IJCSN International Journal of Computer Science and Network, Volume 3, Issue 5, October 2014
ISSN (Online) : 2277-5420 **www.IJCSN.org**
Impact Factor: 0.274

Health Care Using Telemedicine: A Case Study of Yobe State, Nigeria

[1] Matawalli Ajagana Geidam, [2] Ibrahim A. Bello, [3] Rajesh Prasad

[1] Department of Chemistry, Yobe State University
Damaturu, Yobe State, Nigeria

[2] Department of Computer Science, Yobe State University
Damaturu, Yobe State, Nigeria

[3] Department of Computer Science, Yobe State University
Damaturu, Yobe State, Nigeria
Department of Computer Science & Engineering, LDC Institute of Technical Studies
Allahabad, Uttar Pradesh, India

Abstract - Telemedicine can be broadly described as the use of telecommunications and information technologies to deliver healthcare services at a distance. It is most useful in the development of rural area, where availability of doctors and health facilities are very less. Recent research shows that the telemedicine has improved the general health care (especially in the rural areas) in whole the word. This paper proposed a framework for the use of telemedicine to improve general healthcare in the Yobe State, where approximately 60 percent of whole the state comes under the rural sector. We also perform a case study taking consideration of all 17 Local Government Area (LGA), 12 secondary hospitals, medical staff and population of state. Based on the facts, we find that the telemedicine is essential to improve the healthcare in Yobe State Hospitals.

Keywords - *Telemedicine, Telepathology, rural health care, remote health care and telenuring.*

1. Introduction

Telemedicine can be broadly described as the use of telecommunications and information technologies to deliver healthcare services and exchange of valid information for diagnosis, treatment and prevention of diseases, injuries, research and evaluation, and for continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities, where distance is a critical factor [1, 3, 6, 11, 13].

Telemedicine helps to eliminate distance barriers and can improve access to medical services that would often not be consistently available in distant rural communities.

Advantages of Telemedicine: Due to recent developments in mobile technology and video conferencing [12], healthcare professionals in multiple locations can share information and discuss patient issues as if they were in the same place [2]. Remote patient monitoring through mobile technology can reduce the need for outpatient visits and enable remote prescription verification and drug administration oversight, potentially significantly reducing the overall cost of medical care [7, 10]. Telemedicine can eliminate the possible transmission of infectious diseases or parasites between patients and medical staff. Additionally, some patients who feel uncomfortable in a doctor's office may do better remotely. For example, white coat syndrome may be avoided. Patients who are home-bound and would otherwise require an ambulance to move them to a clinic are also a consideration.

Disadvantage of Telemedicine: The disadvantage of telemedicine includes the cost of telecommunication, data management equipment and technical training for medical personnel who will employ it. Virtual medical treatment also entails potentially decreased human interaction between medical professionals and patients, an increased risk of error when medical services are delivered in the absence of a registered professional, and an increased risk that protected health information may be compromised through electronic storage and transmission [7]. There is also a concern that telemedicine may actually decrease time efficiency due to the difficulties of assessing and treating patients through virtual interactions. Additionally, potentially poor quality of transmitted records, such as images or patient progress reports, and

decreased access to relevant clinical information are quality assurance risks that can compromise the quality and continuity of patient care for the reporting doctor [4, 5]. Another disadvantage of telemedicine is the inability to start treatment immediately. For example, a patient suffering from a bacterial infection might be given an antibiotic hypodermic injection in the clinic, and observed for any reaction, before that antibiotic is prescribed in pill form.

Telemedicine is mainly useful in the rural areas [14], where availability of doctors are rare [5, 6]; in advanced surgery, where only few countries are having expert doctors [5, 10] etc. It is also used to save lives in critical care and emergency situations.

Though telemedicine did exist even before the 20th century, but the inventions and advancement in the field of Information and Communication Technology (ICT) has eased and increased the vast scope of telemedicine [8, 9]. It has become easy to send any kind of medical data anywhere across the globe for seeking medical help. Communication between the medical staff and doctors with expert opinion for the patient has changed the face of the treatment - videoconferencing, Teleradiology, Telenursing, Telepathalogy, Teleradiology, Telepharmecy etc. are some of them.

The public health system in Yobe State is divided in to a three tier network comprising sub-centers, primary health centers and community health centers. Sub-centers are the primary point of care for patients with primary and community centers delivering health services to rural Yobe State. However, in spite of the extensive infrastructure and accessibility, quality and affordability are major problems affecting nearly 60% of Yobe States's population which live in rural areas.

This paper proposed a framework and its possible implementation for the use of telemedicine to improve healthcare in rural area of Yobe State, Nigeria. According to a report presented to the Hospital Management Board (HMB), Damaturu, Nigeria, in February 2014, the north east zone carries the stigma of having the worst rural health care. With the use of Telenursing, Telesurgery, and general health care delivery, this challenge can be minimized. According to the same report, the state is also lacking in physical infrastructures, non-availability of expert doctors, nurses, and other basic amenities. With the introduction of Telemedicine and Information Technology, the problem related to availability of medical experts, health care facilities can be improved.

We also perform a case study while taking consideration of all 17 Local Government Area (LGA), 12 secondary hospitals, 1 tertiary hospital, medical staff and population of state. Based on the facts, we find that the telemedicine is a need to really improve the healthcare in Yobe State Hospitals.

Rest of the paper is organized as follows. Sec. 2 presents the literature review and related work in the field of telemedicine. Sec. 3 presents the proposed framework and its possible implementation for the Yobe State. Sec. 4 presents the finding and conclusion.

2. Related Concepts

2.1 Types of Telemedicine

Telemedicine can be divided into three main categories [15]: *store-and-forward*, *remote monitoring* and *(real-time) interactive services*.

Store-and-forward telemedicine involves acquiring medical data (like medical images, bio-signals etc.) and then transmitting this data to a doctor or medical specialist at a convenient time for assessment offline. It does not require the presence of both parties at the same time. Example includes: Dermatology, radiology, and pathology.

Remote monitoring, also known as self-monitoring or testing, enables medical professionals to monitor a patient remotely using various technological devices. This method is primarily used for managing chronic diseases or specific conditions, such as heart disease, diabetes mellitus, or asthma.

Interactive telemedicine services provide real-time interactions between patient and provider, to include phone conversations, online communication and home visits. Many activities such as history review, physical examination, psychiatric evaluations and ophthalmology assessments can be conducted comparably to those done in traditional face-to-face visits. In addition, "clinician-interactive" telemedicine services may be less costly than in-person clinical visit

2.2. Early Systems

- 1920 (USA): Transmission of ECGs and EEGs on ordinary telephone lines.
- 1920 (USA): Medical advice services for sailors based upon Morse code and voice radio.

- 1950's (USA): Telepsychiatry between a state mental hospital and the Nebraska Psychiatric Institue using microwave link
- 1950's (USA): NASA and the US Public Health Services developed a joint telemedicine programme to serve the Papago Indian Reservation in Arizona.
- 1960's (USA): Two-way closed-circuit television systems to facilitate both the transmission of medical images such as radiographs as well as consultations between doctors.
- 1970's (USA): Paramedics in remote Alaskan and Canadian Villages connected with hospitals in distant towns and cities using the ATS-6 satellite systems
- 1971, Japan: First time implemented in two areas: Nakatsu-mura and Kozagawa-cho, Wakayama using telephone line for voice and Fax transmission and CATV system for image transmission.
- 1972, Japan: Between Aomori Teishin Hospital and Tokyo Teishin Hospital over 4 Mhz TV channel and several telephone lines.

Other systems came up for Tele-nursing and General Health Care Delivery especially suitable for child and mother care.

2.3 Telenursing

It refers to the use of telecommunications and information technology in order to provide nursing services in health care whenever a large physical distance exists between patient and nurse, or between any numbers of nurses. As a field it is part of telehealth, and has many points of contacts with other medical and non-medical applications, such as telediagnosis, teleconsultation, telemonitoring, etc. In Australia, during January 2014, Melbourne tech startup Small World Social collaborated with Australian Breastfeeding Association to create the first hands-free breastfeeding guidance application for new mothers.

The application, named Breastfeeding Support Project, allows mothers to nurse their baby while viewing instructions about common breastfeeding issues (latching on, posture etc.) or call a lactation consultant via a secure Google Hangout, who can view the issue through the mother's Google Glass camera.

The trial concluded in April 2014, and 100% of participants were breastfeeding confidently [9]. Other system includes: Teleradiology, Telepathology, Teledermatology, Telepsychiatry etc.

2.4 General Health Care Deliveries for Rural Area

The first interactive telemedicine system, operating over standard telephone lines, designed to remotely diagnose and treat patients requiring cardiac resuscitation (defibrillation) was developed and launched by an American company, MedPhone Corporation, in 1989 [16]. A year later under the leadership of its President/CEO S Eric Wachtel, MedPhone introduced a mobile cellular version, the MDPhone. Twelve hospitals in the U.S. served as receiving and treatment centers.

As discussed in the Introduction, the public health system in Yobe State is divided in to a three tier network comprising sub-centers, primary health centers and community health centers. Sub-centers are the primary point of care for patients with primary and community centers delivering health services to rural Yobe State. However, in spite of the extensive infrastructure and accessibility, quality and affordability are major problems affecting nearly 60% of Yobe States's population which live in rural areas. Following steps are needed to implement telemedicine in rural health care [14]:

Need evaluation

Patient need evaluation- Infant and maternal mortality rate, Communicable diseases, Trauma and rural emergency care, Care provider's need- Travel distance between facilities, reduced and power for the healthcare needs, lacking specific skills etc.

Identification of services

Connectivity between primary/community health centers to district or state super specialty hospitals, mobile telemedicine units

Source of medical services

Community health workers, physicians, tele- health organizations

Mode of delivery of services

EHRs, empowering primary health centres, community health centres and district hospitals. Provider location and patient location must be documented with clear specifications of patient facilities. Guidelines and protocols towards delivering these services must be specified. Equipment for audio video streaming and ultrasound imaging, blood pressure, pulse rate and body weight monitors to be specified. Protocols for referring patients by primary care provider, scheduling tele-health examination through videoconferencing, communicating with remote site staff, examination between patients and physician must be specified.

Risk analysis and business development

Developing a business plan is critical for sustainability of the program. This would include, all

possible increases and decreases in cost, increase in revenue and risk assessment. It is recommended to evaluate the business plan prior to considering the technology.

Planning for technology

Consider listing the priorities in Need Evaluation step:

Develop specification for the equipment

Technology facilities to be considered for primary/ community health centres include, selective medical, medico-IT equipment, connectivity requirement (ISDN, Leased line, VSAT, Broadband, wireless technology). IT compatible medico- IT equipment, computer hardware/ software platform (PC, server, switch etc), IT electronic equipment Connectivity/ bandwidth requirements include ISDN, leased line, VSAT, broadband wireless, point- to-point video conferencing system.

Training site staff

Operational trainings for remote physicians, nurses and patients are required. Considering training, the referring providers with respect to function of application specific tele- health and its potential benefits to the patients is required.

Testing technology implementation

Perform a pilot program by limiting the number of patients and staff members. Pilot services can be provided in one or two clinics.

Evaluation

Evaluation of patient, provider and organization centric outcomes can be done in the last step.

3. Proposed Framework for Yobe State Hospitals

In this section, we first describe the details of Yobe State Hospitals, man power (Health Practitioners) and current populations (Courtesy: Yobe State Ministry of Health and Research). Then we discuss the proposed framework for the implementation of Telemedicine for the rural health care.

3.1 Yobe State Health Care Centers at a Glance

Currently, the Yobe State is divided into 17 Local Government Area (LGA), having total population of 2,995,997 (in year 2013). An executive summary of health centers and manpower (Health Practitioners) is given in the following Tables I and II. Table III shows the human resource for the 12 secondary hospitals. Fig.1 depicts the human resource for the twelve (12) secondary hospitals.

Table I: Summary of Health Centers in Yobe State

Health Centers	Present No.
Tertiary	1
Dispensary	234
General Hospitals (Secondary)	12
Child Health Centers	8
Health Center	47
Health Clinics	97
Health Post	56
Maternity Care Centers	47
Model PHC Centers	13
Total	517

Table II: Summary of Man Power (Health Practitioners) in Yobe State

Item Description	Present No.
Doctors	56
Nurses	837
Midwives State Own	45
MSS Midwives	29
SURE-P Midwives	62 CHEWS-1 Nurses

Table III: Summary of Human Resource of the12 Secondary Hospitals

Item Description	Present No.
Total Population of the State (in year 2013)	2995997
Total Number of Doctors in the State	56
Average No. of people served per Doctor	53499
Total No. Medical staff	632
Average No. of people served per Medical staff	4740

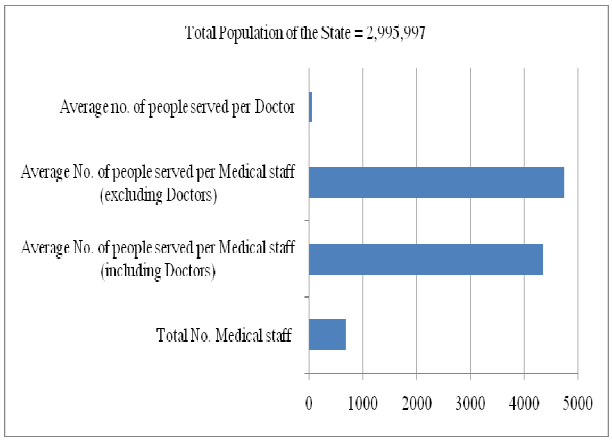


Fig 1: Present Human Resource for 12 Secondary Hospitals

From Fig. 1, it is clear that the Yobe State is lacking in Doctors and other medical facilities. Table I shows that the state is having less number of rural health care centers with respect to the respective population of state. Hence introduction of Telemedicine can improve these health care facilities.

In an effort to reduce existing problem of health care in rural areas, we want to develop a model involving Health Care Tracking System (HCTS), facilitates universal access to general health care services. This system not only allows healthcare providers for efficient use of the technology, but, also enables empowerment of patients. Fig. 2 depicts the proposed framework for General Health Care (GHC) system. Following are the salient features of the framework:

There are two centers: Referral Center and Nodal Center equipped with all telecommunication facilities as shown in Fig. 2. Referral center is having different types of server, medical experts and same set of server and may be other level of expert are also there with Nodal Center.
There are two ways in which patient can use the services of referral system. One way is to register through the nodal center and expert at nodal center will guide them. This is applicable for the patients living in rural areas and having less idea about technology. Other way is that the patient can connect themselves with referral system by using mobile, land line, personal computer to access the facilities in the nodal center. This is applicable for the patients having good idea of technology.

The web based database application tool of HCTS permits real time entry of information related to various problems of patients. For example, information can include maternal and child care services provided by or received, at any public or private care facility.

The framework enables generation of a work plan for base level service in identification of high risk patients or those in need of specific services.

Mobile based SMS technology is used to ease information exchange between policy makers, health managers and administrators at different tiers of health care delivery system.

Tracking scheduled services are also facilitated by GHC framework.

Information on scheduled vaccinations can be retrieved using this technology. Working can be best described by the flowchart given in Fig. 3.

4. Conclusion

Telemedicine has enormous benefits in the sector of health care. Various applications can be developed for the telemedicine to provide better services using ICT with combined effort of medical science. It can help to improve the quality of rural health service in Yobe State. It also helps in providing expert opinion to the remote areas that are deprived of advanced medical facilities.

References

[1] Berman, Matthew; Fenaughty, Andrea (June 2005). *Technology and managed care: patient benefits of telemedicine in a rural health care network*. "Health Economics". *Health Economics* (Wiley) 14 (6): 559–573.

[2] Conde, Jose G.; De, Suvranu; Hall, Richard W.; Johansen, Edward; Meglan, Dwight; Peng, Grace C. Y. (January–February 2010). *Telehealth Innovations in Health Education and Training*. "Telemedicine and e-Health". *Telemedicine and e-Health* 16 (1): 103–106.

[3] Hjelm, N. M. (1 March 2005). *Benefits and drawbacks of telemedicine*. "Journal of Telemedicine and Telecare". *Journal of Telemedicine and Telecare* **11** (2): 60–70

[4] Angaran, DM (15 Jul 1999). "Telemedicine and Telepharmacy: Current Status and Future Implications". *American Journal of Health-System Pharmacy* **56** (14). pp. 1405–1426.

[5] Nakajima, I.; Sastrokusumo, U.; Mishra, S.K.; Komiya, R.; Malik, A.Z.; Tanuma, T. The Asia Pacific Telecommunity's Telemedicine Activities, IEEE Xplore.com website, 17-19 Aug. 2006, pp. 280 – 282.

[6] Rogove, Herbert J.; McArthur, David; Demaerschalk, Bart M.; Vespa, Paul M. (January–February 2012). *Barriers to Telemedicine: Survey of Current Users in Acute Care Units*. "Telemedicine and e-Health". *Telemedicine and e-Health* **18** (1): 48–53.

[7] Blyth, W. John (1990). *Telecommunications, Concepts, Development, and Management* (Second ed.). Glencoe/McCgraw-Hill. pp. 280–282.

[8] "Nurses Happier Using Telecare, Says International Survey". eHealth Insider. 15 June 2005. Retrieved 4 April 2009.

[9] Pangburn, DJ (April 21, 2014). "Turns Out Google Glass Is Good for Breastfeeding". *Motherboard*. Vice Media Inc. Retrieved May 9, 2014.

[10] *E-health care information systems: an introduction for students and professionals*. John Wiley and Sons. 2005. p. 21

[11] Arora, Sanjeev; Karla Thornton, Glen Murata, Paulina Deming, Summers Kalishman, Denise Dion, Brooke Parish, Thomas Burke, Wesley Pak, Jeffrey Dunkelberg, Martin Kistin, John Brown, Steven Jenkusky, Miriam Komaromy, Clifford Qualls (9 June 2011). "Outcomes of Treatment for Hepatitis C Virus , Infection by Primary Care Providers". *New England Journal of Medicine* **364** (23): 2199–2207.

[12] "Videoconferencing Enhances Access to Psychiatric Care for Children and Adults With Mental Illness in Rural Settings". Agency for Healthcare Research and Quality u rl=http://www.innovations.ahrq.gov/content.aspx?id=3945. 2013-12-04.

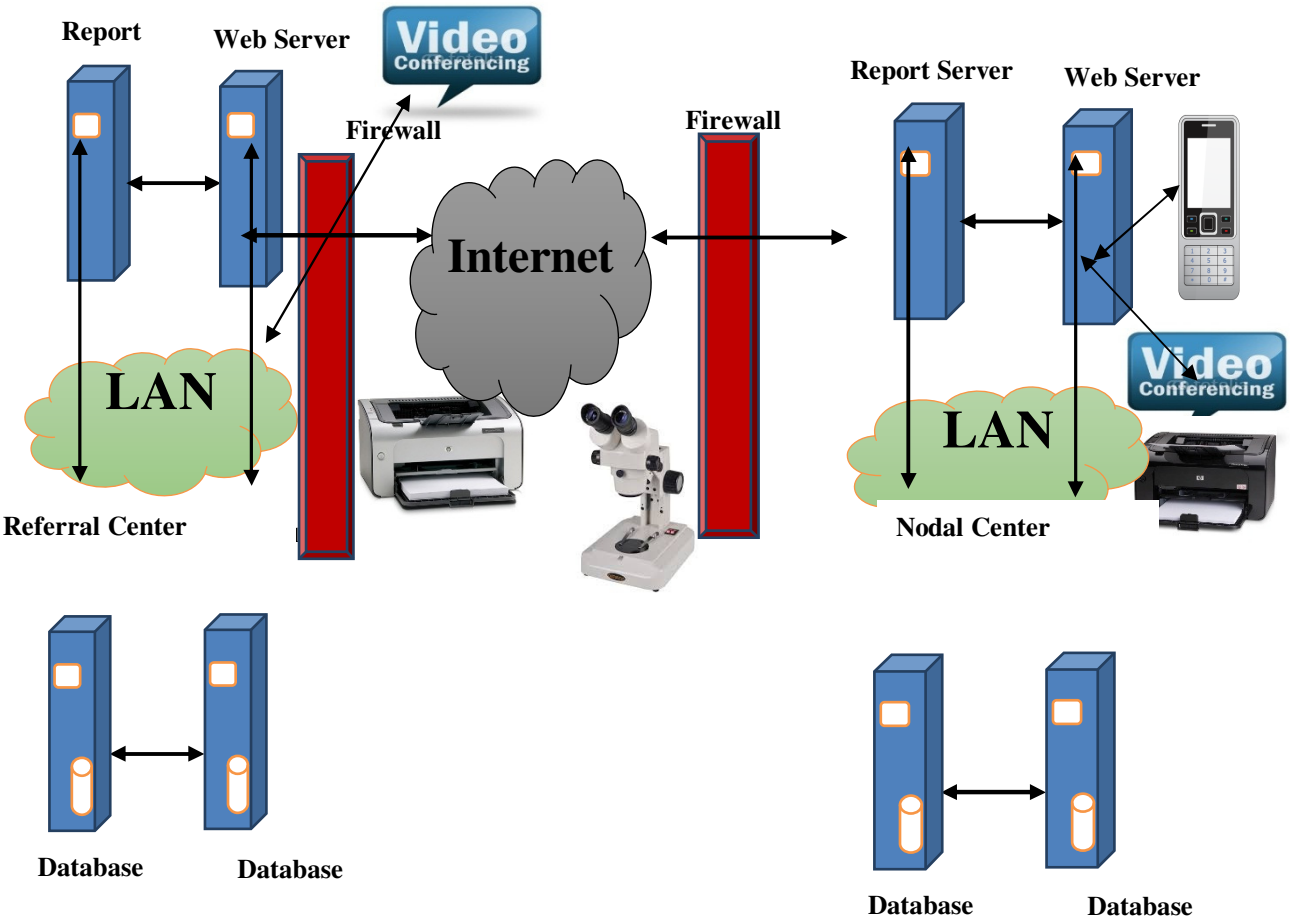
[13] Weinstein, RS; Graham, AM; Richter, LC; Barker, GP; Krupinski, EA; Lopez, AM; Yagi, Y; Gilbertson, JR; Bhattacharyya, AK et al. (2009). "Overview of telepathology, virtual microscopy and whole slide imagining: Prospects for the future". *Hum Pathol* **40** (8): 1057–1069.

[14] Roadmap for Telemedicine, Innovative Working Group (IWG), Asia, Technical Report, 2014, pp. 1-48.

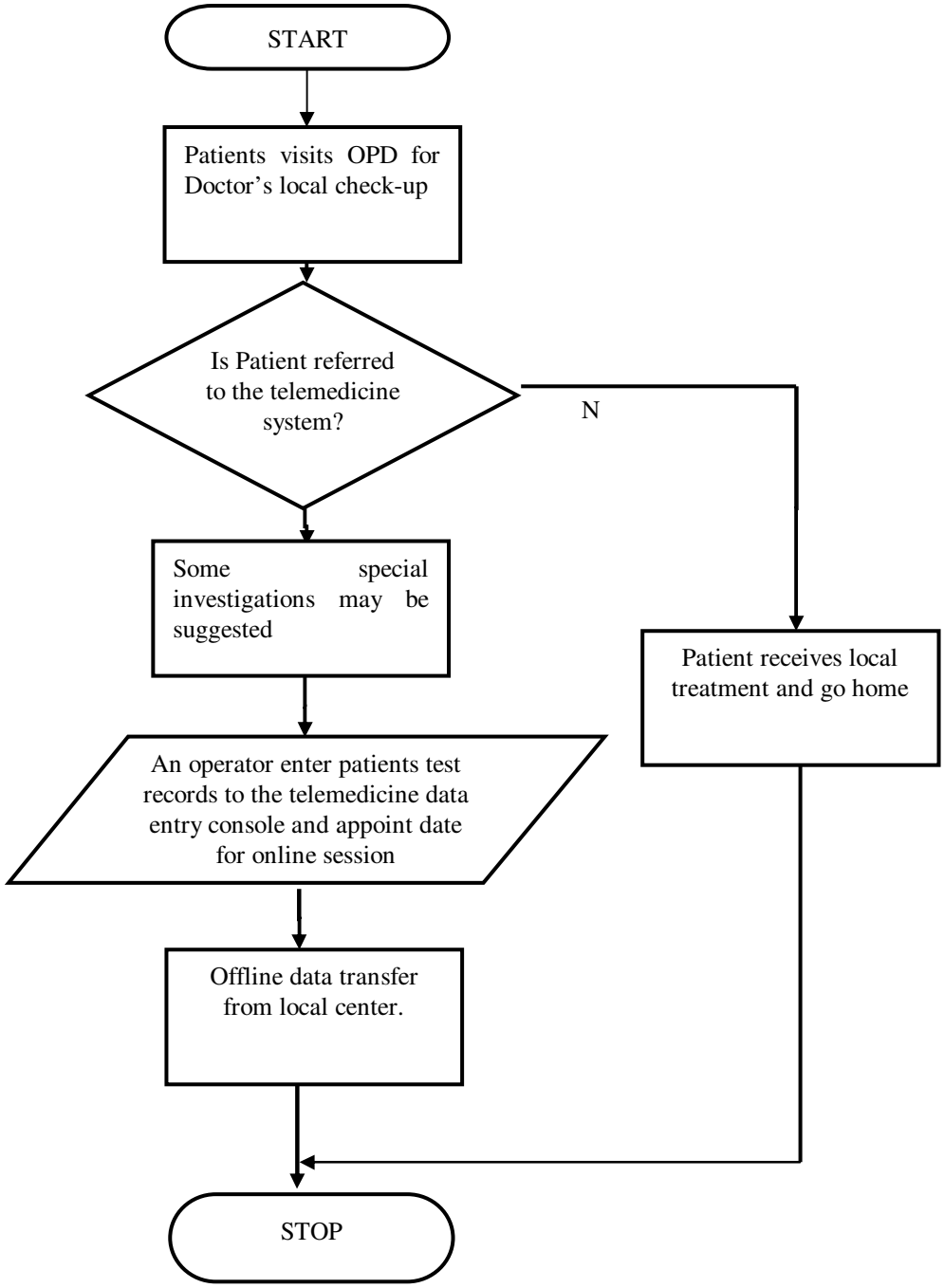
[15] "What is Telemedicine?". Washington, D.C.: American Telemedicine Association. Retrieved 21 August 2011.

[16] Blyth, W. John (1990). *Telecommunications, Concepts, Development, and Management* (Second ed.). Glencoe/McCgraw-Hill. pp. 280–282.

Proposed Framework (GHC)



DAY ONE ACTIVITY



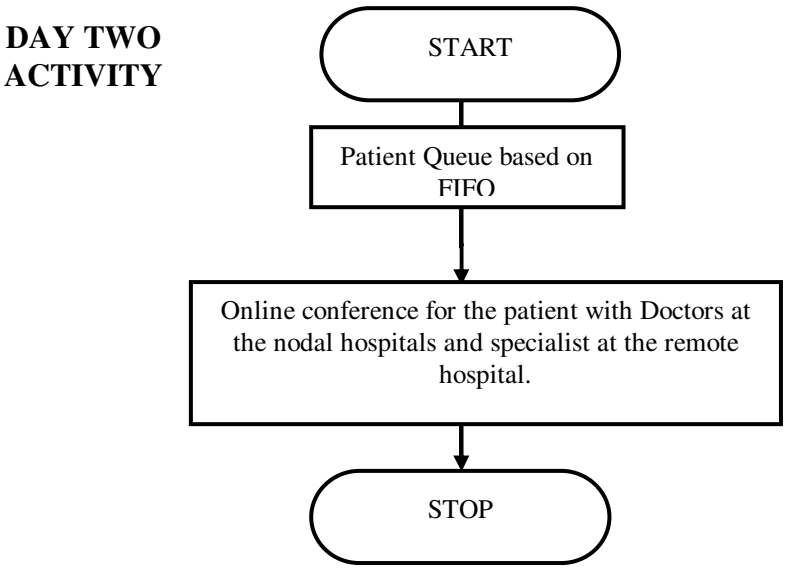


Fig. 3. Flowchart illustrating the working of GHC

Dr. Matawalli Ajagana Geidam has completed his B. Sc. (Hons) Biochemistry in 1988 from University of Maidguri, Nigeria, M. Sc. Biochemistry in 1991 and Ph. D. Biochemistry in 2003 from University of Jos, Nigeria. He is active member of Biochemical Society (UK), Nigerian Association of Biochemistry and Molecular Biology and Chemical Society of Nigeria. He was Associate Professor of Biochemistry at University of Maiduguri, Nigeria (2007-2013) and Rector at Mai Idris Alooma Polytechnic Geidam (2005-2013). Currently, he is Deputy Vice Chancellor Academic Services, and Associate Professor of Biochemistry at Yobe State University Damaturu, Nigeria (2013-Date).

Ibrahim A. Bello received his B. Tech degree in Computer Science from the Federal University of Technology, Yola, Nigeria in 2007, and the M. Sc. degree in Computer Science from Birmingham City University, UK in 2012. His primary research interests include data mining, data compression, networks and software engineering.

Dr. Rajesh Prasad is currently working as a Professor in the Department of Computer Science at Yobe State University, Damaturu, Nigeria. He is also associated with LDC Institute of Technical Studies, Allahabad, India. He received his M. Tech. in Software Engineering and Ph. D. in Computer Science and Engineering from Motilal Nehru National Institute of Technology, Allahabad, India. He has more than 14 years of teaching experience in various colleges affiliated to UP Technical University, Lucknow, India. His research area includes: algorithms, automata theory and software engineering. He has published more than 30 research papers in international conferences/national conferences/journals. He is active member of IEEE.