



# Antiretroviral Drug Management Tool and Performance of HIV/AIDS projects in Kisumu County, Kenya: A Digital Health Solution Approach

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## Abstract:

The aim of this study was to assess the influence of utilization of the digital health intervention for antiretroviral drug management on performance of HIV/AIDS projects in Kisumu County. An ex-post facto cross-sectional descriptive study was conducted to gain understanding on the influence of the use of the digital health intervention for antiretroviral drug management on the performance of the HIV/AIDS projects. The study was conducted in eight (2 level V and 6 level IV) health facilities providing HIV/AIDS care and treatment in Kisumu. Using a census approach the study recruited 191 participants who were health service providers across the study sites. The study used a 5-point Likert scale to measure the

perspectives of the participants on aspects of utilization of the digital health intervention for antiretroviral drug management and performance of HIV/AIDS projects. A key informant interview guide was used to collect qualitative data. There was a positive significant relationship between utilization of digital health interventions for antiretroviral drug management and performance of HIV/AIDS projects with a Pearson Coefficient value=0.507, p value<0.001. A linear regression model gave an R square value of = 0.332, indicating that utilization of the digital health intervention for ARV drug management could positively influence up to 33.2% of improvement in performance of HIV/AIDS projects. This study concluded that using technology to manage drugs has potential to significantly improve overall performance of a health project. Increased investment towards scaling implementation of the Web antiretroviral dispensing tool as the commonly used intervention.

**Keywords:** *Antiretroviral Drug Management, digital health intervention, HIV/AIDS, Health project management.*

## Introduction

Considerable gains have been made towards controlling the HIV/AIDS epidemic in Africa. This is evidenced by the reducing number of new infections compared to HIV/AIDS related deaths with both new infections and deaths

being on a significant decline over time an indication that there are concerted efforts to turn the HIV/AIDS tide by ending the epidemic by 2030 (Frescura L et al., 2022). People living with HIV/AIDS and are not on treatment have occurrences of higher morbidity and mortality

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compared to those on treatment. The need to put all people living with HIV/AIDS on treatment is critical in order to achieve the goals set by the Joint United Nations Programme on HIV/AIDS (UNAIDS) (Frescura L et al., 2022; UNAIDS (Joint United Nations Programme on HIV/AIDS), 2014). The UNAIDS 95-95-95 program targets envision that 95% (1st 95) of all people living with HIV/AIDS should have known their status; 95% (2nd 95) of all those who know their status should be linked to HIV/AIDS care and treatment and 95% (3rd 95) of those on treatment should be virally suppressed by 2030 (Frescura L et al., 2022; UNAIDS (Joint United Nations Programme on HIV/AIDS), 2014); World Health Organization, 2020).

It is critical to monitor patients on care and treatment at any given time so as to ascertain the progress being made. However, public health systems in many developing countries are constrained by inefficient paper-based pharmaceutical information systems. Paper based systems are inefficient and often result in longer patient waiting times, increased work load, challenges in tracking defaulters, inaccurate, irregular, inaccessible and unreliable data for decision making on patients and stocks (Mabirizi D et al., 2018). Lack of a proper health commodities management system contributes to persistent stock-outs leading to non-adherence to treatment and poor health outcomes among patients. To achieve this milestone, there has always been the need to replace inefficient paper-based systems at the pharmacies in HIV/AIDS care and treatment projects with information technology-based systems. Evidence has shown that pharmaceutical information systems provide more reliable, real time and quality data that could be used to improve performance of projects (Baines & Babar, 2019; Schneider, 2018).

Beyond preparing and distributing the medicines and health commodities, it is becoming apparent that Pharmacies can be useful in providing critical data that can be used to make decisions aimed at ensuring uninterrupted supply of antiretroviral drugs (ARVs) for people living with HIV/AIDS. Digital health interventions

aimed at improving availability and use of medicines are essential in improving performance of health projects hence attainment of desirable health outcomes among patients (Babar, 2021; Baines & Babar, 2019; Bhattarai, 2004; Schneider, 2018; Vilela & Jericho, 2019). With support from development partners, the HIV/AIDS program in Kenya has adopted the Web ADT system to support management and especially in dispensing of the ARV drugs. The tool is used to manage dispensing of antiretroviral drugs at pharmacies in HIV/AIDS care and treatment centres. The tool is aimed at ensuring that there is high accountability of the ARV drugs at the health facilities. In addition, the tool enables service providers to monitor and account for the clients on care and treatment.

We conducted a study to assess the influence of utilization of the digital health intervention for antiretroviral drug management to determine its contribution to the overall performance of HIV/AIDS projects in selected health facilities providing care and treatment in Kisumu County. To measure utilization of digital health intervention for antiretroviral drug management, the study used a 5-point Likert scale (*1=Strongly disagree, 2= Disagree, 3=Neutral, 4=Agree and 5= Strongly agree*). The study examined the perspectives of the service providers on the volume of clients on the system who are using the antiretroviral drugs, drug pick-ups per day, use of the digital solution to dispense drugs and use of the solution to monitor antiretroviral drug stock status. Performance of the HIV/AIDS projects was measured by examining the aspects such as 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 and project's expenditure.

## Materials and Methods

### Design of the Study

An ex-post facto cross-sectional descriptive design was used to gain 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 choice of the study design was to enable 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. The HIV/AIDS projects were already on going and utilizing the digital health intervention for ARV drug management hence the aim of the study was just to assess whether the health service providers perceived the intervention as being beneficial to the performance of the projects in selected health facilities where the intervention was being implemented.

### Data Collection Tools

A mixed methods approach was adopted in this study. Both quantitative and qualitative methods of data collection and analysis were used concurrently. 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*). Twelve statements were used to measure perspectives of the participants on each variable. Qualitative data was collected using an in-depth interview guide. Data was recorded and later transcribed using word document. Data collection was done in January 2022.

### Study Sites

Eight health facilities -two level V hospitals and six level IV hospitals – were selected to be part of the study. These were health facilities where the digital health intervention for ARV drug management were being used to enhance services at the pharmacies in the comprehensive care centres.

### Study Participants

The study managed to recruit 191 participants using a census approach. A mapping exercise that had been conducted a week before the actual data collection activity had shown that in total there were 224 service providers across the eight health facilities who could be targeted

during the study. However, during the period of study some of the participants who were missed were out of their work stations due to trainings or on leave. Inclusion criteria included individuals who had interacted with the digital intervention for ARV drug management such as those working at the Pharmacies and those who were providing care at the comprehensive care centres.

### Data Analysis

SPSS version 26 was used to analyse quantitative data. There were two levels of analysing quantitative data: Descriptive analysis which involved means and standard deviations and inferential analysis which involved generation and use of the Pearson Coefficient of Correlation and Linear regression models. Qualitative data was analysed based on themes derived from the narratives. Presentation of quantitative results has been done using tables while qualitative results have been presented using using narratives in verbatim.

## Results

### Descriptive statistics

Table 1 presents the scores of the participants on the twelve statements used to measure perceptions on utilization of digital health intervention for ARV drug management.

Participants agreed that there was high level of utilization of the digital health intervention for ARV drug management with a composite mean score of 4.42 (SD=0.67); CI=95%. Specifically there was high scores on the following statements: use of DHI to ensure a large proportion of clients are on ARVS (mean score =4.48; SD=0.64); there is ability to effectively account for clients on ARVS using the DHI (mean score =4.48; SD=0.61); use of DHI to improve the daily ARV pick-ups (mean score=4.47; SD=0.65); use of the DHI for management to ensure regular ARV pick-ups by clients (mean score=4.46; SD=0.63); mechanisms have been put in place to ensure most of our clients are on ARVS in our facility (ies) (mean score=4.45; SD=0.64); use of DHI

to improve our level of accountability on ARV stock status (mean=4.42; SD=0.68); use of the DHI to ensure there are no ARV stock outs in our facilities (mean score=4.41; SD=0.68); it is easy to use the digital health intervention to dispense drugs in our facilities (mean =4.41; SD=0.70); use of DHI to better account for our daily ARV pick-ups per day with the use of the

digital health intervention for the last five years (mean=4.40; SD=0.65); use of DHI to regularly monitor ARV drug stocks (mean=4.40; 0.70); mechanisms are in place to ensure increased use of digital health interventions for ARV drug dispensation (mean=4.34; SD=0.70) and reliance on digital health intervention for ARV drug dispensation (mean 4.33; SD=0.74).

**Table 1. Utilization of digital health intervention for ARV drug management**

Description	SD	D	N	A	SA	Total	Mean	Std. Deviation
	n %	n %	n %	n %	n %	n %		
<b>Clients on ARV drugs</b>								
We have put mechanisms in place to ensure most of our clients are on ARVS in our facility (ies)	1 0.50%	1 0.50%	5 2.70%	83 45.60%	92 50.50%	182 100.00%	4.45	0.64
We use DHI to ensure a large proportion of clients are on ARVS	1 0.50%	1 0.50%	5 2.70%	78 42.90%	97 53.30%	182 100.00%	4.48	0.64
We are able to effectively account for our clients on ARVS using the DHI	0 0.00%	2 1.10%	5 2.75%	79 43.41%	96 52.75%	182	4.48	0.61
<b>ARV pick-ups per day</b>								
We use the DHI for management to ensure regular ARV pick-ups by clients	1 0.50%	1 0.50%	4 2.20%	83 45.60%	93 51.10%	182 100.00%	4.46	0.63
We use DHI to improve the daily ARV pick-ups	1 0.60%	1 0.60%	6 3.30%	77 42.50%	96 53.00%	181 100.00%	4.47	0.65
We use DHI to better account for our daily ARV pick-ups per day with the use of the digital health intervention for the last five years	1 0.60%	1 0.60%	7 3.90%	87 48.10%	85 47.00%	181 100.00%	4.40	0.65
<b>Use of DHI to monitor stock status</b>								
We use the DHI to ensure there are no ARV stock outs in our facilities	1 0.60%	2 1.10%	8 4.40%	80 44.20%	90 49.70%	181 100.00%	4.41	0.68
We use DHI to regularly monitor ARV drug stocks	1 0.60%	3 1.70%	7 3.90%	82 45.30%	88 48.60%	181 100.00%	4.40	0.70
We use DHI to improve our level of accountability on ARV stock status	1 0.60%	2 1.10%	7 3.90%	80 44.70%	89 49.70%	179 100%	4.42	0.68
<b>Use of DHI to dispense drugs</b>								

We have mechanisms in place to ensure increased use of digital health interventions for ARV drug dispensation	1 0.60%	1 0.60%	14 7.80%	83 46.40%	80 44.70%	179 100.00%	4.34	0.70
We rely on digital health intervention for ARV drug dispensation	1 0.60%	3 1.70%	14 7.70%	80 44.20%	83 45.90%	181 100.00%	4.33	0.74
We find it easy to use the digital health intervention to dispense drugs in our facilities	1 0.60%	2 1.10%	10 5.60%	77 42.80%	90 50.00%	180 100.00%	4.41	0.70
<b>Composite mean</b>							<b>4.42</b>	<b>0.67</b>

Table 2 shows perceptions of the participants on aspects of performance of HIV/AIDS projects [also published by the author in another paper

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

**Table 2. Performance of HIV/AIDS in Kisumu County**

Frequency and percentage								
Description	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Total	Mean	SD
	n %	n %	n %	n %	n %	n %		
<b>Evidence based decision making</b>								
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
<b>Linkage of clients to appropriate care</b>								
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
<b>Level of adherence to treatment plans by clients</b>								
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
<b>Quality of project reports</b>								
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
<b>Quality of services</b>								

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
<b>Projects expenditure</b>								
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
<b>Composite scores</b>							<b>4.47</b>	<b>0.57</b>

On the other hand, the composite mean score on performance of HIV/AIDS projects was 4.47 (SD=0.57) CI=95%. The findings showed that majority of the participants perceived the HIV/AIDS projects to be performing well. However, scores on specific statements 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 [published by the author in another paper entitled “*Enhancing Performance of HIV/AIDS Projects through Digital Health Interventions for Client Appointments in Kisumu County, Kenya*”].

### Inferential statistics

To assess the influence of utilization of the digital health intervention for ARV drug management on the performance of the HIV/AIDS projects, the following null hypothesis was tested:

*H<sub>0</sub>: There was no significant relationship between utilization of digital health intervention for antiretroviral drug management and performance of HIV/AIDS projects in Kisumu county.*

A Pearson Correlation Coefficient was used to determine the strength and direction of relationship between utilization of the digital health intervention for ARV drug management and performance of HIV/AIDS projects. Results in Table 3 illustrate that with a Pearson Correlation Coefficient value=0.507, p value<0.001 there was a moderate and positive statistically significant relationship between utilization of DHI for ARV drug management and performance of HIV/AIDS projects.

**Table 3. Pearson Correlation between utilization of DHI for ARV drug management and performance of HIV/AIDS projects**

Utilization of digital health interventions for ARV drug management	Pearson Correlation	.507**
	Sig. (2-tailed)	0.000
	N	182

Further, the researcher sought to understand the extent to which utilization of the digital health intervention could influence performance of the HIV/AIDS projects using a linear regression model.

Summary of the model:

**Model:**

$$y = \beta_0 + \beta_3 X_3 + \epsilon$$

Where:

$y$  = the performance of HIV/AIDS projects

$\beta_0$  = the constant

$\beta_3$  = coefficient of utilization of digital health intervention for drug management

$X_1$  = utilization of digital health intervention for drug management

$\epsilon$  = random error

The linear regression model results in Table 4 demonstrates the extent to which the predictor variable (utilization of digital health intervention for ARV drug management) accounts for the overall change in the outcome variable (performance of HIV/AIDS projects). Given the R square value = 0.332, the results indicate that utilization of DHI for ARV drug management could positively influence up to 33.2% of improvements in performance of HIV/AIDS projects.

**Table 4. Model Summary for utilization of digital health intervention for ARV drug management**

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	.576 <sup>a</sup>	0.332	0.283	0.84867115	0.332	6.794	12	176	0.000

**Note:** a. Predictors: (Constant), Utilization of digital health intervention for ARV drug management

The influence of utilization of the digital health intervention for ARV drug management on performance of HIV/AIDS projects was statistically significant with  $F_{(12, 176)} = 6.794$ ;  $p$  value < 0.001. Table 5 shows a beta value = 0.507 implying that a unit increase in the utilization of

the digital health intervention for ARV drug management could result in 50.7% in performance of the HIV/AIDS projects. The model was fit to determine performance of HIV/AIDS projects with a  $p$  value < 0.001.

**Table 5. Coefficients of utilization of digital health intervention for ARV drug management**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.022	0.064		-0.339	0.735
	Zscore: Utilization of digital health interventions for ARV drug management	0.516	0.065	0.507	7.885	0.000

a. Dependent Variable: Zscore: Performance of HIV/AIDS projects

Thus, the study rejected the null hypothesis and accepted the alternative hypothesis that there was statistically significant relationship between utilization of digital health intervention for ARV drug management and performance of HIV/AIDS projects.

Further, evidence from the qualitative data showed that the most common digital health intervention for ARV drug management was the Web ADT. The respondents reported that the Web ADT was critical in monitoring ARV pick-ups, dispensing drugs, monitoring stock status

and monitoring of how well clients were adhering to treatment. Some of the respondents said:

*R: I'd say the use of the Web ADT is optimal. Web ADT is used to facilitate ARV pickups, dispensing drugs and monitoring stock status. KII ID-MH 005.*

*R: Web ADT use is optimal. ARV drug management as it is, is entirely done under Web ADT. KII ID-KH 001.*

*R: At the pharmacy they use Web ADT to administer ARV drugs that is dispensing, stocking and client adherence. Utilization in their case is above optimal since the system is seriously relied on. – KII ID-MH 001.*

*R: The use of the Web ADT in this CCC [comprehensive care centre] is Optimal. EMR/ADT integration enables prescription of drugs from Kenya EMR and dispense from ADT, navigation of active, and past orders also ascertained- KII ID-AH 005.*

## Discussion

Results show that there was high level of utilization of the digital health intervention for ARV drug management. Specifically, the study found out that the Web ADT was the commonly used intervention with participants reporting that the use was optimal in most of the sites. This implies that there could be adequate efforts being put in place to ensure uptake and use of the WEB ADT. Participants expressed confidence that the tool was easy to use and that it was critical in managing the ARV drugs. The study found out that majority of the participants, who were healthcare observed that their projects were performing well.

From the inferential statistics, it is evident that utilization of the digital health intervention for ARV drug management had a statistically significant influence on performance of the HIV/AIDS project even though the study

conceptualized the performance HIV/AIDS broadly. In interpreting these results, it is critical to note that the researchers were aware of other interventions being implemented but the focus of this study was to unearth the effect of this particular digital intervention on the overall performance of the HIV/AIDS projects across the facilities. The findings from this study agree with findings from other studies which have shown that technology is critical in enhancing pharmaceutical management processes hence positively impacting on health programs (Babar, 2021; Baines & Babar, 2019; Christian, 2017; Mafirizi et al., 2018; Schneider, 2018). Of particular importance is the role digital health interventions play in generating high quality data for decision making in terms of managing projects. High quality data helps in improving performance of projects. A study in Namibia showed that the integrated pharmaceutical management information system enabled the Country to collect more than 90% of transactional commodity and patient dispensing data from more than 85% of all ART sites. Data from the system was used to prepare making decisions regarding quantification of medicines and service delivery. The system was also critical in monitoring early warning indicators for HIV drug resistance; ART defaulter tracing; and for planning, reporting, and research purposes.

The limitation of this study was that it did not abstract data from records neither did it collect data from the patients to ascertain the levels of utilization of the digital health intervention and performance of HIV/AIDS projects. However, it is critical to note that the objective of the study was to find the perspective of users of digital health interventions at health facility level. The researchers designed this study with the assumption that the perspectives of users, who are also service providers, about a system play a critical in determining how the system will might be adopted and utilized. This perspective of the study is critical because it could explain why some systems have high adoption and utilization rates while others have low levels of uptake. One aspect that was highly agreed upon by the participants was the aspect of the digital health intervention enabling them to account for the



ARV stocks and their clients on treatment. As evidence has from other studies has shown, this finding indicates that cases of drugs getting lost, expiring before use, prescription errors or high levels of lost to follow up patients could be avoided by use of the digital health interventions.(Bhattarai H, 2004).

## Conclusions and Recommendations

There is need to increase investment in the implementation of the digital health interventions for ARV drug management. Having demonstrated the potential for positive improvement on performance of HIV/AIDS projects, the Web ADT should be scaled to all Antiretroviral Therapy sites in Kenya. The findings from this study presents the Ministry of Health and its stakeholders with evidence that should be used to strengthen the policy environment around the use of digital health interventions for ARV drug management at all HIV/AIDS care centres. Programmatically, this study calls for the need of HIV/AIDS projects to implement and utilize already existing digital health interventions to manage pharmacies and drug management. This study has demonstrated that using technology could potentially lead to high levels of accountability for commodities hence improved performance of the projects. This will result in better patient outcomes hence contributing to controlling of the HIV/AIDS epidemic. This study suggests that other health projects beyond HIV/AIDS and generally management of health products, technologies, commodities and medicines should adopt use of technology to achieve high levels of performance. Further, this study recommends implementation of pharmaceutical management information systems beyond HIV/AIDS program. There should be concerted efforts for innovations to help in management of other health products and technologies including other medicines in other areas of health. This could significantly improve accountability for both drugs and patients on care.

## Ethical Considerations

The researcher obtained all the necessary approvals from the UON/KNH ethics and research committee. A permit to conduct the study was obtained from the National Commission for Science, Technology and Innovation. 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.

## Contribution by Authors

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

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