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Implementation of Remote Health Monitoring in Medical Rural Clinics for Web Telemedicine System

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----------**ABSTRACT**----------

The problem with limited numbers of physicians, nurses, and other healthcare providers is expected to exacerbate. Health care must be as efficient as possible. This situation provides an opportunity for the application of telehealth clinics. It is time for organizations providing health care to objectively consider telehealth clinics. Information and communication technologies (ICTs) have great potential to address some of the challenges faced by both developed and developing countries in providing accessible, cost-effective, high-quality health care services. Telemedical clinics use ICTs to overcome geographical barriers, and increase access to healthcare services. This is particularly beneficial for rural and underserved communities in developing countries – groups that traditionally suffer from lack of access to health care. In this work we propose an equipped system with new technology to provide wide range of services in Telemedical clinics which facilitates the provision of medical aids from a distance. It is an effective solution for providing specialty healthcare in the form of improved access and reduced cost to the rural patients and the reduced professional isolation of the rural doctors. Telemedical clinics can enable ordinary doctors to perform extra-ordinary tasks.

Keywords—**Telemedicine, ehealth, Healthcare webportal, Medical Center, ICT, Rural Health Clinics.**

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I. INTRODUCTION

More than urban areas, rural communities depend on a system of small clinics and health centers to provide primary care services, often utilizing non-physician health professionals. This system consists of rural health clinics (RHCs). Rural areas are facing a limited supply of pharmacists, dentists and mental health professionals. Because training programs have not kept pace with the rapid and growing demand for pharmacists, there are relatively few pharmacists available to serve rural areas [1]. Likewise, the availability of dental care is much lower in rural areas than in cities. Overall, we found that measured performance of rural physicians tended to be lower than performance of physicians in urban or suburban areas.

To better understand the health issues facing rural communities, we asked physicians and consumers about their views on the most pressing health challenges in their communities and found that chronic conditions were major concerns for both groups. Primary care physicians in both urban and rural areas identify diabetes, cardiovascular disease and cancer as major challenges, as shown in Figure 1. Additionally, drug abuse and teen pregnancy were significantly higher concerns of primary care physicians in rural areas.

II. RURAL CLINICS AND HEALTH CENTERS

The role telemedicine can play helping clinics expand services in rural areas by connecting patients to specialists. Mobile clinics equipped with new technology can move beyond traditional functions and provide broader range of services.

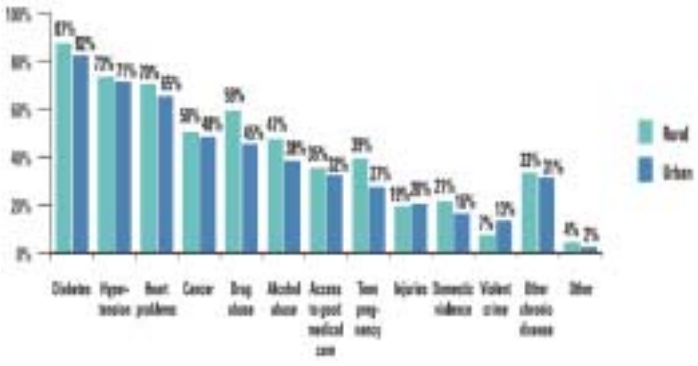

Figure 1."What would you say are the major health problems affecting your community today?"[1]

Advances in communications and information technology are transforming medical care by changing the way care is delivered and how people access medical services. One technology driving these improvements is telemedicine: the provision of clinical services using the electronic exchange of

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medical information, cross-site transmission of digital images and electronic communications (e.g., physicianpatient email, remote monitoring of vital signs and video patient consults with physicians). Rapidly emerging as a component of telemedicine is medical care that relies on mobile devices such as cellular phones, personal digital assistants and laptops (often referred to as mHealth). High resolution cameras, digital imaging, the use of smart phones and broadband high-speed connections have dramatically improved the scope and scale of telemedicine's applicability. The concept of telehealth, often used interchangeably with telemedicine, refers to a broader set of uses of the technology that includes but also extends beyond the delivery of medical care. Telehealth involves using technology to support activities such as remote medical education, health services research and some administrative functions [2].

III. How is Telemedicine Used in Rural?

By diminishing the impact of distance and time, telemedicine can in theory expand capacity, foster coordinated care, improvethe quality and efficiency of the delivery system and support more patient self-management. Figure 2 shows the types of telemedicine that are most functional today primarily expand the capacity of the rural health care delivery system, making it easier for patients to be seen and treated, especially by specialists. These types of telemedicine include:

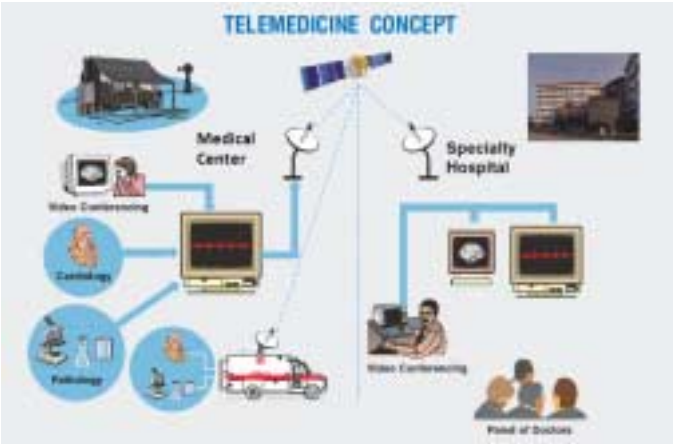

Figure 2.Telemedicine Usage in Rural [3]

• **Transmission of data or images for analysis**. The transmission of images or clinical data from an electronic device to a medical center is known as "store and forward." Clinical information is "stored" with a patient record and then forwarded to a provider for further review. Dermatologists and radiologists increasingly use this technology as do emergency medical personnel who can transfer medical information and images from ambulances to hospital emergency rooms. Store and forward technology also supports ongoing remote patient monitoring and management of key medical indicators (e.g., blood glucose levels) in patients with chronic illness.

• **Facilitation of consultations between patients and providers**. These consultations, commonly conducted over the Internet using secure live connections and Web cams, can either substitute for in-person visits or support care between appointments. Audio and online approaches may also be used. In rural areas, video consultations extend the reach of scarce specialists; some federally qualified health centers use video technology for this purpose. The interactive capabilities provided by video also support the technology's use in behavioral health care; federal veterans hospitals use telemedicine to facilitate treatment for Post-Traumatic Stress Disorder. Online care is well-suited to conditions where a one-on-one consult could result in a quick diagnosis, such as respiratory infections, urinary tract infections, acute conjunctivitis and hypertension. Current technology allows patients to connect to more than one provider at a time: a primary care physician can join with a specialist, for example, to confer with a patient. If physicians and patients are not available at the same time, either one can prepare a video report that can be accessed at a later time by the other [3].

• **Support for patients managing their own health**. Patients can use the Internet to obtain specialized health information and to access online discussion groups for peer-to-peer support. Surveys show that patients are often willing to manage their personal health information over smart phones and are interested in pursuing other types of care delivery via mobile devices [2]. Phones now have the ability to store health information like immunizations and prescriptions. When connected to portable medical devices, phones can capture blood glucose levels, blood pressure values and vitals, and transfer information to personal health records. These tools can help people address their health and wellness needs through online care management and wellness programs that teach positive long-term behavior change.

• **Remote monitoring.** Providers use remote monitoring to track changes in important patient vital signs such as weight, body temperature, blood pressure and heart rhythms. Patients wear monitors or use devices such as scales located in their own homes but connected to their physicians' offices, making it possible to monitor a patient's health without an office visit. This remote monitoring supports the early detection of possible health problems (for example, patients with congestive heart failure who suddenly gain weight may be retaining water, a sign of decreased heart function that can be treated with medication). Pharmacists may use information from remote monitoring to counsel patients on the effective and safe use of medications [2].

• **Intensive care unit (ICU) telemonitoring (e-ICUs).** These programs extend the reach of critical care providers. Specialist physicians and critical care nurses staff round-the-clock tele-ICU centers (or tele-hubs) that receive data from monitoring devices tracking patients in ICUs in small hospitals, including those in rural areas. The ICU specialists

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in the tele-hub can support the care given on-site by providers who may have less critical care expertise.

• **Telepharmacy**. Remote, rural clinics may not be able to provide a full-scale pharmacy, but access to an electronic connection to a pharmacy and a pharmacist can help patients receive both medications and medication counseling (ultimately improving medication compliance). By connecting pharmacies at urban hospitals to small rural hospitals, pharmacists can guide dispensing technicians to fill prescriptions [3]. In some cases, however, legal requirements that pharmacists be present for the dispensing of medication may complicate this practice [4].

IV. TELEMEDICINE'S EFFECTS ON COST AND OUTCOMES

Harnessing telemedicine technology to reduce readmissions to hospitals, avoid unnecessary visits to physician offices, improve medication compliance and strengthen communication between patients and health care professionals holds significant promise in practice. Policymakers, researchers, health care professionals and consumers are interested in whether in practice, and to what extent, the widespread adoption of telemedicine technology can reduce costs and improve outcomes.

The deployment of telemedicine is still in its early stages and varies greatly in its use, location, technology, specialty and objectives. As a result of this variation, local travel costs, prices and investments in technology/infrastructure must all be considered in estimations of economic benefit. The wide range of metrics used to measure cost-savings and efficacy across studies currently limits the ability to draw generalizable conclusions about full deployment. Additionally, much of the research on telemedicine originates from small demonstration projects. Recent legislation includes telemedicine in a list of potential delivery reform ideas for the Centers for Medicare and Medicaid Services to test through its new innovation center. The law specifically identifies the technology's use to treat chronic conditions and behavioral health issues in medically-underserved areas and at Health Service facilities. Research on cost-effectiveness and health outcomes is, however, starting to generate some initial results:

• An extensive literature review reported that telemedicine reduced time-to-diagnosis, improved access to care for patients in remote areas and improved patient satisfaction [5].

• A 2005 Veterans Affairs study in Florida showed a 50 percent reduction in hospital admissions and an 11 percent reduction in emergency room services using home telehealth services [6].

• A review of 13 tele-ICU studies found that telemedicine in the e-ICU reduced ICU mortality by 20 percent and reduced the average length of ICU stays by an average of 1.26 days. However, the use of telemedicine did not reduce hospital mortality or overall length of stay [7].

• An Agency for Healthcare Research and Quality (AHRQ) review of 97 articles revealed that much of the literature on effectiveness is focused on the practice of dermatology. While the literature shows that the accuracy of diagnosis in store-and-forward teledermatology is comparable to in-person encounters, some studies have shown interactive teledermatology to be inferior to in-person diagnosis, though health outcomes are comparable. These results may be due to the use of outdated technology [8].

• The Veterans Administration (VA) found that veterans who used text messaging to report blood pressure readings taken at home to their care providers achieved blood pressure goals sooner than those using other methods [9].

• Researchers are also identifying organizational and staffing benefits from telemedicine, especially in ICUs. A recent study found that when e-ICU staff monitored patients virtually, bedside staff had more time to spend with families and to perform tasks such as tracking data [10].

• A recent study of the Health-e-Access web portal, which connects pediatric patients in child care centers, schools or community centers with their own providers at local pediatric centers, reported a 22 percent reduction in emergency department visits among children with telemedicine access over a seven-year period [11].

V. APPROACHES TO INCREASE AND IMPROVE THE USE OF TELEMEDICINE IN RURAL AREAS

While telemedicine technologies can be deployed across different geographic areas and care settings, they are particularly well-suited to rural areas, where distances, low patient density and low provider density contribute to challenges in accessing and providing care. Here we discuss six strategies to make fuller use of this potential.

1. Expand broadband connectivity to enable growth of telemedicine adoption.

To successfully engage in telemedicine, physicians must have the necessary infrastructure access to broadband, video-conferencing technology and telemetry-enabled medical-devices.

2. Encourage physicians to incorporate telemedicine into their practice.

Many physicians remain uncomfortable with telemedicine [22]. The technology requires a shift in the practice of medicine. While telemedicine has the potential to benefit physicians and their patients, education and support are needed to ease the transition for many providers. As with electronic health record adoption, the adoption of telemedicine will also require structural changes in many practices: staff composition, work schedules and record

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keeping are all likely to evolve in practices that use telemedicine extensively [23]. Health plans, employers and public purchasers of care can all encourage providers in their networks to use telemedicine by educating them about its ability to serve patients better by combining telemedicine encounters with face-to-face care. Demonstrations of the technology and its capabilities tailored to physicians in small practices may also help. To encourage specialists in urban areas to participate in telemedicine referrals, similar approaches should be deployed.

3. Use telemedicine to build primary care capacity in rural areas.

Telemedicine builds capacity in rural areas by making it easier for primary care physicians to connect with and monitor their patients; allowing nurse practitioners and physician assistants to practice in more areas while still being advised by physicians; and increasing the availability of specialists. Rural areas without ease of access to specialists use telemedicine to provide care without the need for transporting patients from small hospitals or physician offices to urban centers. Through video conferencing, physicians located in urban hubs can visit with, treat and prescribe medications for patients in distant rural locations. New telemedicine systems can capture radiology images and eliminate the need for local film processing and reading. Telemedicine makes mobile care units more functional and versatile. Health plans and employers can collaborate with providers to deploy telemedicine in ways that enhance primary care needs in local areas. Ensuring that there are clinical partners to connect to is crucial to the success of this technology in expanding primary care capacity.

4. Increase access choices for rural beneficiaries.

Employers and other purchasers can provide greater choices for rural residents in how they communicate with health care professionals by making available telemedicine applications, such as video consultations, online care and patient kiosks. Telemedicine broadens the scope of care and types of provider networks available to rural residents and makes it more convenient to access services. Telephonic and web-based primary care referral programs can be used to direct patients to appropriate care.

5. Raise patient comfort levels with telemedicine technology and encourage its use in rural care models.

Patients who are not accustomed to technology may resist using telemedicine devices. However, given the general advancement in society's overall comfort with technology over the past decade, combined with the convenience of gaining access to services remotely, we may in the future see more patients select this mode of care delivery. Providers can encourage patients to use telemedicine tools, such as remote monitoring, as part of their care. These tools are especially helpful to rural residents with chronic illness who need to track this information to stay healthy, and can lead to greater engagement by patients in the management of their own health.

6. Improve care coordination and patient safety in rural areas.

Providers should consider adopting telemedicine to aide in efforts to improve patient safety and care coordination. Telemedicine can improve health system efficiency by connecting professionals to each other and to pertinent data (medical records, data from remote monitoring systems, and images). It can also enable greater follow-up with patients post-surgery. Remote patient monitoring in ICUs can improve patient safety and reduce the need for patient transfers. Data transfers from ambulances to hospitals can improve the speed and effectiveness of emergency care. The federal government should encourage adoption of telemedicine in new payment reform models, such as the patient-centered medical home and accountable care organizations [11].

VI. PRINCIPLE APPLICATIONS OF TELEMEDICINE USED IN TELEHEALTH MEDICAL CENTERS

A. Telecardiology

Figure 3.Telecardiology-how it works [12,13]

ECG or electrocardiograph can be transmitted using telephone and wireless. Teletransmission of ECG using indigenous methods. One of the oldest known telecardiology system .This system enabled wireless transmission of ECG from the moving ICU van or the patients home to the central station in ICU of the department of Medicine. Transmission using wireless was done using frequency modulation which eliminated noise. Transmission was also done through telephone lines. The ECG output was connected to the telephone input using a modulator which converted ECG into high frequency sound. At the other end a demodulator reconverted the sound into ECG with a good gain accuracy. The ECG was converted to sound waves with a frequency varying from 500 Hz to 2500 Hz with 1500 Hz at baseline.This system was also used to monitor patients with pacemakers in remote areas. The central control unit at the ICU was able to correctly interpret arrhythmia. This technique helped medical aid reach in remote areas.

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B. Teleradiology

Teleradiology is the ability to send radiographic images (x-rays) from one location to another. For this process to be implemented, three essential components are required, an image sending station, a transmission network, and a receiving / image review station.

The most typical implementation is two computers connected via Internet. The computer at the receiving end will need to have a high-quality display screen that has been tested and cleared for clinical purposes. Sometimes the receiving computer will have a printer so that images can be printed for convenience.

Figure 4.Teleradiology [14]

The teleradiology process begins at the image sending station. The radiographic image and a modem or other connection are required for this first step. The image is scanned and then sent via the network connection to the receiving computer.

VII. MEDICAL DEVICES USED IN HEALTHCARE CENTERS

A. LifeGuard :NASA developed the wireless LifeGuard system [15], a lightweight, portable device that enables physicians to monitor the health and safety of explorers in remote locations. The system allows real-time monitoring of vital parameters such as heart rate, blood pressure, electrocardiogram (EKG), breathing rate, and temperature. The LifeGuard's button sensors stick to the skin to take EKG and breathing rate. The system's sensors connect to the LifeGuard by wires. LifeGuard's data logger has a transmitter that radios collected data by satellite to a base station computer. This is a good example of a system that could be used in telemedicine.

Figure 5. Digital Otoscope [16]

B. Digital Otoscope

With Digital Otoscope, you can conduct a full range of ear, nose and throat examinations that provide the remote physician with clear, live and still images of the ear canal and tympanic membrane. This features an insufflation port for a pneumatic otoscopy exam.

C. Digital stethoscope

A digital stethoscope can be used to assist physicians in analyzing cardiac signals in real time during auscultation to reduce the risks of not detecting certain conditions. digital stethoscope used to serve as a platform for potential computer aided diagnosis (CAD) applications for the detection of cardiac murmurs. The system uses a custom-built sensor to capture heart sounds at 8 kHz and converts them to electrical signals to be processed by an ATmega644 microcontroller. The captured signals are outputted via pulse-width modulation to a standard 3.5 mm audio socket for real-time auscultation. In addition, the stethoscope uses a 1MB external Flash memory chip to record and playback audio waveforms. For the user interface, the system includes a 4-line 20-character wide LCD display and a 16-button keypad. Real-time and recorded data can also be visualized using a MATLAB interface that runs on a separate PC and connects to the stethoscope system via the USART interface on the microcontroller. The MATLAB interface also uses the transmitted data to calculate and display the patient's average heart rate in beats per minute.

Figure 6. Digital Stethoscope System [17]

D. Tele-Echo System

A new "Tele-Echo System" for real-time telediagnosis using medical ultrasound (US) image sequences on a public digital network has been implemented and evaluated. The Tele-Echo System compresses and transmits US image sequences in real-time using a network bandwidth up to 1.5 Mbps. This system compresses US image sequences with Motion Picture Experts Group (MPEG) compression algorithm and transmits with Internet protocol (IP) and user datagram protocol (UDP). Experiments were conducted on the Tele-Echo System for US image sequences of the heart. The transmitted US image sequences contained 9% root-mean-square-error (RMSE) and a 30-dB peak signal-to-noise ratio (PSNR) when the size of images was 352 X 240 pixels, and the speed was about 27 frames per second. The experiments confirmed the clinical

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effectiveness of the Tele-Echo System for remote diagnosis. The transmission of US image sequences was conducted in a few seconds, and some contained noise. The "Tele-Echo System" enables real-time ultrasound image sequences on the network.

Figure 7. Tele-Echo system [18]

VIII. PROPOSED IMPLEMENTATION OF REMOTE HEALTH MONITORING CENTER FOR WEB TELEMEDICINE SYSTEM

Figure8 indicates that the telemedicine process through Medical center is implemented through 4 main stages as follow:

First: Registration

Medical center Representative can register in Ain Medical portal by entering his/her information (name, address, e-mail, user name and password and specialty), the center's information (center's name, address, image, specialty and Commercial Registration No.), and doctors' information who work in the center (names, graduation year, e-mails, specialties and Trade union figure).

The site sends confirmation e-mail to confirm the registration then the site will include this medical center to his database then center will appear to all users in search.

Second: Doctor Addition

The medical center can search for doctor by (name, specialty, graduation year, experience, ……..)

Then can see doctor's profile then he can book an interval of time and if the doctor confirms that, the site will send confirmation message to the medical center.

Third: Booking an appointment

The medical center can search for doctor by (name, specialty, graduation year, experience,……..)

Then can see doctor's profile and see available timeslots and if these suitable to the patient ,he will insert patient's information and book a timeslot and if the doctor confirm that ,the site will send confirmation message to the medical center and doctor including the video conference link as shown in the screenshot in figure (9).

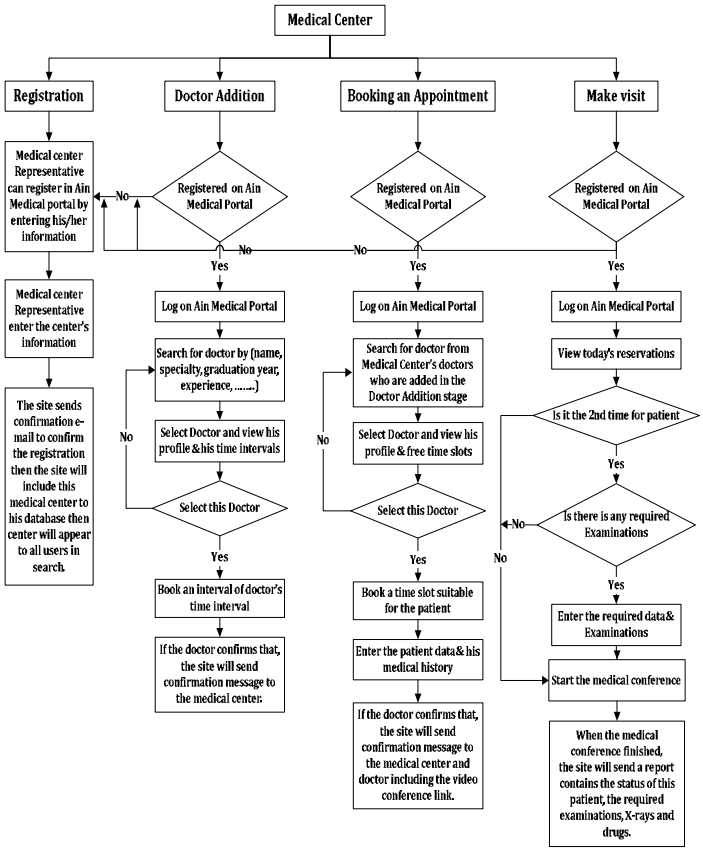

Figure 8.Proposed Implementation of Remote Health Monitoring center for Telemedicine system

Figure.9 Video Web-conference between doctor and patient

Fourth: Make visit

First the medical center will review today's reservations and if it's the 2nd time for patient and he has required examinations or digital data so he will insert them and send them to the doctor then open the link of video conference and when the reservation ends the site will send a file contains the status of this patient, the required examinations, X-rays and drugs.

IX. REQUIREMENTS IN MEDICAL CENTERS

- Tele-consultation room
- Patient engagement facilities (bed, scopes, etc.)

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- Selective medical and medico-IT equipments, preferably IT compatible, with interface to Telemedicine and/or other software / hardware
- Computer hardware / software platform (PC, switch, etc.) and IT electronics equipments
- Mobile vans are a part of telemedicine service
- Desktop PC platform with Laser Print
- IP Video Conferencing Kit
- Tele medicine software
- Digital ECG
- A3 Film Scanner
- Digital Microscope & Camera
- Glucometer &Haemogram analyzer
- Non-invasive Pulse & Blood Pressure unit
- Connectivity device & Router

Figure.10 Requirements in Medical Centers

Looking to the past experience for success of telemedicine:

- Video conferencing
- Accompanied by data and image transfer (live)
- Common software usage at both ends, thus globalization of a single database software
- Role of trained technical personnel is equally important and necessary at the patient end.
- Successful remuneration system to attract private practitioners

Distant Site:

The Centers for Medicare and Medicaid Services (CMS) define the distant site as the telehealth site where the provider/specialist is seeing the patient at a distance or consulting with a patient's provider. Others common names for this term include – hub site, specialty site, provider/physician site and referral site. Figure (11-a).

Digital Camera (still images):

A digital camera is typically used to take still images of a patient. General uses for this type of camera include dermatology and wound care. This camera produces images that can be downloaded to a PC and sent to a provider/consultant over a network.

Document Camera:

A camera that can display written or typed information (e.g., lab results), photographs, graphics (e.g., EKG strips) and in some cases X-Rays. Figure (11-b).

Figure.11 (a) Digital Camera (b) Document Camera (c) Patient Exam Camera [19-21]

Patient Exam Camera (video):

This is the camera typically used to examine the general condition of the patient. Types of cameras include those that may be embedded with set-top videoconferencing units, handheld video cameras, gooseneck cameras, camcorders, etc. The camera may be analog or digital depending upon the connection to the videoconferencing unit. Figure (11-c).

X. CONCLUSION

The Proposed Implementation of Remote Healthcare Monitoring center for Telemedicine system through www.AinMedical.com web-Portal is achieved and running. The equipped system with new technology is used to provide wide range of services in Telemedical center which facilitates the provision of medical aids from a distance. It is an effective solution for providing specialty healthcare in the form of improved access and reduced cost to the rural patients and the reduced professional isolation of the rural doctors. Telemedical centers can enable ordinary doctors to perform extra-ordinary tasks. While some forms of telemedicine, such as store and forward applications for imaging reads, are commonly in use, other uses of the technology are still in developing. Among rural hospitals, about one-fourth participated in tele-cardiology and video teleconferencing for consultations and about 10 percent used tele-emergency services. Steady growth is occurring with e-ICU hubs and their use is increasing in small critical care hospitals.

FUTURE WORK

Other telemedicine technologies hold promise for the future, although their full realization may be some way off , These include:

• **Telehealth services**. This approach to telemedicine uses cloud computing — servers hosted on the Internet — to allow providers to connect with systems from different

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organizations and share health data generated from patients remotely. It can, for example, link remote health monitoring, electronic health records and services such as 24-hour call centers. This approach removes the burden of having to invest in telemedicine infrastructure and distributes costs among multiple parties.

• **Robotics**. Telemedicine robots allow doctors to travel virtually to a patient's bedside. Robots are also beginning to be used in remote surgery, although most robotic surgery is still carried out by on-site surgeons.

• **Clinical kiosks**. These care sites may become a tool to bring medical care directly to patients and help increase access in areas with limited broadband connectivity. When fully realized, clinical kiosks should be capable of taking biometric readings and allowing individuals to upload vital signs with the eventual aim of providing a full diagnostic evaluation and recommendations for treatment without the use of on-site personnel.

REFERENCES

[1] U.S. Department of Health and Human Services and Services Administration Bureau of Health Professionals (2000). The Pharmacist Workforce: A Study of the Supply and Demand for Pharmacists.

[2] Sarasohn-Kahn J (2011). The Connected Patient: Charting the Vital Signs of Remote Health Monitoring, California Health Care Foundation.

[3] American Telemedicine Association (2007). Telehealth and Health Care Provider Shortages. American telemedicine Association Position Statement.

[4] Edwards J, et al (2009). Hype Cycle for Telemedicine, Gartner Industry Research. Publication G00169011.

[5] Bergmo TS (2010). Economic Evaluation in Telemedicine – Still Room for Improvement, *J Telemed*Telecare 16.5 (2010): 229-31. DOI: 10.1258/jtt.2010.009008.

[6] American Telemedicine Association (2007). Telehealth and Health Care Provider Shortages. American telemedicine Association Position Statement.

[7] Young LB, et al (2011). Impact of Telemedicine Intensive Care Unit Coverage on Patient Outcomes: A Systematic Review and Meta-analysis, Arch Intern Med 171.6: 498-506. oi:10.1001/archinternmed.2011.61.

[8] Agency for Health Research and Quality (2006). Telemedicine for the Medicare Population: Update. AHRQ Publication No. 06-E007.

[9] U.S. Veterans Administration (2010). U.S. Veterans Administration Brochure Series, Rural Health, 2010.

[10] Berenson RA, Grossman JM and November EA (2009). Does Telemonitoring of Patients – the eICU – Improve Intensive Care? Health Affairs, 28.5: w937 – w947. DOI: 10.1377/hlthaff.28.5.w937.

[11] McConnochie KM, et al (2009). Acute Illness Care Patterns Change with Use of Telemedicine, Pediatrics 123.6: e989 – e995. DOI: 10.1542/peds.2008-2698).

[12] http://www.news-medical.net/health/What-is-Telecardiology.aspx

[13] http://jrs.sagepub.com/content/103/11/442/F1.expansion.html

[14] http://www.news-medical.net/health/What-is-Teleradiology.aspx

[15] http://kiosbukugema.blogspot.com/2011/06/gps-found-its-way-into-telemedicine.html

[16] http://www.amdtelemedicine.com/telemedicine-equipment/clinical configurations/ TelemedEDforSchool-BasedTelemedicine.html

[17] http://people.ece.cornell.edu/land/courses/ece4760/FinalProjects/s2012/myw9_gdd9/myw9_gdd9/

[18] http://online.liebertpub.com/doi/abs/10.1089%2F107830200311860

[19] http://www.flagstaffmedicalcenter.com/OurServices/Telemedicine/Telemedicine101/tmedterms

[20] http://www.maximed.pro/en/

[21] http://www.amdtelemedicine.com/telemedicine-equipment/clinical-configurations/amd-3000-dispatch-case.html

[22] Chen P (2010). Are Doctors Ready for Virtual Visits? New York Times, January 7, 2010.

[23] Edwards J, et al (2009). Hype Cycle for Telemedicine, Gartner Industry Research. Publication G00169011.

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