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Table of Contents

Synthesis3

Development Problem5

Project Process6

Principal Findings7

Fulfilment of Objectives8

 Achievements with respect to the objectives:8

 OpenEMR Record System:8

 Mobile Services using SMS/MMS9

 Collaboration between APPNA, NUST-SEECS and UM-Healthcare Trust10

 Free Medical Camps10

 Capacity building of Medical Doctor/Staff10

 Capacity Building for LHWs10

Project Design and Implementation13

 Project Design:13

 Technologies Implemented:13

 Electronic Health Record System (OpenEMR) (Module 1)13

 SMS/MMS Module (Module 2)13

 Sharing the patient medical records with APPNA doctors for expert advice (Module 3)14

 Health Grid Module (Module 4)14

Project outputs and dissemination16

 Outputs Achieved16

 Software16

 Collaboration and Capacity Building16

 Research Results and Analysis16

 Technical Writing/Expected Publications16

 Dissemination of Project Information17

 Project website17

 Blogs17

 Samaa TV Coverage18

 APPNA video Coverage18

Project Management18

Project Sustainability19

Impact19

Overall Assessment20

Recommendations20



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Synthesis

This final technical report provides the summary on the progress of project, “**Capacity Building of Lady Health Worker via ICT based Tele-Healthcare in rural Mardan, North-West Frontier Province (NWFP), Pakistan**”. This project is being funded by two major bodies, namely ISIF Asia and Pak-USAID. This report is submitted to ISIF Asia for evaluation of the progress made during year 2010.

Despite the steady improvement in the Pakistani health sector over the years, the condition of healthcare in Pakistan is not yet satisfactory. One of the reasons for this lag is the fact that the health sector in Pakistan suffers from inadequate funds that fail to even fulfill the basic needs of the public. This situation is due to the rapid population growth and the limited financial resources allocated to the health sector. The conditions are worse in rural areas where people have difficulty accessing the most basic health facilities. This is mainly due to a shortage of doctors and a lack of resources. The number of doctors registered in Pakistan at present is about 122,248. It is estimated that about 25,000 of these doctors are working abroad, thus leaving 85,000 for a population of about 160 million; this leaves a very low ratio of one doctor for every 2000 patients. The doctor to patient ratio recommended for developing countries like Pakistan by the World Health Organization (WHO) is 1 doctor for 1,000 people. At this ratio the requirement of doctors in Pakistan is nearly double the available doctors currently available. Furthermore, Pakistan has one of the highest infant (86.8/1000) and maternal mortality (170.8/1000) rates in the world, which is further exacerbated in rural areas (76/1000 infant and 201/1000 maternal mortality rates).

The WHO estimates that 70% of Pakistanis never get to see a doctor in their entire life and instead rely on Lady Health Workers (LHW) for their medical needs. These LHWs are government-trained healthcare workers who operate out of their homes in rural areas of Pakistan providing primary and maternal care. There are over 100,000 such healthcare workers in Pakistan, each responsible for a community of about 1,000 in their neighborhood. These LHWs are expected to treat all sorts of diseases and illness, which are far beyond their training. At times, they need an opinion of a specialist for better diagnoses. Unfortunately for most of the developing world, including Pakistan, these specialists are simply out of reach. Once trained, LHWs are sent to communities to work; they usually operate in complete isolation with little or no support from any medical community or a doctor. This makes their task of providing community healthcare cumbersome.

Our project aims to utilize a mobile platform to extend tele-healthcare services in rural Mardan. This will include voice, Short Text Messaging (SMS), Multimedia Messaging (MMS), GPRS/Edge, and VSAT to quickly and efficiently extend the reach of medical advice to LHWs in the field by connecting them to our network of specialists. This will enable LHWs to provide better quality healthcare to the communities they serve. This technology will also enable LHWs to download short audio and video files to keep them abreast with latest developments in the medical field. These multimedia files will act as quick training sessions for LHWs in the field as well.

This project has two major funding bodies: ISIF and United States Agency for International Development Higher Education Commission (USAID/HEC). It is currently being implemented in Zahidabad, a village of Mardan, North-West Frontier Province (NWFP) Pakistan. Our goal is to train 50 LHWs in the Mardan District this year. The project has been successfully deployed in Mardan and we intend to replicate this model in other areas of Pakistan.

We have treated more than 60,000 patients including Internally Displaced Persons (IDPs) at our facility. During the IDP crisis in Pakistan our facility and Tele-healthcare initiative played a vital role in saving thousands of lives. It is important to note that our facility is very close to the border area of Swat and Buner where the Army operation against the Taliban was carried out in 2009. During this exercise, we



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learned about new diseases and epidemics plaguing the area and had an opportunity to strengthen the collaboration with our US partners by working closely with them to diagnose and treat patients.

During 2010, 61% of the population that was treated using our system was female which is remarkable for rural areas of a developing country. This is particularly important to note, because due to Pakistani cultural reasons, women have lower accessibility to healthcare and are hesitant to visit medical facilities operated by men. We were able to hire a female doctor who acted as a catalyst in increasing access to healthcare for women. Our team has successfully developed and deployed our Tele-healthcare solution at a centralized facility in rural Mardan. This facility enables a much larger coverage area, and enables rural health workers to treat more people with higher success rates. Medical record sharing with US doctors has also been successfully carried out, and Pakistan's First Health Map module along with the extended functionalities has also been developed. The health map, which will be referred as the Health Grid Module in this document, is a unique aspect of this project. This represents the first instance of a system for sharing important medical data among different stakeholders in Pakistan; the Health Grid Module depicts the incidence of various diseases on a geographical map.

Jaroka Telehealth has made remarkable achievements in terms of capacity building for LHWs and fellowships and awards won. Dr. Mian Qasim Nasr-ud-din (our project team medical doctor), Mr. Atif Mumtaz, and Ms. Shamila Keyani presented the project on the established platform of the Association of Pakistani Physicians of North America (APPNA) in the USA. As a result, Dr Qasim was offered training with renowned physicians in Boston and Houston. In 2009, Ms. Hina Mushtaq won the ITU Cyber-security and ICT Application Essay Competition Internship Program, and we also won the DHL Yes Award for that year. Atlas Corps - Fellowship for Social Entrepreneurs was awarded to Ms. Keyani in 2010, as well as a scholarship to attend the Women Deliver conference 2010 (USA). We have won awards from Paragon Asia 100, namely Asia's Most Inspiring Social Change Makers 2009, and we are proud recipients of the mHealth award from the mBillionth Award South Asia 2010. Mr. Atif Mumtaz has been invited to share the project and its findings at various conferences in India and United Kingdom.

We have been contacted by medical teams in Haiti and Mera Bhagwal (village in Pakistan) to assist them in replicating this project in their areas. We have also been contacted by local industry members as part of their corporate social responsibility initiatives to replicate this system in Karachi's urban slums. We believe that replication of Jaroka at different sites will lead to more affordable and effective healthcare in different regions across the country. We are also partnering with the leading public and private hospitals to provide sustainable and affordable healthcare to the under-privileged in the rural areas and urban slums of Pakistan.

We are behind schedule as per the timeline submitted at the beginning of the project to ISIF, as a result of the IDP crisis. During this time, our foremost priority was to assist with the emergency situation. We have successfully treated 17,000 IDPs in three months with the help of our partners in the US. Through this we have had a chance to improve upon our Tele-healthcare solution and learn and share about new diseases, which were not prevalent before the crisis.

All activities carried out during the entire course of the project are described in detail in the following sections of the report.



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Development Problem

Providing affordable and accessible healthcare to the rural population of Pakistan is a big challenge. Pakistan is experiencing an acute shortage of qualified healthcare specialists and adequate health facilities in rural areas. It is estimated that 66% of the population of Pakistan resides in rural or remote areas where there is hardly any access to basic health care services. Due to the geographical isolation and the distances between Basic Health Units (BHUs) and local hospitals, patients only receive treatment from hospitals when their medical condition becomes acute or severe. It is estimated that 80% of all deaths and 90% of all illnesses in Pakistan result from preventable diseases.

Mostly the specialists and qualified doctors confine themselves to urban areas leaving the rural population to be totally dependent on LHWs for medical care. LHWs are comprised of local rural women, who are provided with basic health care training by the government in collaboration with NGO sector. Each LHW, on average, serves a community of 1,000 citizens. There are around 100,000 LHWs currently employed by the Ministry of Health in Pakistan, thus creating one of the largest medical workforce anywhere in the world.

We believe that the percentage of diseases and deaths can easily be decreased through early diagnosis, awareness, and affordable regular treatment for under-served communities through proper utilization of ICT technologies made available to LHWs.

Our goal was to devise newer and more effective ways to bring about a rapid change in healthcare services for rural communities. The mission of this project is to lower the cost of delivering healthcare dramatically by employing ICT to deliver the scarcest resource, medical expertise, remotely. Jaroka will provide an Internet-based and mobile ready tele-medicine network that will connect clinicians and LHWs in Mardan with specialists in major cities of Pakistan and APPNA, USA. We also aim to replicate our system in other rural and urban areas of Pakistan in order to improve overall healthcare conditions in Pakistan.



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Project Process

Our team worked hard to ensure that the activities of this project run smoothly and in coordination with the timeline. Our project is divided in five main modules:

- 1) Open source Software for e-patient data and records (Customized OpenEMR system)
- 2) SMS and MMS Services Module
- 3) Sharing patient medical records with APPNA doctors for expert advice
- 4) Capacity Building of LHWs
- 5) Pakistan Health Grid/Map (Added Module:- Vital feature for greater health impact)

For each of the modules our team completes the following process cycle to fulfil its objectives:

- 1) Requirement analysis (User perceptiveness)
- 2) Evaluation of the tasks/modules
- 3) Assignment of tasks/modules to team members
- 4) Coordination among team members (Discuss flow of information and modules)
- 5) Regular meetings held on every Tuesday - Meeting minutes of each meeting is saved and shared among all the team members and USA collaborators.
- 6) Bi-weekly meetings with US doctors
- 7) Sharing of progress updates via "Jaroka: Intranet", which is assisting with project management
- 8) Update and submission of the assigned tasks every Tuesday
- 9) Testing of the software/module at NUST, APPNA USA, and UM Healthcare Trust Facility
- 10) Regular update of the work done via Social Media Infrastructure
- 11) Provide training workshops to the team members and staff as per requirements
- 12) Installation of software at facility
- 13) Feedback from the users and improving the system accordingly
- 14) Monitoring of the deployed software
- 15) Evolving the module

This project cycle is helping us conduct our tasks efficiently. All of our modules are dynamic e.g. our doctors at UM Healthcare have suggested we introduce new SMS services and some modification to software and previous SMS services. Initially our SMS system for patient registration contained a format-specific National Identification Number (NIC) field, but while treating IDPs we realized that most of them didn't have their NIC numbers. This led us to change the format of our service. Similarly, while treating the IDPs, we learned about different previously unknown medical problems, and some new SMS/MMS services had to be incorporated into our system such as disease information acquisition. Our Health Map is a module that has been continuously evolving according to the feedback from our doctors in Mardan who use it to analyze disease rates among patients.



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Currently we have shifted the time frame of some of the activities as per the requirement of the project. The training of LHWs strongly depends on the mobile services and this task was given priority. Now our vital mobile services are ready for the first LHWs training session.

Principal Findings

Following are the main project findings of our team during project execution:

- Tele-healthcare is a practical and affordable solution for developing countries such as Pakistan. It is also easy to replicate with respect to the information technology infrastructure, making it is the best solution for effective health care.
- Local rural communities have been very cooperative. Once they are sure that the project being carried out in their area is credible and beneficial, they usually own it. We have found it beneficial to involve local community members and provide them with respectable voluntary work. The staff working in UM Healthcare Trust is very pleased that local community is extremely cooperative with them in every way. Whenever the Free Medical Sessions are arranged, everyone in the community seems to want to offer their time, efforts, and volunteer services.
- Before we started the project, we believed it would be a huge challenge for us to motivate women in the rural area of Mardan to visit hospitals, but we were proved wrong. We found that women want better healthcare, provided it is affordable and within reach. To date, we have treated about 50% of females in Mardan.
- The main causes for high maternal and infant mortality rate are contaminated water, anemia, and lack of contraceptive measures for pregnancy. Our team is collaborating with health agencies and other government and NGOs to help us spread awareness on these issues.
- SMS/MMS services aspects of this project are continuously evolving. Through our research, we have learned to make these services generic instead of area-specific. This will enable us to respond to the requests from Haiti, Mera Bhagwal and other areas of the country, with generic SMS services that are easy to use.
- This project has taught us the importance of visualizing information. For the first six months of the project, data (statistics) collection occurred on regular basis. Graphical reports were shared among the team members prior to the implementation of Pakistan's First Health Grid. The Grid has enabled our doctors and medical professionals to easily check the epidemic outbreaks and track diseases. The Health Grid will also assist but various stakeholders in making important decisions regarding national health care.
- Our project team nurses (who are certified LHWs) have had the opportunity to test the module at the facility. We believe that implementation of their suggestions gave them confidence to share the common medical problems in the project areas.
- Through the workshops, training, and capacity building sessions, our team has polished their skills and gained a lot of valuable knowledge.
- In addition to providing better and affordable healthcare to rural communities, this project has also provided job opportunities for local community members.

We are behind schedule according to our timeline originally submitted to ISIF, as we had to deal with the emergency IDP situation in Pakistan. IDP treatment played an important role in strengthening our tele-healthcare software, SMS/MMS services, and development of Pakistan Health Grid, but due to this crisis



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we had to rearrange the timing for the LHW training module. For this reason, we requested an extension. The government needed the assistance of all LHWs to treat IDP patients, so they were unavailable for training at the time. Our team took this crisis as an opportunity to treat homeless people by establishing free medical camps in Swat and Buner. We aimed to conduct training in July, but we had to modify our systems after finding architectural flaws in the design of the software modules. The system kept crashing, so we immediately started working on solving those issues. The system is now very stable, and we are working on incorporating system redundancy by running parallel servers. This will enhance our ability to run a 24-hour service, which will be scalable to other parts of the country and perhaps other regions as well. We will be replicating this project in Haiti, Shikar, and Karachi during the next two months.

Fulfilment of Objectives

Our project aims to utilize voice, Short Text Messaging (SMS) and Multimedia Messaging (MMS) over mobile phones to quickly and efficiently extend medical advice to LHWs in the field by giving them access to our network of specialists. This will enable LHWs to provide better quality healthcare to the communities they serve. The specific objectives as per ISIF proposal are as follows:

- Provide the most efficient access to immediate, sustainable, and affordable medical care to the needy
- Employ innovative technologies, including web and mobile technologies, in extending healthcare services
- Add value to the Mobile Network infrastructure in Pakistan
- Capacity building for LHWs by connecting them to Health Centers and specialists through the use of ICT Tele-medicine
- Enhance the collaboration of APPNA, NUST-SEECs, and UM Trust in the health care domain
- Participate in government initiatives and other relevant organizations regarding health care, population welfare, vaccination, emergency medical services, extension of health care education, etc.
- Develop an efficient healthcare model that can easily be replicated to various parts of Pakistan

While treating IDPs we realized that a live, geographical representation of disease incidence along with the patient numbers will be highly useful for various stakeholders aiming to provide better healthcare for Pakistanis. So we have added following project objective:

- ➔ Develop and deploy Pakistan's First Health Grid/Map to be integrated into our application to provide highly detailed information about patient demographics for further analysis.

Achievements with respect to the objectives:

OpenEMR Record System:

We have developed a customized tele-healthcare open-source software solution to store patient records. The software has been successfully tested and installed at the facility. Some of the highlighted features of OpenEMR include:

- Patient registration
- Patient appointment



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- Subjective Objective Assessment Plan (SOAP records which are shared with doctors in the US)
- Records attachments (ECG, Digital X-Rays)
- Search facility
- Medical Prescription
- Health Map

On average, the records for 150 patients is stored in the database daily, and regular data analysis is carried out in order to make decisions regarding individual health care. The real data that is being gathered with OpenEMR provides research opportunities for us and other stakeholders involved in our project. This analysis showed us what are the most common diseases in the area, monthly patient statistics of patients, medicines required, disease prevention measures, and how to reduce infant mortality. During the treatment of IDPs we learned the importance of tracking communicable diseases such as hepatitis, tuberculosis, and HIV; we believe that identifying the disease origin can play a crucial role in population treatment.

This software has assisted us in making beneficial healthcare decisions for communities. For example, our records collected using the tele-healthcare system showed that most people in Mardan are suffering from waterborne diseases due to unhygienic conditions. Our local sponsors provided us with water purification tablets, which dramatically helped us to reduce the percentage of waterborne diseases.

We have also shared the medical records of our patients with APPNA doctors in the US using OpenEMR. The diagnostics helped the doctors at the facility to better understand the cases they were treating. This exercise has been extremely successful and we now share three to five cases per week with APPNA doctors.

Mobile Services using SMS/MMS

We have developed a sustainable tele-healthcare system that utilizes the mobile platform to extend tele-healthcare services in rural Mardan. This includes the Short Messaging Service (SMS) and Multimedia Messaging Service (MMS). The system was developed using the open source technologies Kannel and Mbuni. This is one of the most vital objectives of our project, as we will be providing training to LHWs via mobile platform. As mentioned in our proposal, large populations in Pakistan use mobiles and provide services through mobile networks, making this one of the best ways to reach the public to achieve the spread of health awareness.

The following SMS-based mobile services have been implemented:

1. New patient registration
2. Child vaccination alerts
3. Acquisition of the Subjective Objective Assessment Plan (SOAP)
4. Provision of disease definitions, symptoms, and treatments available via SMS to doctors or LHWs

We have tested all of these services at the facility and they are continuously being improved using the feedback from our team. The improvement of these services largely depends on the feedback that is provided by our doctors and staff working in Mardan. The service through which we provide the disease definition and symptoms is unique. We have received assistance from the National Health Service (NHS), UK who have authorized us to use their data for providing disease information to medical practitioners working in the field through SMS. This is \$50,000 per year service provided to us at no cost, making this one of our major achievements as part of this project, and further adds to the credibility of our work.



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We are working on replicating the services at “Love a Child” (Haiti) and other areas of Pakistan in the coming months.

Collaboration between APPNA, NUST-SEECs and UM-Healthcare Trust

In order to foster collaboration and exchange knowledge about health issues and tele-healthcare, Ms Shamila Keyani, Mr Atif Mumtaz, and Dr. Qasim attended the 32nd APPNA Annual meeting. The five-day APPNA meeting was held in San Francisco from 1-5 July 2009. Our team had the opportunity to present our tele-healthcare project and explain the uniqueness and innovation of our work in the Pakistani healthcare domain. APPNA is currently serving as one of our partners and is helping us to provide consultancy services and medical advice. APPNA has assisted us in signing an MoU with the **Houston Shifa Services Foundation (HSSF)**. Volunteer doctors at HSSF will help us in diagnosing complex medical cases.

Free Medical Camps

UM Healthcare Trust in collaboration with APPNA, NUST-SEECs, and other NGOs organized several free medical camps during May and June 2009. Thousands of patients and IDPs visited the facility and were provided with free medicine, treatments, and expert advice. It is important to emphasize that UM Healthcare Trust was the only facility active in supporting IDPs in the area of Rustam.

Capacity building of Medical Doctor/Staff

In order to exchange knowledge and enhance our staff's skills, we hold regular training sessions for the staff and medical doctors. Our team doctor, Dr. Qasim, was sent to the US for two months' training (July-September) in the field of tele-healthcare. Our doctors have been fully trained to use ultrasound machines and other important testing equipment (purchased with the funding from USAID) so that patients can get affordable medical tests at the facility and the images/video files can easily be shared with doctors in US via our tele-healthcare system.

We also conduct regular training for network administrators so to ensure our communications technology infrastructure at the facility is maintained to the best of our ability.

We strongly believe that involving and training local community members is vital to the success of this project. In order to equip local communities with basic knowledge, a Basic Life Support (BLS) training session was organized by UM Trust, NUST-SEECs, APPNA, and Comprehensive Disaster Response Services (CDRS). The participants were from various backgrounds including medical staff, LHWs, students, and professionals. The purpose of the workshop was to spread information on emergency life-saving procedures such as cardiopulmonary resuscitation, bleeding control, shock treatment, stabilization of injuries and wounds, and basic first aid.

Capacity Building for LHWs

Now that our system is fully functional, we will begin to hold capacity building sessions for LHWs. These sessions will require strong coordination from government health agencies, which we are in the process of negotiating. We have developed packages for LHWs that contain training materials and all the tools that are required by LHWs to use our system. Right now we are in process of scheduling the training sessions and purchasing required equipment. We aim to train 50 LHWs in the first session.

At UM Healthcare Trust we have two female nurses who are also certified LHWs. They regularly use our SMS/MMS services to register and treat patients. Their feedback has been extremely helpful in improving the system and designing curricula for LHW sessions.

Awards and Achievements



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Along with all the technological achievements, our project and team members won the following awards and fellowships.

- 2009 ITU Cyber-security and ICT Application Essay Competition Internship Program: Ms. Hina Mushtaq
- DHL Yes Award of Young Social Entrepreneur of 2007, 2nd runner-up in nationwide competition, Pakistan
- Paragon Asia 100 Fellow, Foundation of Youth Social Entrepreneurship (FYSE): Ms. Shamila Keyani
- Atlas Service Corps Fellowship (US): Ms. Shamila Keyani
- Scholarship to Attend Women Deliver 2010 (US): Ms. Shamila Keyani
- mBillionth Award South Asia 2010 in the mHealth category



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Publications and Technical Reports:

The following are publications and technical reports published for the project:

1. *“Affordable and Accessible Tele-healthcare to rural areas of Pakistan through web and mobile based technologies”*, presented at High Capacity Optical Networks and Enabling Technologies (HONET 2009) at Parosh University Egypt. (Paper is submitted for IEEE publication).
2. *“Diseases surveillance in rural Mardan”*, Dr. Asif Sardar and Mr. Atif Mumtaz.
3. *“Tele-Healthcare Model for rural Pakistan”*, Presented at APPNA U.S.A platform by Dr. Qasim Nasar and Mr. Atif Mumtaz.

Health Grid/Map:

Unstructured electronic information sources, such as news reports, are proving to be valuable inputs for public health surveillance. However, staying abreast of current disease outbreaks requires scouring a continually growing number of disparate news sources and alert services, resulting in information overload. Our objective is to address this challenge through the Jaroka Health Map Web application, an automated system for visualizing unstructured data on disease outbreaks. The map will further assist with data mining and vital decision-making regarding health care.

During the past six months, we have been able to add two further extensions to this Health Map. First is the Demographics Map, which categorizes patients in specific villages by disease groups. In addition, we have also developed a Proximity Map, which shows the regions falling within a certain radius of a selected location. This map shows the outreach of our healthcare facility so we can analyze the regional breakdown of our patients.

Upcoming Conferences:

Mr. Atif Mumtaz is likely to attend the following conferences:

- 7th International Conference on E-Governance at IIM-B, 22-24 April 2010
- International Conference on Information and Communication Technologies and Development (ICT4D) at Royal Holloway, University of London, 13-16 December 2010.
- mBillionth Congress and Award Gala at New Delhi, India, 23 July 2010

Ms. Shamila Keyani will be attending the following conferences:

- Women Deliver 2010, Washington DC (US), 5-9 June
- APPNA Conference 2010, Massachusetts, USA



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Project Design and Implementation

Project Design:

Our project consists of five major modules in terms of implementation:

1. Electronic Management of Records
2. Mobile Services (SMS/MMS)
3. Sharing patient medical records with APPNA doctors for expert advice
4. Capacity Building for LHWs
5. Health Grid Module

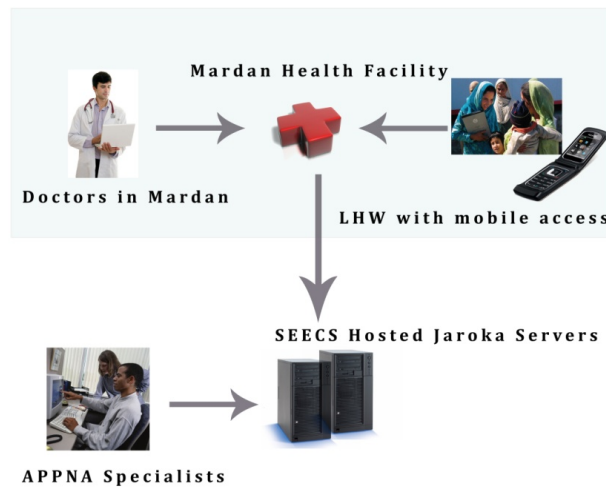


Fig 1: Jaroka Tele-Healthcare Model

Technologies Implemented:

Electronic Health Record System (OpenEMR) (Module 1)

Customized version of OpenEMR, deployed at UM Healthcare Trust Mardan.

SMS/MMS Module (Module 2)

Kannel is used as an SMS gateway for implementing SMS services used in the Jaroka Tele-healthcare project. It is installed on our Jaroka server, and a GSM modem is connected to the server. The GSM modem receives SMS messages from LHWs requesting different SMS services and passes the SMS requests to Kannel, which triggers our web-based application. The application then processes the requests and forwards the requested information to the LHW. For example, when a LHW registers a patient using our SMS-based registration service, it sends an SMS with a particular format to the GSM modem. The GSM modem receives the SMS, passes it onto Kannel and in turn to the web-based application. The web-based application parses the SMS, retrieves the patient details from the SMS and



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stores the patient record to our database. The application then sends a reply via SMS, which contains the patient ID assigned to the patient by the Jaroka system, to the LHW. The LHW keeps track of the patient using the replied patient ID from the system.

When the patient is registered, an attending doctor in the hospital facility can view the patient's details using the Jaroka system. The doctor can see the patient and his/her medical problems; a diagnosis and prescriptions or other indications can then be provided. When the doctor has entered the prescription into the Jaroka system, the system automatically sends a notification about the medical prescription and dosage information to the LHW, who registered the patient.

The following SMS-based mobile services have been implemented and are now being tested:

- New patient registration
- Child vaccination alert
- Patient medical problems
- Disease definitions

Mbuni MMS gateway is configured to provide MMS-based services to the Jaroka System. The LHW sends requests to the Jaroka System via SMS to access training and other healthcare-related videos, as well as images of patients and other diagnostic materials including X-rays, ECGs etc. This service assists the LHWs and doctors, clinicians, and specialists to retrieve the patient's uploaded videos and other diagnostic images.

The Mbuni MMS gateway is configured in such a way that it retrieves SMS requests and sends the MMS notification messages via Kannel. The mobile phone then retrieves the MMS content from the Mbuni server machine through GPRS/EDGE technology. In order to retrieve MMS messages using Mbuni MMS gateway, we have to configure the mobile phone to retrieve MMS messages from the Mbuni server. In order to do this, we customize MMS message settings in MMS-enabled mobile phones.

The LHW or doctor sends an SMS to the Jaroka System that he/she requesting an image of a patient with a particular patient ID. The Jaroka System locates any existing images, which are then passed through the Mbuni MMS gateway for MMS conversion. Mbuni then creates a notification message and sends it to the mobile phone of the LHW or the doctor. Kannel gets the notification from Mbuni and sends the SMS notification via GSM modem. The LHW or doctor receives the notification and then the mobile phone contacts the Mbuni server to retrieve the MMS message. The following MMS services have been successfully implemented:

1. Patient Image transmission from the Jaroka System to a mobile phone upon request
2. Video transmission using MMS from Jaroka System to the mobile phone upon request

Sharing the patient medical records with APPNA doctors for expert advice (Module 3)

Medical records of complex cases that require a second opinion are successfully being shared with doctors in US. Sample records can be found in the Annex. The objective is to share at least three records per week with APPNA doctors. We have recently integrated the volunteer form on Jaroka's website so that the maximum number of doctors can be registered in the system.

Health Grid Module (Module 4)

Under this project we have developed Pakistan's first Health Grid. Visual health information representation is one of the key components for an effective health management system. Health managers and planners



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need descriptive information to conducting programs and to predict outbreaks of a particular disease in a specific area. It is also important to keep this visual information updated so that we have the latest statistics available. This system aids effective and prompt decision-making.

There are many ways to visually represent data, and these methods have evolved from tabulated data representation to graphical representation. Google has provided another state-of-the art form of visual data mapping with Google Maps. We have customized Google Maps to plot patients onto a map according to their particular locations. Our data set consists of live data coming from our tele-healthcare system. We began by mapping patients according to their locations, and this system has since been improved from that initial stage. The following figure represents our map modules that we have developed:

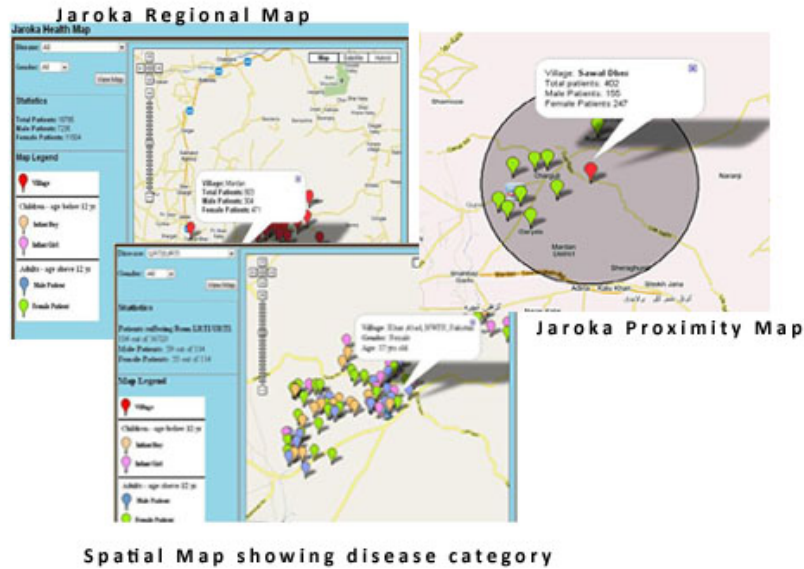


Fig 2: Jaroka Health Grid Modules



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Project outputs and dissemination

Outputs Achieved

The following project outputs have been achieved so far:

Software

- Customized OpenEMR software
- Implementation of the mobile services (SMS/MMS) via mobile platform
- Record sharing with APPNA doctors using store and forward method along with OpenEMR
- Health Grid Module

Collaboration and Capacity Building

- Collaboration between various stake holders e.g. APPNA, UM Healthcare Trust, NUST etc
- Regular trainings/Capacity building sessions for staff and team
- Employment of six to ten Research Assistants under the ISIF Asia project at different times and three RAs have been hired under the USAID project. They are given opportunities to attend seminars and workshops relevant to their areas of research and other faculties.

Research Results and Analysis

This year more than 60,000 patients with different diseases were treated under this project, out of whom 61% were female patients. The increase in the number of female patients is an indication of the success of Jaroka.

We learned that most common diseases prevailing in rural areas are due to the contaminated water supplies. We, along with other NGOs, are working on water quality solutions such as filter plants, water purification tablets, and awareness videos to improve water quality in rural areas. Women in these areas are suffering from anemia, which presents a high risk of miscarriage and developmental diseases such as cerebral palsy.

A lot of data has been acquired through the Jaroka system. We are further analyzing this data to find patterns of disease spreading throughout the country. A recent analysis by Dr. Hammad and Dr. Amina found that a major cause of infant mortality, low birth weight, has a strong correlation (95%) with improper weight gain during pregnancy. A system is being developed to monitor the health of pregnant women in order to facilitate the early identification of at-risk pregnancies early.

The emergency treatment of 17,000 IDPs introduced us to new diseases, which are regularly shared with APPNA doctors to obtain a second opinion.

Delay in Training Module

The LHW training module needs an extension, and has been shifted to the July. Due to the IDP crisis, our team and the government of Pakistan was busy in providing the assistance and support in healthcare services. We are in the process of developing the manuals and training kits for LHW training.

Technical Writing/Expected Publications

The following are technical reports based on project activities:



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1. "Diseases surveillance pattern in rural Mardan", Dr. Qasim and Mr. Atif Mumtaz.
2. "Affordable and Accessible healthcare to rural Mardan, Pakistan through web and mobile based technologies ", Saba Batool, Dr. Amir Shafi, Shamila Keyani, Atif Mumtaz.
3. "Mobiles for Development: Enabling Low-Cost e-Applications for Rural and Remote Areas (e-Health)" Essay written in 2009 ITU Cyber security and ICT Applications Essay Competition by Hina Mushtaq.

Presentation for US Ambassador

We recently presented this project to the US Ambassador who came to Pakistan in June 2010 and we received very encouraging feedback from the delegation. Dr. Arshad Ali, Mr. Atif Mumtaz, and Dr. Hammad Qureshi presented the project to the delegates while Dr. Qasim, Dr. Amina, and Dr. Haider showed how medical doctors benefit from the system. Ms. Qurat, Waleed Zubair, and Saifur Rehman highlighted the various features of the system and the technical design.

Dissemination of Project Information

Our project information uses following media for the dissemination of information about the project:

Project website

The project website (<http://tele-healthcare.org>) contains all the relevant information about the project, including records and reports available for download.

Blogs

The project has been covered in numerous blogs and news magazines including:

- Tele-healthcare Blog (<http://blogs.tele-healthcare.org>)

The purpose of this blog is to inform our project activities to the people and increase awareness surrounding tele-health Care. This blog is also is also a journal of the project from its initial phase to the present.

- Green & White Blog (<http://www.greenwhite.org>)

This blog is dedicated to Information and Communication Technologies projects. Since our project depends on IT for its execution, we have had articles published here.

- Social Bridges (<http://www.socialbridges.org>)

Third party blog, which covers social projects implemented in Pakistan.

- NUST blog (<http://niitsec.blogspot.com>)

NUST has established its social entrepreneurship club and this blog refers to the activities of the club as well as other social projects. Jaroka is often mentioned in this blog.

- UM Trust (<http://umtrust.org>)

This project is in progress at the UM Healthcare Medical Facility at the Village Zahidabad, in rural Mardan District of NWFP Province of Pakistan. This website features updates on all related activities.



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Samaa TV Coverage

Samaa TV covered our healthcare project in their program named, "Innovation". The video is a short highlight of the documentary that was made during their visit to NUST and the UM Healthcare facility in Mardan. This is the video link:

<http://blogs.tele-healthcare.org/2009/03/samaa-tv-talks-about-our-tele.html>

APPNA video Coverage

During the APPNA conference, Dr. Qasim discusse our project and its outcomes:

<http://www.youtube.com/watch?v=qsWfmH-gVcl>

Other Social Media Tools

We are actively disseminating information via our Facebook group and Twitter. We have also run successful donation campaigns via Twitter.

Project Management

To achieve self-actualization in our work, we have to satisfy the basic level needs first. Basic level needs include leadership, teamwork, motivation, communication, and negotiation. Our project team members and partners, and skilled leaders are our most valuable assets. Our leaders help us to work smarter rather than harder to get efficient outputs from the system.

In order to maximize the human resources potential within our project team, we have regular meetings with the project manager and stakeholders where tasks are assigned via intranet. We have regular tele-conferences with APPNA on alternating weeks to discuss important issues and deliver monthly reports. Tasks given to various team members are practical and are discussed among the entire team before finalizing. For example: For each mobile service we first had meeting to discuss the flow of information. This was done with flow charts, and we analyzed the charts and asked for suggestions. This brought another element of innovation to handle tasks efficiently. The minutes of each meeting are carefully noted and acted upon, which also informs our decision-making as a team.

For the recruitment of Research Assistants, Doctors, and Nurses we adhere to a defined selection criteria produced by a selection committee. The job advertisement is first published in newspapers and job portals, and disseminated by groups on the Internet. The selection committee includes a Project Investigator, Project Co-Director, and Project Coordinator who select the candidates, as per their requirements. The Selection Committee ensures that the candidates have recognized degreeS in their respective fields. The Selection Committee's candidates are then subject to approval by the NUST Headquarters. Following are the requirements that must be satisfied before induction:

Requirements for Medical Doctor:

- Must have an MBBS, and must be registered with PMDC
- Should have at least 2 years experience after house job , preferably in gynecology or primary care
- Must be fluent in Pushto (The local language spoken at village)
- Willing to work in Village Zahidabad, Mardan District



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Requirements for Female Nurse:

- Registered with Pakistan Nursing council (PNC)
- Preferably two years experience in pediatrics and gynecology
- Must be fluent in Pushto
- Computer knowledge is preferable
- Willing to participate in rural Community Health related programs

Requirements for Research Assistant:

- Bachelor's level education from an accredited college/university
- Capable of meeting the strict deadlines of the project
- Basic research skills and willingness to learn
- Sound knowledge of programming languages, preferably PHP and MySQL

Similarly for the purchase of equipment, training sessions, visits for conference a strict procedure of getting approval from SEECs Director General, Accounts department and NUST HQ is carried out.

Project Sustainability

Two major funding bodies namely, ISIF ASIA and USAID, are currently sponsoring the project. To make our project sustainable we charge a minimal fee (Pak Rupee 30=0.40 cents) from our patients who can afford to pay. This amount helps to cover the project's operational costs.

With the strong credibility and innovation that UM Healthcare Trust brings to this project, we are attracting more patients to hospital. We have started administering medical tests, including ultrasounds at our facility.

As a measure for attaining a sustainable level of efficiency, we have partnered with the Telenor for an SMSC agreement. This will enable our SMS/MMS services to achieve independent and flexible software and hardware architectures for message transmission. This will also make our future enhancements easier to integrate, as the interfaces will be provided. Furthermore, a local corporate by the name of Lakhani group has recently offered to partner with us in implementing the system for Karachi's urban slums, bearing the entire cost of that project.

Impact

The following points explain the impact of the project to date and for the future:

- Affordable and accessible healthcare to under-served (surviving on less than \$1 a day earning) sections of the community. It is worth mentioning that Mardan has a higher maternal and infant mortality rate than the national average.
- Innovative solution for the resource-deprived rural areas of Pakistan where extreme shortages of healthcare and medical professionals



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- For the first time, rural Pakistan has a direct link to US doctors
- Disease tracking with the help of regular data and statistics collection
- Collaboration with APPNA, UM Trust, NUST, and many other non-profit organizations
- Value added to existing mobile technology infrastructure
- Employment opportunities generated
- Volunteering opportunities generated under this project (e.g. medical camps and IDPs assistance)
- The Health Grid enables healthcare professionals and other stakeholders to visualize demographic information with respect to gender, area, age etc. This module, which can trace the origins of chronic disease, is a revolution in Pakistani healthcare.
- Empowerment of women. Through this project we are reaching out and educating women who have seen doctors and medical facilities for first time in their lives.
- Awareness for women regarding hygienic and contraceptive issues
- Involvement and cooperation of local community
- Opportunities generated for team members of the project (e.g. doctor training from US , conferences and workshops attended, fellowships and essay competitions won by team members)
- Training sessions for LHWs provides them with opportunities to grow in an effective learning environment and increase the total number of system operators
- New algorithms and techniques are being devised for disease tracking and early alarms

Overall Assessment

Overall the project played a significant role in providing better healthcare to Pakistan's rural communities. The whole team, along with local community members and other partners are dedicated to making this project a success. Due to the services and support of this project, we successfully helped our country during the difficult time of SWAT operation. Millions of IDPs moved to Mardan to seek asylum and the unhygienic conditions, weather, and interaction caused disease to spread faster than usual. Our facility was active in providing healthcare and registering each patient to the database. Our doctors worked day and night treating more than 250-300 patients daily. Although this event also presented us with our biggest challenge, as we had to rearrange our LWH, training schedule, the opportunity to treat patients and gather volunteers was very valuable. The data we collected will enable us to make more informed decisions about future implementations of this project in other areas. The data has also helped us in developing the plan and curriculum for LHW training, which will be held during this year.

Recommendations

We are highly grateful to ISIF for its one-time funding and support.



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