E-Health Applications in Healthcare Delivery: Lessons for Africa

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Abstract
Recent developments in digital technology have revolutionised the modes and patterns in which we communicate, collaborate and share information. It has advanced with years, and has changed the way we purchase products, the way we live, the way we travel, the way we learn and the way we receive medical attention or treatment, etc. In the healthcare sector, technological advances have expanded rapidly over the years to a point where consumers and patients are directly reached through information and communication technologies. In this article, we examine how the healthcare systems in Africa can be developed from an e-health perspective. Facts gathered show that digital health technologies can help boost the development of this sector in Africa by providing the needed assistance required in a sector that is in dire need of manpower and equipment. Consequently, it is recommended that there should be promotion of national, political commitment and awareness of e-health and the mobilisation of financial resources for e-health development in Africa.
Keywords: Digital Health, Development, Developing Countries

1.   Introduction

By nature, humans are social beings. They are happier when they interact with fellow beings. Abraham Maslow conceived human nature by taking a biological view of humans. He identified stages in our growth and aspirations. According to Maslow (1958), cited in Asemah (2011), humans, in the process of growing, have five categories of needs arranged hierarchically beginning from a base to the top. He notes that humans have continual wants, and their needs are arranged in a hierarchy of importance. At the base of man's hierarchy of need is the physiological need. These are needs governed by the desire to satisfy yearnings for food, sleep, sex, exercise, rest, health, water, etc. Of importance to this article is the human need to stay healthy in the immediate environment.

According to Batta (2013), health; besides life itself, is the most important human resource. Without good health, not much is possible. Politics, education, agriculture, trade and commerce; indeed everything depends on an optimal enjoyment of good health. Defining health, the World Health Organisation (2004), sees it as a state of complete physical, mental and social well-being. This signifies that health is not just the absence of disease or other infirmities. Buttressing this, Batta (2013) notes that, it also carries the impression that physical, mental and social aspects of human healthcare are equally important and that no single aspect should be given overriding attention.

At the beginning of the present century, precisely in September 2000, a total of 192 member-nations of the United Nations signed the UN Millennium Declaration. It specifies the Millennium Development Goals (MDGs), and identifies eight critical and international goals to be achieved by the global community by the year 2015. To identify the importance of health, the fourth to sixth goals address health issues. According to Olatunji (2008),

> The fourth goal sets out to reduce child mortality especially of children under the age of five years by two-thirds; the fifth seeks to reduce by three quarters, the maternal mortality ratio, while the sixth goal addresses the needs to combat HIV/AIDs, malaria and other diseases (p. 23).

One can deduce from this that, the importance of health cannot be over-emphasised. The state of health in African countries is precarious and huge populations are in quandary. The current situation is disheartening. Hospitals are under siege, as doctors, nurses and patients battle with broken equipment and shortage of drugs. Add to this scenario, is the critical shortage of healthcare professionals. These challenges are enormous, considering the fact that African countries are in dire need of qualitative health experts and facilities.

In the last 20 years, the Internet has flattened the world in many ways; increasing transparency for consumers in multiple industries. Information and communication technologies (ICTs) have the potential to improve the lives of people in rural communities. It is providing access to digital technologies for continuous development. The need to develop and organise new ways to provide efficient healthcare services has thus, been accompanied by major technological advances, resulting in dramatic increase in the use of ICT applications in healthcare and e-health (Ruxwana, Herselman and Conradie, 2010).

Information and communication technologies (ICTs) solutions (e-health, telemedicine, e-education) are

often viewed as vehicles to bridge the digital divide between rural and urban healthcare centres, and to resolve shortcomings in the rural health sector. It is within this context and the vision of achieving universal access to quality healthcare service in Africa that the potentials of electronic health (e-health) systems need to be analysed. It is tempting to believe that the technological advancement experience of other sectors can be applicable in healthcare development in Africa,

2.   Literature Review
2.1 The Concept of e-health

Recent developments in digital technology have revolutionised the ways and patterns, in which we interact, communication, collaborate and share information. These technologies have a significant impact on information management, process improvement (logistical systems help organisations deliver better and more efficient results) service improvement, communications, gaming and entertainment, and provision of health care information (Department for Communities and Local Government, 2008). However, e-health is an emerging field in the intersection of medical informatics, public health and business, with referral and information delivery enhanced through the Internet and related technologies (Eysenbach, 2001).

In a broader sense, the term characterises not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for network, global thinking to improve healthcare locally, regionally and worldwide by using information and communication technologies. E-health or digital healthcare/digital health involves the use of information and communication technologies to improve the quality, safety, accessibility and productivity of healthcare. These technologies include both hardware and software solutions and services. According to Airedale Digital Healthcare Centre (2014):

> Digital healthcare or e-health is concerned about the development of interconnected health systems to identify real problems, identifying relevant theories, select appropriate technologies and develop new solutions for healthcare professionals and patients, manage illness and health risks, as well as promote health and well-being (p.1).

Thus, ICTs are widely perceived to have the capability, if used effectively to bridge social and economic gaps that divide rural and urban communities (Gurstein, 2005); improving access and providing a wider range of health services to enhance the well-being of under-privileged people (Ruxwana *et al.* 2010). There is great interest to use digital technology in health provision (to provide information on health promotion and health care services, and support staff training). The integration and assimilation of e-health into the everyday life of healthcare workers is becoming a reality in developing as well as developed countries (World Health Organisation, 2004).

According to Weeks (2012), the concept of e-health embodies a significant spectrum of technologies: mobile health (m-health), e-prescriptions, electronic medical records (EMR), telemedicine and similar technologies often couched with an "electronic" or 'e'-prefix. The importance of electronic technology in healthcare provision cannot be over-stressed because of the prevailing shortage of health care services professionals and the ability of these technologies to enable these professionals become more effective in their delivery of prophylactic and therapeutic services to the community.

Furthermore, Edejer (2000) notes that it is possible that people will have better health because of the availability of information on the Internet. Ruxwana *et al.* (2010), observes that, ICTs enable online communication about medical issues and diagnosis of complicated diseases by linking medical practitioners who are separated geographically. They have the potential to change the delivery of healthcare services and patient care, as well as, management of healthcare systems. However, this possibility is underpinned by the assumptions that the potential of information and communication technologies have not been harnessed systematically to bring about improvements in Africa's healthcare system, particularly among those who are poor and isolated in the rural areas. According to a *Harvard Business Review* article, several new technology companies are getting into healthcare. This is quite understandable, since one form of technology or the other could play crucial roles in the diagnosis, management and treatment of numerous diseases and health conditions. Large technology companies such as Facebook are reportedly venturing into health care and Google released Google Fit, a healthcare tech solution that allows users to track activities and set goals (Kocher and Roberts, 2014).

In Africa, phenomenal results have not been achieved. It is true that the provision of digital healthcare services is limited in Africa, and e-health, through the use of distance education, telemedicine and computerised health information systems is seen as a possible solution to the precarious healthcare system in Africa. E-health holds the promise to supplement traditional forms of health promotion using centered design and interactivity,

expansion of access to health information, greater discourse and customisation of information to users. According to Weeks (2012), telemedicine uses information technology to deliver medical services and information from one location to another, and includes medical care delivery, consultation, diagnoses and treatment as well as the education of patients and staff.

Today varied digital diagnostic techniques record and store electrocardiograms. Digital technology is used for secondary catheterisation, trans-oesophageal operation, echocardiograms, position emission tomography and magnetic resonance imaging (Mitchell, 2014). Furthermore, e-health applications can increase knowledge, empowerment, confidence and health. Scott, Gilmour and Fielden (2008) state that, in a New Zealand study, patients were reported to gain many benefits from accessing health information online such as becoming more knowledgeable about their health, gaining helpful advice from patient support sites and consumer groups, accessing opinions and support on the health needs. Similarly, Millard and Fintak (2002) note that, online health information has a major impact on the understanding of patient's health issues. Therefore, one can conclude that access to online health information can also impact on the use of health services and seeking support.

According to Mitchell (2014), intravascular ultrasound guides coronary intervention and digital fluoroscopy uses computerised three dimensional digital mapping for electrophysiological studies. He notes further that, outpatient's cardiac telemetry services such as those provided by CardioNet provide real time monitoring and analysis and highly complex implantable device technologies such as subcutaneous defibrillator, the cardiac monitor and remote monitoring. In Africa, medical experts, health workers, and health services managers through access and utilisation of information and communication technologies stand the chance to learn of the various e-health and mhealth applications that may possibly be adopted to solve the myriads of health problems besetting Africa in its development strides.

2.2 Development: An e-Health Perspective

The value of bringing technology into the healthcare sector in Africa as a continent, and Nigeria as a country is apparent. Digitised data promise to place the control of medical records in the hands of the patients, while data analysis holds the potential to improve the speed and quality of clinical decision-making. The development of electronic health record (EHR) within health care organisations promise to improve the safety and quality of care.

Wright, Ghani, Kemm and Parry (2014) state that digitally provided health services have the potential to provide information and resources on health and healthcare that could impact positively on health and provide health benefits to users. They further state that digitally provided health services could deliver a wide range of information on health; provide information on health services, where to access services locally; provide opportunities for professionals to signpost patients to services and information; contribute to behaviour change; support management of conditions; provide treatment options and choice; provide a "one stop shop" on health information; be a repository for information; provide links to other bits of information; reflect current health concerns; and provide relevant news.

Much as how printed materials revolutionised the way ideas were spread at the time of Renaissance, digitised information is modifying the way we spread and collect information today (Mitchell, 2014). Furthermore, Mitchell states that information recorded in a binary code of combinations of the digits 0 and 1, also called bits, which represent words and images, has opened up the means we have to work, network, navigate, secure services and goods, communicate and do research.

Illustrating the importance of e-health, Weeks (2012) notes that e-health technologies have the potential to improve health care service delivery to a broader community. Supporting this position, Wright *et al.* (2014) state that digitally available health information and resources are shown to increase not just knowledge and understanding of health and conditions but also to reduce anxiety, increase confidence and levels of empowerment. Harping on this, Nelson, Murray and Kahn (2012) state that the Internet did not change people's reliance on the medical profession but it opened up new avenues for obtaining information to help make decisions relating to their own health.

Therefore, digital health services can provide opportunities for Africans to establish online support groups which enable people to exchange social support, discuss specific health concerns/conditions, and share information and offer emotional support to one another. Discussing how digital health or e-health can help people in developing countries, Wireless-Life Sciences Alliance (2015), observes that digital health can be used to a greater extent as developing countries develop better mobile communications systems. Recording, storing and sharing health-related information patients have generated is not a problem: digital health start-up run and maintain their blogs, social feeds and other channels, websites such as "patients like me", allow easy crowd and friends sourcing with other people with similar illnesses within patient's communities. Moreover, conditions can

be diagnosed, important care can be delivered quickly and efficiently, and patients can stay healthy, thanks to digital health and the advancements made in mobile communications technology.

The growth of digital health has also allowed those in the poorer, more rural regions of the world to have a voice in healthcare, many for the first time. Digital health is liberating the general population of many developing areas; as it provides better immediate healthcare and provisions for preventive healthcare as well. Patients are also starting to demand greater access, involvement and control of their own medical and personal data. Price water house Coopers (2014) reports that one in five Americans own a wearable device and 10% use them daily, because they want to use their own digital health technologies.

Electronic health records as opposed to medical health records, may give African patients access to information from all the clinicians involved in their care. According to Piossant, Peraira, Tamblyn and Kawasumi (2005), electronic health record (EHR) has increasingly been deployed within healthcare organisations to improve the safety and quality of care. Network connectivity is improving and storage is becoming more affordable and patients can maintain their own database containing their medical notes, as well as, medical images, x-ray, cross sectional images and ultrasounds, with links into external discussion sites within potentially, their own forum (Mitchell, 2014).

Furthermore, Wireless-Life Sciences Alliance (2015) states that the World Health Organisation (WHO) is using digital health systems in South Africa to aid mothers with pregnancy, and postnatal and baby care by providing information via mobile phone messaging systems. Health care workers in Nigeria are helping to identify and treat infants born with AIDS by transmitting test results via mobile phone. Hence, digitally provided health services can potentially empower and engage people. Tools, appliances and interactivity could encourage people to make changes and increase their engagement.

Wright *et al.* (2014) underscore the fact that emergent technology could deliver an interactive intelligent service for users, which could be user-centred and potentially impact on empowerment. Wireless-Life Science Alliance (2015) adds that apps have been designed to help raise awareness and offer tools for preventing, managing and learning about diseases. We can count for example, smart health applications available for free download to African mobile subscribers. It addresses HIV and AIDs, tuberculosis, malaria, infections, safety, fake medicine and other health and wellness topics. In Nigeria for example through applications initiated by the National Agency for Food and Drugs Administration and Control (NAFDAC), people who buy drugs from dispensaries can text a code to a given number to instantly ascertain if the drugs are genuine or not, using their mobile phones.

E-health can change the way we see health and healthcare around the world, opening up new possibilities for a healthier, more empowered world. It has the potential to also promote healthy lifestyles and facilitate behaviour change by empowering, educating and motivating people. It can improve practice by health professionals as a result of accessing patient's experiences and sharing best practices, provide opportunities to focus on risk groups, and has the potential to improve health services.

According to Weeks (2012), an e-health perspective to healthcare management must take the governance, clinical and education aspects of health care into consideration. Digital technologies such as mobile phones have become an increasingly powerful tool to improve health care by facilitating data collection, enhancing patient engagement, and supporting community health workers. Still on this, Mitchell (2014) notes that in no area have digital age felt more evidence than with the uptake of iPads and particularly, cell phone ownership and usage than the personal computers and land lines. He notes further that, patients have been familiar with recording blood pressure, pulse, height and weight for years but the technology now exists to transfer this information electronically directly to a doctor. Wearable technologies and smart phone devices have increasingly allowed medical practitioners to remotely diagnose and monitor patients.

Although digital health opportunities are enormous, there are lots of challenges. Many available ICTs solutions (e.g. electronic health record (EHR), hospital information systems, district health information systems, telemedicine, patients portals, openMRS (Hanseth and Aanested, 2003), are neither well known nor much used on the African continent. Ruxwana (2010), acknowledges the limited availability of suitable technologies. Herselman and Jacobs (2003), note that, the development of the local economy in rural South Africa and in Africa in general, is severely compromised by lack of infrastructure, services and expertise.

According to Wright (2014), there is clear evidence that not all population groups are able to benefit from these technologies because of the digital divide (access to digital technology, literacy and motivation to use technology). The gap between those who have access to digital technology and those who do not is often referred to as the digital divide and implies, a dichotomy between, the 'haves' and 'have not's.

However, concerning the notion that ICTs have the potential to promote rural development in a number of ways, Herselman and Jacobs (2003), Littlejohns, Wyatt and Garvican (2003), Olugbra *et al.* (2006) and Uys

(2006), note that, the presence of ICTs, although vital, is not enough to realise development. What is needed is the effective use of ICTs in rural development interventions (Gurstein, 2005), as well as access to a supporting communication infrastructure that can serve as a link to relevant networks such as the Internet. Van Audenhove (2001) adds to these, an appropriate infrastructure system that can provide suitable content and applications via the ICTs.

Furthermore, Hughes, Bellis and Tocque (2002) state that, those unable to access the Internet are excluded from gaining information, knowledge and skills, and thus excluded from opportunities to participate in a wide range of activities such as searching for leisure opportunities, travel, educational opportunities, learning and skills training, and online shopping. Asamoah-Odei, Kebede, Zichinsti, Soumbey-Alley, Matshidiso (2012), listed some key challenges countries need to address about e-health. These include:

(a)   Limited awareness of e-health: Policy makers, health authorities and health practitioners are not fully aware of the potential   benefits of the use of ICT, for health. Neither has the health sector developed medium-or-long-term strategic plans for developing e-health infrastructures and services.

(b)   Lack of enabling policy environments: Most countries in Africa have not developed national policies, strategies or regulatory frameworks that are necessary for establishing common technical infrastructure, interoperability, and standardisation protocols. Countries also need to address ownership, confidentiality, security of data and quality of information.

(c)   Inadequate human capacity to plan and apply e-health solutions: The number of health workers capable of leveraging ICT in their work remains limited. Health workers are not systematically   trained in the use of ICT. There are insufficient numbers of health workers with the capacity to design, deploy and effectively   manage e-health projects and programmes. The use of ICT-facilitated learning remains limited in most health training institutions.

(d)   Weak ICT infrastructure and services within the health sector: Existing e-health projects within the health sector are small scale and fragmented, and their scope and coverage are rather limited. In most countries, the ministers in charge of communications technology and finance are primarily responsible for national ICT infrastructure. The challenge is for ministries of health to ensure   that   ICT needs and adequate coverage of the health sector are taken into consideration during the preparation and implementation of national ICT.

(e)   Inadequate financial resources: Financing e-health infrastructure and services requires collaboration and coordination between multiple partners from both the private and public sectors. The challenge is for the health sector to partner with other governmental sectors and the private sector to mobilise the resources required for health.

Despite these challenges, opportunities exist for planning and deploying e-health solutions for Africa's development. These include: rapid advances in ICT, increasing access to mobile phones and broadband connectivity, increasing interest by donors and countries in strengthening health systems and the partnership being built by international health agencies (Asamoah *et al*. 2012). With all these, e-health can strengthen the healthcare system in Africa and thereby bring about development in the following ways:

a.   The standardisation and integration between health and information are needed. When systems are integrated and there is a standard way of keeping and updating patient records, only one entry is necessary for each patient, and will help to avoid the duplication of diagnosis and patient history, reduce medical errors and save cost.

b.   ICT infrastructure should be improved in order to support not only transfer of information across the continent, but also a successful e-health solution such as EHR.

c.   By improving the available quality and use of information and evidence through strengthened health information systems and public health surveillance systems.

d.   Developing the health workforce and improving performance by eliminating distance and time barriers through telemedicine and continuing medical education (Asamoah *et al*. 2012)

3.   Lessons for Africa

As African countries grapple with the challenges of development such as poverty, illiteracy, deficits in health, education and social infrastructure including poor information technology access, it is necessary to note that digital health technologies are not without problems, drawbacks, issues and controversies. Some of these problems have been dealt extensively by Herrick, Gorman, and Goodman (2010), Howard-Jones (2011), Lupton (2012), Lupton (2014a), Lupton (2014b) and Jutel and Lupton (2015). Writing on digitising diagnosis: a review of mobile applications in the diagnostic process, Jutel and Lupton (2015) point out that research suggests that mobile, medical apps, "should be used with great caution by both lay people ad practitioners in the context of

evidence-based practice", adding that, "the lack of verifiable information provided about the evidence or expertise used to develop those apps is of major concern" (p.94).

Similarly, Lupton's (2014a) article on critical approaches to digital health technologies, looked beyond techno-utopia and noted that, while digital health, "devices promise certainty and simplicity, they are often difficult to use and ambiguous in the information they convey" (p.708).

Additionally, in her critical perspective on mobile health and medical apps, Lupton (2014b) viewing medical aps as artefacts, argued that, "in the age of big data, the data that are generated by apps are becoming increasingly commercialised", that, though they, "possess great value to pharmaceutical, healthcare, and biotechnical companies, as well as government agencies and public health enterprises, … there is no way of fully identifying the role that pharmaceutical companies or medical device developers may have played in contributing to the content of apps" (p. 616).

Again, Lupton (2012) while examining m-health and health promotion: the digital cyborg and surveillance society underscores the fact that we often gloss over or even ignore the inherent inequalities pre-produced in the use of medical information and monitoring technologies in the discourse of patient responsibility for self-surveillance. She asks, "will m-health technologies produce a cyborg, post human self in which the routine collection of data about bodily actions and functions is simply incorporated problematically into the user's sense of self hood and embodiment" (p. 240).

Lastly, Herrick, Gorman and Goodman (2010), identify several benefits and problems associated with health information technology. Some of the problems include new errors caused by health information technology, over-reliance on the accuracy of electronic medical records, physician order entry errors, the problem of "assured performance", the problem of data overload as well as privacy and security concerns.

It is therefore necessary that as Africa struggles to meet its healthcare needs by also keying into digital health technologies as a way of modernising its healthcare delivery, it would be important to consider these problems at they approach the digital health superhighway.

4.   Conclusion/Recommendations

The development of e-health on the African continent may help improve access to existing global and local health information and knowledge. E-health can help upgrade access to healthcare, quality of care, illness prevention, health promotion and better efficiency. This implies that e-health can improve the health sector in African countries that are faced with a critical shortage of health care professionals and exhausted doctors, nurses, medical interns and shortage of pharmaceutical, health and medical facilities. To this end we recommend that African countries promote political commitment and awareness of e-health, to help provide the willingness of African leaders to developing and investing in e-health in their countries; build infrastructure and establish services for e-health, to help tackle the shortage of experienced manpower and equipment in African countries; develop human capacity for e-health; and mobilise financial resources for e-health, and to ensure the funding of e-health in African countries.

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