite mean of 4.47 (SD=0.057; CI=95%). A Pearson correlation coefficient of 0.349; p value<0.001, showed a statistically significant positive relationship between the two variables. Utilization of DHI for clients' appointments adherence could potentially influence performance of HIV/AIDS projects by up to 28% ($R^2=0.28$, p value<0.001). The study concluded that the DHI for clients' appointments adherence was critical in improving adherence to treatment plans and management of appointments as an electronic diary at the health facilities hence improving performance of HIV/AIDS projects.

Keywords: *Digital health interventions, HIV/AIDS, Client appointments, Project performance.*



Introduction

Digital health refers to the use of communication technology to address gaps within the health sector. The World Health Organization (WHO) classifies digital health interventions (DHIs) into four, thus categorizing the different ways in which DHIs can be used to support health system needs. The four classifications by the WHO are namely DHIs for clients, DHIs for healthcare service providers, DHIs for health system managers and DHIs for data services. These classifications are based on the user and the use of the specific DHI within the health system. In some cases, one DHI may have multiple categories of users and uses thus cutting across the four classifications (WHO, 2018).

Globally, the use of DHIs has shown potential to build capacity among health service providers, empower communities with health information, reduce the barriers between the patients and service providers such as distance to health facilities and congestion at health facilities by providing services remotely (Kop et al., 2018; Odeny et al., 2019; Vojnov et al., 2017). DHIs have been tested in various fields of health, including promotive, preventive, care and treatment. Most of the studies and projects demonstrate positive impacts resulting from the use of DHIs for both infectious and non-communicable chronic diseases (Hong & Guo, 2018; Lester, 2013; Mohammed et al., 2016). Further, DHIs are capable of enhancing systems in a much more effective and efficient manner while creating accountability compared to manual processes (Mohammed et al., 2016; Okal et al., 2016; Vojnov et al., 2017).

Among people living with HIV/AIDS, studies have shown that the use of reminder messaging as a strategy improves adherence to treatment leading to viral suppression. Studies have shown that patients who receive mobile phone text messages (whether daily or weekly) or a call are usually at lower risks of being non-adherent to treatments compared to those receiving standard care (Gitau et al., 2014; Horvath T et al., 2012; Huang et al., 2013; Lester, 2013; Mukanya, 2017; Sherman et al., 2020). A review of the impact of

DHIs in low-to-middle income countries (LMICs) found that most interventions were those that fall within the client communication and behaviour change domain. This was because of the high uptake of mobile phones in LMICs. The area of treatment adherence has so far received much attention. With people becoming more contactable, mobile technologies are offering a useful avenue to deliver health information thus improving health-seeking behaviours and clinical decisions.

However, there are other circumstantial and contextual issues that could negatively affect the effectiveness of some DHIs. Some studies have shown that patients who received short weekly mobile phone text messages were at no different risk of being non-adherent (statistically nonsignificant) compared to those receiving standard care. In a randomized controlled trial in China, a mobile phone call intervention to patients could maintain high adherence rates but there were no statistically significant differences found between the control and treatment groups (Huang et al., 2013). A qualitative study to discuss programmatic barriers to SMS-based interventions for HIV-positive youth in Uganda revealed that the youth strongly felt that the success of the SMS reminder intervention hinged on ensuring confidentiality about their HIV-positive status. Further, the study noted four main challenges of implementing SMS interventions which included inaccessibility to mobile phones by all targeted beneficiaries, sharing of mobile phones which could be problematic among youth who had not disclosed, restrictions on use of mobile phone by parents and teachers among the youth and potential for accidental disclosure of HIV status because others may knowingly or unknowingly read their messages when their phone is not with them (Dowshen et al, 2012).

The use of DHIs within the HIV/AIDS program in Kenya dates back to over a decade with the roll-out of the electronic medical records (EMR). In Kisumu County, HIV/AIDS projects in different health facilities are utilizing various DHIs to enhance service delivery to patients. Whereas evidence already exist on the positive effect of DHIs on specific outcomes

such as improving appointments and treatment adherence, and reducing lost to follow-up, there was no study known to the researchers that focused on unearthing the overall influence of utilization of DHIs for clients' appointments adherence on performance of the HIV/AIDS projects from a broader perspective. The novelty of this study is that it examined the extent to which utilization of DHIs for clients' appointments adherence could account for improvements in the performance of HIV/AIDS projects in terms of evidence-based decision making, quality of services offered, linkage of clients to appropriate care, level of adherence to treatment plans by clients, quality of project's reports and project expenditure based on health service providers perspectives.

Materials and Methods

Design of the Study

The study employed an ex-post facto cross-sectional descriptive design to elicit understanding on the influence of the use of the digital health intervention for clients' appointments adherence on the performance of the HIV/AIDS projects in Kisumu County. The study design enabled the researcher to describe the situation in terms of the influence of utilization of digital health intervention for clients' appointments adherence on the performance of HIV/AIDS without much external control or manipulation of the independent variable. This design was suitable because the HIV projects at the selected facilities in Kisumu County were already utilizing DHIs and the study was to only find out what the influence of the utilization of the DHIs was on performance of the HIV/AIDS projects.

Data Collection Tools

The study used a mixed methods approach by combining both quantitative and qualitative approaches. Quantitative data was collected using a questionnaire that was built on a 5-point Likert scale (*1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree*). This was to ensure that measuring of the perspectives of the participants was standardized based on the

scores across the 12 statements on the Likert scale. An in-depth interview guide was used to collect qualitative data from participants. Data was recorded and later transcribed into narratives in word documents. Data collection was done in January 2022.

Study Sites

The study was conducted in eight hospitals in Kisumu County comprising two level V hospitals and six level IV hospitals where the digital health intervention for clients' appointments adherence was being utilized within the HIV/AIDS projects.

Study Participants

Using a census approach the study managed to recruit 191 participants who were at their work stations at the time of data collection out of the targeted population of 224 based on a mapping exercise that had been conducted a week to the study period. The participants were health service providers who were utilizing the DHI for clients' appointments adherence at the hospitals during service delivery. They included clinical staff and other users of the DHI such as health records and information officers.

Data Analysis

Analysis of the quantitative data was done using SPSS version 26. Descriptive analysis involved generation of means and standard deviations while inferential statistics involved generation of the Pearson Coefficient Correlation and linear regression models. Qualitative data was analysed based on a thematic framework that was developed iteratively the narratives. Quantitative findings have been presented using tables while qualitative findings have been presented using narratives in verbatim.

Results

The results are presented under three main sub topics namely i) Perceptions of the participants on performance of HIV/AIDS projects, ii) Perceptions of the participants on utilization of DHIs for clients' appointments adherence and iii) Relationship between utilization of DHIs for

clients' appointments and performance of HIV/AIDS projects.

Perceptions of the Participants on Performance of HIV/AIDS Projects

The study assessed the perceptions of performance of HIV/AIDS projects from a broader perspective involving both patient level outcomes and project management indicators. Performance of HIV/AIDS projects was measured in terms of evidence-based decision

making, quality of services, linkage of clients to appropriate care, level of adherence to treatment plans by clients, quality of project's reports, project's expenditure. Data in Table 1 presents the results in terms of participants' scores on various aspects of performance of HIV/AIDS as conceptualized in this study using 12 statements based on a 5-point Likert Scale (*where 1=strongly disagree, 2= agree, 3= neutral, 4= agree and 5=strongly agree*).

Table 1. Performance of HIV/AIDS Projects

Frequency and percentage								
Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	Mean	SD
	n %	n %	n %	n %	n %	n %		
Evidence based decision making								
We base our clinical decisions on the health of our clients on evidence generated from data	0 0.00%	1 0.53%	3 1.58%	78 41.05%	108 56.84%	190 100.00%	4.54	0.559
We base our project management processes on evidence generated from data	0 0.00%	1 0.53%	3 1.58%	69 36.32%	117 61.58%	190 100.00%	4.59	0.554
Linkage of clients to appropriate care								
We link our clients to the appropriate care based on evidence	0 0.00%	0 0.00%	1 0.53%	70 36.84%	119 62.63%	190 100.00%	4.62	0.497
We link a high proportion of our clients in a timely manner	0 0.00%	0 0.00%	2 1.05%	73 38.42%	115 60.53%	190 100.00%	4.59	0.513
Level of adherence to treatment plans by clients								
Majority of our clients adhere to treatment plans	0 0.00%	0 0.00%	4 2.11%	77 40.53%	109 57.37%	190 100.00%	4.55	0.539
Our numbers of loss to follow up clients has declined over time	0 0.00%	4 2.11%	15 7.89%	74 38.95%	97 51.05%	190 100.00%	4.39	0.724
Quality of project reports								
We have improved the quality of our project reports since introduction of DHIs	0 0.00%	0 0.00%	6 3.16%	71 37.37%	113 59.47%	190 100.00%	4.56	0.557
Quality of services								
Majority of our clients are satisfied with the services we offer	0 0.00%	0 0.00%	8 4.21%	75 39.47%	107 56.32%	190 100.00%	4.52	0.579
We deliver better services to our clients	0 0.00%	0 0.00%	2 1.05%	67 35.26%	121 63.68%	190 100.00%	4.63	0.506
We have improved HIV/AIDS program outcomes	0 0.00%	1 0.53%	2 1.05%	84 44.21%	103 54.21%	190 100.00%	4.52	0.551
Projects expenditure								
We have reduced HIV/AIDS project expenses as a result of utilization of DHIs	0 0.00%	2 1.06%	6 3.17%	81 42.86%	100 52.91%	189 100.00%	4.48	0.615
Composite scores							4.47	0.57

As shown in Table 1, the study used 12 statements on a standard 5-point Likert scale to measure perceptions of the participants regarding performance of HIV/AIDS projects. Performance of HIV/AIDS projects had a composite mean of 4.47 (SD=0.57). The mean scores on specific statements or aspects of performance were as follows: basing clinical decisions regarding the health of the clients on evidence generated from data 4.59 (SD=0.55); making project management process decisions based on data 4.59 (SD=0.554); linking clients to the appropriate care based on evidence 4.62 (SD=0.497); linking high proportion of their clients to care in a timely manner 4.59 (SD=0.513); majority of their clients adhering to treatment plans 4.55 (SD=0.539); the number of their lost to follow-up clients having declined 4.39 (0.724); improvements in the quality of project reports 4.52 (SD=0.557); majority of clients being satisfied with services being offered 4.52 (SD=0.579); health facilities delivering better services with DHIs 4.63 (SD=0.506);

experiencing improvements in HIV/AIDS program outcomes 4.52 (SD=0.551) and reduced HIV/AIDS project expenses due to utilization of DHIs 4.48 (SD=0.615). Overall, most of the parameters had higher means and smaller standard deviation compared to the composite mean and SD indicating increased levels of agreement among participants on high performance on those specific parameters.

Perceptions of the Participants on Utilization of DHIs for Clients' Appointments Adherence

The study sought to establish the perceptions of the participants on four aspects of utilization of DHI for appointments' management namely clients enrolled on the DHI, clients receiving automated reminders, defaulted clients traced using DHI and use of DHI to manage clients' appointments. Twelve statements were used to measure the aspects of utilization of DHIs for clients' appointments adherence as shown in Table 2.

Table 2. Utilization of DHIs for Appointment Management

Frequency and percentage								
Description	SD	D	N	A	SA	Total	Mean	Std. Deviation
	n %	n %	n %	n %	n %	n %		
Clients enrolled on the DHI								
We have created adequate awareness among our clients to enable them enrol on the digital health intervention for client's appointment adherence	2 1.10%	4 2.20%	9 5.00%	91 50.30%	75 41.40%	181 100.00%	4.29	0.757
We have the necessary resources to ensure we enrol a large majority of our clients on the digital health intervention for client's appointment adherence	1 0.60%	6 3.30%	21 11.60%	86 47.50%	67 37.00%	181 100.00%	4.17	0.802
A large proportion of our clients are already enrolled on the digital health intervention for client's appointment adherence	1 0.60%	1 0.60%	6 3.30%	78 43.10%	95 52.50%	181 100.00%	4.46	0.646
Clients receiving automated reminders								
We have the necessary resources to support continued implementation of the digital health intervention for clients to receive the automated messages	1 0.60%	13 7.20%	32 17.70%	89 49.20%	46 25.40%	181 100.00%	3.92	0.875

We have put in place efforts to ensure that a large proportion of our clients receive automated appointment reminder messages using a digital health intervention	1 0.60%	4 2.21%	10 5.60%	85 47.20%	80 44.40%	180 100.00%	4.33	0.731
A very small proportion of our clients have declined receive appointment reminders through the digital health intervention for appointment adherence	4 2.20%	14 7.80%	15 8.30%	86 47.80%	61 33.90%	180 100.00%	4.03	0.968
Defaulted Clients traced using DHI								
We have the necessary resources to ensure that defaulters are traced promptly using the digital health intervention	2 1.10%	18 10.00%	22 12.20%	80 44.40%	58 32.20%	180 100.00%	3.97	0.974
All defaulter tracing outcomes are documented using the digital health intervention for appointment adherence in our facilities	1 0.60%	5 2.80%	12 6.70%	88 49.20%	73 40.80%	179 100.00%	4.27	0.754
We use the data collected using the defaulter tracing to make key decisions	1 0.60%	3 1.70%	4 2.20%	87 48.30%	85 47.20%	180 100.00%	4.40	0.674
Use of DHI to manage clients' appointments								
In our facilities We manage appointments using the digital health intervention for client's appointment adherence	2 1.20%	1 0.60%	4 2.30%	63 36.80%	101 59.10%	171 100.00%	4.52	0.689
It is easy to use the digital health intervention for client's appointment adherence	1 0.60%	0 0.00%	4 2.20%	77 42.50%	99 54.70%	181 100.00%	4.51	0.602
We manage more appointments using digital health intervention for clients' appointment adherence compared to manual registers	1 0.50%	3 1.60%	8 4.40%	66 36.30%	104 57.10%	182 100.00%	4.48	0.711
Composite mean							4.28	0.77

Findings in Table 2 show that based on the perceptions of the health service providers, utilization of the DHI for clients' appointment adherence scored an average of 4.28 (SD=0.77). Mean scores on specific statements used to measure utilization of DHI for clients appointments adherence were as follows: having created adequate awareness among clients to enable them enrol on the DHI 4.29 (SD=0.757); having the necessary resources to ensure enrolment of majority of the clients on the DHI 4.17 (SD=0.802); a large proportion of clients already having been enrolled on the DHI 4.46 (SD=0.646); having the necessary resources to support continued utilization of the DHI 3.92 (SD=0.875); having put in place the necessary efforts to ensure a large proportion of clients continue to receive automated messages 4.33 (SD=0.731); a very small proportion of clients

having declined to be part of the intervention 4.03 (SD=0.968); having the necessary resources to ensure that defaulters are traced promptly using the DHI 3.97 (0.974); having all defaulter tracing outcomes documented using the DHI 4.27 (SD=0.754); using data collected from the DHI on defaulter tracing to make key project decisions 4.40 (0.694); actually using the DHI to manage appointments in their health facilities 4.52 (SD=0.689); easiness of use the DHI for clients' appointments adherence 4.51 (SD=0.602) and managing more appointments using the DHI compared to the use of manual registers 4.48 (SD=0.711).

Relationship Between Utilization of Digital Health Interventions for Appointment Adherence and Performance of HIV/AIDS Projects

The study tested the following null hypothesis:

H0: There was no significant relationship between utilization of DHI for appointment

adherence and performance of HIV/AIDS projects in Kisumu County.

To examine the relationship between the two variables, a Pearson Correlation Coefficient was used. Findings are shown in Table 3.

Table 3. Pearson Correlation Between Utilization of DHI for Appointment Adherence and Performance of HIV/AIDS Projects

Correlation		Zscore: Performance of HIV/AIDS projects
Utilization of DHI for appointment adherence	Pearson Correlation	.349**
	Sig. (2-tailed)	0.000
	N	182

With a Pearson correlation coefficient = 0.349 and a p value < 0.001, it is evident that there was a statistically significant positive relationship between utilization of DHI for clients' adherence and performance of HIV/AIDS projects as conceptualized in this study. The Pearson Correlation coefficient result showed that indeed utilization of DHI for clients' appointment adherence could influence performance of HIV/AIDS projects in a positive direction.

A linear regression model was used in order to determine how much influence the utilization of DHI for clients' appointments could have on the performance of HIV/AIDS project.

Summary of the model:

$$y = \beta_0 + \beta_1 X_1 + \epsilon$$

Where

y = the performance of HIV/AIDS projects

β_0 = the constant

β_1 = coefficient for utilization of digital health intervention for clients' appointment adherence

X_1 = utilization of digital health intervention for clients' appointment adherence

ϵ = random error

Results of the linear regression model are shown in Table 4

Table 4. Linear Regression Model Between Utilization of DHI for Appointment adherence and Performance of HIV/AIDS Projects

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df 1	df 2	Sig. F Change
1	.529 ^a	0.280	0.225	0.88678372	0.28	5.088	12	157	.000 ^b
Predictor: Utilization of DHI for clients' appointment adherence									
Coefficients									
Model	Unstandardized Coefficients			Standardized Coefficients	t	Sig.			
	B	Std. Error	Beta						
1	(Constant)	-0.004	0.070		-0.063	0.950			
	Zscore: Utilization of DHIs for clients' appointments adherence	0.350	0.070	0.349	4.996	0.000			
a. Dependent Variable: Zscore: Performance of HIV/AIDS projects									

Based on the R square value of 0.28; p value < 0.001, the results show that utilization of DHIs

for clients' appointment adherence contributed to performance of HIV/AIDS projects by

28.0%. To establish whether the influence of the utilization of the DHIs for clients' appointment adherence was significant, Table 4 presents the coefficient of the independent variable (utilization of DHI for clients' appointments adherence) in the model.

Results in table 4 show $F_{(12,157)} = 5.088$; p value < 0.001 indicating that there was a statistically significant relationship between utilization of DHI for clients' appointments adherence and performance of HIV/AIDS projects. The results in Table 4 generated a beta value of 0.349 indicating that a unit increase in the utilization of DHIs for clients' appointment adherence contributed to 34.9% of the positive changes in performance of HIV/AIDS projects. The implications of the study finding is that utilization of DHI for appointment adherence was critical in determining performance of the HIV/AIDS projects.

The model would therefore be:

Performance of HIV/AIDS projects = $-0.004 + 0.350$ (utilization of DHI for clients' appointment adherence + ϵ ; $t=4.996$; p value < 0.01). Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted implying that there was statistically significant relationship between utilization of digital health intervention for clients' appointments adherence and performance of HIV/AIDS.

Key informant interviews were used to unearth in-depth perceptions from the participants on how utilization of DHIs for clients' appointment adherence influences performance of HIV/AIDS projects in Kisumu County. This enabled the researcher to gain more insights from the respondents. Majority of the respondents reported that "USHAURI" which was the main DHI for clients' appointment adherence was being used optimally and was very useful in scheduling of appointments, reminding clients about their appointment days, managing appointments at the health facilities and tracking clients who were defaulters. Asked to explain the use of any digital health intervention for clients' appointments adherence in their health facilities, some of the respondents said:

R: The use of USHAURI is very optimal. This is done by USHAURI, that is, client enrolment, client reminders via SMS, defaulted client tracing, and managing client appointments. Adherence also foreseen, counselling, registration and charts drawn, reports I mean everything to do with appointments is done using USHAURI- KII - ID KC-003.

R: USHAURI does client enrolments, all client reminders in 7 days and 2 days' time, defaulted client tracing and managing client appointments through bookings. It has made our work very easy- KII-ID-AH 002.

The qualitative research findings implied that once clients' appointments were well managed and clients were able to adhere to treatment schedules, it was clear that there would be good performance of the HIV/AIDS projects in terms of accessibility and use of services at the health facilities, management of the appointments at the facility, creating reports given that the data was available and generally making their work as service providers much easier.

Discussion

This study found out that most of the respondents who were actually health service providers agreed that the HIV/AIDS projects were performing well based on aspects measured. The study measured performance from a very broad perspectives including patient outcomes and project management processes and indicators. It is critical to note that the aspect of facilities being able to manage appointments using the DHIs for client's appointment adherence scored the highest mean (mean 4.52: SD= 0.689) and this was closely followed by the aspect of easiness of use of the DHIs (mean=4.51; SD=0.602). This implies that the technology used is simple and easy to use. Evidence has shown that DHIs based on simple technologies have higher chances of being adopted and scaled resulting in achievement of the objectives by utilizing the interventions on a

large scale(Butler et al., 2012)(Haynes et al., 2008)(Dowshen et al, 2012). However, the study found out that the aspect of availability of the necessary resources to support continued implementation of the DHIs for clients to receive the automated messages scored the lowest mean (mean 3.92; SD=0.875). Many resource poor countries have competing needs for the health sector. It is clear that a lot of investments target other areas such as infrastructure, human resources for health, and health commodities. This leaves very little investment to be put into digital interventions. Currently, most of the interventions are fully funded by development partners. This situation makes it difficult to achieve sustainability of the interventions. The Kenya eHealth Policy (2016-2030) prioritizes the need for Government's leadership and investment into eHealth. The policy calls for the need for the Government to develop an eHealth investment plan and encouragement of Public-Private Partnerships so as to ensure that the interventions go beyond piloting phases(Ministry of Health Kenya, 2016).

Whereas previous studies have demonstrated the positive impact of digital health interventions on specific health outcomes such as adherence and retention(Butler L et al., 2012; Finocchiaro-kessler et al., 2014; Glasgow et al., 1999; Kop et al., 2018; Maduka & Tobin-west, 2013; Mbuagbaw et al., 2013; Mukanya, 2017; Rana et al., 2015; Sherman et al., 2020; Viladoms & Rovira, 2014), this study examined the influence of utilization of DHIs on the performance of HIV/AIDS projects from a much more broader perspective. This was innovative as the study attempted to establish the extent to which utilizing the digital health intervention for clients' appointments adherence could potentially improve overall project performance from a management point of view. The findings of this study are critical to HIV/AIDS projects' managers as they demonstrate that importance of incorporating technology into management of clients on care. Technology has potential to improve the quality of services especially improving efficiencies and effectiveness, increasing the level of satisfaction among clients for example by saving on waiting time and

cutting down on expenses such as budgets needed to buy manual registers or diaries.

One of the limitations of this study was that it did not consider the perspective of the patients who are the targeted beneficiaries of the DHIs. This was because the conceptualization of the study was to be at facility level and from the users (service providers') perspectives. Further, the conceptualization of the dependent variable of the study, performance of the HIV/AIDS projects, would largely have benefited from the service providers' perspectives than the patients.

Conclusion

The study found high levels of utilization of DHIs for clients' appointments adherence across the study sites. The study revealed that the service providers rated performance of their HIV/AIDS projects highly. It is clear that utilization of DHIs had significant influence on the performance of HIV/AIDS projects. The study determined a statistically significant and positive relationship between the two variables. The findings are critical for HIV/AIDS project managers who may want to incorporate the use of technology in their projects to improve performance of service delivery to their clients. This study calls for increased investment into the implementation of the DHIs for clients' appointments adherence to achieve optimal use thus achieving optimal value in terms of influence on performance of the HIV/AIDS projects. The study recommends the use of similar technology in other health program areas where clients are managed for longer periods of time.

Acknowledgement

MCM conceptualized, carried out the study, analysed the data and wrote the paper. MA, KD and CM helped in reviewing and shaping the study. All authors reviewed the paper before submission for publication.

Ethical considerations

The study was approved by the University of Nairobi/ Kenyatta National Hospital Ethics and Research Committee. A permit to conduct the study was obtained from the National Commission for Science, Technology and Innovation ethics. Permission was sought from the County Government of Kisumu. All participants provided consent to participate.

Declaration of Conflict of Interest

All authors declare no conflict of interest.

Funding

There was no external funding for this study.

References

- Butler, L., Horvath, T., Baggaley, R., Suthar, A., Negusie, E. & Rutherford, G. (2012). Proceedings from 7th International AIDS Society (IAS) Conference on HIV Pathogenesis, Treatment and Prevention: *Mobile health technologies (mHealth) for promoting adherence to antiretroviral therapy : a systematic review*. UCSF.
- Dowshen, N. (2012). Improving adherence to antiretroviral therapy for youth living with HIV/AIDS: A pilot study using personalized, interactive, daily text message reminders. *Journal of Medical Internet Research*, 14(2), 168–175. <https://doi.org/10.2196/jmir.2015>
- Finocchiaro-Kessler, S., Gautney, B. J., Khamadi, S., Okoth, V., Goggin, K., Spinler, J. K., Mwangi, A., Kimanga, D., Clark, K. F., Olungae, H. D., Preidis, G. A., & HITSystem Team (2014). If you text them, they will come: using the HIV infant tracking system to improve early infant diagnosis quality and retention in Kenya. *AIDS (London, England)*, 28 Suppl 3(03), S313–S321. <https://doi.org/10.1097/QAD.0000000000000332>
- Gitau, L., Boruett, P., Njogo, S., Nguhiu, P., Awour, C., Kagai, D., Chalker, J., Tomson, G., & Abuya, T. (2014). Implementing Tools to Promote Adherence to Antiretroviral Therapy at Facilities in Kenya. *East African medical journal*, 91(10), 353–360.
- Glasgow, R. E., Vogt, T. M., & Boles, S. M. (1999). Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *American journal of public health*, 89(9), 1322–1327. <https://doi.org/10.2105/ajph.89.9.1322>
- Hall, C. S., Fottrell, E., Wilkinson, S., & Byass, P. (2014). Assessing the impact of mHealth interventions in low- and middle-income countries--what has been shown to work?. *Global health action*, 7, 25606. <https://doi.org/10.3402/gha.v7.25606>
- Nieuwlaat, R., Wilczynski, N., Navarro, T., Hobson, N., Jeffery, R., Keepanasseril, A., Agoritsas, T., Mistry, N., Iorio, A., Jack, S., Sivaramalingam, B., Iserman, E., Mustafa, R. A., Jedraszewski, D., Cotoi, C., & Haynes, R. B. (2014). Interventions for enhancing medication adherence. *The Cochrane database of systematic reviews*, 2014(11), CD000011. <https://doi.org/10.1002/14651858.CD000011.pub4>
- Guo, Y., Xu, Z., Qiao, J., Hong, Y. A., Zhang, H., Zeng, C., Cai, W., Li, L., & Liu, C. (2018). Development and Feasibility Testing of an mHealth (Text Message and WeChat) Intervention to Improve the Medication Adherence and Quality of Life of People Living with HIV in China: Pilot Randomized Controlled Trial. *JMIR mHealth and uHealth*, 6(9), e10274. <https://doi.org/10.2196/10274>
- Horvath, T., Azman, H., Kennedy, G. E., & Rutherford, G. W. (2012). Mobile phone text messaging for promoting adherence to antiretroviral therapy in patients with HIV infection. *The Cochrane database of systematic reviews*, 2012(3), CD009756. <https://doi.org/10.1002/14651858.CD009756>
- Huang, D., Sangthong, R., McNeil, E., Chongsuvivatwong, V., Zheng, W., & Yang, X. (2013). Effects of a Phone Call Intervention to Promote Adherence to Antiretroviral Therapy and Quality of Life of HIV/AIDS Patients in

Baoshan, China: A Randomized Controlled Trial. *AIDS research and treatment*, 2013, 580974. <https://doi.org/10.1155/2013/580974>

Kop, M. L., Muhula, S., Nagide, P. I., Thabane, L., Gelmon, L., Awiti, P. O., Abunah, B., Kyomuhangi, L. B., Budd, M. A., Marra, C., Patel, A., Karanja, S., Ojaka, D. I., Mills, E. J., Ekström, A. M., & Lester, R. T. (2018). Effect of an interactive text-messaging service on patient retention during the first year of HIV care in Kenya (WelTel Retain): an open-label, randomised parallel-group study. *The Lancet. Public health*, 3(3), e143–e152. [https://doi.org/10.1016/S2468-2667\(17\)30239-6](https://doi.org/10.1016/S2468-2667(17)30239-6)

Lester. (2013). 8th International Conference on HIV Treatment and Prevention Adherence: *Call Me Maybe? Text messaging to strengthen ART adherence and retention in care in global settings*.

Maduka, O., & Tobin-West, C. I. (2013). Adherence counseling and reminder text messages improve uptake of antiretroviral therapy in a tertiary hospital in Nigeria. *Nigerian journal of clinical practice*, 16(3), 302–308. <https://doi.org/10.4103/1119-3077.113451>

Mbuagbaw, L., van der Kop, M. L., Lester, R. T., Thirumurthy, H., Pop-Eleches, C., Smieja, M., Dolovich, L., Mills, E. J., & Thabane, L. (2013). Mobile phone text messages for improving adherence to antiretroviral therapy (ART): a protocol for an individual patient data meta-analysis of randomised trials. *BMJ open*, 3(5), e002954. <https://doi.org/10.1136/bmjopen-2013-002954>

Ministry of Health Kenya. (2016). Kenya national eHealth policy 2016-2030. Policy Document. Retrieved from <https://health.eac.int/publications/kenya-national-ehealth-policy-2016-2030>

Mohammed, S., Glennerster, R., & Khan, A. J. (2016). Impact of a Daily SMS Medication Reminder System on Tuberculosis Treatment Outcomes: A Randomized Controlled Trial. *PloS one*, 11(11), e0162944. <https://doi.org/10.1371/journal.pone.0162944>

Mwangi, C. & Mukanya, C. (2017). Does

Message-Based Communication Through Mobile Phones for Medication and Treatment Adherence Improve Health Outcomes? A Systematic Review. *Journal of Pharmaceutical Care & Health Systems*, 04. <https://doi.org/10.4172/2376-0419.1000179>

Odeny, T. A., Hughes, J. P., Bukusi, E. A., Akama, E., Geng, E. H., Holmes, K. K., & McClelland, R. S. (2019). Text messaging for maternal and infant retention in prevention of mother-to-child HIV transmission services: A pragmatic stepped-wedge cluster-randomized trial in Kenya. *PLoS medicine*, 16(10), e1002924. <https://doi.org/10.1371/journal.pmed.1002924>

Okal, J., Saraswati, L. R., Singh, R., Matheka, J., & Owuor, D. (2016). Proceedings from 12th International Conference on HIV Treatment and Prevention Adherence: *Effectiveness of Cellphone counseling on PMTCT retention and uptake of early infant diagnosis in Kisumu, Kenya*. Miami, Florida. Retrieved from https://iapac.org/AdherenceConference/presemtations/ADH2017_OA276.pdf

Rana Y, Jessica H, Huang H, Kambugu A, Mukasa B, Thirumurthy H, Wabukala P, Wagner G, & Linnemayr S. (2015). *Short Message Service (SMS) -Based Intervention to Improve Treatment Short Message Service (SMS) -Based Intervention to Improve Treatment Adherence among HIV-Positive Youth in Uganda: Focus Group Findings*. *Health Psychology and Behavioral Medicine*, 5(1), 101-109. <https://doi.org/10.1371/journal.pone.0125187>

Segun, A.D. & Oyer, S. (2015). Overcoming the Challenges of Early Infant Diagnosis of HIV in Low-And Middle-Income Settings. *International Journal of Novel Research in Life Sciences*, 2, 16-26.

Sherman, E. M., Niu, J., Elrod, S., Clauson, K. A., Alkhateeb, F., & Eckardt, P. (2020). Effect of mobile text messages on antiretroviral medication adherence and patient retention in early HIV care: an open-label, randomized, single center study in south Florida. *AIDS research and therapy*, 17(1), 16. <https://doi.org/10.1186/s12981-020-00275-2>

Key Populations. (2019). My Future. My Choice. Using Information Communication Technology

and mHealth to Engage and Retain Key Populations in HIV Services in Vietnam. Retrieved from <https://www.pepfarsolutions.org/solutions/2019/1/4/my-future-my-choice-using-information-communication-technology-and-mhealth-to-engage-and-retain-key-populations-in-hiv-services-in-vietnam>

Anglada-Martinez, H., Riu-Viladoms, G., Martin-Conde, M., Rovira-Illamola, M., Sotoca-Momblona, J. M., & Codina-Jane, C. (2015). Does mHealth increase adherence to medication? Results of a systematic review. *International journal of clinical practice*, 69(1), 9–32. <https://doi.org/10.1111/ijcp.12582>

Vojnov, L., Markby, J., Boeke, C., Penazzato, M., Urick, B., Ghadrshenas, A., Harris, L., Ford, N., & Peter, T. (2017). Impact of SMS/GPRS Printers in Reducing Time to Early Infant Diagnosis Compared With Routine Result Reporting: A Systematic Review and Meta-Analysis. *Journal of acquired immune deficiency syndromes* (1999), 76(5), 522–526. <https://doi.org/10.1097/QAI.0000000000001526>

WHO. (2018). Classification of digital health interventions V1.0. Retrieved from <https://apps.who.int/iris/bitstream/handle/10665/260480/WHO-RHR-18.06-eng.pdf>