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Availability and Integration Of E-Health Technologies in Routine Service Delivery in Western Kenya

ONDULO Jasper[1], ADUDA Dickens[2], RAMBIM Dorothy[1]

Department of Computer Science, School of Computing and informatics
Masinde Muliro University of Science and Technology, Kakamega, Kenya[1]

School of Health Sciences & Center for Research, Innovation and Technology,
Jaramogi Oginga Odinga University of Science and Technology, Bondo, Kenya[2]

Corresponding author: Jasper Ondulo.

Abstract: Globally, ICT has emerged as a critical enabling-tool to achieve effective facilitation, monitoring and management of service delivery. As governments accept, adopt and move to invest in e-health implementation, there is need to evaluate and understand the state of adoption, the process and impacts at different stages of implementation. In Kenya, eHealth Policy (2016-2030) envisions progressive sustainable adoption, implementation and efficient use of eHealth products and services at all levels of healthcare delivery. The study explored e-health services availability by type and level of implementation to support service delivery at level 3 and 4 healthcare facilities. The presentation is based on data derived from literature review; triangulated with empirical data on e-Health implementation collected during a survey of three county referral hospitals, in western Kenya. The facilities lacked enough technologies in place; poor technological infrastructure, if not wholly lacking and low computer to task ratio. There were significant barriers to e-health implementation; notably, not enough skilled e-health practitioners to drive the implementation process. However, Kenyan government, through Health Policy and with the support of donor community partnership, seek to strengthen and accelerate integration of ICTs into healthcare system and health outcomes.

Keywords: E-Health Services availability, Utilization, Level of Integration, Service Delivery.

I. BACKGROUND

Worldwide, the use of Information and Communication Technologies (ICT) to support health services has grown rapidly since the last two decades. The fifty-eighth session of the World Health Assembly [1] adopted resolution WHA 58.28 on e-Health, recognizing its strategic potential to trigger rapid growth and reforms in the health sector, which is essential towards realizing the post-2015 agenda for health. The World Health Organization [2] defined e-Health as "the secure and cost effective transmission and exchange of health data and information either locally or at a distance", capturing a view of a basic functionality. Modern ICTs contribute to improved healthcare outcomes in a number of ways. Countries may nonetheless prioritize only some of the eHealth solutions to help address specific strategic health policy initiatives. These may include: *i)* mHealth to support distant healthcare and monitoring to address equity issues in health coverage; *ii)* eLearning for remote or virtual training of healthcare workers to address competencies and skills gap; *iii)* electronic health records to improve availability of quality health information for decision-making in a timely and efficient manner; *iv)* telehealth to improve availability of specialized interventions to address access to specialized care [3]. Scaled up implementation of ICT solutions to support e-health is thus considered critical towards realizing universal health coverage especially by way of enabling more comprehensive and coherent health systems improvement interventions, management and monitoring [4; 5] Whereas since 2005 just about half 58% of the WHO member countries have developed eHealth policies, recent studies [6; 7] have shown important broad-level challenges that continue to dog implementation of these strategies both at national and subnational levels. Economic affordability for initial investments and sustainable implementation continue to pose enormous challenges to its full implementation. However, few studies have evaluated sub-national and unit-level implementation experiences and how, amidst the existing challenges, institutions are adapting and the nature of these adaptations in relation to their effect on eHealth effectiveness on set health goals.

To a large extent, the context of eHealth implementation programs in the developing countries is characterized by widespread multi-level disparities. These are thought to impact disproportionately on the health systems improvement interventions as well as their uptake [8; 9]. Therefore, efforts to harness and integrate eHealth operations into the health systems require inter-sectoral collaboration, commitment and strategic planning focused on: *i)* building the physical

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infrastructure; *ii)* deploying appropriate eHealth services and applications; *iii)* developing a capable health workforce; *iv)* ensuring a sound legal and regulatory environment; and *v)* improving governance, policy, standardization and interoperability (table 1).

Table 1: E-Health Components

E-Health Components	Description/Examples
Telecommunication	Including mobile phones, smart phones, routers, receivers, cables and sensors.
Computing	including regular or specialized desktop personal computers (PCs), laptops, tablet PCs, personal digital assistants (PDA s), the Internet and e-mail
medical equipment	including ultrasound, videoconferencing, radiological such as digital X-rays, remote clinical monitoring such as electrocardiograms, blood pressure machines, laboratory diagnostics and microscopy
Infrastructures	Basic requirements for connectivity and functioning of the systems including availability of electrical power supply and back up. The physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions.
Infostructure	the human resources, organizational and administrative structures, policies, regulations, and incentives that facilitate fully integrated and sustainable use of innovative ICTs and services to improve health care in an organized response to health and health care needs, issues, and challenges

In Kenya, implementation context of eHealth coincides with major health sector reforms to achieve universal coverage through the primary healthcare strategy. In the post-devolution era, Counties are responsible for services delivery. Adoption of eHealth technologies is a strategic priority expected to not only enable delivery of essential healthcare but act as a catalyst for economic growth [10].To facilitate achieving the eHealth policy goals, the national government has initiated investment in the basic requirements, including: *i)* background superstructures (involving connection to submarine optical fibre cables and the laying of the national optic fibre backbone linking major towns) and continues to build on it; *ii)* promoting increasing availability of and access to efficient, reliable and affordable high-speed wireless broadband connectivity as well expanded penetration of mobile technologies into previously marginalized and difficult to access regions [10]; *iii)* has developed a national eHealth policy, which also identifies key strategic investment priorities to drive the "Vision 2030" health agenda. These are divided into 5 pillars: Telemedicine; Health Information Systems; Information for Citizens; M-Health, and; E- Learning. However, broadly considered, progress in eHealth implementation nationally remains at its infancy and the progress towards operationalizing the priority initiatives is still slow largely due to social, economic, and technical challenges. Alongside these are ongoing reorientation, retraining and redeployment of health manpower to meet manpower demand projections and resource availability. Whereas these represent considerable investment towards realizing the national health goals, there is still little success for eHealth strategy across Counties. There is need to evaluate contextual variations within Counties as the events underlying these challenges are diverse.

In Kenya's current context, the overall status can be described as having 'stalled' at the early adoption stage. Here both the ICT and enabling environments are at an early stage and eHealth is project-based, featuring a few small initiatives that are seldom connected to each other. Projects tend to be either time-bound, proof-of-concept pilots, where ICT is introduced (or imported) to demonstrate a technology in a limited context or are related to vertically supported research or public health programs [7]. Development partners, notably USAID and its affiliates, are currently supporting the roll-out of infrastructure (hardware and software) for EMR implementation in a number of Counties, which is a step forward. High costs of investment and sustainability of eHealth systems and innovations; low ICT literacy amongst users; fragmentation; lack of interoperability of eHealth systems; market fragmentation; weak regulatory framework; a lack of ownership by the healthcare providers and possible violation of patients' privacy and confidentiality account for a greater part of the challenges that have slowed down the growth of eHealth across Kenya's Counties. However, there is general lack of information of specific eHealth activities under implementation due to inadequate registries by both national and county governments. Based on the national eHealth 6 guiding principles (standardized eHealth solutions, integration into existing systems, research and development, equitable access to quality care, participatory approach, patient centered healthcare approach), the current study assessed availability of standardized eHealth solutions and scope of integration into existing systems.

II. METHODOLOGY

Study site

Two County (Ministry of Health level 4) health facilities (Kisumu and Kericho hospitals) and 1 sub-County (Ministry of Health level 3- Bondo) were selected as ideal study sites according to the following criteria:

a) The technologies available were to include a range of e-Health domains (i.e. management, communication, decision support and information);

b) The study sites were to include a range of clinical contexts (i.e. primary, secondary and community care);

c) The study sites were to exemplify a range of sponsors of the implementation, as sponsorship is an important variable.

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d) The study sites were to be representative of rural, urban or semi-urban locality differing in economic endowment [12].

In addition, the study sites differed in respect of: geographical location, population catchment and economic endowment, levels of utilization and normalization of e-Health services, domains of e-Health used, different service and policy contexts. These criteria allowed the study to examine health professional perspectives on e-Health implementation from those located in different environments – and so contribute to the objectives. These selection criteria enables maximizing transferability and generalizability of the results by achieving a maximum variability sample.

Research Design and techniques

Nachmias & Nachmias [11] view research design as deriving its importance from its role as a critical thread between the theories and arguments that informs the research and the empirical data collected. To align to this argument, the study adopted both an exploratory and descriptive design using mixed methods. The objective was to investigate the number and type of ICTs that were available and could support e-health solutions in three level 3 or 4 healthcare facilities in Western Kenya and describing their integration and embedding in routine service delivery. Data was obtained through desk review of national and County eHealth reports; non-participatory observation, and; administering questionnaires to the sampled respondents.

Questionnaires were to: identify e-health initiatives within the care facility; clarify integration issues identified from desk reviews and researchers' observations, and; identify the perceptions of the participants on the following matters:

i. the different types of ICTs which supports healthcare operations and service delivery currently available at the healthcare facilities
ii. the current access to computer equipment at the healthcare facilities
iii. the current access to the Internet at the healthcare facilities
iv. the benefits that ICT applications can bring to healthcare services and communities in the environs of the healthcare facilities, and
v. The perceived barriers for ICT applications or implementations in the healthcare facilities.

Researcher Observations - These were ***conducted*** over a consecutive five day period by observing and documenting the details about availability and integration of eHealth technologies versus activities and structural setting of the facilities as well as process layout and flow, during the morning and afternoon sessions. During morning hours ***from opening at 08:00 to 13:00*** hours, being the peak of activities anonymous observations of structural setting of the facilities, routine service delivery activities as well as process layout and flow**.** However, timestamps were gathered during the afternoon sessions, from 14:00 to 17:00 hours, when there were very fewer or no outpatient arrivals to be logged in. The timestamps covered all the points in time relevant to the Patient turnaround time- PTAT (or Patient Length of Stay- PLOS).

To understand the actual processes and problems faced on the ground, a state analysis was performed. A global assessment of all work processes and a time motion study, was conducted for respective 5-days observations at each of the selected study sites. This allowed for the analysis and understanding of the bottlenecks and problem areas within the patient flow. This entailed characterization of patient flow to determine the points of start and end; and other patterns of movements within the flow. Conventional events within the patient flow process were taken into consideration (Registration, billing, triage, provider/patient consultation, diagnosis (Laboratory, Pharmacy and Radiology), staff scheduling and loading, etc. When this had been done, it was mapped against the service charter to compare and contrast for the variations whether positive or negative.

Participant interviews

Healthcare workers were hand delivered self-administered semi-structured questionnaires with the help of contact persons at each study site. The respondents, who participated in the study from the three study sites, were a broad mixture of cadres involved in various aspects of patient care at the facility to align with the aims of the study. Specifically, respondents included: medical doctors, radiologists, health administrators, nurses, pharmacists, Laboratory Technologists, Health records and information officers and, clinicians. Semi-structured interview protocols were used to guide the study not only on what happened, but also on the implementers' perceptions on why it happened. The content of the interview was informed by theoretical concepts pertaining to e-health implementation related to factors that affect its successful implementation, integration and embedding. Quantitative data was analysed descriptively while qualitative one were thematically analyzed to identify issues emerging.

III. RESULTS AND DISCUSSIONS

eHealth implementation characteristics by facility

Based on the literature review findings, three different levels of implementation of e-health services were identified. These are: *i)* experimentation and early adoption; *ii)* developing and building up, and; *iii)* Scaling up and mainstreaming [7]. Analysis results of availability and application of eHealth solutions to support service delivery tasks in the out-patient revealed the facility level of eHealth implementation, categorized as follows:

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Site 1: From observation results, Site 1 does not have telephone in place, besides poor ICT infrastructure; majority of staff use personal mobile phones for communication. The hospital has only one computer at the billing point; the other available computers are for administrative purposes found at the Medical Superintendents and the hospitals' administrators' offices which also remain fragmented (not networked). The role of the government is very minimal if not nil in terms of funding or supporting the e-health programs through provision of skilled staff. There was no implementation project at all.
Consequently, the site was viewed to be in category I eHealth implementation: experimentation and early adoption where both the ICT and enabling environments are at an early stage. Within this context, eHealth is project-based, featuring a few small initiatives that are seldom connected to each other (silo based)

Site 2: had most of the processes and operations being manual save for the division of HIV/AIDS which has implemented components of e-health from government-donor collaboration funding (USAID). Other presence of computers, are found at the offices of the Medical Superintendent, finance and at the registry which are mainly used for administrative purposes and not for clinical functions. Furthermore, the implementation is more of donor funded for specific disease; there is very little of government involvement if any in the implementation of the e-health project. The rest of other operations of the wider facility's' functions lacks e-health implementation; thus, its operations are based on the old traditional ways of clinical medicine processing which are basically manual, and paper based for patients' record keeping. The greater part of the healthcare facility is characterized by long (queues, length of stay, patient turnaround time) and at times patients leaving without being attended. Data is buried in dusty files within the facilities' registry save for the HIV/AIDS department which is automated.

Site 3: has a networked environment; e-health presence starts at billing where computers are used to capture patients' details and print receipts, triage, pharmacy, Laboratory, finance and administrative offices; however, they remain silo based or fragmented in nature. The administrative functions are networked whereas the other functions (clinical) remain silo based. The facility, however is struggling with the sustainability of the system due to funding difficulties. The e-health project is the facility's initiative with very little support from the government if any. The e-health project is purely administrative, there is no clinical component implemented as yet. The role of the government is mainly payment of the staff salary who are involved in the e-health project.

Availability of clinical electronic decision support tools:

In response to the question of whether the facility has "e-Health clinical decision support tools (e.g. medication guides, chronic condition care plans, EMR, etc.) that providers can use at the point of care, 30% of the respondents indicated that what was available could support decision but they were not operational, while 70% were of the view that the facility did not have what could support electronic decision. About the need for availability of good infrastructure in terms of electricity, communication network for successful implementation of e-health, all respondents unanimously agreed, in the ratio of 24% agreeing and 76% strongly agreeing. Electricity supply was frequently interrupted and lack of without power backups. At all the study sites, channels for laying optic fibre networks were being prepared and the cables being drawn more so in the urban environments.

IV. DISCUSSION

Comparative assessment of the 3 facilities indicate important variation in implementation of eHealth solutions. Sites 2 and 3 were larger, the eHealth-related projects bigger with greater awareness of their potential but, eHealth implementation was virtually project-based (vertically supported). They had eHealth equipment in some given sections which supported their program processes. In site 1, there was no implementation project at all as compared to the other two study sites which at least of the facilities under study.
Whereas these characteristics, experimentation and early adoption, indicate an emerging ICT environment and a potentially enabling environment for e-health application and growth, they are largely driven by donor support through implementing partners while little if any government support was available. This is of concern considering the need for sustainable scale-up, standardization and organizational learning. Whereas vertical support is beneficial for set-up, systems strengthening and making a case for e-health [7], active government support is necessary for long-term improvement in infrastructure and coordination of eHealth systems such as for health information, supply-chain management, and electronic medical records. The observed eHealth characteristics in this setup are typical of majority of African countries.

Availability of infrastructure (such as electricity supply and backup etc.) is the backbone of the existence of any e-health project. Whereas there was a strong showing from the respondents of the need for eHealth and support structures, the facilities either largely lacked them altogether or where available were inadequate, except for the ones available for the donor projects. This is consistent with low implementation status. In addition, independent of the pace of adoption of

eHealth, there are both general and healthcare-specific issues, which may influence availability of eHealth in a given context [13]. These include: **Complexity** of the healthcare tasks to be performed hence type of ICT solutions required e.g. managing dependencies between infrastructure, applications, information, integration and clinical administration; **Governance and organizational management** , e.g. ensuring alignment between initiatives, processes, overall organization and outcome governance; **Local conditions**, e.g. balancing national, sub national and institutional priorities and funding; **Stakeholder engagement**, e.g. ensuring involvement and acceptance from managers, clinicians and IT staff; **Vendor engagement**, e.g. ensuring contracts with clear responsibilities and liabilities hence consistency in supply and maintenance logistics; **Adapting to and managing change**, e.g. successfully communicating changes, training staff and ensuring that projects do not become IT projects, but really clinician-led projects aimed at improving ways of working; **Measurements across the implementation continuum** e.g. establishing baseline measurements and agreed success metrics; hence monitoring and evaluation.

There were considerable differences between facility 1 and facilities 2 & 3 with regard to level of implementation. In Kenya the presence of implementing partners providing specific HIV-programs related support have played a major role in strengthening eHealth in western Kenya which is the region with the highest HIV burden in Kenya. This might explain the observed project-oriented eHealth implementation status and the attendant variations. According to Tan [14] the level of eHealth support' the operational environment and standard of care would potentially influence availability. Besides the above factors, the level of government funding for eHealth implementation and variations in clinical practices, might also have profound implications. Low economic potentials in majority of African economies, where information systems are not fully established, continues to be a great challenge in adopting a fully developed European/western based eHealth solutions [15; 16].

Kenya Vision 2030 and other national development blue prints recognize the need to prioritize health investments to ensure a healthy and productive population. Policy documents derived from this Vision such as the Kenya Health Policy Framework 2012-2016 and the third National Health Sector Strategic Plan 2013-2017, all recognize the need to scale up investment in health in terms of increased budget allocations and also to prioritize issues related to the health workforce. The drawback however is, despite the recognition of the need for scale up of increased budget allocation for investment in health, this is hardly the case. Also, external resource support on health in Kenya has been increasing over the years without proportionate increase from the central government expenditures [18; 19].

External resources on health in Kenya has also been increasing over the years without proportionate increase from the central government expenditures and therefore putting the country in a precarious scenario since relying on external resources to finance health care is not sustainable. EHealth systems that are successful in the developed world may not be replicated with the same result in resource constrained environments, because of differences in the operational environment in which the system operates.

With increased resources from development partners, donor coordination, alignment and harmonization need to be prioritized to ensure external resources are used to fund critical and priority areas as per the health plans. This can be achieved through the use of the various e-health boards to provide governance, guidance and implementation oversight. Further there is need for friendliness of the country's market, political and regulatory environment or regulatory framework in supporting ICT uptake. Business and innovation environment for successful implementation of eHealth also requires: fundamental cultural and business process changes in terms of the way health care is delivered across the facilities, including the reengineering of workflows to improve efficiency and effectiveness; clinical practice and process reform to enhance delivery of health care, and provide more integrated and timely access to health information; and an underlying commitment to the long-term, collaborative and integrated gathering, thinking about, using, and sharing of clinical and management information.

For successful implementation of e-health, hence availability and integration, successful implementers have focused on a number of strategic priorities and key activities such as Strategy and Leadership; Stakeholder Engagement; Standards and interoperability; Governance and Regulation; Investment, Affordability and Sustainability; Benefits realization Capacity and workforce; eHealth foundations Applications and Tools to support healthcare delivery; Monitoring and Evaluation of the eHealth Strategy [20].

The critical challenge of any eHealth strategy is delivery and implementation. Delivery of eHealth systems have proven to be a complex undertaking involving many stakeholders and diverse interests. This therefore requires a collaborative and coordinated effort in pulling the complexities and the diverse interests towards one goal of building a successful e-health venture with less or minimal variations despite the complexities.

Many lessons can be learnt from different implementers' experience who have included the importance of proper planning and a phased approach to implementation i.e. not taking on too much too soon. Also important is the use of local authorities and partnerships; development of procurement, funding and governance models. Information should be communicated in non-technical and easy to understand format for all stakeholders.

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V. CONCLUSION

There are a number of factors which interact in different ways to influence the adoption and implementation of e-health. The current study highlights the strides that have been made and the gaps that still exists in the Kenya health system towards the implementation of e-health to support services delivery in typical County referral hospitals. There are indications that implementation of eHealth system in these Ministry of Health level 3 health facilities have proven to be a complex undertaking mainly performed by development partners. But being largely vertical projects, and focused on priority program need, implies that integration of ICT solutions in routine health services delivery is likely still less comprehensive as observed among these 3 health facilities studied. However, though still at the formative stages of implementation, availability of external support for eHealth and governmental good will is beneficial towards achieving successful and sustainable implementations of e-health.

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