



Design and Implementation of Telemedicine for Medical Health Centres

Lawal, Moshood O.^{1,*}, Lawal, Tadese A.², Ogunleye, Temitope O.³ and , Akporherhe, Oniovosa A.⁴

¹²³⁴ Computer Science Department, Federal Polytechnic Ede, Nigeria

Abstract: In this program, a proposal for Telemedicine approach in The Federal Polytechnic Ede, medical centre is presented where healthcare facilities are not sufficient due to insufficient availability of medical doctors and medical staff. The system is meant to introduce healthcare system to the staff and students of the institution and environment through telecommunication media, be it a web based or mobile based technology. For this sake, web based clinics will be lunched at the medical centre, and patients will visit this web based application for complains. Each complains would be addressed to each doctor and the doctor would be available to take all necessary information that will be sent to his web application profile. The doctor in return would read the patients complain and his prescription will be sent back to each patients profile via the web application. The design of project topic is to help The Federal Polytechnic Ede Medical centre to treat their patients remotely from their respective location.

Keywords: Telemedicine, Patients, telecommunication, Healthcare, Doctor

1.0 Introduction

Telemedicine is a concept that focuses on any medical action concerning a factor of distance in which the interaction between doctors and clinic involve telecommunication technique. Telemedicine projects in developing countries provide a chance for people living in rural areas to achieve better healthcare services. On the order hand, there are untapped resource of professional doctors that are currently not practicing. Hence, the proposal of virtual clinic provides possible solutions to the above cited problem. Deficiency in healthcare services in the rural areas as a major concern in under developed countries and the use of telemedicine will proffer a solution non-practicing doctors as resource to be utilized.

Telemedicine is the distribution of health-related services and information via electronic information and telecommunication technologies. It allows long-distance patient and clinician to contact, care, advice, reminders, education, intervention, monitoring, and remote admissions of patients (Health Resources and Services Administration 2017).

Telemedicine refers to a broad application of technology to facilitate health care delivery and health management, improving access to care and patient health. In other hand, Telemedicine services include the use of technology devices to collect and transmit patient information, clinical services that provide health care remotely through means such as secure video conferencing, patient engagement tools such as mobile device applications and web applications. Health Information Technology (HIT) infrastructure is crucial in making these reforms and transformation possible. There has been an unprecedented increase in the number of people who now have Health Plan or private health insurance, resulting in increased demand for health care and provider capacity. Telemedicine services can be used to support health care transformation efforts and to extend medical care across long distances, including the exchange of medical information from one site to another via electronic communication to improve a patient's health status. Telemedicine technology is applied to areas of emergency healthcare, video consulting, telecardiology, telepathology, teledermatology, teleophthalmology, teleoncology, telepsychiatry, teledentistry, etc.

There are typically three types of Telemedicine:

- i. Interactive medicine: this allows Telemedicine and Physicians to communicate in real time while maintaining HIPAA (Health Insurance Portability and Accountability Act) (Health Resources and Services Administration, 2017).
- ii. Store and Forward: it permits providers to share patient information with a practitioner in another location (Health Resources and Services Administration (2017)).
- iii. Remote Patient Monitoring: this allows remote caregiver to monitor patients that reside at home by using medical device to collect data (e.g. blood sugar or blood pressure) (Health Resources and Services Administration, 2017).

2.0 Motivation for the study

- Nigeria had continued to suffer major set-back in the area of Healthcare delivery to its citizens, especially those in the rural areas which has purportedly resulted in high mortality rate. However the advent of Telemedicine, as an experimental tool in Nigeria, has helped shown that if the country can key into it fully, it will seriously reduce the issue of poor health.
- At a recent session with Professor Akin Osibogun, chief medical director of the Lagos University Teaching Hospital, said Telemedicine employed modern technology to improve medical education and would also be used for communication between medical experts in Nigeria and abroad (Tunde, 2010).
- The pioneering initiative is aimed at encouraging exchange of expertise between Nigeria and India, and is funded by the ministries of education, health science and technology.
- Many wealthy Nigerians are finding it difficult to obtain visas for medical treatment in Western Europe or North America. Even when they do get visas, the medical fees are exorbitant and discouraging. The idea of travelling to India is expensive and less appealing.
- To solve this problem, a group of medical academics came up with the telemedicine idea and Indian universities were chosen as partners for three reasons.
 - i. First, telemedicine is well developed on the subcontinent because of India's strength and advanced expertise in information and communication technologies. Indian expertise is available in Nigeria - in fact, the development of ICT in the country has been supported by the presence of Indian hardware computer scientists and software developers (Tunde, 2010).
 - ii. Second, medical education in some Indian universities is on a par with the best universities in the West, and their services are not as expensive (Tunde, 2010).

Third, there is a tradition of collaboration between Nigerian and Indian medical teachers and experts (Tunde, 2010).

3.0 Aims and Objectives

The overall aim of this Telemedicine research work is to bring the application of technology, medical practice and medical care at a distance as well as their supporting technologies such as, computing, communications, and networking technologies with emphasis on Telemedicine techniques. The design of project topic is to help The Federal Polytechnic Ede Medical centre to treat their students from their respective location.

The main aims and objectives of this project are:

- To design a web-based Telemedicine for medical health center in order to reduce the number of physical visitation to the medical center for minor illness.
- To implement the system in order to reduce General Practitioners (GPs) workload.
- Providing remote or healthcare patients access to general practitioners
- Increasing patient engagement and satisfaction
- Improving patient convenience
- Improving leverage of limited physician resources
- Reducing unnecessary emergency department visits
- Decreasing medical center readmissions
- Providing 24/7 access to general practitioners
- Improving general practitioners efficiency

4.0 Literature Review

- In recent years, healthcare reforms and federal legislation has pushed forward the spread of Telemedicine technology and other technological advancements. Telemedicine technology first began as a form of healthcare delivery in the late 1960s due to the needs of the National Aeronautics and Space Administration (NASA) and the Nebraska Psychology Institute, according to a paper written by researchers from Saint Louis University and Bentley University and published in the, throughout the last fifty years, there have been multiple barriers standing in the way of widespread adoption of Telemedicine technology and remote monitoring tools. Financial, regulatory, and technological challenges made it more difficult to advance Telemedicine adoption, but current healthcare reforms may bring about a change in this arena (Vera, 2015).

Todd et al, (2018), discussed telemedicine relating to substance use disorder (SUD) and describes the treatment service delivery pattern and outcomes. The paper propounded that there was an increased in use of technology within society at large, and adoption of video and mobile telemedicine technologies in SUD care was found to be <1% in a 2012 analysis [10].

Jeremiah et al, (2018), describes the use of telemedicine in mental healthcare (Telemental) in low- and middle-income countries. The paper illustrates how Telemental offers the LMIC unique opportunity to improve access to quality mental health services including enabling remote care delivery, expanding access to qualified mental health personnel, improving clinical supervision and training, promoting cost and time efficiency of care, and enhancing clinician daily workflows and clinical routines.

Molfenter et al. (2015) also described the technologies being applied in SUD settings. Yet the level of interest in and use rates of these technologies in SUD settings are not known. Barriers and facilitators to adopting telemedicine in SUD treatment need to be better understood.

4.1 Challenges of Telemedicine in Nigeria.

I. Human

- Low literacy level of population (especially in computer literacy).
- Language / Cultural barriers / Privacy □ Human acceptance is poor amongst hospital staff especially many senior ones who rose through the ranks on analogue.
- Minimal involvement of end-users of the Hospital Management Information System (HMIS) at the developmental stages of the software.
- Lack of E-health strategy which should serve as a policy guideline.

II. Finance:

- Millions of US dollars have been sunk on E-health by Lagos and some other states, the federal government and donor agencies. Timely release of committed funds are uncommon on most projects in Nigeria. The E-health budget has to compete with other projects and often not enough; even when there are no leakages. With worsening price of crude oil per barrel, adequate funding pose real threat (Ahmid, 2016).

III. Technical

- Hospital Management Information System (HMIS)
- Built to run on real time basis
- System availability and reliability must be in the five 9's (99.999%) i.e. 5.26 minutes downtime in a year. This is not achievable with the ICT infrastructure we have on ground.
- A system breakdown in any service area will put all activities on hold, unlike a web based system solution infrastructure.
- Hardware, software and power failures are major challenges (My country requires about 40,000 MegaWatts of electricity for its 170 million populace but still struggling to generate 5000 MegaWatts as of today (Ahmid, 2016).

4.2 Telemedicine cases in Nigeria

- **CASE 1**
Barton Associates and VSee, a Health Insurance Portability and Accountability Act (HIPAA-compliant) Telehealth app and video conferencing software company, in 2016 partnered to examine the company's telemedicine field kit in a Shell oil field in Nigeria. Shell, a multinational oil and gas company and long-time user of VSee has benefited from the app's delivery of clear video and real-time data to workers in remote, hard to reach areas and often harsh environments (Femi Ekanoye, 2017).
- **CASE 2**
Another case that displays the use of telemedicine takes place at Obio Cottage Hospital in Port Harcourt, one of 27 medical centers in South-South Nigeria. A one-month old baby boy had been admitted to the hospital for about 6 days with a severe cough coupled with high fever. They used virtual Doctor Visit (Femi, 2017).
- **CASE 3**
As part of its 4Afrika initiative, the software giant, Microsoft, has provided financial, technical and mentorship support to transform Sabaoth Technologies Ltd, Nigeria's foremost e-health and telemedicine consultancy firm. Sabaoth technologies have developed the All Purpose Medical Information System (APMIS) which is Nigeria's number one and only medical care platform that makes it possible for medical care facilities to capture, store, and exchange relevant data at an affordable cost, easily and securely (Femi, 2017).

5.0 Methodology

Study Population. In an occupational health care setting, the telemedicine system was used in an institutional medical centre to reduce student population in the medical centre. Students and medical healthcare workers were used in the pilot testing of the application. The application was designed using a PHP framework to for ease of direct connection and using query language to select information of both the patients and the medical healthcare work.

The research methods used for this project are classified under the following headings:

- i. Personal interview were conducted with the Director General of The Federal Polytechnic Ede Medical Center.
- ii. Consulting relevant books, journals and materials on the internet that are relevant to the project.

6.0 Result and Discussion

The program designed for the research work follows a structured programming approach. The system was designed using the following technologies; Apache server, MySQL, Laravel Framework, Cascading Style Sheet (CSS) and Visual Studio code was used as the Integrated Development Environment (IDE) for coding. The features provided for the programming languages are used to enables the flexibility of the system. This feature also made the sequential arrangement of the modules for easy adjustment and correction when the need arises.

6.1 The model of the system

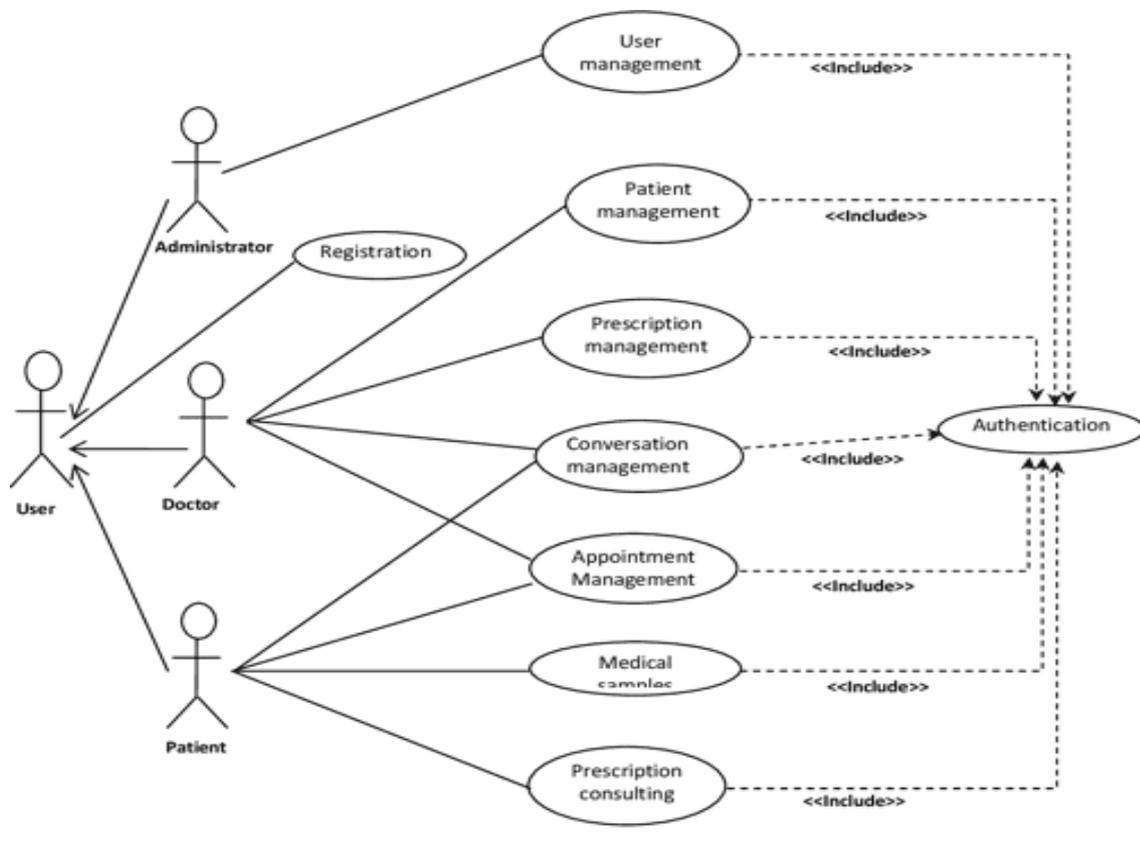


Fig 1 UML diagram

7.0 Description of the Interface

7.1 Input Design Specification

The system is designed to accept data through keyboard to the screen and also through enhanced mouse by clicking on necessary button or choosing various options. The proposed system is designed to transfer the input data into file for further processing. The data required as input for this system are in the figures below;

7.2 Doctor Dashboard

The page gives access to doctor after entering his or her email address and password to login and can view the details, edit details, various activities and operations that can be carried out such as manage appointment, schedule time off, reply messages and profile details etc. The screen below has shown the dashboard below in figure 2.

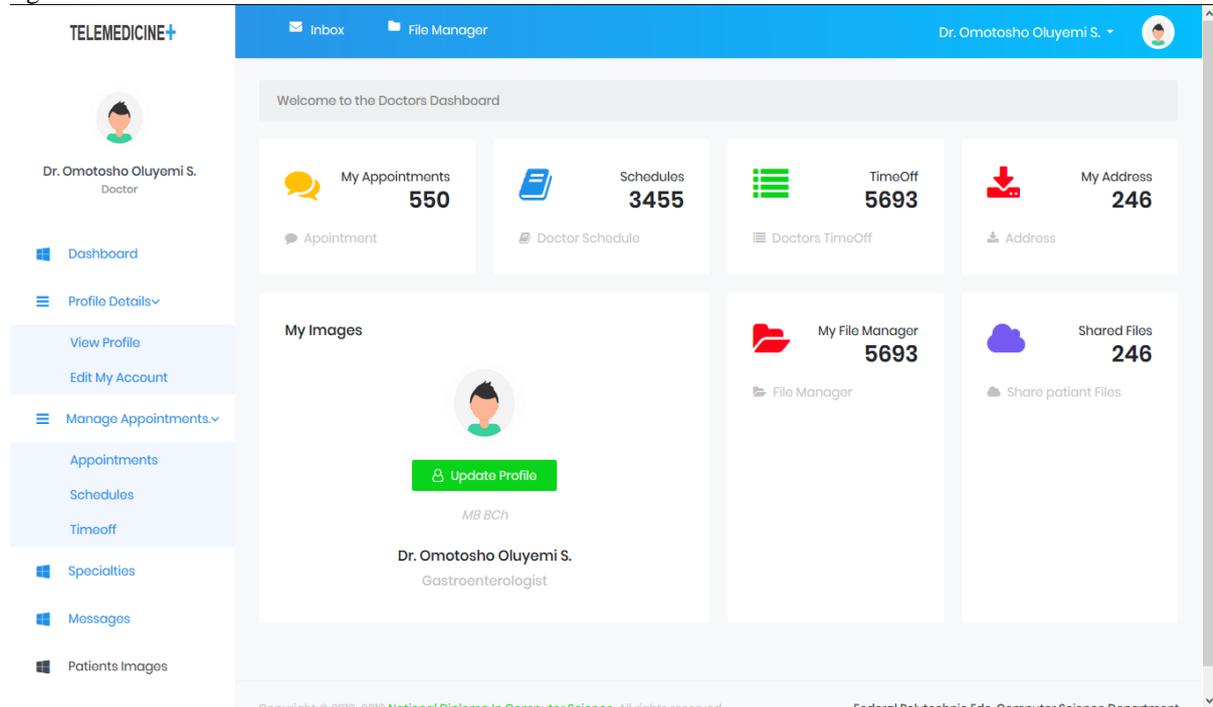


Fig 2. Doctor Dashboard

7.3 Patient Registration Form

The page gives access to the admin to register patient to the system. Patient can later login to view the details, edit details, various activities and operations that can be carried out. The screen below has shown the registration form below in figure 3.

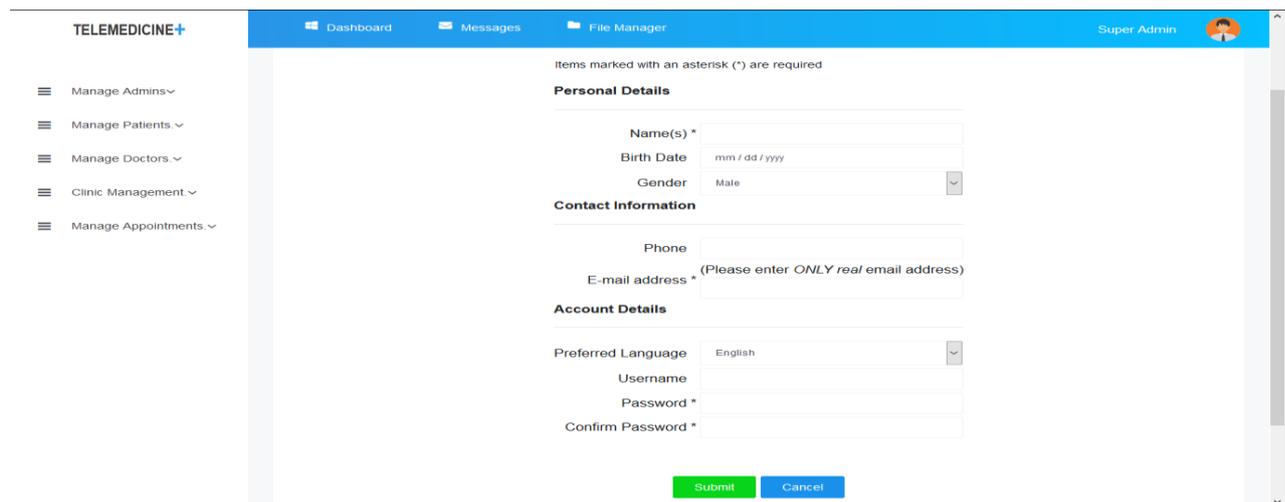


Fig 3. Patient Registration Form

7.4 Patient Dashboard

The page gives access to patient after entering his or her email address and password to login, user can view details, edit details, various activities and operations that can be carried out such as edit account, patient appointment, lodge complain and reply message etc. The screen below has shown the dashboard below in figure 4.

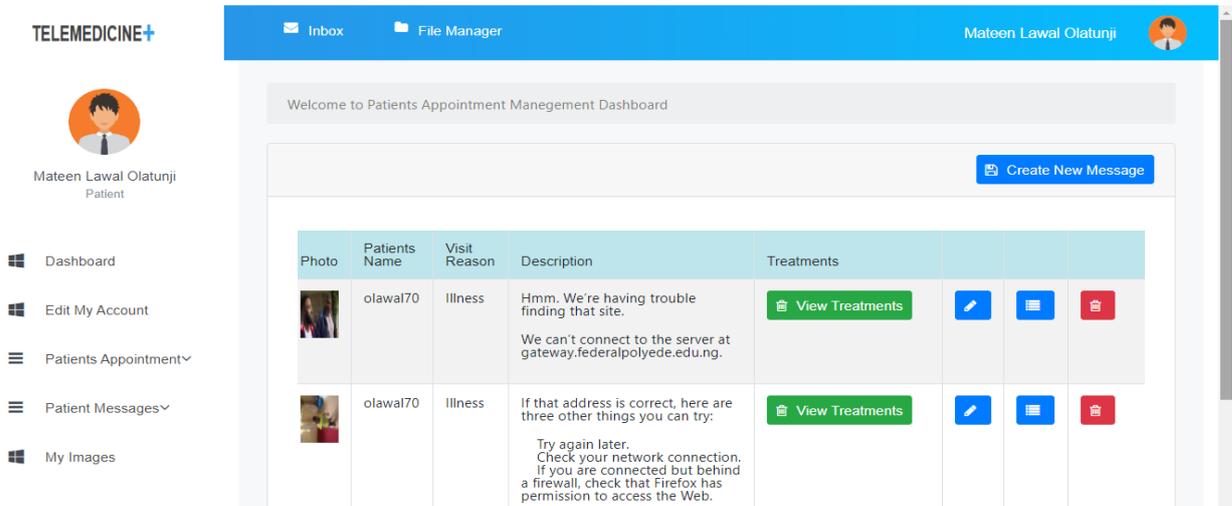


Fig 4. Patient Dashboard

7.5 Patient to Doctor Appointment Form Input

The form page gives access to patient to book appointment with doctor available on duty to lodge complain on his or her illness. The screen below has shown the various input required below in figure 5.

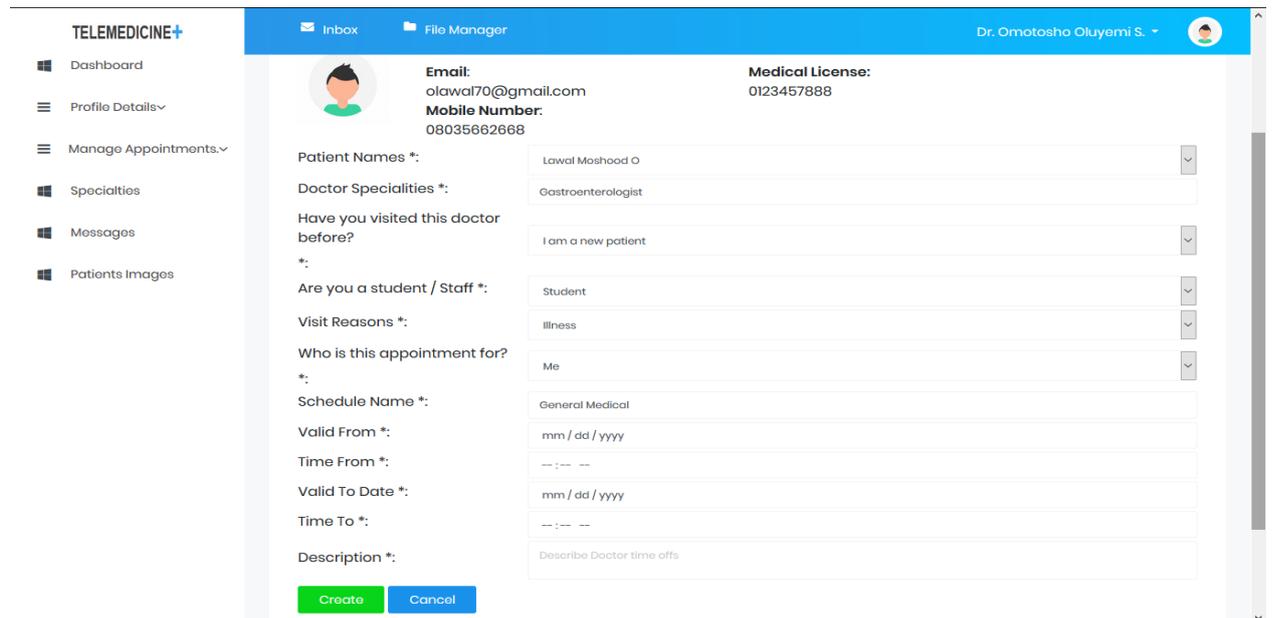


Fig 5 Patient to Doctor Appointment Form

7.6 Patient Complaint Form

This is a form that has to be filled by patient to lodge complaint to his or her respective doctor. The screen below has shown the various input required below in figure 6.

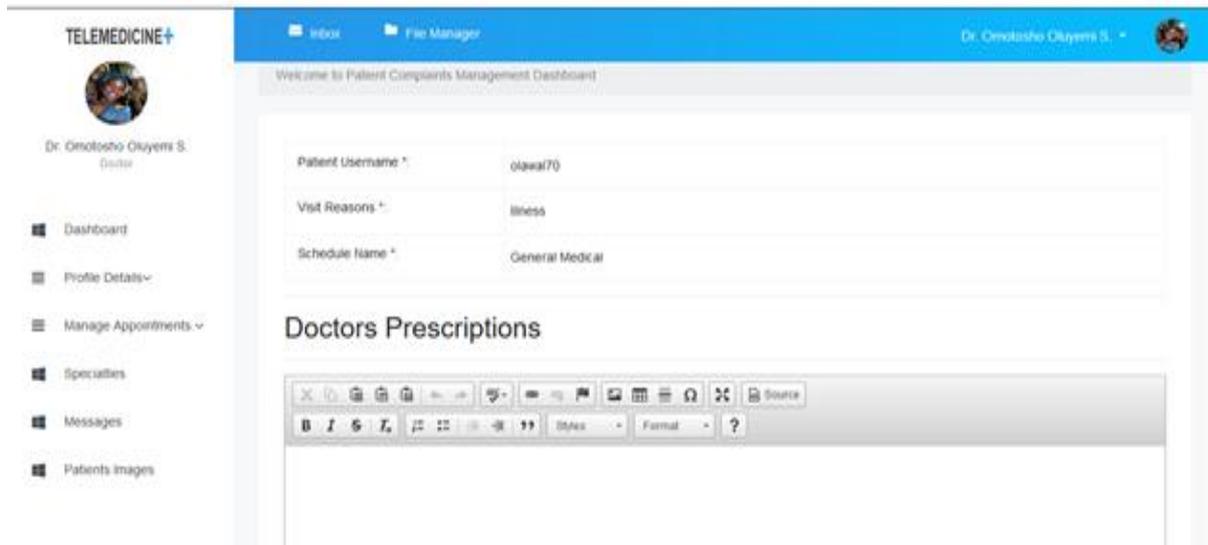


Fig 6. Complaints or Message Form

8.0 Conclusion and Recommendation

Telemedicine has several advantages over normal healthcare system. It promotes more efficient use of beds, resulting in cost savings, and patients tend to recover health more rapidly at home. The active involvement of patients in their own care results in a sense of empowerment over their illness.

This research work presents a novel idea of virtual clinic which is a Telemedicine approach to facilitate The Federal Polytechnic Ede Medical Centre healthcare where healthcare facilities are far from availability. Through this system the non-practicing doctors can be connected to the web based clinic through the Information and Communication Technology (ICT). In this way the patient would be benefited by a cheaper diagnosis.

With regard to the investigation, findings, problem encountered and strength of the new system during the course of this study. It is recommended that;

- People in the community should be exposed to computer application courses in the school so as to enable them embrace the usefulness and advantages of computer.
- The government and non-government organization should try as much as possible to make provision for the implementation of Telemedicine and the equipment required.
- The medical center should set up virtual clinic for the implementation of the Telemedicine program.
- Telemedicine should be appropriately adapted to local regulatory frameworks, which may include licensing of Telemedicine platforms in the best interest of patients.
- National Medical Associations should encourage the development of ethical norms, practice guidelines, national legislation and international agreements on subjects related to the practice of telemedicine, while protecting the patient-physician relationship, confidentiality, and quality of medical care.
- Telemedicine should not be viewed as equal to face-to-face healthcare and should not be introduced solely to cut costs or as a perverse incentive to over-service and increase earnings for physicians.
- Use of telemedicine requires the profession to explicitly identify and manage adverse consequences on collegial relationships and referral patterns.
- New technologies and styles of practice integration may require new guidelines and standards.
- Physicians should lobby for ethical telemedicine practices that are in the best interests of patients.

REFERENCES

1. Erin Dietsche (2017) "Advantages of Telemedicine" Georgia-based Reach Health, a telemedicine software company from <https://medcitynews.com/2018/03/biggest-challenges-for-telemedicine-programs>
2. Roki Chauhan (2016) "Disadvantages of Telemedicine" Conference Presentations from <https://healthinformatics.uic.edu/blog/challenges-facing-the-telehealth-industry/>
3. Vera Gruessner 09-11-2015 "History of Telemedicine" from <https://mhealthintelligence.com/news/the-history-of-remote-monitoring-telemedicine-technology>

4. WHO. *A health telematics policy in support of WHO's Health-For-All strategy for global health development: report of the WHO group consultation on health telematics, 11–16 December, Geneva, 1997.* Geneva, World Health Organization, 1998. From https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
5. Tunde Fatunde 17-1-2010 “Challenges why Telemedicine was adopted in Nigeria” from <https://www.universityworldnews.com/post-mobile.php?story=20100114190633688>
6. Ahmid O. Balogun MB, Bs, PGDHA,FMCP,FNSEM,Retired Permanent Secretary, Lagos Nigeria (2016) “Challenges of Telemedicine in Nigeria” from <http://www.ha.org.hk/haconvention/hac2016/proceedings/downloads/IHF2.2.pdf>
7. Beth Principi 08-06-2015 “Lapses in Telemedicine” from <https://www.americanwell.com/think-there-are-still-problems-with-telemedicine/>
8. Erin Dietsche (2017) “Reason for system adoption” Georgia-based Reach Health, a Telemedicine software company from <https://medcitynews.com/2018/03/biggest-challenges-for-telemedicine-programs/“System-analysis-and-design”> from https://www.tutorialspoint.com/system_analysis_and_design/system_analysis_and_design_overview.htm International Journal of Environmental Research and Public Health by MDPI. Retrieved 2012-04-04. (“IJERPH”) from <https://www.mdpi.com/journal/ijerph>
9. Fuhmei Wang, (2016), Continuing Medical Education via Telemedicine and Sustainable Improvements to Health, Volume 2016, 6 pages.
10. Todd Molfenter, Roger Brown, Andrew O’Neill, Ed Kopetsky, and Alexander Toy, (2018), Use of Telemedicine in Addiction Treatment: Current Practices and Organizational Implementation Characteristics, Volume 2018.
11. Louise Newbould, Gail Mountain, Mark S. Hawley, and Steven Ariss, (2017), Videoconferencing for Health Care Provision for Older Adults in Care Homes: A Review of the Research Evidence
12. Jeremiah W. Acharibasam and Rolf Wynn, (2018), Telemental Health in Low- and Middle-Income Countries: A Systematic Review, International Journal of Telemedicine and Applications, vol 2018.