

Development of a Framework for Collaborative Healthcare Services Delivery

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Abstract— Patients require treatment and care that work, good relationship with practitioner, provision of information, and remaining in control of treatment. Patients need to be empowered to live healthy lifestyles through promotion and the delivery of health information. Seventy-five percentages of Nigeria's estimated 166million population at 2.87% annual growth rate in 2012 live in rural and underserved areas lacking equitable access to both ICT services and healthcare due to poverty and inadequate health care facilities. A shortage of almost 4.3 million doctors, midwives, nurses, pharmacists, and support workers worldwide is most severe in the poorest countries, especially in sub-Saharan Africa, where they are most needed to direct and guide everyone who becomes ill on the correct use of medications. This is compounded by high illiteracy level, poverty and inadequate Health Care Facilities and personnel. Self-medication offers a way out as people begin to sense the positive benefits of multiplying their options in healthcare. Because of the constraints of distance, costs, and availability of providers (doctors and nurses) in specific areas of medical specialties, the model of treating patients in the general hospital is losing its lustre in favour of dedicated clinics dispersed in the community and remote care in the home. The deterioration of the patient-provider relationship, the overutilization of technology, and the inability of the medical system to adequately treat chronic disease have contributed to rising interest in Complementary and Alternative Medicine. Communication is critical to ensuring delivery of the best possible patient-oriented healthcare among all providers towards achieving equitable access to healthcare. Exchanging information and building communication channels are critical ingredients of biomedical education and research. Today, the patient and the physician should not be alone anywhere in the world as long as there is some form of acceptable technology present. Seamless transmission of medical information through the internet enables teleconsultation of doctors from one corner of the world possible. This paper presents a collaborative framework connecting providers directly to patients for healthcare services delivery in response to the dire need for a framework which would facilitate the development of a national fibre optic backbone infrastructure that ensures high bandwidth availability, universal access, encouragement for private operators to roll out the infrastructure and use of existing government structure as platforms for extending ICT to rural and urban communities. The presented framework facilitates healthcare institutions collaborate and share their resources to provide comprehensive, high-quality and accessible healthcare at an affordable cost.

Keywords: Collaboration; Communication; Complementary and Alternative Medicine; Healthcare delivery; Teleconsultation

I. INTRODUCTION

Providing equitable access to healthcare becomes an indispensable imperative to achieving well-being. Healthcare is broadly divided into modern (conventional, orthodox, Western or allopathic) and traditional (indigenous, complementary, alternative or integrative) groups [1]. Healthcare aims achieving the best health outcomes in the most efficient manner. Patients require treatment and care that work, good relationship with practitioner, provision of information, and remaining in control of treatment. Health disparities have been widely recognized as a problem throughout the world. The frequency of nonoptimal patient care, the wide variations in practice, and the inefficiencies, dangers, and inequalities have been reported in literature. Information and Communications Technologies (ICTs) are needed in addressing the global challenges of healthcare worldwide [2]. We require technology-based strategies that would assist in determining specific healthcare scenarios where mobile health and telehealth can add value, improve access to high quality care and reduce the cost of healthcare delivery.

At the core of any healthcare delivery system is the Patient as depicted in Fig. 1 where stakeholders, incorporating tradomedical authorities among others, are in a collaborative healthcare delivery network.

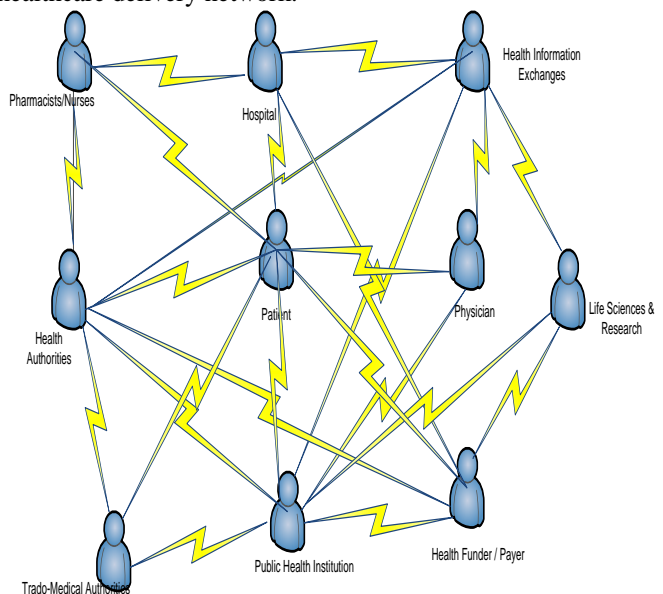


Fig. 1 Patient at the core of healthcare delivery system

The model is grounded in the client-centered psychotherapy model which refers to a philosophy of care that aims at the best integration possible of the patient's perspective. The patient's needs and priorities for care are at the core of care provision. Collaborative health care entails physicians and other health care service providers using complementary skills, patients based on trust, respect and an understanding of each other's skills and knowledge. This involves a mutually agreed upon division of roles and responsibilities that may vary according to the nature of the practice personalities and skill sets of the individuals. The relationship must be beneficial to the patient, the physician and other providers.

Today's health delivery systems' challenge is how to provide improved services to an increasing number of people using limited financial and human resources for increased productivity and quality of care without increasing the economic costs [3], [4]. Patients need to be empowered to live healthy lifestyles through promotion and the delivery of health information. The increasing prominence of health promotion theory and a corresponding shift toward emphasizing wellness and empowerment, holistic and family-friendly design, and empirically supported treatment were exploited to drive this research.

As healthcare providers are mostly hosting diverse information systems, promoting quality and efficient delivery of healthcare require the use of interoperable healthcare information systems. With the advent of pervasive and ubiquitous computing technologies, the requirements for information technology to healthcare process alignment can be met with the least possible intervention from the participating parties. For example, a health information system architecture that places emphasis on supporting collaboration and coordination among various healthcare services can also fulfill the requirements to support mobility of healthcare professionals that may lead to a pervasive computing infrastructure [5].

While in virtual reality the user enters the world created by computers, in pervasive computing it is the computing that enters the physical world and bridges the gap between the virtual and physical worlds. This bridging is perhaps best described by three important enabling technologies: ubiquitous computing, ubiquitous communication, and intelligent user-friendly interfaces. Important ubiquitous communication technologies include ad hoc networking and wireless communication, such as low-power, short-range networks. Intelligent user-friendly interfaces enable natural interaction and control of the environment by the users, or inhabitants of the ambient environment. One of the most important applications for pervasive computing technologies is healthcare, including wellness and disease management, and support for independent and assisted living. Ubiquitous communication based on mobile phone networks, Wireless Fidelity (WiFi), and other wireless technologies makes it possible to deliver and access data including measurements, person-to-person communications, and health information anywhere and anytime. Mobile devices provide ubiquitous user

interfaces for users ranging from healthcare professionals to average citizens. Pervasive healthcare is an exciting, emerging research area that is bound to play an important role in an increasingly aging society as it also helps patients to manage their own diseases better and helps healthcare professionals to communicate and collaborate [6].

Because of the constraints of distance, costs, and availability of providers (doctors and nurses) in specific areas of medical specialties, the model of treating patients in the general hospital is losing its lustre in favour of dedicated clinics dispersed in the community and remote care in the home. The combination of the aging population, the prevalence of chronic diseases, and the emergence of telemedicine technologies have been instrumental in ushering home care as a viable alternative to the traditional in-patient model of care [7]. Transmission of medical information through the internet, as an attachment, enables consultation of doctors from one corner of the world possible through these technologies. Today, the patient and the physician should not be alone anywhere in the world as long as there is some form of technology present and acceptable [8]. A typical patient's encounter for healthcare services delivery illustrates the need to achieve effective collaborative delivery.

A. SYNCHRONOUS AND ASYNCHRONOUS ELECTRONIC HEALTHCARE SYSTEMS

A basic issue concerning communication is the choice between the transmission of real time multimedia, electronic health record and biosignals data and the "Store and Forward" method which implies asynchronous communication. The "Store and Forward" system is simpler, cheaper and does not require synchronous communication of the two stations. Due to the asynchronous transmission of data the delays of the network are less important and thus lower bandwidth network can be used. Furthermore, the clinical examination procedure is quite easy to program due to the fact that both sides (physician and patient) can interact with the system independently. However "Store and Forward" systems may not be applied for the provision of emergency electronic healthcare services in case of accidents. In addition, the physicians seem to prefer in general the synchronous electronic healthcare systems since they offer interactive contact with the patient and simulate better the clinical examination [9].

B. NIGERIA HEALTH CARE DELIVERY SYSTEMS

Nigeria's population was 140,437,790 in 2006 and her projected population for 2012 was put at 166,426,961 at 2.87% annual growth rate. Nigeria operates a Federal System of Government with three levels; the Federal, the State and the Local Government Areas/Councils (LGAs). There are 774 LGAs within the 36 states and Federal Capital Territory (FCT) Abuja. The 774 LGAs are further sub-divided into 9,565 wards. The states and FCT are grouped into six geo-political zones, namely: the South-South, the South-East, the South-West, the North-East, the North-West and the North Central zones [10], [11] as presented in Table I and Fig. 2.

Table I Geo-Political Zones of Nigeria [10]

sn	Zones	No. of States	Names of States
1.	North-Central	7	Benue, Kaduna, Kogi, Kwara, Nassarawa, Niger, and Plateau.
2.	North-East	6	Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe
3.	North-West	6	Jigawa, Kano, Katsina, Kebbi, Sokoto, and Zamfara
4.	South-East	5	Abia, Anambra, Ebonyi, Enugu, and Imo
5.	South-South	6	Akwa Ibom, Balyesa, Cross River, Delta, Edo, and Rivers
6.	South-West	6	Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo
7.	FCT	1	FCT (Federal Capital Territory)



Fig. 2 Political Map of Nigeria [10]

Structurally in Nigeria, health services are provided at tertiary, secondary, and primary health-care facilities. Various professional and regulatory associations are also involved in health service delivery through training, accreditation and certification of professionals. They include the Medical and Dental Council of Nigeria, Nigerian Medical Association, Association of General and Private Medical Practitioners, National Association of Nigerian Nurses and Midwives, Nursing Council of Nigeria, Community Health Practitioner Association and Pharmaceutical Society of Nigeria. Government agencies involved in regulatory and oversight functions include the National Agency for Food, Drug Administration and Control (NAFDAC) [12]. Patients in

Nigeria's rural areas (where over 51% of population reside) lack access to HCFs and human resources [13]. Health costs are soaring. Freedom of choice with respect to selecting private physician, clinic and hospital is spreading, specialisation of treatment and treatment places (locations), etc., and all these within a framework of increased differentiation of and collaboration between private and public health delivery systems [14].

Nigeria's National ICT Strategy has thirteen policy objectives. The ones with a direct bearing on broadband are:

- i. To promote widespread access to high quality advanced communications technologies and services, in particular the Internet.
- ii. To divest NIPOST of its regulatory function and transform into a commercial provider of postal and integrated data communications services.
- iii. To encourage the development of Broadband services that will enable Nigerians to enjoy the benefits of globalization and convergence.
- iv. In order to achieve these policy objectives, it focuses its attention on four key ICT infrastructure objectives:
 - v. national ICT backbone and Broadband infrastructure;
 - vi. infrastructure that will foster digital literacy and Internet usage;
 - vii. affordable Universal Access to ICT; and
 - viii. national physical infrastructure (including power).

The Strategy asserts that 70% of Nigerians live in rural areas and do not therefore have access to ICT services and that some living in urban areas are unserved or underserved. It says that the following need to be considered to address these problems: the development of a national fibre optic backbone infrastructure that ensures high bandwidth availability, universal access, encouragement for private operators to roll out the infrastructure and use of existing government structure (like NIPOST) as platforms for extending ICT to rural communities.

The Strategic Plan for the period 2013-2017 of Nigeria's Universal Service Provision Fund (USPF) has the following objectives: the extension of the national fibre optic backbone from major cities/towns where they are currently existent to surrounding Local Government Areas to enable affordable and sustainable access to data services; continued support for the development of community centres where rural dwellers can benefit from the lower prices associated with shared data services; exploring opportunities to implement programmes targeted at creating awareness of the benefits of Internet usage and training end users of the Internet in un-served and underserved areas; and supporting the development of local content and applications (i.e. m-health, m-learning, m-banking, m-government applications) which stimulate demand for Internet services and provide sustained socio-economic benefits for recipients of these services [15].

Recently, there has been a substantial reduction in the availability of health professionals in developing countries, accompanied by a rise in the demand for high-quality healthcare. A shortage of almost 4.3 million doctors, midwives,

nurses, pharmacists, and support workers worldwide is most severe in the poorest countries, especially in sub-Saharan Africa, where they are most needed to direct and guide everyone who becomes ill on the correct use of medications. This is compounded by high illiteracy level, poverty and inadequate Health Care Facilities (HCFs) and personnel. Self-medication offers a way out as people begin to sense the positive benefits of multiplying their options in healthcare. This combination has forced healthcare institutions to collaborate and share their resources to provide comprehensive, high-quality and accessible healthcare at a reasonable cost [16], [17], [18].

II. COMPLEMENTARY AND ALTERNATIVE MEDICINE

Complementary and Alternative Medicine (CAM) encompasses a “wide spectrum of health and healing strategies” with unique systems of evidence, and is defined in relation to “diagnoses, treatment, and/or prevention, which complements mainstream medicine by contributing to a common whole, by satisfying a demand not yet met by orthodoxy or by diversifying the conceptual frameworks of medicine.” CAM’s complementary and alternative roles account for biomedicine’s tendency to take CAM seriously. This is premised on the realization that therapeutic interventions, hitherto dismissed as within the purview of charlatans and their gullible patrons, are sometimes credible alternatives to, and capable of complementing, medical orthodoxy [19], [20]. Current trends favour enhanced cooperation among various healthcare services providers and the integration of CAM therapies into conventional medical treatments. However, researchers have also suggested that merging concepts and practices from local medicinal knowledge and Western science have the potential to improve public health and support medical independence of local people [21]. No communication between patients and their conventional doctors regarding their CAM use. Communication is critical in ensuring delivery of the best possible patient-oriented healthcare [22]. Connecting providers directly to patients who would otherwise be inaccessible due to distance or transportation using communication technologies based on synchronous (telephones and audio-video links) and asynchronous (e-mail) modalities has been a major objective. Patients preferred synchronous communication mechanisms such as videoconferencing sessions with the counsellors to detailing their problem to the kiosk owner who relays the information via e-mail along with a picture [23]. The extensive use of CAM for patients can complicate dialogue between physicians and CAM practitioners, but not much data have been collected on the expectations and attitudes of physicians and complementary and alternative medicine practitioners concerning their communication and collaboration. While physicians support a physician-guided model of teamwork in clinical practice, CAM practitioners support a more collaborative model. Educational programs for primary care physicians and CAM practitioners should focus on aspects of communication between the groups and practical methods for writing referral or medical letters [20].

A. PATIENT-PROVIDER RELATIONSHIP

Healthcare providers expand their current focus on episodic, acute care to encompass the enhanced management of chronic diseases and the life-long prediction and prevention of illness. Consumers assume personal responsibility for their health and for maximizing the value they receive from a transformed healthcare system. Payers and health plans help consumers remain healthy and get more value from the healthcare system and assist care delivery organizations and clinicians in delivering higher value healthcare. Suppliers work collaboratively with care delivery organizations, clinicians, and patients to produce products that improve outcomes or provide equivalent outcomes at lower costs. Societies make realistic, rational decisions regarding lifestyle expectations, acceptable behaviours, and how much healthcare will be a societal right versus a market service; and governments address the unsustainability of the current system by providing the leadership and political will power needed to remove obstacles, encourage innovation, and guide their nations to sustainable solutions [24].

The deterioration of the patient-provider relationship, the overutilization of technology, and the inability of the medical system to adequately treat chronic disease have contributed to rising interest in CAM. CAM therapies are used in an effort to prevent illness, reduce stress, prevent or reduce side effects and symptoms, or control or cure disease. Patients are also demanding less aggressive forms of therapy, and they are especially leery of the toxicity of pharmaceutical drugs. Adverse drug reactions have become the sixth leading cause of death in hospitalized patients. Emerging new infectious, chronic and drug-resistant diseases have prompted scientists to look towards Medicinal and Aromatic Plants (MAPs) as agents for treatment and prevention.

Conventional physicians are unable to appreciate the imperative of CAM in collaborative healthcare delivery due to paucity of their knowledge of CAM’s underlying epistemology and methodologies. People find complementary approaches to be more aligned with “their own values, beliefs, and philosophical orientations toward health and life. In Nigeria, a country stepped in the use of and belief in traditional medicines, MAPs play a major role. Traditional livelihoods are at risk. Traditional communities' health is threatened [25]. The compositions of plants contain many substances including vitamins and minerals; one important aspect of technology is to ensure that the amount of intake of any component does not exceed a toxic level that may result in health damage rather than healing. Medical technology is not always used for assistive remedy and it is also extremely important when providing a range of solutions for maintaining optimal health. There are many ways that we can keep ourselves healthy with technology, such as dietary monitoring and various massaging devices that apply reflexology to alleviate stress and tension [26].

The low accessibility or inaccessibility and nonaffordability of modern drugs among the rural populations of tropical Africa have made a large proportion of rural people depend on traditional herbal drugs in order to be healthy and economically

productive [2], [27], [28], [29], [30], [31]). Driven by consumer demand, integrating conventional and CAM practices has gained popularity. The lack of disclosure by patients of their CAM use to their physicians and the potential impact on health (e.g. drug interactions) is a primary reason for the integration of conventional and CAM therapies at the primary care level. This is supported by some evidence that CAM therapies are effective in treating chronic pain or disease, typically high cost conditions [32]. With the increasing enhancement of people's awareness of self-care, the voice for humans to return to nature is growing louder and louder. Because of the integrative medical model of patient-centered healthcare and a combination therapy with both botanical and chemical drugs evolving into a new trend of the modern medicine in preventing and curing diseases, the combined applications of Chinese and Western medicine are also increasing, and the potential of their interactions are raising more and more concern [33].

III. COLLABORATIVE HEALTHCARE CONCEPT

The concept of collaborative health (CH) encapsulates the physical, psychological and social health resources the individual uses in teamwork; resources which at the same time are influenced by the teamwork [34]. Any collaborative virtual healthcare system equipped with modern technology increases access to essential healthcare services, especially for rural and underserved populations. By bringing together in real time the competencies, experience and judgment of a variety of professionals, organizations are trying to respond to a reality that is becoming increasingly complex in terms of both the knowledge and the working methods that are being applied [35], [36]. A dire need has been identified for "a nationwide ICT infrastructure that will support national broadband connectivity and accelerate socio economic development." To achieve, the following elements are highlighted; giving ICT infrastructure the status of critical national infrastructure; connecting State and Federal Government networks with optical fibre; and accelerating the existing power sector reforms [15].

Exchanging information and building communication channels are critical ingredients of biomedical education and research. Collaboration tools can help researchers work in harmony and learn together at a distance. Many collaboration tools use the server-client architecture or its variants on a network of computers. A collaboratory is as an information technology large-scale infrastructure that supports cooperation among individuals, groups, or organizations in pursuit of a shared goal by simplifying communication and knowledge sharing. Using collaboratories, researchers can share access to large datasets and shared environments, support expensive equipment to address complex problems, and speed up discovery and innovation. They can also use an emerging class of advanced network-based applications referred to as "grid" computing. Developing a collaboratory empowers teamwork and collaborative approaches that support large-scale and information-rich biomedical investigations. Scientific research at regional and national collaboratories provides new insight

into the biology of health as well as the prevention and cure of diseases [37].

As more healthcare delivery is provided by collaborative care teams, there is a need to design tools to support such teams. Much of the electronic patient health record work has focused on semantic interoperability. While that work is important, collaborative care delivery is largely process driven, meaning that process interoperability must also be considered. The application of lean techniques and lean management principles in healthcare has focused on improving the safety, quality and efficiency of healthcare delivery in areas such as improving information and communication flow, the delivery of innovations to drive continuous service delivery improvement, redesigning the patient journey to improve access and reduce waiting times, medical supply chain management, implementation of IT solutions, and policy implications ranging from the local organizational level to decisions on national healthcare policy. Lean has been implemented both in large health institutions and across the wider area of health service delivery systems that they are a part of. It has been found that lean can have a positive impact in healthcare on timely delivery of services, cost, quality and healthcare productivity.

IV. OBJECTIVE

Providing a secure, extensible, pervasive and easy to implement collaborative environment for healthcare services providers and medical applications poses a significant challenge for state-of-the-art computer systems and networks for well-being. A paradigmatic approach to collaboration and CAM integration could create a common basis for scientific dialogue, encourage exchanges between medical communities, and establish policies for the development of a true multidisciplinary healthcare cooperative that is consistent with the current public health model [38]. Research efforts in Western countries have been largely concerned with the interrelated issues of quality, safety and efficacy of only certain forms of CAM, especially biologically-based form. This paper presents a collaborative framework connecting providers directly to patients for ubiquitous services delivery, using Nigeria as a case study.

V. FUTURE OF HEALTHCARE SERVICES DELIVERY

By gathering and integrating health care information associated with the application of CAM procedures into a patient's electronic health record (EHR), more accurate measurement of outcomes can be generated. Best practices can then emerge showing which complementary medical practices are most effective when coupled with conventional medical treatments of specific disorders.

The future promises a consumer-centric system that will use a variety of technologies and innovations to create the "smart" EHRs that: deliver information, services, and data via mobile, multi-purpose devices anywhere, anytime; remind you when it's time for your annual check-up and anticipate your need with intelligent digital agents; integrate physician records, hospital services, medication histories, and other clinical

information into a unified digital record that is available to patients at home or at the point of care; monitor vital signs and clinical indicator continuously and communicate wirelessly and seamlessly; and incorporate complementary and alternative medical (CAM) information and practices along with conventional Western medicine.

The next generation ePersonal Health Records (ePHR) will incorporate emerging technologies, be electronically connected to the Internet, be intelligent with the latest "health coach" mindware will remind and anticipate a person's health needs. It will also include complementary and alternative medical (CAM) software in addition to patient billing, pharmacy, laboratory, and other modules normally found in existing EHR systems [39].

VI. CONTRIBUTIONS

An aggregated collaborative framework for ubiquitous healthcare services delivery for exchanging health delivery information among physicians, CAM practitioners, scholars, and researchers in a collaborative virtual manner was developed in this study as depicted in Fig. 3. Fig. 3 shows typical collaborative virtual healthcare reference architecture for implementing an e-Health integration solution between two general hospital locations, say, Sokoto (Sokoto State) and Calabar (Cross-Rivers State) in Nigeria. The Reference Architecture is centered round the use of the Connected Health Services Hub, which enables the provision of a number of services including: Collaboration services and Communication Services. The communication infrastructure (mobile telecommunication technologies) included Bluetooth and

wireless local area networks technologies. The device types used to collect medical data included Personal Digital Assistance (PDA), smart phones, or tablet PC. These devices are available to the patient to message dissemination anywhere and at anytime once network connectivity is in place.

The aggregated collaborative framework for ubiquitous healthcare services delivery shows the communications infrastructure and the principal stakeholders including: (1) CAM Practitioners exchanging clinical/referral notes with GPs. (2) Payers (Regulatory/Government/Patients) ensuring higher efficiencies produce lower costs; standardization of care producing healthier (cheaper) patients; and better knowledge of outcomes. The regulatory body ensures that harmful social or traditional practices do not interfere with access to appropriate medical treatment. (3) Patients demanding better healthcare; real choice; enhanced services; professional record keeping; and lower cost. (4) Doctors / Nurses / Hospitals' expectations are higher efficiencies produce lower costs (more value); focus on core competencies; and new, more lucrative, more rewarding roles. (5) Growing drug resistance, in part caused by the misuse of medications, has rendered several antibiotics and other life-saving drugs useless.

Consequently, scientists and pharmaceutical companies are urgently looking for new drug sources and are increasingly turning their eyes to CAM [40]. Researchers/Pharmacy interested in data mining, outcomes, drug interactions in the population; better targeted, faster, drug trials; and accessible (anonymized) historic record.

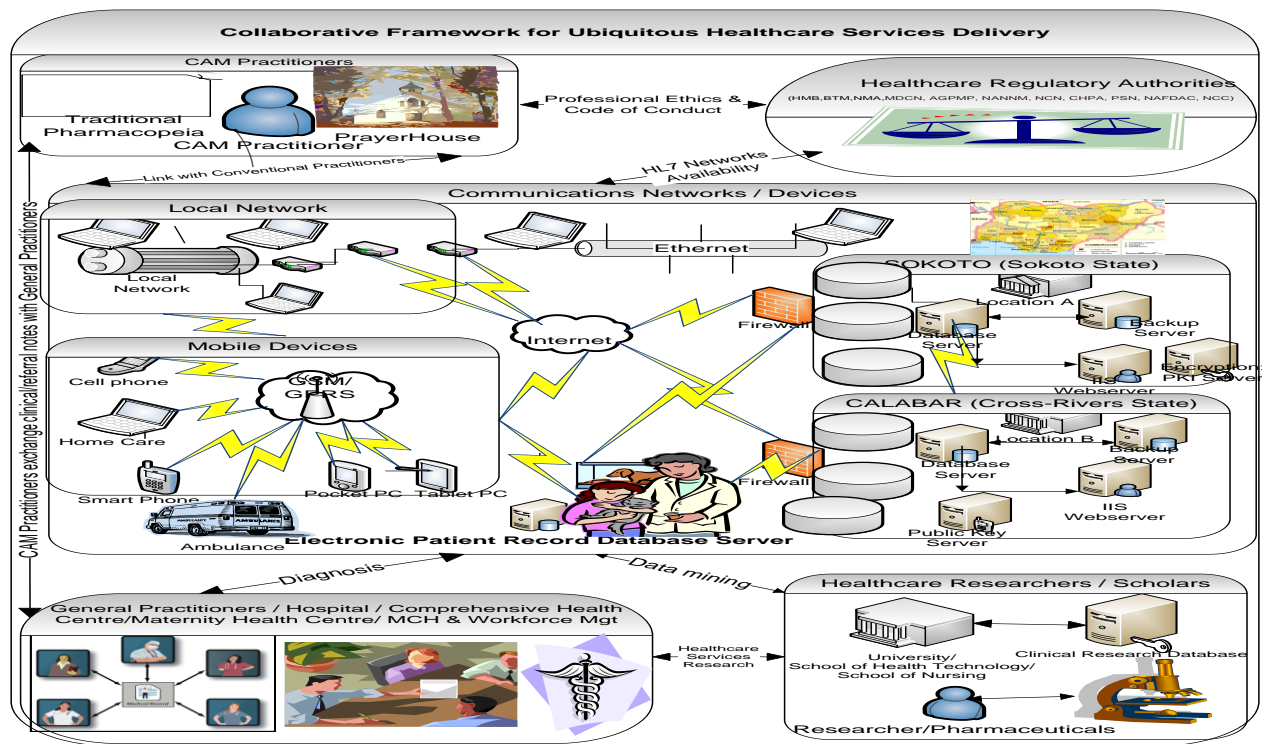


Fig. 3 Aggregated Collaborative Framework for Ubiquitous Healthcare Services Delivery

The implementations of this work are ongoing in a number of clinical and CAM settings across Nigeria. For example, a Use Case Diagram and a corresponding Sequence Diagram are for teleconsultation are shown **Fig. 4** and **Fig. 5**

respectively. A Teleconsultation system Use Case diagram shows the interaction by the Referring Physician and Consultant / Expert actors with various use cases. It also shows the relationship between the use cases.

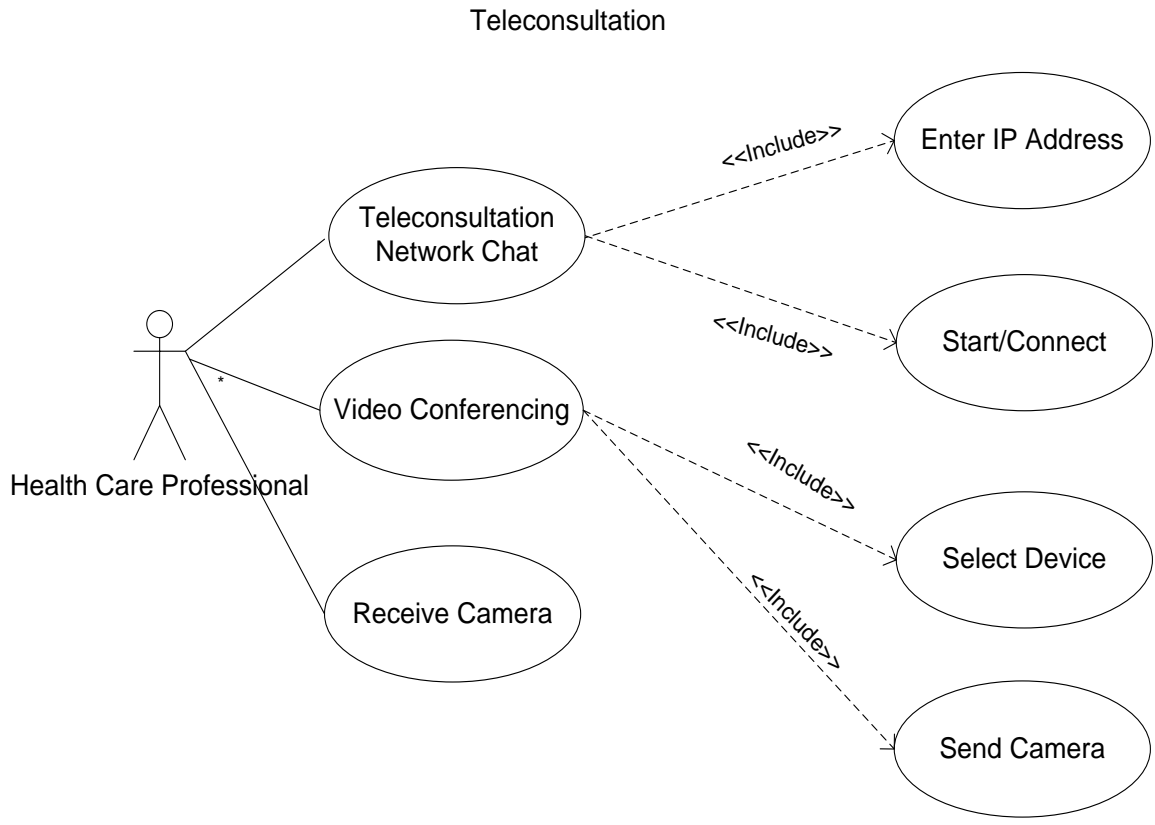


Fig.4 Teleconsultation Sub System

Sequence Diagram for Verifying Physician

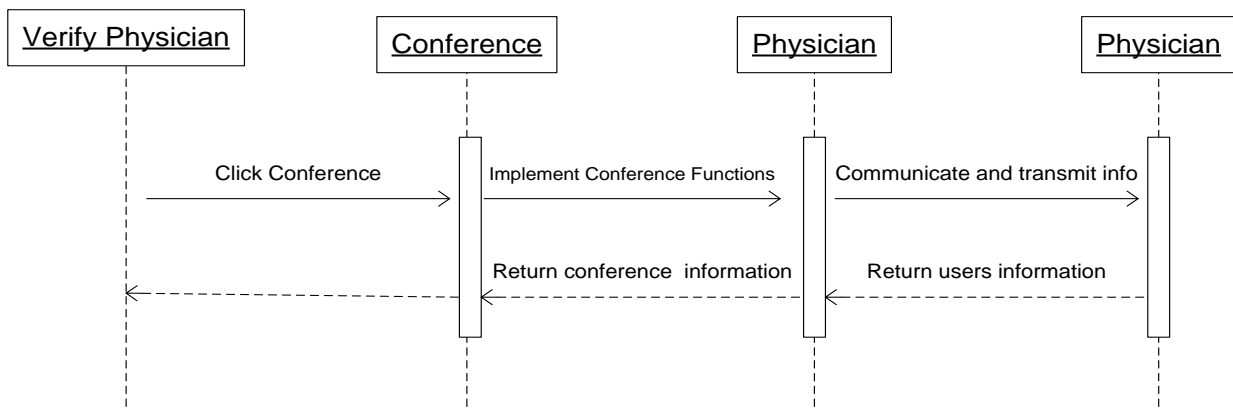


Fig. 5 Sequence Diagram for Tele-Consultation

VII. CONCLUSIONS

The development of system architectures utilizing new computing technologies that support Collaborative Virtual Environments in CAM is a growing necessity just as continuity of care requires a cooperative environment among autonomous complementary medical departments in terms of data and functions. It is expedient to increase access to essential healthcare services, especially for rural and underserved populations. It is equally expedient strengthening and improving the CAM infrastructure to foster greater information exchange, improving and increasing the understanding, dissemination, and use of CAM for well-being. Governments' commitment to providing implementable and sustainable ICT policies with tenacity of purpose on the use of wireless broadband systems in healthcare sector would provide better connectivity due to sensitivity of the medical applications to data loss, corruption or delay. This would provide vital aid for patients and grant access to citizens mostly living in the rural and underserved areas thereby enhancing life expectancy in the developing nations. Understanding healthcare's attitude to new technologies and the growing expectation of interoperability in mobile and telehealth, developing the mobile technology that enables clinical professionals to remotely share information in real time, and using connected technology to enable access to healthcare for millions from the world poorest communities, and investing in the development of mobile and connected health infrastructures as an alternative to traditional models of healthcare delivery are critical success factors in this exercise to usher in the much preferred healthcare outcomes.

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