A Framework for Mobile Health Management for Diseases in Nigeria with Benefits and Challenges

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ABSTRACT

World Health Organization (WHO) estimates that African Region has a shortfall of 817,992 health workers. Sub-Saharan Africa faces the greatest challenges with 11% of the world's population and 24% of the global burden of diseases; the region has only 3% of the world's health workers commanding less than 1% of world health expenditure. The ratio of available facilities to the teeming population is also grossly inadequate. These are among the major reasons why computer (Information Technology (IT)) has been employed over the years to help in different areas of health care- diagnosis, treatment, monitoring and medical records. It is very obvious that most of these computer based health management systems lack among other things the real time live interaction between health practitioners and patients. Mobile applications are now increasingly popular, though used mostly for instant messaging and social networking. In this paper we have proposed the use of mobile application to improve health care delivery system in Nigeria with real-time live chatting mode similar to the instant social chatting where diagnosis, treatment and monitoring of patients can be done through mobile technology. While readers' attention was drawn to this, a framework of the proposed system was developed for health practitioners and researchers to look into so as to move Nigeria and other developing countries in African forward in the health sector.

Key words : Healthcare, IT, Telemedicine, Mobile Technology, Diagnosis, Treatment.

1. INTRODUCTION

The internet and information communication technology (ICT) infrastructures are transforming the future of health management. The cost of healthcare delivery systems, products and services continue to rise unabated, especially in Nigeria- a developing nation that needs technology transfer. Knowledge is one of the crucial resource and precondition to strengthen health systems. Access to knowledge has large impact on health system management and up to date care. The great challenges lie on the optimal utilization of rapid speeding information and communication system (ICTs) and innovative applications such as telemedicine and e-health. Telemedicine is the practice of diagnosis, consultation and treatment between physicians and distant patients through the use of telephone and computers that transmit data for remote television viewing and treatment from a distance. Telemedicine is the use of telecommunication technologies to provide healthcare services across geographic, temporal, social and cultural barriers. Similarly, the World Health Organization (WHO) defines it as the delivery of healthcare services over distances especially where distance is a critical factor; by healthcare professionals using ICTs for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation and for the continuing education of healthcare providers, all in the interest of advancing health in their communities. It offers the potential to alleviate severe shortage of medical specialists in resource- poor regions, such as rural areas in Nigeria [7]. The telephoned countries as well as leading countries in technological advancements have exploited these ICT potentials in bringing hospital to homes [3].

The concept of telemedicine is a dream to come through in Nigeria, but if developed and taken right to the community hospitals, it can prove to be very beneficial, especially in giving timely treatment to wounded soldiers or plague patients, as a majority of the specialists prefer being stationed at big urban centers, with the rural populace being the real sufferer. Telemedicine provides a cost effective means of technological transfer both machine and expatriate advice through ICT connectivity [8]. ICT has been globally credited for changing the course of history and adding value to human lives in various ways. Of all the technologies that add value and enhance human life, the introduction of telemedicine which perhaps go down in history as the most defining and has the potential to impact positively on humans, especially those living in the rural areas [7].

Mobile wireless technology is any technology that uses radio frequency spectrum in any band to facilitate transmission of text, data, voice, and video (multimedia) services to mobile devices at anytime and anywhere. With the introduction of mobile network data services such as General Packets Radio Services (GPRS), Enhanced Data rates for GSM Evolution (EDGE) and Third Generation (3G) in particular, innovative applications and services are gradually becoming popular. A mobile device is no longer considered being luxury item rather it is considered being necessity [10]. The world of apps is set to transform healthcare in the coming years. It is estimated that some 30 percent of smart phone users are likely to use wellness apps by 2015, while the smart

phone and tablets are becoming the most popular technological development for doctors since the invention of the stethoscope. The apps available on these devices will also turn them into tools that assist with patient monitoring, imaging and bedside care. And many companies, seeing the commercial potential of these trends, are developing professional apps exclusively for healthcare professionals [18].

The International Telecommunication Union estimates that, in only four years (2007-2011), mobile broadband subscriptions in the developing world increased by more than tenfold: from 43 million to 458 million. Mobile devices and internet access are becoming increasingly necessary professional tools for health-care workers at all levels in developing countries. New fiber and wireless infrastructure, as well as the rapid growth of computer processing power, provide an unprecedented opportunity to scale up health worker training and improve its quality, as well as to optimize health services delivery and strengthen health systems [15]. Medical health care is undergoing a significant change of paradigm. Moving health care from health centers to home environments poses new challenges for acquisition, management and mobile exchange of information [4].

In most tropical countries, most of which are developing countries, medical personnel and facilities are not adequate for effective tackling of tropical diseases. In rural areas, medical attention is grossly inadequate. Intelligent systems have become vital in the growth and survival of healthcare sector. Recently, much research efforts have been concentrated in designing intelligence systems [5]. Computers and information devices hold tremendous promise- doctors can now hold in their hands a searchable database of information that they can access at the point of patient care-right when they need the information. Do not be put off if your doctor starts searching Google during your consultation. That is a good thing- it means they know how to access information and are not afraid to do so, even if just as a check on their memory, or to make sure they have not forgotten anything or missed any new and relevant publications. In adding to accessing information, computers can be used to process information. These applications are called expert systems (because they are meant to be used by experts), and while such applications have been developed for more than two decades, their use in practice is still minimal. Part of this is simply integration- the doctor cannot use what they do not have access to. But also these systems have been a bit awesome and doctors and hospitals need to learn how best to incorporate them into the workflow of treating patient [17].

Hospitals have some history with mobile technologies as they were first significant institutional adopters of pagers, and many doctors have enthusiastically embraced mobile telephones and personal digital assistants (PDAs) for their personal use [13]. The increased in demand for high- quality medical services coupled with the explosive growth of medical knowledge led to the suggestion that computer programs should be used in assisting physicians and other healthcare providers in discharging their clinical roles such as diagnosis, therapy and treatment [6]. Expert medical consultation is a scarce, expensive, yet critical component of any health care system. World Health Organization (WHO) in his annual report reported that, the global population is growing, but the number of health workers is stagnating or even falling in many of the places where they are needed most. They further added that, an additional four million health workers are needed throughout the world. Because of the deficit in health workers, at least 1.3 billion people around the world have no access to basic health care [6,15].

WHO estimates that the WHO African Region has a shortfall of 817,992 doctors, nurses and midwives, which means a need to more than double the work force among these professional categories. Yet it takes six years to train a new doctor, three year or four to train a nurse and four to train a midwife. Moreover, current training facilities are insufficient to meet the need fast enough. The medical schools in continental Africa currently turn out only 5 100 graduates per year, and many of these newly qualified doctors migrate to jobs abroad. Waiting for enough new workers to graduate through the conventional systems will mean lengthy delays in providing urgently needed services [20].

In the WHO report, it was highlighted the "enormous" inequalities in the distribution of the workers across different regions. In Africa, there are about 2.3 health workers per 1,000 inhabitants, as compared to 24 per 1,000 in the Americans. Even with the lowest ratio of health workers per inhabitants, most diseases are found in those regions. Africa and South-East Asia, which have the highest global burdens of disease, 25 and 27 percent respectively and have the fewest health workers per capita, while the Americans, the region with the lowest burden of diseases, has the highest number of health workers. Even in the region with the fewest health workers per capita, there is still unequal repartition of health workers between the urban and the rural area. Most of them are concentrated in the urban area. One approach to reduce this lack of expert is by implementing e-health which aims at providing health services through information system medium. This range from tele-health system which is the delivery of health related services and information via telecommunication technologies to specialized expert system developed to perform the duty of expert in a specific health care [6].

In most developing countries of the world, insufficiency of medical specialist has increased the mortality of patients who suffer from various diseases. The insufficiency of medical specialist will never be overcome within a short period of time. The institutions of higher learning could however, take an immediate step to produce as many doctors as possible. However while waiting for students to become doctors and doctors to become specialist, many patients may die. The waiting time for the treatment normally takes a few days, weeks or even months. By the time the patients see the specialist the disease may have already spread out, as most of the high-risk diseases could only be cured at

the early stage. Consequently, computer technology could be used to reduce the number of mortality and reduce the waiting time to see the specialist [19].

2. REVIEW OF RELATED LITERATURE

It is obvious that several health challenges have been solved using computer systems. Samples are collected and mailed as images from a non-expert to the specialist for analysis and diagnosis. Medical practitioners now use Information Technology to strengthen their knowledge by acquiring knowledge from the internet or online interaction with colleagues for decision making, most especially on the unusual cases of health challenges. A number of systems have been developed by computer experts in collaboration with medical practitioners using statistical, mathematical and artificial intelligence tools. Some of these systems are developed for peculiar diseases, which mean there is no generalized system that could handle all the diseases in the universe. There are hundreds of these computer-based diagnostic or computer based treatment systems available on the internet today. Despite the effort of these researchers, some of these systems have not been implemented or put into use, most especially in Africa and Nigeria in particular. It is obvious that some of these systems have challenges ranging from diagnosis without treatment, treatment without diagnosis, poor implementation or no implementation and poor accessibility. Though too numerous to mention all, we shall discuss few of these systems briefly.

In [16], Knowledge based expert systems for symptomatic Automated Healthcare was developed. The system was developed as e-Health solution system for the diagnosis of Malaria and typhoid fever. Though Typhoid and malaria are prevalent in Africa but there are other diseases affecting humans and another issue of concern is "how many people have access to this system?" Adebor and Burrell in [1] developed the Integrated Management of Health Care Strategies and Differential Diagnosis by Expert System Technology. The system carries out the diagnosis of malaria and typhoid based on signs and symptoms. No clear implementation and not generally accessible, more so only meant for two diseases. Multimodal Approach for Clinical Diagnosis and Treatment was developed in [9]. The system focused mainly on the diagnosis and treatment of stress. This is yet another computer aided diagnostic and treatment system that is limited to a disease and also with poor accessibility.

Clinical Decision Support System for the diagnosis of pneumonia in children was developed in [2]. A fuzzy expert system was developed for the management or diagnosis of pneumonia, using fuzzy logic. This system lacks implementation, a particular disease in focus, what happens to other diseases? In [7] telemedicine was applied to primary healthcare delivery in Nigerian. Healthcare data form, disease surveillance data form and immunization data form were designed with e-reporting on patients. The study only handled distribution of healthcare institution and diseases surveillance. Application of Soft Computing Methodologies to the management of Hypertension was developed in [11]. This is a good diagnostic system but how many people have access to it and only a disease is diagnosed out of the numerous diseases of the world today. In [12], a machine learning technique was used to diagnosis typhoid fever. The system developed is of very good accuracy with poor accessibility, besides, it focuses on typhoid fever only. What is the fate of people affected by other diseases?

Permanand and Sultan developed a mobile healthcare management system for the Caribbean region in [14]. The system has four modules- patient interface, healthcare provider interface, reasoning engine and alert notification and network infrastructure. The important part of the system which is the section that carries out the diagnosis was handled by a reasoning engine which means not all the diseases of the world could be taken care of. Health Net System for Mobile and Wearable Health Information Management was developed in [4]. The system allowed the trainer to always see the position and vital parameters of the runners. The system demonstrated that health monitoring using mobile network is feasible. This is one of the achievements of mobile technology in health sector, though no diagnosis or treatments was carried out. In [10] MMES: A Medical Expert System for Health Institutions in Ghana was developed. Knowledge base and search pattern-matching techniques were used to develop the system. The system was symptoms based, expected to handle as many as possible disease. No additional space provided for symptoms observed by the patient but not available on the software. Use of expert systems can only imitate, but cannot be like real human experts.

The expert systems on diseases diagnosis and treatment systems are hundreds but there is no single system that can integrate all, while most of them are effective but lack accessibility. While effort is on to improve the accessibility of these systems, there should be an alternative that could save lives using mobile technology.

3. METHOD

The proposed system is to borrow a leaf from the online solutions available to solving problems. For instance, telecommunication companies in Nigeria solve issues related to their services using mobile customer services termed customer care number/E-Mail. Conversation with service provider agents if need be is also being used to solve problems. Another scenario of interest to this work is mobile chatting systems such as mobile face book, blackberry messenger (BBM), 2go, Whats app, badoo, and other social instant message media which connect millions of people of the world together but for chatting only. A mobile application of such could be developed to serve this time not as chatting media but only health care management media. It is proposed that the system will have a central database which registers only qualified medical doctors in hundreds if not thousands and individuals who subscribed to the system using a unique

registration details including user name and password will be assigned a medical doctor who will have a medical chat with the patient, which will lead to diagnosis and drug prescription. The drug prescribed will be sent to the registered mobile number or E-Mail of the patient. In cases where such an ailment could not be diagnosed based on interaction, the affected patient is advised to visit the nearest hospital. Users could subscribe at affordable amount per month or per year as the case may be. A collaborative effort between the three tiers of government of Nigeria, telecommunication companies and mobile software developers will make the mobile health care management a reality.
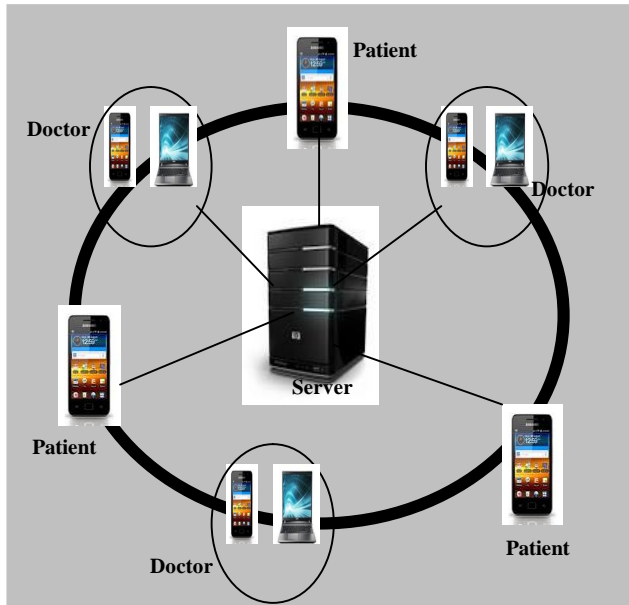

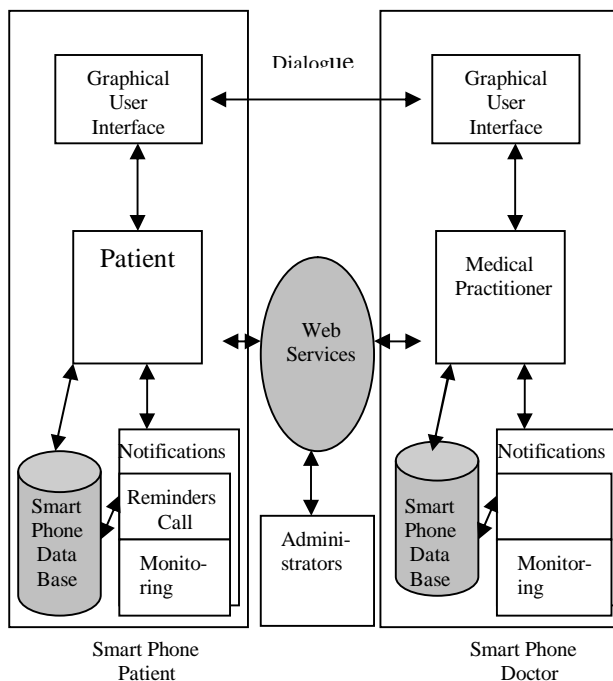Figure 1: Interactive Platform of Doctor-Patient in the Cloud

Figure 2: Frame Work of the proposed system

First Module

Government licensed and approved medical practitioners are registered by the administrators to serve as health service providers (live inference engine) for the system, username and password are created for them. After downloading the mobile application, the subscriber's (intending patients) register with the system, supplying the required information and an account or medical record is created for the subscriber with a unique username and password.

Second Module

This module is purely invisible to both the subscribers and the registered medical doctors. It is purely for administrators or administrative work. Here the subscriber's information and the medical practitioner's details are registered with the system through the cloud. System's maintenance takes place here.

Third Module

The third module is the surface layer. It is to serve as the interactive platform between the medical personnel and the subscribers. Here information may be retrieved from the internet and also sent to the internet.

The proposed integration of the modules in the cloud and the frame work are shown in figure 1 and figure 2 respectively. Figure 1 shows the Interactive Platform of Doctor-Patient in the Cloud while Figure 2 shows the Framework of the proposed system.

4. EXPECTED BENEFITS AND CHALLENGES OF THE SYSTEM.

The system is expected to reduce the number of patients visiting hospitals for minor illness or diseases. The system is expected to reduce the cost of health management or care since no transportation, consultation fee is involved. It will promote confidence since patients can freely express what they feel to the medical doctors, no shyness. Confidentiality will be improved since discussion is between unknown parties or since the two parties (doctor and patient) do not know each other and more so no paper medical record movement. Prompt diagnosis and treatment is another plus to the system. Finally the system is expected to reduce death duo to minor illness as most illness when treated on time will not pose a danger. The system will be of benefit mostly in rural areas where there is network but no hospitals and more so the doctors can communicate from urban to rural arrears since they are not willing to stay in rural areas. Moreover, the apps enable patients to take a more active role in their own healthcare- managing appointments, updating prescriptions and accessing their health records. When patients take on more responsibility for their own care, their health improves.

In order to achieve the expected benefits of the system, the system's security must be put into consideration. The system must be secured from attacks while the partnered telecommunication companies must strengthen the network to ensure uninterrupted signal supply. Another challenge is power supply. Nigeria Government should make effort to

improve the erratic power supply. The compatibility of the medical live chat mobile application across multiple devices from smart phone to tablets should also be put into consideration.

5. CONCLUSION

Challenges facing the health sector of the economy today are peculiar to every country of the world with no exception but prevalent in the developing countries like Nigeria. Health is wealth, a collaborative effort is essential to face the challenges and it is to be noted that Information Technology has played a prominent role in bringing health caring to homes, yet there is still a lot to be done in the health sector to reduce the number of deaths and people waiting to see doctors or traveling from rural to urban areas on minor health challenges. In this work, we have developed a framework for the real-time live mobile consultation that could be of immense benefit if looked into and implemented by the Federal Government of Nigeria and other developing countries. We therefore suggest that the Federal Government, medical experts, IT professionals and telecommunication industries in Nigeria (MTN, GLO, AIRTEL, ETISALAT) should look towards this direction in making life more meaningful. Rather than using mobile phones for social network and chatting, Nigerians can use it to improve the health sector.

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