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Implementing a Web-based Routine Health Information System in Kenya: Factors Affecting Acceptance and Use

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Abstract: ***Use of computer-based systems to manage developing countries' health information is expected to lead to improved efficiencies in healthcare delivery, yet there is evidence to suggest that such systems are not always readily accepted by the targeted users. Since 2010, Kenya has been in the process of implementing and scaling up the use of a web-based system (DHIS2) for managing the entire country's routine health information. This descriptive qualitative study was undertaken to get a deeper understanding of factors considered as barriers or enablers to the successful scale up and use of DHIS2 in Kenya. A total of 25 key informant interviews were conducted using unstructured, in-depth and active interview approach. Subsequently the transcribed data was analyzed with the NVivo computer-assisted qualitative data analysis software (CAQDAS) to explore the themes and sub-themes represented in each interview. All interviewees appreciated that DHIS2 is a radical improvement on the previous systems implemented in the country. They recognized its capacity for improved dissemination of public health information through the public login option. Also appreciated was the fact that it is easy to undertake simple, customized data analysis in the system, which should encourage data use right from the lowest levels. The interviewees however pointed out the need to address the challenges of inadequate infrastructure, low computer proficiency, inadequate staffing capacities, lack of proactive leadership and information ownership at all levels, as well as the still unmet demand for better quality and complete health data.***

Keywords: Health Information, DHIS2, Data for Decision Making, Barrier and Enabling Factors

1. Introduction

Good quality information is necessary to monitor health, and to evaluate and improve on the delivery of health-care services and programs. However there is a large gap both in availability and accessibility of such information in many developing countries. The need to minimize this gap has led to initiation of interventions aimed at streamlining health data reporting processes, and to reform the existing paper-based systems through computerized information systems. As is the case with other developing countries, Kenya has gone through the phase of operating an almost totally paper-based system which could not be relied upon to provide accurate and timely information, and which led to the mushrooming of several parallel sub-systems supported by different healthcare implementing partners. Despite the country having identified Health Information as a Strategic requirement for provision of better healthcare way back while developing the second National Health Sector Strategic Plan (NHSSP II) 2005 – 2010, the challenge of a fragmented and unreliable HIS persisted even up to the end of the NHSSP II's implementation period [1–3].

Kenya initiated an overhaul of the existing inefficient routine health information system to replace it with the free and open-source, web-based District Health Information Software (DHIS2) in 2010. Subsequently DHIS2 was adopted and its deployment in all of the countries 8 provinces (now the 47 counties in the devolved system of government) was completed by December 2011 [4]. The DHIS2 system has been in active use throughout the country for about three years, and it has significantly improved the process for reporting of routine health data. This is a major milestone; however DHIS2 in Kenya has not yet fully achieved all its intended milestones given that the system is mostly being used by Health Records Information Officers (HRIOs) for data entry, rather than by health workers at all levels of the health system for decision making. Efforts to turn this situation around are ongoing, spearheaded by the Ministry of Health with support from various development and implementation partners. An in depth understanding of the factors that hinder or encourage the optimal use of DHIS2 in Kenya will be useful in providing health IT implementers and policy makers with a basis on which to initiate interventions to enhance acceptance and use of this and other such systems in the country.

2. Literature Review

In the Health Metrics Network (HMN) Framework, the World Health Organization (WHO) and partners emphasize the need for countries to build stronger systems to gather, manage and distribute health information. It is anticipated that sharing of this information will provide the knowledge about health and sickness of the country population, which could in turn be used to prevent spread of diseases and improve healthcare services [5]. Good quality health information enables adequate monitoring of a country's health status thus facilitating informed decision making, and can ultimately contribute toward sustainable public health development and improved health outcomes especially in developing countries [6], [7].

In the past, management of health information in developing countries has been plagued by major challenges. These range from the low levels of ICT knowledge among health workers, inadequate investment in health information systems, and presence of donor-supported parallel reporting

sub-systems [8–10]. Though there are several sources of health information in developing countries, one major source is the routine health information system (RHIS) which mostly collects, collates and analyzes data from all health facilities. The importance of strengthening RHIS is recognized as one approach that will support public health reform initiatives and improve delivery of health-care services in developing countries. The demand for credible health information is also intensified following the performance based resource allocation adopted by donors and development partners.

In the past the RHISs of these countries have mostly been paper based, compounding the challenges of managing health information due to the limited capacity for data aggregation, analysis and dissemination inherent in manual systems. The combination of these factors has led to initiatives in the developing countries to streamline health data reporting processes and adopt computerization of health information systems [5], [7]. One system that is commonly being used in developing countries to support this computerization process is the web-based and open-source District Health Information Software (DHIS2). DHIS2 is a free and open source database application (FOSS) for collecting, processing, and analyzing health information [11], [12] .

The fact that DHIS2 is based on FOSS gives implementing countries, Kenya included, an opportunity to get the software free of charge and to make use of local expertise to customize it according to local needs [13]. DHIS2 Data is collected routinely on all services provided by a facility, as well as periodically on infrastructure and human resources, as part of health facility surveys. This data is collected by means of a paper-based system of registers, tally sheets, and monthly data collation forms. The collated monthly data is either entered directly into the web-based DHIS2 or sent to the sub-county level where it is entered on to the web-based DHIS2 software, then analyzed in the system.

3. Objectives

This study was undertaken to explore the experience-informed opinions of interviewees drawn from various categories of key HIS stakeholders in the Kenya health sector. The main objectives of the study were:

- To gain an understanding, from the perspective of key stakeholders, of factors considered as critical to the successful scale up and use of DHIS2 in Kenya
- To breakdown the role played by these factors, either as barriers or enablers of this scale-up process.
- To understand the perceived opportunities and threats that this system faces in view of the ongoing implementation of the devolved system of government in the country.
- To make recommendations on how barriers and threats can be addressed to hasten acceptance and scale-up the use of DHIS2 in Kenya.

Health Technology acceptance and adoption research suggest that success in adoption of health information technology is influenced not only by technological factors but also by factors related to behavioral, social, organizational and cultural aspects. Thus while acknowledging that DHIS2 is based on a sound and proven technology for managing health information, it is also important to seek to understand how the implementation is faring from the perspective of key stakeholders in the health sector [5], [14], [15]. What these stakeholders perceive to be barriers or enabling factors in scaling up use of DHIS2 needs to be taken into consideration as it may provide the key to the successful adoption and use of DHIS2 in the entire country. Such knowledge will also be useful to health management teams as well as policy makers at national and county levels in designing interventions that that will minimize the barriers to scale up of DHIS2. It is expected that this will ultimately lead to adoption of the culture of increased data demand and information use by all cadres of healthcare workers in the country.

4. Materials and Method

The descriptive qualitative study was done through conducting key informant interviews (KIIs) with a wide range of stakeholders in the implementation of DHIS2. These ranged from the External implementing Consultants, Local implementing Coordinators, National Priority Health Programs Managers, Senior Health Records Information Officers, NGO Implementing Partners, Local University developers supporting the systems and WHO Program Officers. A total of 25 interviews were conducted and these were audio recorded with the informants' consent. The informants selected had all interacted widely with the DHIS2 system implemented in Kenya, either in the capacity of developers, implementation coordinators, system reviewers, system users, or a combination of these roles.

A topic guide with open ended questions was used to guide the discussions and collect information around key themes which included: perceived role of DHIS2 in shaping Kenya's health care sector; the key processes that have guided implementation of DHIS2 and the main challenges encountered; the barriers and enablers of adoption of DHIS2; and recommendations on the way forward in order to reap maximum benefits from this system. The Interviews were organized around the study guide questions but conducted using the unstructured, in-depth and active interview approach [16]. Subsequently a general thematic data analysis was undertaken to identify all discussions on the pre-specified themes and sub-themes, as well other themes raised by the interviewees.

Each interview was treated as an individual case, and the transcribed data was analyzed with the NVivo computer-assisted qualitative data analysis software (CAQDAS). NVivo assisted in the qualitative analysis process by enabling easier data management, storage of the interview transcripts, and help in coding the text. Finally the researchers identified patterns across categorized data and used them to draw conclusions and recommendations on factors that need to be addressed in order to enhance user acceptance and use of DHIS2 in the country.

5. Results

All interviewees recognized the great opportunity that DHIS2 has presented for Kenya to streamline its national health information. One key system characteristic that was appreciated is the fact that is operated in open-access mode, enabling unrestricted access to DHIS2 reports via the public login option. This has greatly eased dissemination and access to public health information. Also recognized was that the DHIS2 system enables undertaking of simple, customized data analysis, which should encourage data use right from the lowest levels. This potential will be enhanced further as more and more health facilities get connected to the system for direct reporting.

While considering these opportunities that DHIS2 presents, one major theme that emerged from the analysis of the KIIs was the need to recognize the barriers and enabling factors that exist in scaling up implementation and use of DHIS2. Now that the initial objective of deploying the system nationwide has been completed, the next couple of challenges remain pushing the use of this system to higher levels such that it becomes more accessible to all healthcare workers and that they actually use its data for evidence-based decision making. This section discusses the perceived barriers and enabling factors, and the informants' perspective of their potential impact on the scale up of DHIS2.

5.1 The Role of Age and Gender

With a few exceptions, the general consensus among the informants is that age is playing a role in the way health workers are adopting and using DHIS2 in Kenya. The main perception was that the younger health worker is more comfortable with the use of technology based tools and resources such as DHIS2, especially when the people concerned have had no formative training on computers and technology issues. The informants were also of the opinion that most members of the District Health Management Teams (DHMTs) are relatively older and as such are not comfortable with use of the new technology and systems like DHIS2. Most people however did not perceive gender as being a key factor that influences the use of DHIS2. This is despite the fact that the majority of the respondents (85%) were male.

In the words of some informants:

"I think the younger people - and this is really the IT generation - so you know the younger health professionals, for them it is really part of their lives. I mean they have gadgets, electronic gadgets, so for them their effort towards learning that skill is very low, compared to the older generation." - Int024

"Younger generation are very positive because they are I.T. compliant, but the older generation are challenged because they take too long to learn" - Int019

5.2 Attitude, Information Ownership, and Behavior Change

The common thread linking this theme was identified as attitude. It emerged that despite the presence of other challenges such as unreliable infrastructure and inadequate training, most of the informants consider the user attitude to be main determinant of whether the DHIS2 system will be successful or not. And this starts right from the top with most of the health managers having the false notion that use of DHIS2 data is the reserve of Health Records Information Officers (HRIOs) or program M&E officers. Being a country where health workers tend to follow their managers unquestioningly, management attitude toward DHIS2 greatly influences the attitude of the sub-ordinates thus leading to sub-optimal use of the system. In addition most users see the implementation of a new system, not as an opportunity to benefit their work productivity and efficiencies, but rather as an opportunity to get maximum personal benefit during the project implementation by getting new computers, modems, training and other benefits. Implementation of DHIS2 should have presented an opportune moment to address some of these negative attitudes and institute the requisite behavior change, but as one informant put it:

"…when we talked of DHIS2 roll out people thought trainings, just training this district, training this county and so on; and it was done all around the country but then we did not focus on those other soft factors ….. What does it mean for the person who is going to be affected and also what opportunities can we take as a result of this change [brought about by DHIS2]? We lost the opportunity to get this issue of health information from health record officers, yet that would have been a very good opportunity to show everybody that it's not just about data collection, it's health information that we are looking for and everybody should be involved." - Int012

5.3 Local Capacity for Technical Support and Training

Many of the informants interviewed did not have the confidence that the country possesses the required technical capacity to support the system locally without having to resort to escalating issues to parties external to the Ministry of Health. This is especially important when considering the quick implementation of the system in the country, and on a very large scale, meaning there was no time to critically test the system to ensure error free and optimal functionality. In addition as the end-users, especially the health programs continue using the DHIS2 data to monitor various priority disease trends; they are naturally coming up with requests for system enhancement, additional functionality, elimination of certain software glitches or inclusion of more sophisticated data validation rules. It emerged that many such users are getting disillusioned by the slow rate of responding to such support requests. Though a lot of health workers were trained on use of DHIS2 nationwide, some of informants were of the opinion that the quality of this training could be improved. As one informant put it:

"We also get challenges with the people providing support… [There is need for] highly qualified people who are able to fix up that system. …. who are able to support that system at that

high technical level. But one of the biggest bottle necks we have is the capacity of IT support within MOH to manage this system... They should be a cadre that is highly qualified to that level. The challenge for the Ministry is to motivate such highly qualified people to work for the ministry" - Int018

5.4 Championship, Leadership and Management

The general consensus under this sub-theme was that for the DHIS2 scale up to be a success, health managers, right from the point of data generation to the highest national office need to have total buy-in on the system and recognize the potential it has to transform healthcare delivery in Kenya. It is not enough to demand that other people use the system. Rather the system champions, who naturally would be managers at the different levels, need to show by example that they value the system by first of all taking time to understand the role DHIS2 is intended to play, and then actually logging on to the system to scrutinize data for themselves. Several informants gave examples of situations they have come across within the health sector where the champions and leaders have propelled their projects to excel much more than other projects in similar settings. To quote a representation of these sentiments:

"..behavior changes as the leadership, if the leadership is not demanding use of information, forget about the rest. So it starts from the top… and we are seeing it in many other arenas, I mean now as a governor, how do you operate? In any institution in any environment, the leader shows the way." - Int013

5.5 Computer Proficiency and Anxiety

Since the launch of its e-government strategy, the Kenyan government has been at the forefront in advocating for computerization of public services for more efficient service delivery. The Kenya National e-Health Strategy (2011 – 2017) brings the focus of this computerization to the health sector[17]. But as results of this study confirmed, many healthcare workers suffer from computer anxiety and would prefer to have nothing to do with use of related technologies such as the DHIS2. According to the information obtained in this research, this anxiety can be attributed to several causes, the first one being the fact that many health workers consider themselves as 'Born Before Computers' having been educated in an era where everything was done manually and there was no mention of computers in their formal studies. Another reason given is that some health worker fear that use of computers will bring with it efficiencies that will lead to exposure of the loopholes they have been taking advantage of to get unfair gains at the work place. Other less ominous reasons are simply resistance to change and the need for some training and sensitization on these skills before they take the plunge. In the words of one informant:

"Some people are BBT, born before technology, so when you put things in a system and they don't have those capacities, they may not use it. Particularly our health workers who were trained a long time ago and they have not made some efforts to go for computer training , so it becomes a challenge…" - Int007

5.6 Social Influence and Behavior Change

The theme of social influence and behavior change was found to be closely interlinked with the other theme on the need for a Champion and Leadership on data ownership and use. The bottom line is that health workers will in most cases adapt their behavior in accordance to what they perceive to be the expectations of their immediate supervisors. At the same time peer influence on health worker behavior is significant, and hence the need to provide more opportunities for sub-regional sharing of experiences in data reporting and use for decision making. One informant summed up this perspective as follows:

"The culture of information use needs to be developed… inculcated over time starting from the very top. And what I've heard from informal circles, I don't know how true it is, is that the president demands that people provide evidence for the decisions that they make. So he's requiring that of his managers of that level, so am hoping or expecting that it trickles down all the way so that you have evidence for the decision that you make…" - Int018

5.7 Direct Data Entry by Health Facilities

Majority of the informants were of the opinion that direct data entry by health facilities into DHIS2 needs to be encouraged as this would bring about several benefits. These perceived benefits include increased sense of ownership and accountability for the data quality by the health facilities, reduced opportunities for introducing errors in the data, and freeing the HRIOs to undertake what should be their proper mandate of data analysis and verification. However there are those who thought direct data entry would overload the DHIS2 systems and have some negative effect on data security. All acknowledged the need for health facilities to be supported in terms of computing and internet infrastructure if direct data entry is ever to become a reality.

"..so if we are able to have adequate staffing, if we are able to have adequate financial commitment to install the internet to these facilities, if we are able to have adequate financial commitment to procure the computer hardware and software, I think that would be the way to go, so that we can be able to improve the quality of the data that we collect, hence we can improve on the quality of the information we can get for decision making." - Int016

5.8 Ease of Access and Use of DHIS2 Data

The informants were in agreement that DHIS2 is generally easy to use for those who are familiar with it, and especially for data entry since the system mimics the actual paper collection forms. There was however concern that for first time users, the system can be quite daunting because the user interface is not intuitive and can be confusing. Some criticized the current need to undertake some of the data analysis outside of the system such as using Excel Pivot tables. It seems a short orientation on how to navigate through the system would go along way if presented to all the targeted users.

"One of the things we really focus on is to make –to avoid a steep learning curve because for some people who are not technically skilled it's really a big step to go from the safe old paper form. And one of the things we do to ensure that is we try to copy the form as exactly as possible to the system so that they feel comfortable at once..." - Int014

5.9 Funding, Infrastructure and Other Resource Requirements

Getting the use of DHIS2 at optimal levels, especially at health facilities, is very closely linked to availability of funding to support various resources including computing and internet infrastructure, data collection tool, adequate staffing levels and training. The informants were wary of the country's seemingly over-reliance on donor funding in support of these resources.

"..maybe the government needs to put a lot of funding [aside] so that we don't also have over reliance of DHIS coming from partners; because otherwise they [health workers] may not have the motivation. But if the directive comes from the government and DHIS is fully supported as a government tool, then nobody will resist it." - Int005

5.10 Health Worker Orientation & Training

All the informants interviewed had a lot to say about the need for adequate training of health workers if at all they are ever going to use DHIS2 as envisaged. And it is very important that this training be packaged properly depending on the cadre of users who are targeted. The question of just how long the training should be was found to be complex, with some asserting that the one week standard training period is less than adequate, especially considering that most of them will not have had much interactions with computers before hand. The need to rethink the protocol to follow when training the managers was also touched on, primarily because such personnel will neither appreciate being trained by their juniors nor sitting in the same class as their juniors. All were in agreement that when the workers are well trained and sensitized on the benefits of using the system, then this contributes directly to how well they use the system both for their routine work as well as in generation of information products that can aid in relevant decision making. In the words of one of them:

"*I think at national level we did not train people, it was a one-two hour presentation of this is DHIS, you can view data here, and you can do maps. Most of the training was done understandably at the facility and for direct users, but then at national level we should have had a more tailored presentation, training and sensitization on exactly what you would expect them to do in DHIS." - Int001*

5.11 Assuring the Information Security

The informants expressed concern about whether Kenya has put in adequate measures to ensure security of the data collected and processed through DHIS2. In particular informants were concerned by the fact that this data is available through open access to any interested party from any part of the world as soon as it had been entered at the district and health facility levels. This despite the reality that some of the data keyed in is erroneous and has not been validated by the data owners. Some interviewees however informed the researchers that the ministry was in the process of setting up a web-portal that will only contain the validated version of DHIS2 data. In the meantime it was noted that some researchers were already using the available data and misrepresenting the Kenya health situation at international conferences. In the words of one informant:

"...again if you are allowing people to access this data you should be very sure about that data because I went to one meeting and a professor was using DHIS data from Kenya. The guy is from outside the country and he was making a presentation on Kenya in a conference we were in and it was on brucellosis - and he was bringing forth the magnitude of brucellosis in Kenya. In the open access you need to be very careful because people outside Kenya from all over know [think] that is the true situation .You have posted it there, it's open access so they take that data and they use it. I'm telling you they use it in conferences to [erroneously] project what is happening in Kenya..." - Int007

5.12 Institutional Capacity and Staffing Levels

One of the challenges that continue to plague the health care sector in Kenya is the issue of high workload and low workforce, especially in the lower level health facilities. This compounds the challenge of trying to scale up use of DHIS2 in the country because some rural health facilities have one clinical staff who is expected to attend to several clinical roles in addition to finding time to collect and collate the health information. The situation is not much better at the higher health facilities where the resident HRIO is expected to support roles which are seen as more important than data management, such as patient registration. These challenges are even more complicated by the fact that the managers in charge of these health facilities are in most cases not fully aware of the role of DHIS2 and how it can assist them in their day to day work. Infrastructural challenges in many Health Facilities (HFs) means that even the most proactive ones are unable to access DHIS2 directly for data entry and information use. In the words of an informant:

"..apart from even the skills, the staff are few. So you find like the facility is run by one nurse, she's a nurse, she's a pharmacist, she's everything; it becomes quite hectic for such a facility" - Int020

5.13 Performance Enhancement and Value Addition

Those who have had a chance to interact with DHIS2 agree that the system adds real value to the country's health data management scene, especially when compared with previous HIS systems. The range of values includes the ease of access to the health information and the timeliness with which that information is available. It also has to do with the ease of report generation especially for the standard charts and reports that are already inbuilt in the system. The added fact that the system is for the most part friendly and easy to use is like an added bonus. Despite the fact that the system was

initially only targeted to report on routine service delivery data from the HFs, DHIS2 has since been used innovatively to report on malaria commodities. This has led to such improved reporting rates that quantification of malaria medicines can now be done based on consumption data. Subsequently, one of the stakeholders affiliated with the malaria program made this comment:

"I would recommend this [DHIS2] for other commodities management as well because the data is in a timely version, you can drill down to the facility level and check which facilities are stocked out and which are not stocked out, in which district or county. I would recommend it for this mostly because it will improve reporting rate and again availability and timeliness of the data." - Int002

However, it also emerged that most of the targeted users are unaware of this value addition and hence are not benefiting as they should from DHIS2. In this regard one informant had this to say:

"The value of DHIS2 for managers has to be promoted aggressively, and the moment that managers see this as directly affecting their work, whether it is resource allocation, making some policy-type decisions and all that, they'll actually start using it and actually start interacting with it. But for as long as they feel like this is a system to be used by health records and information officers, they won't use it." - Int024

5.14 Policy and Legislation on HIS Reporting

The majority of the informants interviewed were very categorical on the need for there to be some form of policy and legislation to guide the issue of health information reporting in the country. They were aware that only when considered holistically can the health information be used effectively for planning and improving public health services in the country. In particular they emphasized the need for the private and Faith Based Organizations (FBO) sectors to be legally bound to provide data on the minimum dataset agreed upon by the Ministry of Health (MoH). Paradoxically, the informants were not sure whether such legislation is in existence already or not, and some clearly stated that if it exists, then it is certainly not being enforced. A few of the informants thought making reporting mandatory might be counter productive, either by causing some to report erroneous data, or to simply be defiant and refuse to report. In the words of one informant:

"*It's only a bill ,a health bill put in place that can help us because if we put a bill in place which says that all facilities irrespective of private or non-private ,they are supposed to report so that we can have a clear picture of what is happening in the country , .. if we have a health bill which is emphasizing on health information and reporting, that will bail us out, because as for now even if you go tell private hospitals you are supposed to report ,there is no bill ,you cannot quote any .." - Int003*

5.15 Sensitization and Advocacy at Management Level

The key selling point for DHIS2 is not just the fact that it is capable of collating and aggregating reports from all service delivery points in a speedy manner, but more so the fact that health care workers at all levels can be able to access and use this information for appropriate decision making. Yet according this research's informants, very few healthcare managers were sensitized on this aspect of DHIS2, with most viewing it as a tool for the HRIOs and the program M&E officers. The situation is more dire now with the establishment of the county government. If the governors and County Health Executives are not sensitized on the role of DHIS2, they may view it as a tool for the central government and not embrace it as expected. Given their administrative roles, training and sensitization for the management teams needs to be handled with care to ensure observation of all protocols. Some words of wisdom from one informant emphasized this point as follows:

"I think it's just a matter of engaging the leadership and telling them we have a system like this and you are the people who are supposed to be using your own data so please make sure all the reports are uploaded, people are analyzing their data and using their data. You just need to sensitize them." - Int013

5.16 Technology Enhancement, Hosting and Clarity of Roles

While acknowledging that there is a lot of value add and performance enhancement achieved by using DHIS2 even in its current status, a lot of informants were of the opinion that there is still a lot of enhancements that can be added to the system. Among other suggestions, these ranged from improving the DHIS2 user interface, to rethinking the datasets currently defined in the system, to encouraging and improving the automated data analysis within the system; and to using some appropriate technology to eliminate the need for intermediary reporting for the health facilities. Inevitably these suggestions were also linked to the question of whether local capacity exists at the Division of HIS to support these enhancement requirements. Another issue that caused a lot of concern among the informants is the question of where the DHIS2 server for Kenya's data should be hosted. Some were concerned that hosting this outside of the country would be going against the country's e-health policy and probably be a source of security risk for the data. Others argued that these security fears were unfounded, and pointed out that since the hosting was moved to a local Mobile Service Network Operator's cloud after initial hosting abroad, the system has undergone service degradation both in terms of access bandwidth and information processing capacity. Finally some informants were uncomfortable with some aspects of the manner in which the MoH and its implementing partners are collaborating, calling for more openness and clarity of roles. To quote two comments on this subject:

"..as DHIS grows everyone is seeing the potential, we are even moving commodities management into DHIS. The national level probably needs to rethink on how they are

managing DHIS. I think currently we haven't thought about who manages DHIS in the sense that the HIS team expects health programs to be looking at their data [to detect data entry errors]; but even as HIS what are they doing in terms of managing DHIS data quality? Do they have an internal system in place to say so-and-so is in charge of commodity data and so should make sure they know what is happening, and to prompt program or prompt facility when they notice data errors..." - Int001

"..the local Mobile Service Network Operator can say yes we have the cloud computing but it doesn't meet the requirements of the client… To me it was better [when running in the other cloud] in the sense that it was providing us with high speed you don't have internet down times, everything was running smoothly so that means as a provider, they were really adhering to the client, but if you have a provider who is giving you half baked products you cannot sustain the business…" - Int023

6. Discussion

Research on user acceptance and use of ICT has been done extensively over the past decades. Such research has generated many competing models originating from different theoretical disciplines such as psychology, sociology and information systems, as well as different sets of determinants perceived to influence acceptance or use of ICTs. The most popular technology acceptance models based on social psychology perspective have identified some common determinants of acceptance of technology, looked at from each individual's perspective [18–20].

Though user acceptance studies especially in the health sector have mostly been done in developed countries, this research confirmed that many of the identified technology acceptance determining factors are indeed still relevant in the developing countries' context. Additionally there are some determinants that are unique to the developing countries context and some just for the Kenya context alone. Table 1 summarizes the factors that were found to be pertinent in influencing acceptance and scale up of use of DHIS2 in Kenya. The factor names and definitions are adapted from the Unified Theory of Acceptance and Use of Technology (UTAUT)[20].

Table 1: Pertinent Factors that Determine DHIS2 Acceptance and Scale-up in Kenya

Pertinent Factors	Role in Acceptance and Scale up of DHIS2 in Kenya
Performance Expectancy – defined as degree to which an individual believes that using DHIS2 will enable him or her to attain gains in job performance	For them to accept DHIS2, targeted users need to be sensitized on value-add they may expect from using the system. Some value-add items identified include: ▪ Use for mandatory data entry and reporting ▪ Facilitation of decision making based on service delivery data in the system e.g. a health facility could review its workload as reported in DHIS2 to inform its decision on hiring of additional health workers; ▪ Enabling facilities, sub-counties and counties to make decisions on need for commodities based on prior consumption and patient load as recorded in the system
Effort Expectancy - defined as the degree of ease of use associated with the use of DHIS2	DHIS2 is easy to use and this should encourage easier adoption of the system. There is however need to ease the web navigation process especially for new users
Computer Anxiety – defined as the degree to which anxious or emotional reactions are evoked when using computer technology	Intensity of this anxiety was found to be influenced by age as well as the level of prior computer experience among the intended users. Thus exposing targeted users to practical sessions on general computer use before introducing DHIS2 could serve as a mitigating factor.
Social Influence – defined as the degree to which an individual perceives that his or her peers, supervisors, and important others believe he or she should use DHIS2	Social influence was found to play a key role in user acceptance of DHIS2, manifesting itself in the form of: ▪ Culture among health workers that causes them to follow their leaders almost blindly ▪ Practice of passing on information orally instead of recording it ▪ Habit of delaying performance of activities till the very last minute e.g. preparation of monthly report ▪ Emphasis on the need to have a champion(s) that health care workers can look up to in using the system
Training Adequacy – defined as the degree to which an individual believes that the training he or she received is enough to enable him or her use DHIS2 effectively.	Perceived adequacy of Training was sited as a key determinant of the actual use of the system. Some aspects of adequate training as identified in this study include: ▪ The need for the trainers to be selected appropriately as not everyone can make a good trainer ▪ Adequate duration of training
Organizational Facilitating Conditions – defined as the degree to which an individual believes an organizational or technical infrastructure exist to support use of DHIS2	Facilitation that can support faster adoption and scale up of DHIS2 use includes: ▪ Provision of appropriate computing infrastructure and internet access ▪ Conclusively addressing the issue of high workload and low workforce in most health facilities

Factors such as performance expectancy, effort expectancy, training adequacy and organizational facilitating conditions have been tested and found to be pertinent for acceptance of technology in developed countries as well. However training adequacy and computer anxiety may be more salient in Kenya and other developing countries' context because of the prevalent challenges of lagging behind in computerizing of health systems in these countries. Perhaps as recommended by some of the informants, it would be better that training on basic computing skills is integrated into all pre-service training curriculums for healthcare workers.

While identifying the potential for value-addition to be derived from use of DHIS2, respondents were of the opinion that the system is currently being used sub-optimally, mostly for mandatory reporting. There is therefore need for targeted users to be sensitized and trained on data demand and information use (DDIU) aspects, and for advocacy efforts to be made to cause a change in behavior of health workers in this aspect.

The role played by immediate supervisor or regional managers in motivating or de-motivating the use of DHIS2 among health workers is recognized as very important. Lack of appreciation for the system by these higher cadres of staff will trickle down and negatively affect other health workers' acceptance of the system. The senior health workers can be influenced to appreciate the system by sensitizing them on the expected benefits of using DHIS2. Similarly, it is important to ensure that those planning scale-up of DHIS2 improve on the sensitization and training of health workers by selecting appropriate trainers and undertaking pre and post training evaluations to capture participants' perception of training adequacy

As much as possible, health facilities should be empowered to key in their data directly rather than the current practice of delivering manual reports for sub-county HRIOs to enter in DHIS2. A sense of ownership and actual use of DHIS2 data would be encouraged if this facilitation was adequately provided. Other facilitation that needs to be enhanced is the issue of prompt provision of technical support as and when required.

There was divided opinion on the role of gender in acceptance and use of DHIS2. Divergent views were also expressed on whether use of the system should or should not be made mandatory for all healthcare workers. It would be interesting to empirically test the contribution of these and other factors in a future study.

On the issue of the inadequacy of local technical support for the DHIS2, the University of Nairobi, School of Computing and Informatics is currently building an adequate level of technical skills to mitigate this shortcoming. This process of capacity development is being facilitated by the USAID AfyaInfo project and the Ministry of Health.

Finally proper legislation needs to be enacted and enforced to ensure that reporting on a select number of national and international health indicators is done consistently from NGO, Private and Public sectors, as well as from the 47 counties. In addition, there is need to put in place a data governance framework to manage issues such as data security, sharing and access.

7. Conclusion

Implementation of DHIS2 in Kenya has presented an opportunity for the country to move from the era of unreliable and fragmented HIS systems to the more ideal situation of availability and use of quality health information for decision making. This potential can only be realized if the identified challenges are addressed, starting with the need for the health managers in the country to take up proactive leadership in demand for and use of DHIS2 data for decision making. Instigating a culture change that will cause health managers throughout the system start to use the DHIS2 data directly for informed decision making, rather than assuming the system belongs to the Health Records officers is long overdue.

The other challenges that call for urgent attention include the inadequate infrastructure especially at the health facility level, generally low computer proficiency among some health workers, inadequate health facility staffing levels, as well as the still unmet demand for better quality and more complete health data. The DHIS2 in-country technical support capacity will need to be strengthened to make it more responsive and efficient, and capable of addressing new user needs and technology enhancement requirements that emerge with increased use of the system. Additionally there is need to ensure that the DHIS2 data accessible to end users is validated and verified to avoid making erroneous representation of the country's health status. And while recognizing the need for the country to feel secure concerning the hosting of its routine health information, the benefits of local hosting need to be weighed against any degradation in access and performance of the system, two factors that have the potential to derail the scale up of DHIS2 in the country.

The ongoing implementation of devolved systems and services in the country can prove advantageous if the opportunity is seized to proactively sensitize the county health management teams on how DHIS2 can facilitate their monitoring, evaluation and reporting on best practice health indicators. The buck stops with the national and county governments to ensure that proper legislation is enacted and enforced to ensure health reporting and accountability by all players in the health sector.

8. Future Scope of the Study

This study was undertaken as a first phase in investigating the determining factors of computer technology acceptance and use by health workers in Kenya. In the next phases of the study, a conceptual model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) is developed to explain the complex relationships between these factors. The model will subsequently be tested and validated using Structural Equation Modelling (SEM) and a large enough sample size to enable generalization of the findings and the recommendations.

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