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SYSTEM USE AND USER SATISFACTION IN THE ADOPTION OF ELECTRONIC MEDICAL RECORDS SYSTEMS: A CASE OF DHIS2 TRACKER IMPLEMENTATION IN TANZANIA

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ABSTRACT

The adoption of Electronic Medical Records Systems (EMRs) is on the rise in developing countries due to the need to ensure improved quality of healthcare through client continuum and monitoring and information sharing through collecting detailed, good quality and reliable information overtime. In spite the benefits of EMRs, their success depends on use and satisfaction of users with the system. Recently National Tuberculosis and Leprosy Program of Tanzania adopted an EMRs known as the DHIS2 Tracker to help with case management, improve reporting and reduce lost to follow-up cases.

This study therefore aimed to investigate factors influencing use and user satisfaction of DHIS2 Tracker by adapting both the DeLone & McLean Model with the Technology Acceptance Model. The research model consisted of six factors from which an online questionnaire using google forms was developed and shared with users of the system. In order to assess the relationship between factors, nine hypotheses were developed and multiple regression analysis was conducted.

The analyzed data supported five out of nine hypotheses and indicates that system quality and attitude have positive significant influence on both system usage and user satisfaction, while use of the system has a positive significant influence on satisfaction. However, user background and information quality do not have significant influence on either use or satisfaction of DHIS2 Tracker. These findings help implementers understand areas of focus during implementation of DHIS2 Tracker.

Keywords: Electronic Medical Records Systems, DHIS2 Tracker, System Use, User Satisfaction

1. Introduction

According to Karimi, Poo, and Ming [1], prior research on information systems (IS) shows that users' attitudes and continuance intentions are associated with their satisfaction with information systems. As such, the increasing amount of investments in IS signifies the importance of understanding end users' satisfaction and system usage. Furthermore, it is reported that user satisfaction as a subjective or perceptual measure has been widely used to measure IS success which is associated to users' attitudes and continuance intentions [1]-[3]. Similarly, users' satisfaction has also been found to explain intended future use of EMRs. In addition, user satisfaction has been studied in relation to other important IS concepts such as system usability. Most research on EMRs have looked at either satisfaction or use but not both, this research looked at both use and satisfaction of DHIS2 Tracker in Tanzania. The objective of this study is to identify factors that might influence the use and user satisfaction of DHIS2 Tracker in Tanzania and suggest strategies that will foster successful implementations.

2. Literature Review

DHIS2 is an open source platform that has been used to collect, collate, store and retrieve aggregate data [4]–[7]. Since DHIS2, has been so highly adapted and adopted for aggregate data, users and developers thought why not use the same platform to collect detailed information on clients thus the DHIS2 Tracker. Furthermore, the increased demand for details in information also explains the adoption of DHIS2 Tracker. DHIS2 Tracker has been adopted in a number of programs such Maternal Child Health, Drug Resistance Tuberculosis, HIV care and Death registration in a number of developing countries and most recently in Tanzania by Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC).

The measure of IS success has moved away from the use of financial tools like Return on Investment. In order to have a better grip on the tangible and intangible benefits of IS implementation, organizations have used methods such as Kaplan and Norton's balanced scorecard, benchmarking by Seddon et al, and researchers have developed models such as the DeLone and McLean's model (D&M), Doll's model and Technology Acceptance Model (TAM) thus emphasizing the need for better and more consistent success metrics [8].

User satisfaction is one of the most popular ways of determining system effectiveness and hence its success [3], [9], [10]. However user satisfaction alone does not fully measure IS system success [10]. Also, according to Petter et al. [8], the six variables in the D&M are not independent but rather interdependent this is why this research will focus on both system use and user satisfaction. User satisfaction is categorized into three aspects; judgment, affect and a mixture of both affect and judgment. User satisfaction with IS shows the extent to which the user is satisfied with the IS ability to achieve the intended information requirements [3]. User satisfaction helps to show the system from the user perspective. In fact, when a system is deemed poor by its users, then it is indeed poor [1]. Karimi et al [1] goes on to say that it is hard to deny the success of a system that is liked by its users. A number of evaluation studies have been conducted to determine the user satisfaction of IS using different tools or models. For example Amin, Abdul, Wan, & Isa [11] looked at studies that had used perception of usefulness and ease of use and Responsive IT infrastructure. DeLone and Mclean [10] mention that "Use" can still be a considerable variable in mandatory systems because for systems adopted by organisations, as long

as the system performs accordingly it will be mandatorily used by the end users with the blessing of organisation management, and as such “Use” was therefore maintained. It is further argued that researchers need to consider the extent, nature, quality and appropriateness of system use thus simply measuring the amount of time a system is used is not enough but informed and effective use help to indicate the success of said system [12].

3. RESEARCH METHODOLOGY

This study adopted mixed research method allowing sequential explanation of quantitative findings using qualitative tools. The study explored factors that influence use and user satisfaction of EMRs from literature review based on both D&M and TAM models in order to determine the key factors that influence use and user satisfaction of DHIS2 Tracker in Tanzania. Fig. 1 suggests an interdependency between attitude, user background, information and system quality with use and user satisfaction. From literature review, 5 factors were identified that is Attitude (ATT), System Quality (SQ), Information Quality (IQ), User background (UB), System Use (USE) to measure User satisfaction (US) and 4 factors that is ATT, SQ, IQ and UB to measure System Use. The questionnaire items with validated scales were adopted from [13]–[17] to form a 44 item questionnaire survey. A questionnaire survey was used to quantitatively answer 9 hypotheses created in regard to factors that will influence use and user satisfaction of the ETL register. The questionnaire was administered through google forms. A link was shared via the Resources App with in the ETL register system. Data was then transferred from google forms to SPSS for analysis via excel. Observation and interviews were done during training and support supervision. Researcher checked for ease of navigation and ability to recall steps taken to accomplish tasks and ability to troubleshoot in case of issues, how users were using the system in order to provide qualitative understanding of data. The study determined and tested the statistical significance of the causal relationships as hypothesized using multiple regression analysis.

The study was conducted in Tanzania, it involved mostly TB and Leprosy coordinators from both district and region level. The study targeted all the users of the system who had been trained at the regional and district offices.

4. Adapted Research Model and Analysis

The study adopted a mixture of DeLone and McLean Model with Technology Acceptance Model. Most research conducted in relation to EMRs had used either one or both models to explain system satisfaction and system use among users.

4.1 Factor Identification

A comprehensive list factors was generated based on past research and the most suitable factors were selected for this research based on importance, relevance and frequency of appearance in the literature review. Overlapping factors were discarded from the selection and only 6 factors were chosen to be used in the study. Overlapping factors like perceived usefulness and perceived ease of use appeared frequently in the literature, they were seen as attributes of system quality in this study and training as an attribute of user background. Fig.1 shows selected factors.

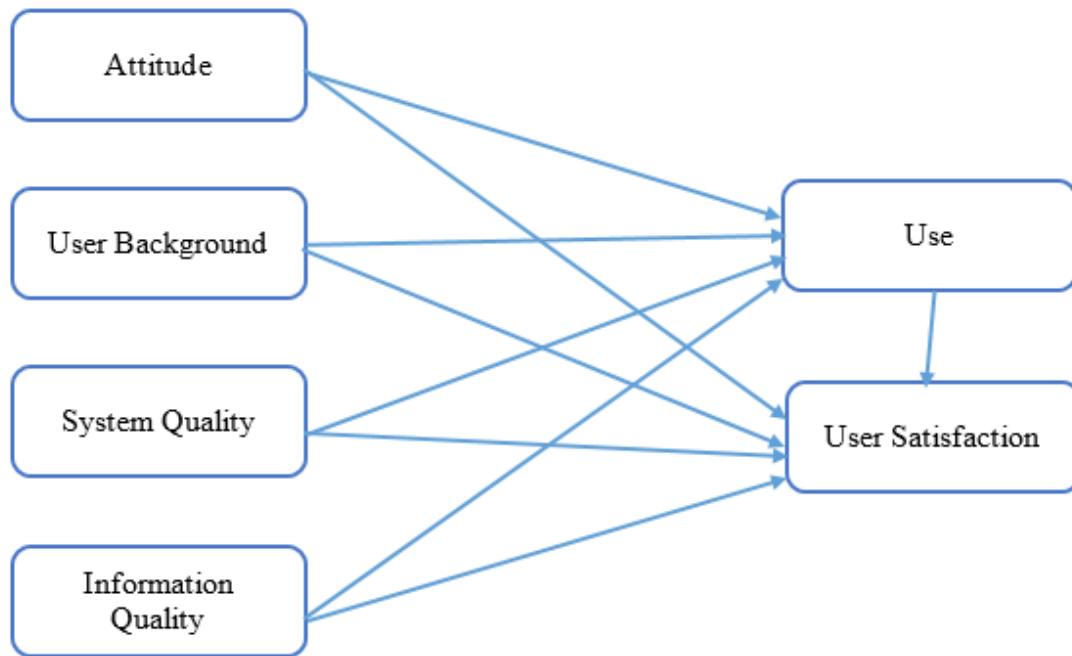


Fig. 1. Schematic representation of Research Model

4.2 Factor definition

4.2.1 Attitude

DeLone and McLean [18] in their quest for the dependent variable advised that studies that measured User Satisfaction should include measure of attitude so that the potentially biasing effects of those attitudes can be controlled in analysis. Attitude was added as a factor because there was no room for subjects to form an intention for or against a behavior making it a better predictor of behavior. Brown, Massey, Montoya-Weiss and Burkman, [13] say that attitude helps understand mandated use environments because it represents the degree to which users are satisfied with the system. The following hypothesis was postulated and tested for this factor:

H1: Attitude towards usage will have a significant influence on Use

H2: Attitude towards usage will have a significant influence on User satisfaction

4.2.2 User background

User background was measured with items like experience, training and skills. It is also recognized that user experience is an important factor that can be associated to IS success. The need for continuously educated and experienced personnel as far as technology is concerned has been emphasized. This is shown by Igbaria that user experience is related to a decrease in computer anxiety and thus an enhancement of user's confidence and satisfaction [19]. Due to poor quality training Kuipers [14] reported that there was a failed HIS implementation in South Africa because the training focused on how to work with the system and not on why use the system. The following hypothesis was postulated and tested for this factor:

H3: User Back ground will positively affect use

H4: User Back ground will positively affect user satisfaction

4.2.3 System Quality

System Quality is the design characteristics of the system for example ease of use, reliability, accessibility, flexibility. It can be defined as the technical quality of the system [10]. It is said to measure the desirable characteristics of an IS. In this study, System Quality will be concerned with characteristics that make it easy for users to use, navigate and perform different tasks. The following hypothesis was postulated and tested for this factor:

H5: System quality will positively affect use.

H6: System quality will positively affect user satisfaction

4.2.4 Information Quality

Information Quality is users' perception of the accuracy, timeliness, completeness, reliability, conciseness and relevance of information output. It is defined as the input and output of the system [10]. It is said to deal with content issues and characteristics of IS output. It has been measured by examining the output of an IS in terms of timeliness, accuracy, reliability and trustworthiness [15]. The study defines IQ in terms of correctness, usefulness and timeliness of the information generated by the system. The following hypothesis was postulated and tested for this factor:

H7: Information quality will positively affect use.

H8: Information quality will positively affect user satisfaction

4.2.5 Use

DeLone and McLean [10] suggested that researcher when looking at use should consider the nature, extent, quality and appropriateness of use. Nature is addressed by looking at whether the full functionality of a system is being used for intended purposes. Extent of use can be based on various states of use that is use or nonuse of basic or advanced system capabilities. System Use is concerned with assessing the manner in which an information system is used. Studies have measured use by looking at actual usage or frequency of use [15]. Since it is mandated to use the ETL register, this study focused on nature of use and level of use. It also relates to who uses the system, training, level of use, belief and acceptance. The following hypothesis was postulated and tested for this factor:

H9: Use will positively affect user satisfaction

4.2.6 User satisfaction

Gelderman [20] says that users will only use the system if they accept it and they will only accept it if they are satisfied with it to a certain extent. Therefore the measurement of usage may be a proxy for the measurement of US. In this study, US was operationalized by looking at overall user satisfaction with the ETL register.

5. Findings

5.1 Demographics Analysis

Results show data of 337 completely filled questionnaires. Descriptive data on users' shows 77.7% of the respondents were male and 22.3% were female. 10.4 % of the respondents were below 30 years of age, 29.7% were between 31 and 40 years of age, 33.2% were between 41 and 50 years, 25.5% were between 51 and 60 and 1.2% were above 60 years. Sixty percent of the respondents were District or Regional Leprosy Coordinators.

5.2 Reliability Analysis

It is important to verify that items are consistent in measuring a given factor, thus to ensure reliability Cronbach's Alpha (α) was used to estimate internal consistency reliability. The reliability of data in this test was

analysed using SPSS. A reliability test was done on all 44 items for this study and results showed $\alpha=.919$. In addition, reliability test was done for each factor in respect to its items. Results shown in Table 1.

Table 1. Cronbach's Alpha Coefficients

Factor	Number of items	Cronbach's Alpha (α) =.919, N=337
User Background (UB)	4	0.571
Use (USE)	9	0.857
System Quality (SQ)	13	0.831
Satisfaction (SAT)	6	0.585
Attitude (ATT)	6	0.829
Information Quality (IQ)	6	0.895

Based on Table 1, SAT and UB had alpha scales below the recommended 0.70 [21], [22]. This can be explained by having a very high variability within questionnaire items.

5.3 Factor Analysis

Factor analysis was done on the 44 items using principal component analysis as a method of extraction and direct Oblimin as the method of rotation. The number of factors was specified as 6 based on the research questionnaire. Two items for different factors were loading >0.3 however they were not deleted from the analysis. Kaiser-Meyer-Olkin's (KMO) sampling adequacy with a value of 0.914 for the dataset is high enough to support factor analysis.

5.4 Regression Analysis

Multiple regression analysis was done to test the hypothesis and determine factors that influence the use and satisfaction of the ETL register to facilitate successful implementation of the system. Based on the results, the research model explained variance with adjusted $R^2 = 0.414$ which indicates 41.4% of system satisfaction can be explained by 5 factors that UB, USE, SQ, IQ and ATT. Furthermore, adjusted $R^2 = 0.393$ indicating 39.3% of system use can be explained by factors that is UB, SQ, IQ and ATT. Table 2 and 3 shows standard beta coefficients and significance level factors against USE and Satisfaction respectively.

Table 2. Standard Coefficients and Significance levels of factors on USE

Factors	Standardized Coefficients (β)	Significance Level (p)
UB	0.028	0.508
IQ	0.085	0.097
ATT	0.328	0.000
SQ	0.317	0.000

Table 3. Standard Coefficients and Significance levels of factors on Satisfaction

Factors	Standardized Coefficients (β)	Significance Level (p)
UB	-0.027	0.526
IQ	0.094	0.062
ATT	0.323	0.000
SQ	0.249	0.000
USE	0.121	0.025

In order for a factor to be significant in influencing users' satisfaction or use of the DHIS2 Tracker, the level of significance (p) has to be <0.05 . Results in Table 2 show that p value for ATT and SQ was <0.05 making them significant while the p value for UB and IQ was >0.05 thus not significant in influencing use of the DHIS2 Tracker. Results in Table 3 show p value for USE, SQ, and ATT was <0.05 thus significant and p value for IQ

and UB was >0.05 thus not significant in influencing satisfaction of DHIS2 Tracker. Fig. 2 shows the final factors that influence use and satisfaction of DHIS2 Tracker in Tanzania.

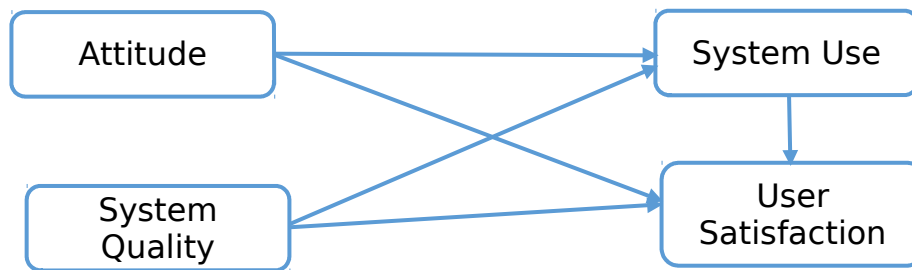


Fig. 2. Final Research Model

5.5 Hypothesis Testing

A summary of tested hypothesis is shown in Table 3, it demonstrates hypothesis that were supported and those that were not supported.

Table 3. Summary of Hypotheses

Hypothesis	Results	Conclusion
H1: Attitude towards usage will have a significant influence on Use	$\beta = 0.328, p = 0.000 > 0.05$	Supported
H2: Attitude towards usage will have a significant influence on User satisfaction	$\beta = 0.323, p = 0.000 > 0.05$	Supported
H3: User Background will positively affect use	$\beta = 0.028, p = 0.508 < 0.05$	Not Supported
H4: User Background will positively affect user satisfaction	$\beta = -0.027, p = 0.526 < 0.05$	Not Supported
H5: System quality will positively affect use.	$\beta = 0.317, p = 0.000 > 0.05$	Supported
H6: System quality will positively affect user satisfaction	$\beta = 0.249, p = 0.000 > 0.05$	Supported
H7: Information quality will positively affect use.	$\beta = 0.085, p = 0.097 < 0.05$	Not Supported
H8: Information quality will positively affect user satisfaction	$\beta = 0.094, p = 0.062 < 0.05$	Not Supported
H9: Use will positively affect user satisfaction	$\beta = 0.121, p = 0.025 > 0.05$	Supported

6. Discussions

Based on the results in Table 3, User Background and Information quality could not explain either use or satisfaction of DHIS2 Tracker. In other words 4 hypotheses that is H3, H4, H7 and H8 were non-significant and thus were not supported.

Furthermore, with factor analysis, it can be stated that KMO value is above the 0.500 threshold for all the factors varying between 0.500 and 0.900. The Cronbach's (a) showed low values of 0.571 and 0.585 for both User background and satisfaction respectively which can be explained by the high variance in items of these questions. For example, User background was looking at experience, skills and training, although users had

obtained the experience and skills from previous encounters with other systems, they had not received any form of computer training.

In relation to satisfaction, although a large number of users agreed that the system was to their satisfaction, when asked whether it was complicated they were equally divided in response, 51% felt it was complicated to use and the rest felt it was not. Despite the above, no items were deleted from the analysis. Sub sections below will further explain results of the hypothesis.

5.6.1 Attitude

Results from the study show that Attitude had a positive significant effect in influencing Use and Satisfaction of DHIS2 tracker. With p value <0.05 and $\beta=0.328$ and 0.323 , implies that users feelings to use and satisfaction towards DHIS2 Tracker were highly positive and significant.

In fact some of the users felt that the system made their work so easy they said, during one of the training sessions one trainee said *“when it comes to leprosy, we can just sit with our clients and fill in this information while they are present because the paper based register is so complicated to use most of us do not understand it.”* Furthermore, results showed that 95% of users were willing to use the system if given a choice because it was efficient, easy to use, helped in planning and intervention development, helped improve the referral system, made communication with colleagues easier and would improve program performance.

5.6.2 User Background

Results also showed that user background was not significant in influencing use or satisfaction of DHIS2 tracker.

5.6.3 System Quality

Results showed that system quality significantly influences use and user satisfaction of DHIS2 Tracker in a positive manner. This means that users were impressed with the various features of the system like accessing information at anytime and anywhere, following up clients, communication within the system and notification and the fact that all necessary registers and information about their clients can be found in one storage system.

This finding is similar to Ojo [15], who suggests that for continued use of the system, at most focus should be on system quality.

Some users, especially regional officers said that,

“... because the system was web based, we do not have to move around districts with flash drives to collect and compile data from each district for the ministry anymore, data can easily be found in the system which gives us time to do other things.” However some users felt that the system was still error prone as it did not have all the data quality checks in place.

5.6.4 Information Quality

Results showed no significant effect of information quality on use or satisfaction of DHIS2 Tracker. This could be attributed to the fact that during the time the questionnaire was administered users may not have fully grasped the reporting features of system.

Contrary to the results above, interviews showed that users were highly appreciative of the reporting features because they felt that all the indicators they needed could be found in the system and reports could be generated automatically in a flexible (as charts or tables) and timely manner. One of the users who has worked with TB and Leprosy for more than 30 years and had used 2 other similar systems said that in comparison to legacy systems, the ETL register facilitated both data entry and automatic report generation.

“...This is because the legacy systems we had to enter data in the system and in the paper registers and during time to generate reports we had to go back to our paper registers and tally we were not able to get reports from those old systems, the process of report generation was highly manual and this duplicated the work load.”

Furthermore, it was noticed that although training sessions did not cover much about report analysis tools, some users had taken the initiative to orient themselves in using the different report analysis apps of the system.

5.6.5 Use

Results also showed that USE had a positive significant effect on satisfaction of DHIS2 Tracker. This is similar to findings from Lin et al. [17] which means that users would keep using the system thus increase their satisfaction with the system contrary to findings from Ojo [15] whose findings showed that use did not influence satisfaction which he attributed to type and context of the system in use. He suggests that in a mandated setting, system quality should be improved in order to incentivize satisfaction.

The positive influence of use on satisfaction can be further explained with how users were using the system. Users felt that because all the registers were in one system, then they would be able to track their clients within the system with the help of message notifications in case of transfers and they would also be able to easily determine the Not Evaluated clients. They also felt that, lab results could quickly and easily be obtained from regional labs with the notification features unlike before where they had to wait for a phone call or post office to receive lab results. One user mentioned that *“... these notifications help quicken the process of administering the right drugs to clients based on results unlike before when we had to wait for EMS to deliver specimen.”* One of the superiors mentioned that *“... with the system in place we are able to know who has done their work and who has not their work unlike before when the lag was blamed on anyone who was not present at that time.”*

5.6.6 Overall Satisfaction

85% of the users responded that that they were satisfied with the system, because they were able to find all the necessary registers in the system, could track patients, do transfers and referrals, receive notifications on lab results, easy to learn, understand, verify data entry and reports, retrieve and share reports, good for case management, web based, useful in day to day work and training on the system was good etc. The remaining 15% were not satisfied because they needed more practice to be conversant with the system, system did not have all the validations necessary for quality data entry, difficult to navigate and involved many clicks. Opinion on the number of clicks changed once users realized for some modules one only enters information once and then they update client information on subsequent visits. Also the availability of automatic reports seemed to positively change people's satisfaction for the system as observed during supervisions.

From observations and interviews, it was found that users were unable to transfer clients to different sites or enroll clients into more than one program. Users found it easy to enroll a client into the first program but they were not sure about the next steps when it comes to enrolling the same client into a second program.

5.7 Suggested Strategies towards successful implementation of DHIS2 Tracker in Tanzania

Based on the results, the following strategies are proposed to facilitate successful implementation of DHIS2 Tracker in Tanzania:

- a) Users felt that it was still error prone because some validation checks such as automatic rescheduling of visits, ensuring certain information is entered at a particular time from the time of diagnosis, previously entered data should not be re-entered were not yet in place. Therefore it is necessary for the developers

and the NTLP team to ensure that all these validation checks are put in place in order to improve the quality, consistency and reliability of data and information.

- b) Many users reported the system was complicated to use, it is necessary that NTLP and other stake holders conduct refresher courses for users, they should also have onsite support supervisions as these help management learn real issues that users experience outside of training settings.
- c) In addition, for users to be well conversant with the system they need to practice more, so on top of support supervision it is necessary for users to enter data on a daily basis in order to improve their appreciation for the system and improve report completeness.
- d) A web-based system is most preferred by management users for a number of reasons, however many users reported that their biggest issue is internet accessibility and availability plus laptops. Therefore, it is necessary to develop and support desktop offline data entry with automatic synching of data to the main server. Alternatively establish an agreement with telecom companies to provide zero cost internet access to the system. This will make the process of data entry much easier and less time consuming.
- e) Information quality did not have significant effect on Use or satisfaction contrary to interview sessions where users were happy with the reporting features. Therefore it is necessary that users be oriented on the importance of informations use, ownership of information and furthermore be trained on the different report analytics apps that are present in the system.
- f) In addition, some of the users such as M&E Officers and Project managers felt they could not do further analysis with the advanced analysis tools. Thus they suggested that existing bugs on the advanced analytic tools should be fixed to improve use of the system and also encourage information use.
- g) In order to improve use, it is necessary to encourage users to use the system on a daily basis and not only during reporting periods. It is also important to show users how the system generally improves their work especially in terms of report generation and reduction in the number of lost to follow up cases.

7. CONCLUSION

The analyzed data supported five out of nine hypotheses and indicates that system quality and attitude have positive significant influence on both system usage and user satisfaction, while use of the system has a positive significant influence on satisfaction. However, user background and information quality do not have significant influence on either use or satisfaction of DHIS2 Tracker. Qualitative results showed that the ETL register met the needs and demand for all stakeholders involved. These findings help implementers understand areas of focus during implementation of DHIS2 Tracker.

The study then proposed strategies that might help in successful implementation of DHIS2 tracker in Tanzania such as support and onsite supervision, offline data entry, or zero cost access to the system and encourage users to use and own their information etc.

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