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RUPRECHT KARLS UNIVERSITÄT HEIDELBERG
Department of Tropical Hygiene and Public health
Master of Science in International Health

Using PDA Phone for Reporting Notifiable Diseases in Yazd, Iran to Improve the Reliability and Timeliness of Aggregated Data

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September 2006

DECLARATION

This thesis is the result of independent investigation. Where my work is indebted to the work of others, I have made acknowledgement.

I declare that this study has not already been accepted for any other degree nor is it currently being submitted in candidature for any other degree.

Farhad Fatehi, MD.
Heidelberg, 12 September 2006

Dedication

I would like to dedicate this work to my 3-year old son, Farzad, who has been apart for one year and is calling me back:

“Come back home! I promise not to make noise anymore; so you can study here.”

Acknowledgment

This work would not have been possible without the support of many people.

I would like to express my deep appreciation to Mrs. Darcey Terris, who taught me a lot, read the drafts of this thesis and helped me the most with her amazing comments and revisions.

I was so lucky to meet Professor Thomas Wetter at the Department of Medical Informatics and receive his constructive comments and discussions, which are highly appreciated.

I would like to express my sincere gratitude to my senior supervisor, Professor Rainer Sauerborn, for providing me with the opportunity to study on the wonderful topic of mobile computing devices and their role in health information systems.

Also, I will wish to acknowledge my appreciation to all my classmates, specially Dr. Ali Alemi, Mrs. Moloud Fakhri, Dr. Hossein Hajiebrahimi, Dr. Habib Jabbari, Dr. Javad Maleki, Mr. Saeed Pourdolati, Dr. Jamal Tahsildar, and Dr. Arash Yallali for their information and discussions.

Special thanks to Mrs. Anke Nitschke-Edert for her sincere help and exemplary support during the one-year course of MSc in International Health.

I should extend my appreciation to Ms. Romy Albrechtall, Ms. Neda Radkhou, Ms. Sandra Dannenberg, Ms. Claudia, Ms. Natascha Petersen, and other staff of the Department of Tropical Hygiene and Public Health, University of Heilderberg for their good job.

And finally, thanks to my wife, parents, and numerous friends in Iran who endured this long process with me, always offering support and love.

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Abbreviations and Acronyms

CDCP	Center for Disease Control and Prevention
DCPO	Disease Control and Prevention Office
DHC	District Health Center
DHN	District Health Network
DSU	Disease Surveillance Unit
HH	Health House
HIS	Health Information System
HNIS	Health Network Information Software
HP	Health Post
MOHME	Ministry of Health and Medical Education
PDA	Personal Digital Assistant
WHO	World Health Organization
YMU	Yazd Medical University

Executive Summary

This is a proposal for improving the reliability and timeliness of notifiable disease reports by using Personal Data Assistant (PDA) in the health system of Yazd province. Yazd is one of 30 provinces in Iran, which regularly report the new cases of notifiable diseases to the Ministry of Health and Medical Education (MOHME). Like many other countries, lack of reliable and timely data leads to inadequate appreciation and use of available information by the Iranian policy makers. This is partly due to the health information system of Iran, which is still mainly paper-based. Many studies have shown effectiveness and efficiency of using handheld computing devices for improving quality and timeliness of the health data. The success of employing mobile technology in some of the least developed countries like Rwanda strongly supports this idea.

The national health authorities in Iran have announced 36 infectious diseases as “Notifiable Diseases”. These are mainly the eradicated diseases like Poliomyelitis, or under-controlled diseases like Cholera. All hospitals, laboratories, physicians and health workers must report any confirmed or suspected case of notifiable diseases to the local health authorities. The District Health Center (DHC) is the first level of reporting for both public and private sector. Each of ten DHCs in the province of Yazd is responsible for immediate telephonic reporting of every suspected case of notifiable diseases to their associates in the provincial level. At the same time, the health professionals should take the specific actions according to national guidelines. The “Disease Control and Prevention Office” (DCPO) in the Province Health Center of Yazd receives the immediate case reports and forwards them to the MOHME if needed. The corresponding health centers record the case in their registries after confirmation of diagnosis.

The current system of reporting notifiable diseases in Iran relies upon hard copy records. The communicable disease officers in each district calculate the cumulative number of cases for each disease manually and send them to the DCPO by ordinary mail. They should send the cumulative reports of these diseases on a weekly basis, even if there is no new case (Zero Report). Upon

receiving the districts data, the CDPO in the Province Health Center aggregates the data and generates the provincial weekly reports using a personal computer. The Province Health Center sends prints of these reports to the MOHME in Tehran by ordinary mail. The Center for Disease Control and Prevention (CDCP) in MOHME is responsible for receiving data from all 30 provinces of Iran and updating the national statistics of the notifiable diseases.

This proposal describes a plan of action to use PDA phones for data collection and report generation in the DHCs and forwarding them to the Province Health Center of Yazd. In this plan, the communication disease officers in each district will register the case reports of notifiable diseases in a PDA phone. The operator will use a user-friendly dynamic form for data entry. The PDA will notify the provincial authorities of the suspected case using Short Message Service (SMS). The software application will store the case as a record in the database after confirming the diagnosis. A secondary message for each case will either confirm or cancel the primary message. At the end of each week, all district PDAs will replicate their database to the province PDA through a cellular phone call. The province PDA phone will receive and store all case reports and relay them to the health authorities in Tehran according to the guidelines. The database management system in the province PDA will also aggregate all replicated data from districts to generate the weekly reports of the province and communicate them to the MOHME each week.

This project will significantly improve the timeliness of the notifiable disease data, which is vitally important in case of outbreaks. Converting the data from conventional to digital format in more peripheral level will improve the reliability of data that is essential for decision-making. In addition to automating the process of reporting notifiable diseases, this project provides an effective way for communicating news, information, and updates between the province and district health centers. The weekly reports of the province will be sent to the DHCs as a rapid feedback enabling them to compare their own health situation to the other districts.

The main strength point of this plan relies on using PDA phones instead of Personal Computers (PC) for automating the health information system. Some of the advantages of PDAs over PCs for this purpose include:

- PDA needs less training time.
- The initial cost of a PDA phone is less than that of a PC.
- PDAs do not need stable power supply.
- PDAs are less likely to crash than PCs.
- The technical support of PDAs is less costly.
- Reloading a fresh copy of Operating System is much faster in a PDA.
- PDA phones offer the features of both mobile phone and PDA in a single device with a good integration.

The Yazd Medical University (YMU) will fund the project that will not exceed € 30’000. The main cost items include hardware, software, and mobile phone contracts that will cost roughly € 8’000, € 5’000, and € 6’000 respectively. The tangible benefits and savings of the project justify its running cost of € 340 per month. The implementation of this project will develop a platform in the health information system of the province that has capability of running further services in the future. The savings of money and time in implementing other services that will share this platform justify the initial investment of this project.

The systematic implementation strategy includes 24 tasks in two main phases: Preparation Phase and Pilot Phase, which will take eight months and six months time, respectively. Four months after running the new system in parallel to the current one, an independent evaluation will be needed. Besides timeliness and reliability of data, the evaluation will assess the acceptability of the system for deciding on switching to the exclusive PDA-based system after the pilot phase. The YMU will notify the MOHME for suggesting the system to the other provinces, and publish the results to propagate the success story.

Background and Significance

Information systems are essential tools for good management in every discipline, including the health sector, especially when the efficacy and efficiency of operations are considered. The United Nations (UN) and the World Health Organization (WHO) have stressed the need to strengthen and integrate health information systems with the national statistical systems of countries in order to better support health policy makers (United Nations 2004). Information can influence the management of organizations when it is used by decision makers in different levels of the managerial hierarchy. Information can be used for situation analysis, priority setting or even implementing projects. This is why not only policy makers and managers, but also health care providers, at different levels of the health system, need to have access to appropriate information when needed.

Unfortunately, despite many efforts and a huge amount of money spent in many countries to develop health information systems, in practice they rarely function systematically (AbouZahr and Boerma 2005) and are unable to provide sound data for decision making. The reasons for such failures can be categorized as resulting from limitations in the following areas:

- Accuracy of data
- Relevancy of data
- Timeliness of data
- Completeness of datasets
- Analysis of data
- Usage of data

The situation is worse in developing countries (Mukama, Kimaro, and Gregory 2005). Many health providers spend many hours filling in endless forms and registries, which are in many cases redundant, and finally these data end up archived in an office in the ministry of health without proper analysis or usage. Considering all these issues, health information systems may seem to be more of an obstacle to health managers than useful tools.

Definitions:

By “System” we mean a set of inter-related elements which work together to achieve a common objective and “Information” is a collection of facts from which conclusions may be drawn. “Information System”, therefore, can be defined as a system of transforming raw data into information useful for a decision maker. Although there is consensus on the definition of these terms, defining “Health Information System” is less obvious. In this thesis, the definition of “Health Information System” of Sauerborn and Lippeveld (Sauerborn and Lippeveld 2000), which describes it as “a set of components and procedures organized with the objective of generating information which will improve health care management decisions at all level of the health system”, is used.

Mobile Phone:

The last 20 years have seen significant changes in the way medical professionals utilize and manage clinical data and health information resources. Recent and rapid advances in Information and Communication Technology (ICT) present every country’s health system with various challenges and opportunities (Chaulagai, Moyo, Koot et al. 2005). Personal computers (PCs) have become more and more common among companies and individuals, while telecommunication technology has enjoyed a similar rapid development, especially in terms of wireless communication and cellular services.

Coverage for mobile phone use is supported by base stations, of which the majority operate under the Global System for Mobile communication (GSM) system. Mobile phone services based on GSM technology were first launched in Finland in 1991. Today, more than 690 mobile networks provide GSM services across 213 countries. In June 2006, the second billionth GSM mobile phone user in the world signed on. New users are currently signing up at the rate of 1,000 per minute. While it took just 12 years for the industry to reach the first billion connections, the second billion was achieved in just two and a half years, boosted by the phenomenal take up of mobile phones in emerging markets such as China, India, Africa and Latin America. Phone users in these

markets accounted for 82% of the second billion subscribers. (GSM Association 2006)

With the achievement of the second billion milestone, GSM has become the first communications technology to have more users in the developing world than the developed world. What this means is that mobile phones are 'bridging the digital divide' at an astonishing rate with relevant, affordable solutions that help families stay in touch, businesses to grow and economies to develop. The GSM Association has launched a number of initiatives to help people in the developing world gain access to mobile communications. As part of its vision to 'Connect the Unconnected', the GSM Association has launched initiatives to produce and deliver low cost mobile phones that would prove attractive to a significant proportion of the world's unconnected people (GSM Association 2006). A new market study from Portio Research predicts that 50% of the world's population will be using a mobile phone by the end of 2009, and Africa now boasts the fastest growth rate in the world, forecasted to add 265 million new mobile subscribers over the next 6 years (Portio Research 2006).

PDA / PDA Phone:

A PDA is a handheld computing device about the size of the palm of the hand. More modern devices can access external networks or the Internet through a wireless connection. A PDA Phone is a combination of a mobile phone and a personal digital assistant in one device.

Since 1993, when Apple launched the first personal digital assistant, or PDA, use of PDAs has increased worldwide. Global PDA sales are projected to surpass 17 million in 2008. This represents a compounded annual growth rate of 17.8% between 2002 and 2008 (eTForecasts 2005).

PDAs in Health Care:

Health care has not been immune to this technological advance in handheld computing. In fact, PDAs have found a wide range of applications in health

care, from radiology information systems in large hospitals (Erberich, Documet, Zhou et al. 2003) and decision support systems (Lee, Starren, and Bakken 2005) to data gathering for epidemiological surveys in many countries including low-income ones (Gething, Noor, Gikandi et al. 2006). Physicians and specialists have been using PDAs for general medical reference, for example to provide information on drug interactions or cardiac risk factors. Other important applications of PDAs are those involving data collection and management, for in-patient tracking, electronic case report forms in clinical trials, patient diaries, and infection surveillance (Garritty and El Emam 2006b). In many countries, PDAs are rapidly becoming an integral part of their health information systems. Deployment of these devices is becoming an important strategy designed to assist in improving the quality of care, enhancing patient services, increasing productivity, lowering costs, improving cash flow, as well as facilitating other critical delivery processes (Lin and Vassar 2004). In the next section, the Iranian health system, health information systems and mobile phone usage is described.

The Iranian Health System:

Before discussing the current strengths and limitations of health information systems in Iran, it is necessary to understand how the health system of Iran is organized. The Islamic Republic of Iran adopted a Primary Health Care (PHC) focus 20 years ago and has a good ranking among the countries of the Eastern Mediterranean region regarding health indices. Here is a brief description of the current structure of health network in Iran:

Structure of the primary health care (PHC) network in Iran

"The PHC network of the Islamic Republic of Iran (Figure 1) is an integrated and stratified health care delivery system. The rural heath centre is a village-based facility staffed by a general practitioner, several health technicians, and administrative personnel, and has 1–5 health houses under its supervision. The "health house" is the most peripheral rural facility in the network, covering an average of 1500 people. Every health house covers one or more villages and is

usually located in a village that is one the route to a larger urban area. At present, there are more than 17000 health houses all over the country covering more than 90% of the rural population.

A male and a female villager known as "Behvarz" staff each health house. Their principal duty is the provision of PHC services for the covered population. Behvarzes are selected from young and interested indigenous people and are trained on an 18-month course in a Behvarz training centre.

Urban health centers are functionally similar to rural health centers and each of them have three to five "health posts", or smaller urban health facilities, under its control. These urban heath posts are responsible for delivering primary health care to urban populations in a way similar to health houses in rural areas. Each health post covers a population of about 12000 individuals.

The district health centre is a managerial level and is responsible for the logistic and administrative affairs of the district health network. The directorate of the district health network is the coordinator of all activities and health programs at district level.

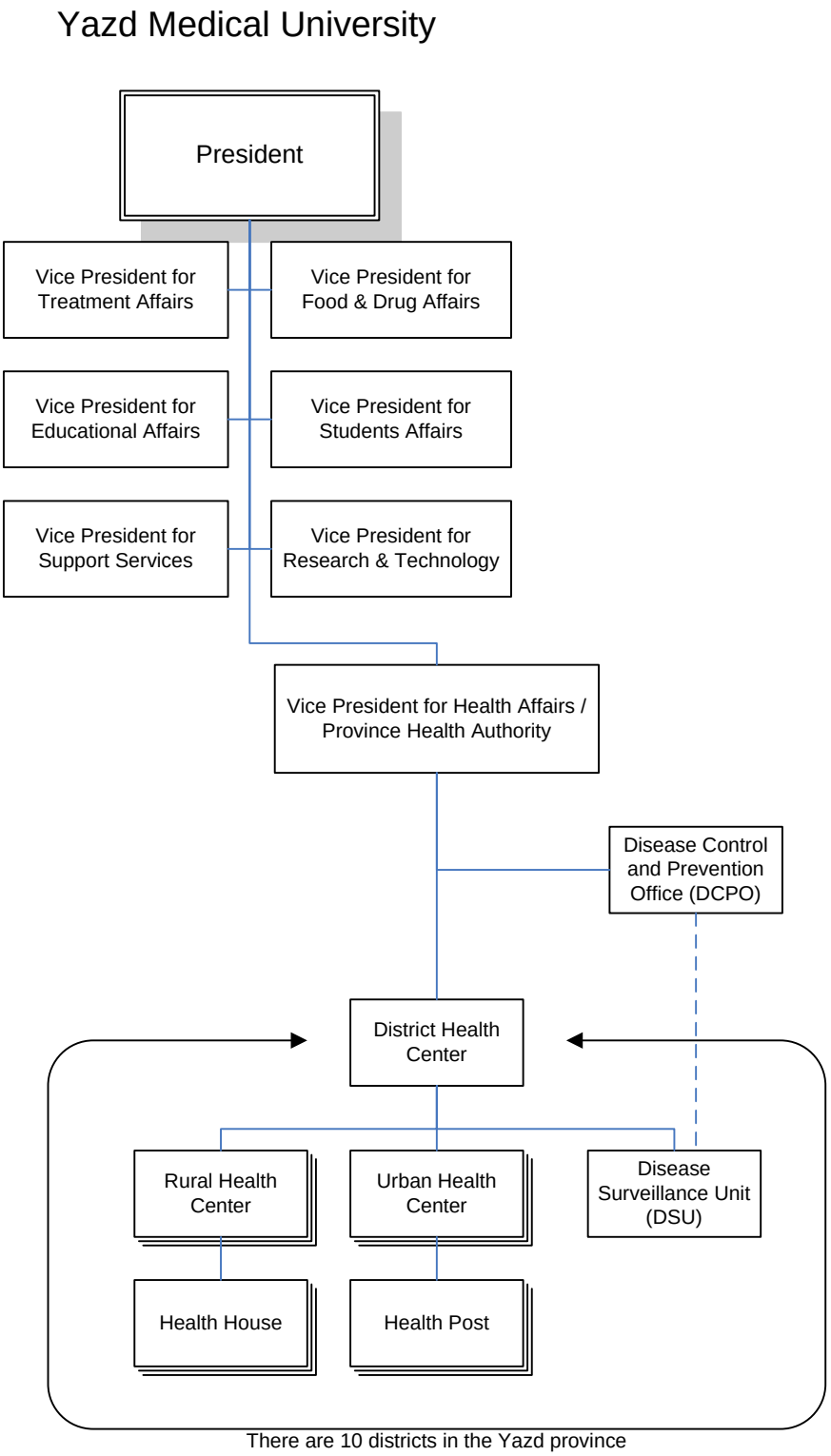

Figure 1: The organogram of Yazd Medical University (summarized)

The PHC Information System

The information system of the health network is mainly based upon data gathered from defined populations covered by the rural and urban health facilities. More than 90% of rural populations are covered by health houses, and in urban areas an increasing percentage of the population is gradually being covered by health posts. In some urban areas, health centers directly cover a defined population and use the same tools and forms as health houses and health posts for data gathering and processing. By conducting annual censuses, these facilities update their information on the population living within their catchment area. In addition to annual censuses, routine data are also gathered using the special tools outlined below.

1. **Household folder** *– a folder belonging to each household contains health-related information such as name, sex, age and literacy status of each member; mother's condition during previous pregnancies; health status of children; history of major diseases; patients requiring long-term care; births and deaths; and sanitary condition of the house.*
2. **Vital horoscope** *– a vital horoscope has been designed to display an up-to-the-hour account of births, deaths, and family-planning activities for a catchment area. It consists of a sheet of paper (50 x 70cm) that is pinned on a wall in the health facility. The chart owes its name to the conspicuous concentrically colored circle at its centre, which resembles the horoscope of ancient astrology.*

   From the centre outwards, the circles represent live births and mortality among infants, children aged 1–5, and those over 5 years of age. Each circle is divided into twelve parts representing the months of the year. Six other tables show the results of the census for that current year, more-detailed information about live births (including birth weight, type of birth attendant, sex, and mother's age at delivery), maternal mortality, classification of all mortalities according to age and sex, under-5 mortalities

by cause, and data on family-planning activities. All data are recorded separately for the main and satellite villages.

3. **Follow-up logbooks** *– in addition to the household folders, health personnel are instructed to record their daily activities in specifically designed logbooks. Each logbook pertains to a specific program or activity (e.g. family planning, dispensed medications, or immunization).*
4. **Monthly report forms** *– all facilities in the district health network are required to gather data on their activities and relay it regularly to the district health centre. To avoid a last-minute rush at the end of each month, all data are tallied daily on large-scale, user-friendly tables pinned on the wall. The only task remaining to be done at the end of the month is a simple addition of the tallies.*
5. **Health Network Information Software (HNIS)** *– expansion of the health network and opening of new facilities is based on a master plan in which the number and locations of facilities comprising the health network are determined for each district. For proper planning and resource allocation, software was developed for gathering and processing data on the expansion of the network in accordance with the master plan. The program also records the human and major non-human resources in each existing facility and the data recorded in vital horoscopes. The district health centre is the most peripheral level of data entry. Floppy diskettes or email are used to transfer data from district to province health centre and from there to the PHC department of the Ministry of Health and Medical Education (MOHME).*

   Periodic surveys are also conducted to gather data on the coverage, household effects, and outcomes of specific health programs." (WHOa 2006)

Information & Communication Technology and Health Care in Iran:

A few years after their first introduction in 1978, personal computers started to be used in many public and private sectors in Iran. Now they are routinely used

for regular official tasks. The Iranian Ministry of Health and Medical Education is no exception; computers and computer networks are widely used in different levels of the Ministry. Almost all of the Provincal Health Centers send their data to the corresponding offices in the MOHME in digital form, using either FTP service, emails or by a point-to-point connection using modem and telephone lines. Unfortunately in most cases, the technology has been used only for data transmission; data aggregation is still done in a separate process by statistical technicians. Recent advanced have been made to allow some departments of the MOHME to automatically aggregate received data and disseminate information or generate desired reports.

The Province of Yazd and its Health Information System:

Yazd province covers an area of 74,214 km^2 and is located in central Iran, bordered by the provinces of Isfahan, Khorasan, Fars and Kerman. According to the 2006 census, Yazd province had a population of approximately 958,318, of which 761,018 are urban dwellers and the remaining 197,300 are rural villagers. The city of Yazd is the economic and administrative capital of the province and therefore the most heavily populated. The province is divided into ten districts, each including at least one town and a number of villages. The districts are: Abarkuh, Ardakan, Bafq, Khatam, Maybod, Mehriz, Tabas, Sadough, Taft and Yazd.

Like in other provinces, the Medical University of Yazd, named Shahid Sadoughi University of Medical Sciences (http://www.ssu.ac.ir) is the focal point of all medical and health affairs throughout the province. Under the Medical University of Yazd are 10 District Health Centers, 51 Urban Health Centers, 41 Rural Health Centers and 212 Health Houses and Health Posts. Currently, the whole process of data gathering in the Health Houses and Health Posts are paper-based and the collected data is transmitted conventionally to the corresponding District Health Center to be aggregated and sent to the Province Health Center. In six out of ten District Health Centers, data aggregation and transmission is done using a personal computer (PC). First, data is entered using forms in spread sheets (usually using Microsoft Excel) and then the files

are transmitted using a utility software called “pcAnywhere” from Symantec Corp. using a regular telephone line and a modem. When the files are received at the provincial level, they are printed out, confirmed by some authorities, and keyed into the computer, including the data which are received on paper from the four District Health Centers which are not computerized (Borghiyan 2006).
The transmission of the aggregated data from the Provincal Health Center to the Ministry of Health and Medical Education (MOHME) depends on the receiving department, some are sent by File Transfer Protocol (FTP) through the Internet, some by fax and some others by surface mail.

There are many problems with the current system of collecting, aggregating and reporting data, including:

- The data are prone to errors when aggregated and transferred from one form to another. Duplication of data is seen frequently.
- It takes a lot of time of the personnel in Rural, Urban and District Health Center to receive, check, aggregate and report the data to the upper level.
- Usually the data are not timely.
- There is almost no feed back for the people who collect the data.
- The flow of information is from the periphery to center, leaving the health professional in the periphery in the dark as to important information that is drawn from the data reported, aggregated and analyzed.

To facilitate an accurate and reliable process of data collection, aggregation and transmission at the levels of District Health Centers and Urban/Rural Health Centers in the province of Yazd, we have proposed using PDAs or PDA Phones as a good substitute for PCs in these centers. This is feasible due to the good telecommunication infrastructure in the province, which has been ranked first in the country for successive years. All of the Yazd health centers are located under a foot print of a national cellular network.

In the plan proposed here, PDAs will be provided so that the data which are currently gathered and reported by Behvarz in Health Houses or Health Posts

will be gathered in a more reliable fashion and reported in a more timely manner to the District Health Center.

Need Assessment and Opportunity Analysis

As briefly described in the previous section, personal data assistants (PDA) or PDA phones can be used to improve the reliability and timeliness of aggregated data in the Iranian health care system. In this proposal, the reporting system of notifiable diseases in the province of Yazd will be changed to automate the process of reporting. All the ten district health centers (DHC) will use PDAs for reporting notifiable diseases to the Province Health Center of Yazd. In this chapter, the specific application of the project is described, followed by a stakeholder analysis and identification of the strengths, weaknesses, opportunities and threats of the plan. An analysis of alternatives to the proposed plan is also included and the chapter concludes with risk estimation of not improving the current system.

Application of this Project

The national health authorities in Iran have announced 36 infectious diseases as “notifiable diseases”. These are mainly the eradicated diseases like Poliomyelitis, or under-controlled diseases like Cholera. Some of these diseases may indicate possible bioterrorism like Anthrax. A complete list of national notifiable diseases in Iran can be found in Annex I. All hospitals, laboratories, physicians and health workers must report any confirmed or suspected case of notifiable diseases to the local health authorities.

The DHC is the first level of reporting for both public and private sector. Each of ten DHCs in the province of Yazd is responsible for immediate telephonic reporting of every suspected case of notifiable diseases to their associates in the provincial level. At the same time, the health professionals should take the specific actions according to national guidelines. The “Disease Control and Prevention Office” (DCPO) in the Province Health Center of Yazd receives the immediate case reports and forwards them to the MOHME if needed. The corresponding health centers record the case in their registries after confirmation of diagnosis.

Besides this immediate telephonic report, each district health center should report the frequency of notifiable diseases seen in the covering area to the province health center every week, even if there was no new cases detected which is called “zero report”. This data is passed to the corresponding office in MOHME after aggregation. For every case, additional data including demographic information, initial signs and symptoms, treatment and follow-up are collected and sent through the same pathway.

Depending on the disease, specific health professionals should take some sort of actions according to guidelines. The Iranian health system has announced some of these diseases as eradicated. Poliomyelitis and Measles are two instances. The timeliness of reports on eradicated diseases is extremely important for the national health system. If any case of Poliomyelitis is seen in village, all the children of the village should be immediately re-vaccinated. If that is a case in a city, all the children within 500 neighboring households should be re-vaccinated at once. In either case, a professional team from the Province Health Center should go to the site and visit the case as soon as possible. They check the interventions of the DHC professionals to make sure the people are not at risk. In addition to eradicated diseases, the diseases known as under-controlled are also highly sensitive for the public health. An increase in the trend of their incidence indicates a potential outbreak in the region and should be promptly investigated.

In this project, the use of PDAs will be introduced to improve the timeliness and reliability of notifiable disease reporting from the DHCs to the Province Health Center of Yazd. Once implemented, the communication disease officers in each district will register the case reports of notifiable diseases in a PDA phone. The operator will use a user-friendly dynamic form for data entry. The PDA will notify the provincial authorities of the suspected case using Short Message Service (SMS). The software application will store the case as a record in the database after confirming the diagnosis. A secondary message for each case will either confirm or cancel the primary message. At the end of each week, all district PDAs will replicate their database to the province PDA through a cellular phone call. The province PDA phone will receive and store all case reports and relay

them to the health authorities in Tehran according to the guidelines. The database management system in the province PDA will also aggregate all replicated data from districts to generate the weekly reports of the province and communicate them to the MOHME each week.

The other important function of the system is providing an information dissemination system for sending the news, updates and information to the health professional in a very effective way. This is especially true for the settings in which the geographical distance of the health center in a natural barrier for proper access to the timely information. Although in this project the use of PDAs is limited to the reporting system of notifiable diseases, it can be expanded in the future both horizontally and vertically. In horizontal expansion, the other services of the provincial health system, e.g. routine health reports, can be added to this system. Expanding the proposed system to the lower level (urban and rural health centers) and also higher level (MOHME) will dramatically improve its functionality.

Why Notifiable Diseases?

Notifiable diseases have a high priority in every country's health system for two main reasons: their large impact on the public health; and the high economic impact on the society. They are extremely sensitive for the health system as many people could be infected in a small period of time. The pandemic of Avian Flu in 2005 is an example of global threat of these diseases, which made the United State to strategically plan for defending against them, at the highest level (Homeland Security Council 2005).

Another important issue with notifiable diseases is their economic impact. The economic cost of infectious disease outbreaks is a global concern. The cost of the SARS outbreak in 2003 was estimated to range from US$10 billion to US$30 billion (Robertson 2006). In 2005, an outbreak of Cholera cost Iranian farmers more than US$ 55 million (IranMania 2005) and "the cholera outbreak in Peru in 1991 cost the country US$ 770 million due to food trade embargoes and adverse effects on tourism" (WHOb;WHOb;WHOb).

Timeliness of information is a key factor for detecting and controlling these diseases especially in case of epidemics and outbreaks. This project will improve this factor. Currently, new cases of any notifiable disease are reported by phone, but the data of weekly reports are aggregated manually and sent by conventional paper-based correspondence. For automating this process the first tool that comes to everybody's mind might be a personal computer (PC), but a PDA has been chosen instead for several reasons which are outlined in the next paragraph.

Why PDAs?

The following list justifies selecting PDAs for this purpose:

- They are less expensive than PCs.
- The users can learn how to work with PDAs in less than a week.
- The processing power of a PDA is enough for this task.
- The maintenance cost of a PDA is less than a PC.
- PDAs are less prone to technical problems (i.e. crashing) compared to PCs.
- The small size of data in notifiable disease reports makes it possible and feasible to transmit by PDA phones and mobile network.
- There are many cases in which outreach teams should collect data and communicate them, so portability of the PDAs is a great advantage.
- In case of software failure, reloading a fresh copy of operating system and software on a PDA is much simpler and faster than a PC.
- PDAs are more suitable for regions with unstable power supply. If necessary, their batteries can be charged by solar cells.
- Integration of a handheld computer and mobile phone makes a PDA ideal for collecting and communicating data in small size.
- Mobile phone networks are generally faster and more reliable than conventional phone networks.
- Two-way communication is much simpler with PDAs than PCs, either through short message service (SMS) or by phone calls.

Besides these advantages, PDAs have also disadvantages that are considered:

- PDAs are not suitable for complex forms with many free text fields.
- PDAs are more likely to be missed or stolen.
- Cellular phone calls are generally more costly than landline phone calls.
- Not everybody will like small screen of PDAs.
- There are fewer companies, which develop / support PDA software.

Implementing this new system, like any other change in organizations, will face opportunities and threats. To identify the opportunities and detect the threats that the project will face with, during or after implementation, an SWOT analysis is necessary. This analysis is also necessary to take advantage of our strengths and uncover our weaknesses. The plan is analyzed based on these four aspects in the next section.

SWOT Analysis

The proposed change is analyzed by SWOT technique for identification of its Strengths, Weaknesses, Opportunities and Threats as following:

Strengths

- The proposed system has the capability of quick detecting and alerting infectious disease outbreaks.
- It provides possibility of rapid feedback to motivate the health professionals who collect and report the data of notifiable diseases.

Weaknesses

- Electronic communications including SMS and e-mail are not officially recognized in Iran.
- Cellular communications are more costly than regular phone calls.
- PDAs are not suitable for long forms, especially those with multiple free text fields.
- The staff is used to paper-based systems and may be resistant to use new devices like computers or PDAs.

Opportunities

- Rapid progress in the field of information technology continues to introduce handheld computers with more capabilities with lower price.
- Rapid progress of communication technology makes it possible to transmit larger amount of data with less price.
- The mobile network coverage is growing rapidly in Iran and especially in the province of Yazd.
- Low cost of PDAs comparing to PCs.
- Low maintenance cost of PDAs comparing to PCs.
- Possibility of two-way communication and simplicity of one-to-many communication.
- Technical training for PDA users would be quite short, fast and cheap.
- Resistant to power supply instability.

Threats

- This plan will increase dependency of system to the new technology that is naturally more prone to failure.
- Computer viruses can attack and infect PDAs that may result in data loss.

Based on this analysis, the implementation strategy can be steered to focus on the strengths, minimize the effects of threats, take the best possible advantage of opportunities and try to eliminate the weaknesses. These aspects are fundamental to the implementation strategy and long-term operational plan.

In addition to all these technical issues, the human resource is another important factor in every project that should be managed very carefully. Identifying the stakeholders of this project is necessary for preparing a plan of action, which is likely to succeed. This is done through stakeholder analysis, which is discussed in the next section.

Stakeholder Analysis

Stakeholder management is the key to success of every project in every organization. A project is most likely to success when the right people are engaged in the right way. To identify the key people who will play the major role in implementation and running this project, stakeholder analysis is used. The benefits of using this technique include:

- By using the opinions of the most powerful stakeholders to shape the project at an early stage, it is more likely that they will support the project. Further, their input can improve the quality of the project.
- Having support from powerful stakeholders will help in identifying and obtaining the necessary resources. This will also improve the likelihood that the project will be successful.
- By communicating with stakeholders at early stage and frequently thereafter, it can be ensured that they fully understand the scope and potential benefits of the project. This should result in their active support when necessary.
- The input of the most powerful stakeholders can also be used to identify the possible reaction of others to the project. The plans can then be optimized to gain the support of all stakeholders.

Stakeholders

The stakeholders in this project are:

- The World Health Organization
    - WHO - Regional Office for the Eastern Mediterranean (EMRO)
    - The Health Metrics Network
- The Iranian High Council of Informatics
- The Management and Planning Organization
- The Iranian MOHME
    - MOHME, Deputy Minister for Health Affairs
        - Center for Disease Control and Prevention (CDCP)
    - MOHME, Deputy Minister for Research and Technology
        - Office of Medical Informatics

    - The E-Health Research Center
- The Yazd Medical University (YMU)
    - YMU, President
    - YMU, Vice President for Health Affairs
        - Statistics Unit
            - Statistics technicians
            - Information officers
        - The Province Health Center
            - The Disease Control and Prevention Office (DCPO)
        - District Health Center
            - The disease surveillance unit
    - YMU, Vice President for Support Services
        - The Chief Financial Officer
        - The university IT Committee
    - YMU, Vice President for Research and Technology
        - Statistics and Automation Services Office
            - Statistics technicians
            - Information officers
- The Statistical Center of Iran
- Iranian Ministry of Communication and Information Technology
    - Department of Mobile Communication
- The Telecommunication Company of Iran
- Private mobile operators in Iran
- PDA / PDA phone manufacturing companies
- PDA software developer companies

In the next section I will categorize the stakeholders into four categories based on their power and interest.

Stakeholder Mapping

There are different methods for stakeholder mapping. According to one of these methods that is described by Rachel Thompson (Thompson 2006), mapping is

based on power and interest. This mapping is important as it helps in planning to take the proper actions to minimize resistance and gain support.

According to this method, shown in Figure 2, our stakeholders should be mapped into four groups:

- High Power / High Interest Group - should be managed closely.
- High Power / Low Interest Group - should be kept satisfied.
- Low Power / High Interest Group - should be kept informed.
- Low Power / Low Interest Group - can be just monitored.

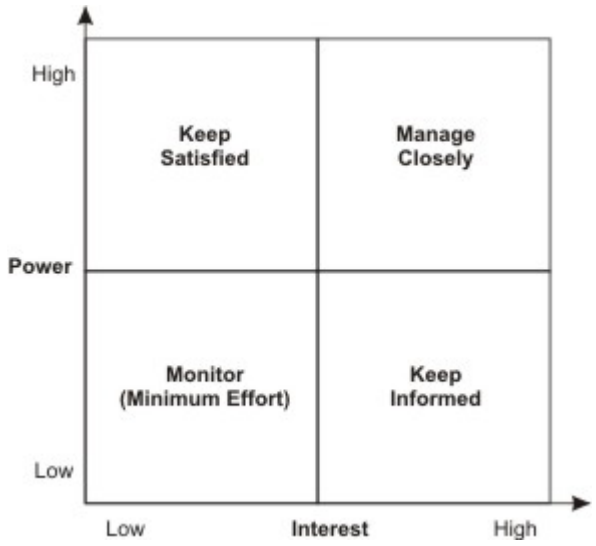

Figure 2: Power/Interest grid for stakeholder prioritization (Thompson 2006).

The previous list of stakeholders is mapped according to this classification, as summarized in Table 1.

Table 1: Stakeholder mapping based on power and interest.

Power		
	Low Interest – High Power	High Power – High Interest
<High>	YMU, IT Committee YMU, Chief Financial Officer YMU, Vice President for Research and Technology Iranian Ministry of Communication and Information Technology Telecommunication Company of Iran PDA / PDA Phone manufacturing companies	YMU, President YMU, Vice-President for Support Services YMU, Vice-President for Health Affairs YMU, Province Health Center YMU, District Health Centers MOHME, Undersecretary for Health MOHME, Center for Disease Control MOHME, Department of Medical Informatics MOHME, Undersecretary for Research and Technology WHO - Health Metrics Network WHO – EMRO
	Low Power – Low Interest	Low Power – High Interest
<Low>	Private Mobile Operators in Iran PDA Software developing Companies	The Statistical Center of Iran The E-Health Research Center YMU, Statistics Unit YMU, Statistics Technicians YMU, Statistics and Automation Services office YMU, Information Officers
	<Low>	**Interest** **<High>**

Key Stakeholders

The key stakeholders are in the High Power / High Interest Group and should therefore be managed closely. The key stakeholders and their role (supporter, advocate, critic or blocker) and motivation can be further identified as:

- YMU, President [critic]: It is important for the reputation of a medical university that its President can provide an effective health information

system for a province, but implementing IT projects has been a matter of debate for many people due to unsuccessful experiences in the past.

- YMU, Vice President for Support Services [blocker]: Implementing new IT projects are usually costly and problematic if not designed well. The Vice President for Logistics, who leads the team responsible for purchasing new devices and monitoring the contracts of the university, tends to avoid such contracts. He doesn't like costly solutions, especially if the current system is still working.
- YMU, Vice President for Health Affairs [advocate]: Implementing an improvement in the current health information system will be a success for him.
- The Province Health Center [advocate]: The Director of the Province Health Center of Yazd has been generally willing to implement new technology to facilitate the process of data collection and dissemination using new technologies.
- The District Health Centers [advocate]: The District Health Centers will appreciate using more advanced facilities. It also will be recognition of the work that they do.
- MOHME, Deputy Minister for Health Affairs [supporter]: The Deputy Minister for Health Affairs will definitely appreciate more timely and reliable reports of notifiable diseases.
- MOHME, Center for Disease Control and Prevention [advocate]: They will appreciate more timely and reliable data in electronic form, especially if the data are in a standard format that could be fed automatically into their own information system.
- MOHME, Office of Medical Informatics [supporter]: This office is seeking new ideas to improve health statistics and support decision-making.
- MOHME, Deputy Minister for Research and Technology [supporter]: He is responsible for evaluating, designing and recommending different projects using advanced technology in the Iranian Ministry of Health.
- WHO - Health Metrics Network [supporter]: The Health Metrics Network is a global collaboration focusing on strengthening health information systems. The network awards grants to countries with approved

proposals, ranging from US$50,000 to US$500,000, to generate sound and reliable data for decision-making at country and global levels.

- WHO – EMRO [supporter]: This office encourages and supports countries to improve their health information systems.

The actions that should be taken for each key stakeholder are discussed in the section “Description of Plan and Implementation Strategy”.

The remaining question to be answered is: “What if not this plan?” Are there alternative options for improving the timeliness and reliability of health data available? This question is answered in the following section.

Alternative Options

Besides the current paper-based solution, there is another alternative for this plan, which is to use personal computers, instead of PDAs, for data collection and aggregation and regular phone calls for data transmission using modems. The following is a list of the strengths and weaknesses of the alternative plan:

Strengths of the alternative plan:

- The main strength of this alternative would be avoiding buying new devices (PDAs) by using the same computer, which is used for other data processing tasks of the health center.
- PCs are much more convenient for data entry. They are also more flexible for working with long and sophisticated forms.
- The cost of developing software applications for PCs are lower than PDAs as there are more PC programmers available.

Weaknesses of the alternative plan:

- Total cost of ownership for personal computers is much higher than PDAs. Not only is the initial cost of a personal computer higher, but maintenance is also much more costly.
- This plan is harder to expand to urban and rural health centers as buying hardware and software for all centers would require a significant investment.

As this project plan will develop a platform for data exchange in the health system and it is intended to expand in the future, and considering the results of this analysis, this plan is the preferred option.

If either solution is chosen and implemented, the ultimate goal is to provide timely and reliable data for the decision-makers of the public health sector at the regional, national and/or international level. However, what is the risk of not changing the current situation? This is the topic of the next section.

Risk Estimation

Outbreak of infectious diseases with potential public health threat has been a major concern of health authorities. A good example is the outbreak of avian influenza (Bird flu) in 2005, which seriously threatened most of the countries of the world. In such situations, many health information systems fails to operate properly, but this is when the decision-makers need reliable and up-to-date data the most. The situation is even worse in case of disease outbreak following natural disasters like tsunami or earthquake because the infrastructure is damaged too. That is why the WHO decided to introduce Health Metrics Network in 2005 to improve public health decision making through strengthening national health information systems.

Plan and Implementation Strategy

To improve the timeliness and reliability of reports of notifiable diseases, Personal Digital Assistants (PDA) will be used to change the process of reporting from paper-based to digital. The PDAs that will be used in this project will include the functionality of mobile phones which are referred to as “PDA Phone”. These PDA phones will be used in all of ten district health centers and the Province Health Center of Yazd. The Yazd Medical University (YMU) supervises these centers.

Current Situation

Like any other country, all the medical practitioners in Iran must, by law, report every case of nationally notifiable diseases to the governmental authorities. According to the structure of the Iranian public health system, at the lowest level the cases are reported to the disease surveillance unit in each district health center (DHC), most often by phone. This unit, in turn, reports the cases individually by phone to the disease prevention and control office in the province health center. The province health center reports the case to the Center for Disease Control and Prevention (CDCP) in the Iranian Ministry of Health and Medical Education (MOHME). In addition to these telephonic reports, each week the district health centers should send cumulative reports of all the confirmed cases of notifiable diseases using paper forms to the province health center and from there to the MOHME. All the health centers should send these cumulative reports, even if they had no new case (Zero Report). These reports are the basis for national reports of notifiable diseases that MOHME sends regularly to the World Health Organization – Regional Office for the Eastern Mediterranean (WHO-EMRO).

Once a notifiable disease is suspected, specific actions should be taken by health professionals in different levels of the health system according to national guidelines. These actions include diagnostic interventions like taking samples and sending them to referral laboratories, treatment interventions which are mainly done by medical professionals, and preventive interventions for the

population at risk. For each case, information is gathered in detail and reported using surveillance forms.

Proposed Change

In this project, the notifiable disease reporting system will change to rely on electronic transactions between DHC PDAs and the PDA in the Province Health Center of Yazd. The communicable disease officers in the district health centers will be trained to use a PDA phone to report notifiable diseases to the province health center instead of regular phone calls. Under the proposed system, Short Message Service (SMS) is used for immediate reports of suspected cases. After confirming the diagnosis, a secondary message for each case will either confirm or cancel the primary message. A message delivery receipt confirms successful delivery of the message. These receipts can be kept for later official reference if needed. A user identification tag is affixed to each case report and makes it possible to recognize the sender of the report in addition to caller ID. This identification will be necessary if there is more than one person using the same PDA to report the diseases.

A software application running on the PDA aggregates and compiles the data to generate the weekly reports of each district health center in a proper format. This weekly reports file is sent to the province health center using a cellular phone call and the data will be replicated to the database on the receiving PDA. After receiving the weekly reports from all 10 districts of the province, the database will generate the provincial report automatically. This report will be sent to the MOHME consequently by fax, e-mail or by file transfer protocol (FTP) through a cellular phone call, provided there will be a PDA or personal computer to receive the file. The format of the electronic report would need to be agreed upon in negotiation with MOHME-CDCP. The following section explains the activities in detail to achieve this objective by using the results of stakeholder analysis and SWOT analysis of the project which is described in chapter 2.

Detailed Project Implementation Plan

The initial project team who raised the idea of this change consists of the communicable disease officers of the Disease Control and Prevention Office (DCPO) in the Province Health Center of Yazd. The head of DCPO will lead the team and be the project manager. He will initiate the implementation process.
In this section a step-by-step approach will clearly explain the implementation strategy. The following is a list of tasks to be done for implementing the project in 2 phases: Preparation Phase (20 tasks) and Pilot Phase (4 tasks).

Preparation Phase:

1. **Presenting the Proposal to the Yazd Medical University (YMU).**

   The university Vice President for Health Affairs is one of the key stakeholders of this plan and will be the first person with which to meet. The initial project team will attend this meeting to create the sense of urgency for implementing the project. When justified, the project manager will present the complete version of the proposal to the university executive board which reviews and evaluates the main issues and change proposals at the highest level of the university. The university President, all Vice Presidents are members of this board which meet every week and make decisions on different issues. Although the President can make the decision by himself, usually he prefers to discuss the issues in the executive board and listen to the arguments. The final decision is made upon consensus. This project will likely be approved as it meets one article of the resolution of the university need assessment project (titled: “Empowering health information systems throughout the university”) which was conducted last year.

2. **Organizing the Steering Committee.**

   At this step, a steering committee should be organized to supervise and manage the process of implementation at the higher managerial level of the university. The university President (or his representative), the Vice President for Health Affairs, the Vice President for Logistics, and the Vice President for Research and Technology and the project manager would

be the members of this committee. These people lead all of the departments and offices which are directly involved in this project. They also have authority for communicating with the external stakeholders.

3. Official Submission and Getting Approval from the MOHME.

Although the Iranian medical universities are independent and can decide on anything in their domain, the MOHME closely monitors, evaluates and regulates most of their activities, especially those which have a potential large impact on the national health status. In fact, most of the activities in the health sector that are initiated in the medical universities end up in the MOHME and vice versa. Reporting health statistics is one of these activities, of which the report of notifiable diseases is the most important and sensitive one. Since this report is sent to the Center for Disease Control and Prevention (CDCP) in MOHME and from time to time some inspectors from MOHME check the process of data collection and aggregation in all provinces, the MOHME should know and approve this project. Besides, this step is a prerequisite for funding the project through the national health budget or international donations which are supervised by the MOHME. An advisory committee in the MOHME undersecretary for health is responsible for reviewing and approving the proposals. Running this project in parallel to the conventional method of data collection and reporting for the first 6 months will assure the MOHME that the reliability of the data will be maintained, if not increased. On the other hand, approval of the MOHME will significantly facilitate implementing the project. The Vice President for Health Affairs will initiate this task and the project manager will follow it up.

4. Negotiating legal issues at the level of MOHME.

Since electronic transactions are not officially recognized in Iran yet, new regulations may be needed to officially employ electronic reporting. Currently, conventional correspondence complements electronic reporting in some cases. For example, if an office sends some data as e-mail attachment, a normal official letter announces that the data is sent

and the other party sends a normal official letter confirming receipt. Also, the hardcopy of all the letters which are sent by fax should be sent by mail, too. This official correspondence is needed in case of a problem requiring further investigation. This task will be done jointly by the Vice President for Heal Affairs and the project manager in Tehran.

5. Reporting the Plan to WHO-EMRO.

WHO has been encouraging countries to strength their health information systems to have reliable and timely data. As Iran is covered by the Eastern Mediterranean Regional Office of WHO, it would be a good idea to notify them of the proposed plan. The possibility of financial support is another reason for this task. The Vice President for Heal Affairs will accomplish this task.

6. Introducing the Plan to the Management and Planning Organization (MPO) and IT Council of the province.

In addition to the annual budget of each governmental organization, the MPO has a branch in each province which can fund, partially or totally, projects in the public sector. Also, the MPO branch in each province acquires some statistics from all governmental organizations of the province and publishes an annual report on their performance. So MPO would be interested in possible improvements to the reporting systems of the provincial health system.

In each province there is an IT council which works under the supervision of the province governor and is responsible for coordination of all IT related activities in the province. This council has some financial resources which can be allocated to governmental organizations based on their performance and approved proposals.

7. Introducing the Plan to the University Managers and IT Committee.

To win the support of different parts of the university, it is necessary to inform the managers and directors of different sub-organizations of the

university. Some of these mangers, like the Chief Financial Officer, should be directly involved in the plan. Regarding the traditional university bureaucracy, it's very easy for blocker stakeholders to stop or slow down the project. On the other hand, there are often some legal shortcuts that can accelerate every process. So gaining the support of managers of different parts of the university will help the project to move forward once started. The plan will be introduced by the steering committee to the managers.

The university IT committee is responsible for reviewing and approving all the requests for goods or services which are related to information technology. For the plans which are proposed from outside of the university (mainly from MOHME) they decide on the technical specifications of the physical tools according to the market, regional situation and the budget allocated. As the physical tools in this project are mainly IT related, we should introduce the plan to this committee in order to use their consultancy later on. The project manager will carry out this project.

8. Negotiating Legal Issues at the Level of YMU.

The steering committee should identify and consider the legal issues that may rise due to running this project. They should discuss and resolve the issues, such as job descriptions, responsibilities and work overload of the personnel who would run the project and work with the system. They also should think of some possible incentives for the users and technical support of the system.

9. Introducing the Plan to the Province Health Center and DHCs.

The Province Health Center of Yazd is the focal point of this project. The university Vice President for health automatically holds the position of director of this center. It is one of the strengths of this plan that the director of the Province Health Center of Yazd is a member of the executive board of the university. The Disease Prevention and Control Office (DCPO) in this center receives the data from the district health

centers and prepares a report for the MOHME-CDCP after checking and aggregating the data on a weekly basis. Special attention should be paid to this center since it is the most critical node of the project. The Vice President for Health Affairs who is currently the director of this center will carry out this task.

All ten district health centers will receive a PDA Phone to use for case report of notifiable diseases. They also use the PDA Phone for generating and sending the weekly reports to the Province Health Center of Yazd. As this is the layer in which data are converted from paper-based to electronic, the accuracy of data depends on the commitment and motivation of the DHC communicable disease officers. So the director and DCPO of these centers should have a good understanding of the whole new system and their role in accuracy of the final data.

10. Organizing the Executive and Technical Teams.

At this step the steering committee will appoint the members of the executive team. This team is responsible for following up the official process of implementation. Due to the slow bureaucracy which rules in the university, some energetic and highly motivated people should follow up each official thread of the activities according to the laws and regulations of the university. The members of the executive team should include one officer from the department of logistics to facilitate the purchasing, signing of contracts and financial affairs, one manager from the Province Health Center of Yazd who will be responsible for all coordination between the center and the DHCs, and one officer from the university department of health who will follow all the paperwork and correspondence. The team should report the progress of the project to the steering committee on a monthly basis and call for help in case of any problem.

The technical team will address all the technical issues of the project. These issues include adopting the standards, setting the technical specification of hardware, software, communication, and other services

to meet the objectives of the project and fulfill the requirement of the university IT committee. They should closely monitor the technical performance of the new system once started, report the possible bugs to the vendors, developers or providers and technically support the users. They are also responsible for designing and preparing the training materials and also the instruction manuals for using the new devices and services. The team members and the leader will be appointed by the university Vice President for Health Affairs. The steering committee will organize this team.

11. Adapting the Workflow Algorithm to the New Situation.

Introducing a hi-tech project to an organization which is used to paper-based work will inevitably face some challenges that should not be overlooked. Fortunately, the Province Health Center of Yazd has been using a paperless office system for their internal correspondence for the past two years. However, their external correspondence is still paper-based. So although the personnel are quite familiar with automated systems, this would be the first time that their interaction with external bodies is electronic-based. Up to now, in every case of using facsimile or e-mail for correspondence, a complementary letter has been sent to leave an officially acceptable trace in the system.

The logical workflow of the reporting system would be the same when using the new system, but the practical workflow may vary due to utilizing new tools. For example, the immediate reporting still would be done from the DHC communicable disease officer to his associate in the Province Health Center, but the actual person in charge may be different. Also, immediate reporting is currently done by regular phone call, but in the new system SMS would be used for this task.

If two or more officers in a DHC use the PDA, an authentication and authorization algorithm will be developed for the reporter to be distinguished. These algorithms should be clear for the technical team to include in the software specifications when ordering from the developer.

Also, if there should be a paper record of transactions, some special hardware like Bluetooth printers may be needed. These are issues for the technical committee to decide on. The project manager will be responsible for this task.

12. Negotiation Technical Issues with MOHME-CDCP.

All the case reports and weekly reports of notifiable diseases from all over the country end up in the MOHME-CDCP for analysis, aggregation and reporting to the WHO-EMRO. Currently, every new case is reported by phone call immediately and weekly reports are sent by official correspondence on paper. Different units of the CDCP use software applications for collecting and analyzing data, but the data entry is done manually. It would be easier for them to receive the data in electronic form to be imported to their databases. This will definitely increase the accuracy of data by eliminating the human errors occurred during data entry. At this step the required format of the files in order to be compatible with their databases would be discussed and then observed in the technical specification of the PDA software. The head of technical team will be responsible for this task, which should be coordinated by the project manager.

13. Identifying Software Requirements.

The paper forms that are currently used for reporting the diseases will be used as the basis of the software application requirements. For immediate case report of a notifiable disease, a simple dynamic form will collect the data and send them as clear text by SMS to the Yazd Province Health Center, instead of a phone call which is currently used. The delivery receipt which returns automatically by the mobile operator company can be used for official tracking, if needed. A database client agent will capture and store these data within the PDA to use it for generating weekly report at the end of the week. According to the workflow algorithm, the DHC PDA can be scheduled to generate and send the weekly report at the end of the week automatically or this can be done by the user on the first working day of the following week. An

acknowledge message from the receiving PDA will confirm delivery of the report. The timestamp of the acknowledge message can be used for official tracking purposes, in case of any problem.

In the Province Health Center of Yazd, the officers in the Disease Control and Prevention Office (DCPO) will receive the immediate case report of a notifiable disease as an SMS message which would be relayed to MOHME. A database agent on the PDA will import the weekly reports of DHCs to the database automatically and aggregate the data on the fly. The data would be available for reporting to MOHME at any given time, either automatically based on a schedule or upon user command.

14. Determining the Software Specification.

This would be the most critical task for the technical team. In this step, the technical specification of the software for the new system will be determined. These specifications include the applications the user will work with, the database management system which will handle the data storage and manipulation, the PDA operating system and some other PDA applications for data communication, PC synchronization, data backup and restore, crash recovery and so on. Emphasis will be on identification of more user-friendly interfaces for more chance of success for the project and sustainability of the system afterwards. Choosing open source software should be explored to make the project more affordable, especially if expanded vertically and horizontally in the future.

There are some standards set by the Iranian High Council of Informatics for the governmental organizations to observe. For example, the UTF-8 standard should be used for encoding web pages in the Persian language. Also, all databases in governmental organizations must have a field for a social security number. In addition, if the database be XML enabled, data exchange between different information systems within the university and outside the university would be facilitated. Compatibility of the system with other related national information systems which are provided by the MOHME should also be considered.

15. Determining the Hardware Specifications.

Considering the workflow algorithms, the technical team will identify the hardware requirements for the new system. In addition to PDA phones, some peripheral devices like printers and accessories like PC connecting cables, Bluetooth adapters or USB cables may be needed. Meanwhile, the technical guidelines and standards imposed by the MOHME, the IT council of the province and the university IT committee should be consulted for determining the technical specification. While determining the hardware specification, security, data recovery, technical support and low maintenance cost will be of high importance. A solution to backup and restore system should also be identified. As all the data on the PDA memory will be lost if the device is reset or reloaded with a fresh copy of the operating system, a memory card for regular data back up will be essential. The feasibility of using a personal computer for synchronizing data as a method of backup should also be studied and compared with alternative options.

16. Developing a Feedback System for Detecting and Resolving the Problems and Bottlenecks.

A feedback system should be developed for the PDA users to report their problems with the new system, both technical and logistical. As user satisfaction is critical for this project to succeed, special attention should be paid to their expectations of this system and complaints. Their suggestions for improving the system should be highly appreciated. Technical problems should also be addressed as quickly as possible while their suggestions can be acknowledged after evaluation. The technical team is responsible for providing the front line technical support for users and reporting the software bugs to the developers to rectify.

17. Identifying Other Needed Facilities and Services.

At this step all other facilities, tools or services that will be needed should be identified. The main item would be subscribing to a mobile network for the ten DHCs and the Province Health Center of Yazd in order to

facilitate their communication using the PDA phones. The project manager will be responsible for this task.

18. Ordering/Purchasing Software, Hardware and Other Facilities and Services.

Having a complete list of all required software, hardware and services with detail technical specifications will make it easy for the purchase unit of the department of health to start purchasing. The hardware should be bought from the authorized dealer of the specified brand name company with valid guarantee and reliable customer service. The software should be put for tender with special attention to the history and capabilities of the bidding companies. The university IT committee will supervise on this process and review the contracts from technical point of view before signing.

19. Training of the PDA Users

In DHCs, the communicable disease officers who are in charge of receiving case reports and relaying them to the Province Health Center will need to get familiar with the two main functions of the PDA phones: mobile phone functions and data processing functions. The mobile phone functions are similar to those of conventional mobile phone devices, except for the interfaces and input devices that include stylus and touch screen. The users will be trained to use SMS to send the immediate case reports of every notifiable disease. Once the data is entered to be sent through SMS, it will be automatically stored on PDA memory and used for generating weekly reports later on.

In the Province Health Center the PDA user will be receiving an SMS for every new case of notifiable disease and also weekly reports of these diseases. Therefore, they should learn how to handle SMS and also how to work with the database software. In addition, they should learn how to synchronize files in the PDA with a PC and how to send the weekly reports to MOHME-CDCP.

20. Evaluating the Current Situation.

Before running the project, the current situation will be evaluated using standard indicators like the delay in reporting and completeness of the reports. These are the main indicators which the MOHME uses to rank the provincial health systems in terms of reporting notifiable diseases.

The 20 tasks of the Preparation Phase will take 8 months to accomplish. as shown in Figure 3.

ID	Task Name	Start	Finish	Duration
1	Presenting the Proposal to the YMU	1/1/2007	1/14/2007	2w
2	Organizing the Steering Committee	1/15/2007	1/28/2007	2w
3	Getting Approval from MOHME	1/29/2007	2/25/2007	4w
4	Negotiating legal issues with MOHME	2/26/2007	3/11/2007	2w
5	Reporting the Plan to WHO-EMRO	2/26/2007	3/4/2007	1w
6	Introducing the Plan to MPO and the IT Council of the province.	2/26/2007	3/4/2007	1w
7	Introducing the Plan to the University Managers and IT Committee	2/26/2007	3/11/2007	2w
8	Negotiating Legal Issues at YMU	3/12/2007	3/25/2007	2w
9	Introducing the Plan to the Province and District Health Centers	3/12/2007	4/1/2007	3w
10	Organizing the Exec. And Tech. Team	4/2/2007	4/8/2007	1w
11	Adapting the Workflow Algorithm to the New Situation	4/9/2007	4/22/2007	2w
12	Negotiation Technical Issues with MOHME-CDC	4/23/2007	5/6/2007	2w
13	Identifying Software Requirements	5/7/2007	5/13/2007	1w
14	Determining the Software Specification	5/14/2007	5/27/2007	2w
15	Determining the Hardware Specifications	5/14/2007	5/27/2007	2w
16	Developing a Feedback System	4/23/2007	5/6/2007	2w
17	Identifying Other Needed Facilities	5/7/2007	5/20/2007	2w
18	Ordering/Purchasing Software, Hardware and Other Facilities	5/28/2007	8/19/2007	12w
19	Training of the PDA Users	8/20/2007	8/26/2007	1w
20	Evaluating the Current Situation	7/30/2007	8/26/2007	4w

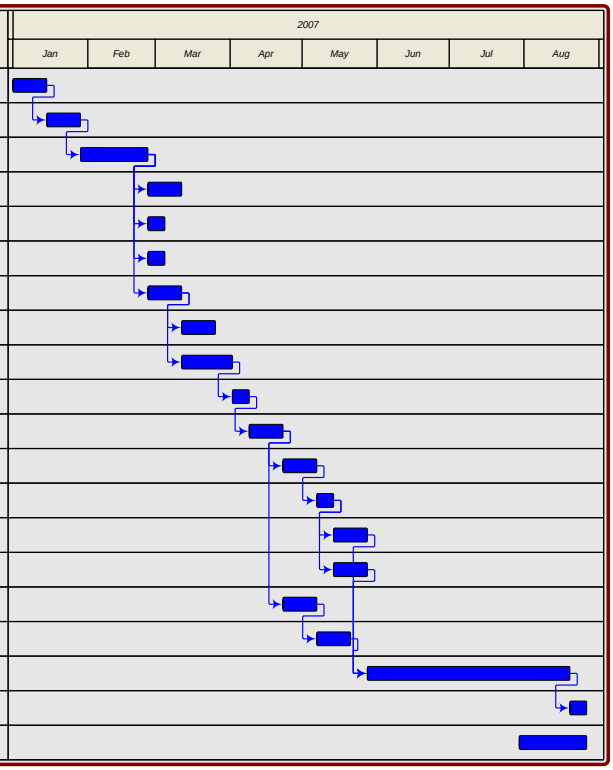

Figure 3: Preparation Phase timetable

The Pilot Phase:

1. Running the Project in Parallel to the Current System for the 6 Month Pilot Phase.

The actual running of the project will initially be done in parallel to the current system. During this period, all the cases will be reported both by phone calls and SMS to the province health center. The DHCs will prepare their weekly reports both manually to be sent by mail and also

electronically to be sent through cellular phone calls. This step is important because of the work overload which is imposed to the officers. Most technical problem and software bugs will rise in the early weeks of this phase and should be addressed quickly. Reflecting the success story of peers will encourage and motivate the DHC officers to use the system effectively and become accommodated to it.

2. Monitoring the Project during the Pilot Phase.

During the pilot phase the project should be monitored closely, both technically and professionally. Technical challenges faced by the PDA users would be of high importance. All of the changes in organizational behavior of the health system due to utilizing the new technology should be considered. Abuse of the facilities is also a managerial concern, especially when new and expensive tools are provided. This abuse will waste the resources in terms of increasing costs and/or decreasing staff performance.

3. Evaluating the Project after Four Months and Reporting the Project Output.

The steering committee will evaluate the project four months after the new system begins to run in order to determine the new system output. The same indicators which were used in prior evaluation of the current system will be measured again. As the users will continue the current system while working with the new solution, this evaluation may be biased due to their dissatisfaction with a work overload. This is not avoidable. This report will be used by the executive board of the university to make the decision to authorize the Vice President for Health Affairs to switch from manual system to the PDA-based system completely.

4. Switching from the Manual Reporting System to the PDA-based System.

Upon getting authorization from the executive board of the university, the current system will stop and the new system will carry on. Publishing the

challenges and results of this project will help the decision makers in the Iranian health system and also in other countries to get a better understanding of pros and cons of introducing PDAs into their reporting systems.

The four tasks of the Pilot Phase will take 6 months to accomplish. The Pilot Phase timetable is shown in Figure 4.

ID	Task Name	Start	Finish	Duration
1	Running Pilot Phase	8/31/2007	29.02.2008	26,2w
2	Monitoring the Project	8/31/2007	2/29/2008	26,2w
3	Evaluating the Project after 4 Months	1/28/2008	2/29/2008	5w
4	Switching to the PDA-based System	3/3/2008	3/3/2008	0w

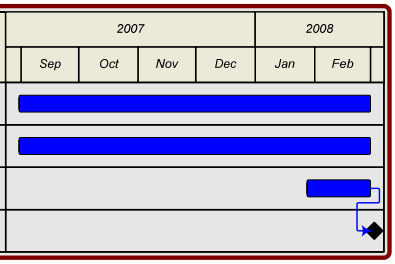

Figure 4: The Pilot Phase timetable

General and Technical Issues

The following general and technical issues should be considered before and during implementing the project.

Security

In many countries including Australia, communicating patients' information over telephone networks is allowed in digital format (like Fax), where as e-mail is not recognized a secure mean. In the current reporting system of notifiable diseases, the personal information of patients, including name, social security number and date of birth are communicated without any confidentiality. The only exception is reporting the cases of HIV/AIDS which has a specific reporting system with high confidentiality. In the proposed system, all the information will be communicated by SMS or FTP through digital mobile network which is operated by a state company.

Case Identification

Each reported case will be assigned a code to guarantee correct identification and verification in follow-up process. The patients' name is not a proper identifier as it will be stored in text fields in the database and these fields are

prone to mismatch due to possible misspelling of the names. The code will be a combination of the year, district zone, and an incremental number which will remain unique even if the system expands in all provinces of the country.

Hardware and Software Compatibility

Regarding the fast changes in hardware technology and rapid turnover of PDAs, the software should be platform independent. It is obvious that buying some additional devices of the same brand and model would be almost impossible after one year's time. Platform independency of software will guarantee possibility of expanding the project which needs buying some additional PDAs. The data entry forms should be as user-friendly as possible to improve the acceptability of the system by users. Using self-validating web form will simplify data entry by users and accuracy of data will be highly improved by using dynamic forms. Xform is the latest standard for designing web-based dynamic forms which will dramatically simplify developing complex form interfaces (Smith 2006).

Identifying Any Single Point of Failure

"Single Point of Failure" is where a problem will stop the whole process. A risk analysis will reveal every single point of failure in the new system in order to think of proper backups. These single points of failures in this project can range from technical problems like mobile network failure to organizational failures such as absence of a key person. This is important for sustainability of the system. The bottlenecks of the system should be identified and addressed before running the project.

Long-term Operational Plan

As briefly mentioned in the first chapter, by introducing PDAs to the health system and creating a two-way data exchange system, a platform will be developed that can host many other applications at a relatively low cost. The project itself can be expanded in the health system of the province of Yazd and furthermore in the whole country, both vertically and horizontally. The following section describes the sustainability of the project in this context.

Sustainability

The socio-technical nature of Health Information Systems (HIS) makes them prone to decay as the environment changes. Complexity of the health care systems may cause critical environmental changes that can degrade or fail almost every HIS. “Even HIS that have gone [come to] life to the satisfaction of their developers and end-users may degrade gracefully or fail catastrophically if not continuously and thoroughly kept in sync with their environment” (Wetter 2006). This is a challenge that has not received enough attention. A study on district health information systems in South Africa highlights human resource development, changing organizational infrastructure and ongoing evaluation as the main strategies for promoting sustainability of the system (Williamson, Stoops, and Heywood 2001).

Regarding these issues, different activities should be carried out to secure the system sustainability among the new and future users. The following is the list of suggested activities:

1. **Human Resource Development:**

   Commitment and motivation of the key stakeholders of the project is necessary for the system sustainability. The university vice-chancellor for health should keep informed of the project. Special attention should be paid to the PDA users to address their problems with the new system and organizational changes they will face with. Ongoing personnel education is important to both make them familiar with the latest changes of the system and also to promote their motivation.

2. **Effective Technical Support:**

   The technical support team should be responsive and supportive and rectify the technical problems of the users as quickly as possible. It is obvious that the more attention paid to determining the technical specifications and development of the software, the less support will be needed afterward. Ongoing improvements in the software applications to be more user-friendly will promote user satisfaction, which is vital for system sustainability.

3. **Keeping the System Up-to-Date:**

   The system should be kept up-to-date, both technically and professionally. Software developers release bug fixes and new versions of their products to keep them running smoothly. The software applications and eventually the hardware should be updated or upgraded as the technology moves forward. Any change in the health reporting workflows should be received and applied to the electronic system in advance. For minor changes, the software should have the capability of customization by authorized users.

As pointed out earlier, ongoing evaluation is a key factor in sustainability of this program. This is the topic of the following section.

Evaluation

A comprehensive evaluation framework is necessary for rapid growing health information technologies. This framework should cover all phases of HIS development, from the very first stage of conception to its routine daily operation(Kaufman, Roberts, Merrill et al. 2006). In South Africa, a set of evaluation criteria for district health information systems has been developed and organised in eight categories: philosophy and objectives, policy and procedures, functionality, facilities and equipment, management and staffing, user/patient interaction, staff development and education, and evaluation and quality improvement (Hanmer 1999). The CDC in the USA suggests assessing seven indicators for evaluating quality of a surveillance: sensitivity, specificity,

representativeness, timeliness, simplicity, flexibility and acceptability (Thacker, Parrish, and Trowbridge 1988). These indicators are the base of many evaluations worldwide. In this project, three indicators have been adopted for evaluating the system performance:

1. **Acceptability of the system:**

   Definition: “Acceptability reflects the willingness of persons and organizations to participate in the surveillance system” (German 2001).

   Method: the proportion of DHCs that would be able to maintain the new system working for the first 4 months.

   Baseline and target: Although no baseline value has been suggested for this indicator, a value of 80% or higher has been chosen as an acceptable target level.

2. **Timeliness:**

   Definition: “Timeliness reflects the speed between steps in a public health surveillance system” (German 2001).

   Method: The time interval between the date of last recorded notification by district health center and the date when the weekly report would be received at the province health center.

   Baseline and target: the baseline is 6 days and the target will be 2 days.

3. **Completeness:**

   Definition: “the proportion of selected data fields completed in each surveillance system” (Ward, Brandsema, van et al. 2005).

   Method: The percentage of records with missing values; and the proportion of missing values in each weekly report.

Baseline and target: The baseline is 60% and target will be 90%.

Potential Modifications

During the pilot phase of the project, the feedback from users will be reviewed and analyzed by the technical team to better meet their needs. The greatest modifications would likely occur in the software applications, especially in the user interface and data entry forms. This will necessitate a comprehensive contract with software developer(s) to revise or update their product according to identified user needs. It has been shown that using more standardized coding and minimizing free text fields will increase the completeness of electronic reporting systems (Panackal, M'ikanatha, Tsui et al. 2002).

Long-term Operations

1. **Expanding the Project to the Level of the Urban and Rural Health Centers.**

   After successful implementation of the project, it should be expanded to the level of the urban and rural health centers of the province of Yazd. Currently there are 51 urban and 41 rural health centers in the ten districts of the province. At least one fulltime physician is working in each health center. These centers are the first level in which a patient receives medical consultation from a physician, so they are a very good source of information in terms of timeliness. According to law, all medical practitioners must notify every case suspected of having a notifiable disease and they should not wait for the laboratory confirmation. By providing a PDA for each urban or rural health center, it would be possible to receive the data from the more peripheral level earlier. Of course, the software for these PDAs will just have the case report module because no routine report is sent from the peripheral health centers to the district health center (DHC) for notifiable diseases. Consequently, the PDAs in the DHCs will be equipped with Short Message Service (SMS) receiving software to be able to receive case reports from the physicians in the peripheral health centers and relay it to the upper level. In this scenario, the physician in the urban/rural health

center will report any case of notifiable disease to the corresponding DHC, which will then relay it to the province health center after confirmation.

2. Establishing an Information Dissemination System for the PDA Users.

A major weakness of the current health reporting system is that the people who are producing the information rarely receive feedback from the upper layers except in cases that a notorious error is detected in the reports. At this step, another software module will be added to the province health center PDA to enable it to send important news or messages to an individual or a group of PDA users in the health system. The very first message to be communicated would be the weekly report of the notifiable diseases of the whole province which is sent to MOHME-CDC. In this case, the district health centers will have the chance to know about the overall status of notifiable diseases in the province. In addition, this information would be an acknowledgment to their weekly reports and a kind of appreciation for their contribution.

3. Expanding the Project to the Microbiological Laboratories.

Microbiological laboratories are the best source of information on notifiable diseases in terms of reliability as their reports confirm the cases that have already been reported as suspected notifiable diseases. During recent years, many laboratories have successfully implemented electronic reporting systems to report positive tests of infectious disease to local public health departments (Backer, Bissell, and Vugia 2001;Effler, Ching-Lee, Bogard et al. 1999). These studies conclude that electronic reports are more timely and complete. At this step, every microbiological laboratory would receive a PDA to report the positive tests of notifiable diseases to the district health center to confirm the previously reported cases or to report a new case.

4. **Expanding the Project to Family Physicians in Rural Areas.**

   The health system in Iran is establishing a referral health care system by introducing the “Family Physician Plan”. Currently, all villages and towns with less than 20,000 inhabitants are covered by this plan. By including the family physicians, this project will cover all rural populations of the province. Due to the large number of physicians at this level, it is suggested that the government subsidize the PDAs for the physicians and provide them the needed software free-of-charge.

   A systematic review of PDA usage surveys concludes that physicians can easily become accustom to using a PDA. However, the review underlined an urgent need to evaluate the effectiveness and efficiency of using PDAs for different tasks. (Garritty and El Emam 2006a) Fortunately enough, currently some physicians in Yazd are already using PDAs for their personal routine tasks. This will facilitate introducing the project to them.

The same approach to long-term sustainability and evaluation of the plan, which is mentioned at the beginning of this chapter, should be applied to these expanded applications, also.

Further Expansion of the Program

PDAs have been used in a growing range of areas in health care. Rapid progress of information and communication technology makes it possible to use handheld devices in some situations that could not be thought of, up to now. Some disciplines and potential application of PDA in health care that can be used with this system are listed in following:

1. **Education:**

   As PDAs have become a popular tool among physicians, medical trainees and health professionals in the past decade, many organizations have tried to use them for educational purposes. These experiences include both developed countries (Kho, Henderson, Dressler et al. 2006;Mattana, Charitou, Mills et al. 2005;Nestel, Brenton, and Kneebone

2005) and developing countries. At the very first step, PDAs can be used for residents of the university hospitals to have immediate access to the needed textbooks and databases.

2. Epidemiological Surveillance Studies:

The high mobility of PDAs is a great advantage over personal computers, although their processing power is significantly lower. This makes a PDA a useful tool in epidemiological surveys in which interviewers should collect data in the field. Many experiences have shown using PDA will improve accuracy and speed of data collection in different settings (Morris, Pajak, Havlik et al. 2006;Vivoda and Eby 2006). In Iran PDAs can be used for assessing the vaccination programs.

3. Geographical Information Systems (GIS):

GIS has been used for many years In Iran in different sectors including health care. The lack of sufficient and accurate data is one of the most important challenges of using GIS for health care. Not many studies have been done on using PDAs in GIS in Iranian health system. Though some studies in different countries conclude by linking a global positioning system (GPS) locator or using a PDA with built-in GPS, it is possible to support disease control programs which are based on GIS (Dwolatzky, Trengove, Struthers et al. 2006). Health workers can use PDAs with built-in GIS locator to provide the data for these Iranian GIS system with less effort and higher accuracy.

4. Clinical and Hospital Information Systems:

One of the most popular domains for using PDAs in health care is hospital information systems. In a clinical setting, a PDA can be used to access to information and for decision making (Honeybourne, Sutton, and Ward 2006) or as a part of clinical information systems (Choi, Yoo, Park et al. 2006).

5. Internet-based Health Information Systems:

With increasing accessibility to the Internet, more health information systems are going to be Internet-based in the future. General Packet Radio Services (GPRS), which has been available since 2000, makes it possible for mobile phones to connect to the Internet easily and with a reasonable price. Therefore, in the future, PDA phones could be used for a variety of Internet-based hospital and health information systems. Currently PDAs are mainly used within hospitals and health facilities using their wireless networking feature which limit their range to around 100 meters.

Although using PDAs in health care has been shown to be effective, the financial burden of implementing IT projects should be considered. In the next chapter, the economical impact of this project will be discussed.

Economic Impact Analysis

In is project the process of reporting notifiable diseases in the province of Yazd will be changed from paper-based to PDA-based system. There are 10 districts in this province and the District Health Center in each district is responsible for the health affairs of the district. The communicable disease officers in the district health centers will use PDA phones for immediate reporting of every new case of notifiable disease to their associates in the Province Health Center of Yazd. The Short Message Service (SMS) will be used for this communication. The data of the case reports will be saved in a database in the PDA to generate the weekly reports of notifiable diseases of districts. The file of these reports will be sent through a cellular phone call to the Province Health Center. A PDA phone will receive the files and aggregates them in a database to generate the weekly report of the province. This report will be sent to the Center for Disease Control and Prevention (CDCP) in the Ministry of Health and Medical Education (MOHME) in Tehran.

In this chapter, the financial burden and benefits of this project will be discussed. The first section will explain the project cost in detail. Afterwards the possible financial resources for this project will come and a cost-effective analysis will conclude this chapter.

The Project Cost

This project is estimated to cost roughly 30’000 euros. The cost items of this project will be divided into three categories based on the nature of the costs. In each category the estimated costs will be given according to the different tasks indicated in the chapter 3: Plan and Implementation Strategy.

General and Administration Costs

- **Salaries and wages**: The project will be carried out by the personnel of the Yazd Medical University (YMU), including the health professionals who are working in the province and district health centers. An extra

payment of € 100 per month will be paid to the project manager. For the overtime working hours, the extra payment will be calculated and paid according the university regulations. For each official mission outside the city a “Mission Fee” will be paid which is around € 10 per person per day.

- **Meetings:** Each person attending a meeting will receive a meeting fee according the university regulations with is about € 10 per person per meeting. Holding each meeting for this project will be estimated to cost around € 100, including the refreshments.

- **Office supplies:** This will include all the office supplies that are needed for printing, copying, documentation and so on.

- **Transport and environment:** Tasks 3 and 12 will need a delegation from the university to go to the MOHME in Tehran. A return ticket to Tehran will cost € 70 including airport transfer. The people will reside in the university facility in Tehran during their mission, free of charge.

- **Training:** Training the users will be done by a technician from the company which will develop the software. Three different trainings will be needed: training of PDA users in DHCs, training of PDA users in the Province Health Center of Yazd and the training of the technical team who will support the users afterward. These training courses will roughly cost € 400.

- **Rent and lease**: A fulltime driver with car will be hired once the executive and technical teams are organized to facilitate the process of implementing the project, especially during the pilot phase. This service will cost € 150 per month.

Technical and Equipment Costs

- **Hardware:** Each PDA phone costs about € 600. Ten devices for the DHCs, one for the Province Health Center and an extra one for redundancy will be needed. This cost includes the external memory card

and all other accessories for meeting the objectives of the software solution.

- **Software:** The cost of developing software will vary based on the technical specifications which the technical team will decide on. It will be roughly estimated to cost € 5000.

- **Mobile phone contract:** Each mobile phone subscription from the Telecommunication Company of Iran which is a state run company will cost € 500. This is in addition to the bi-monthly subscription fee of mobile phones which will appear on the bill.

- **Consultancy:** The most critical technical issue in this project is determining the technical specifications of the software application. Total cost of maintenance, stability, complying with latest standards and ability to exchange data with other systems will be the most important issues that the technical team should consider when deciding on the specifications of the database management system and also the specific application for those PDAs. To have this step accomplished in the best way, the technical team needs to consult a qualified IT company with previous experiments in this field. As programming for PDAs is a relatively new discipline in Iran, the consultancy fee will be high. Around € 2000 and € 1000 will be needed for software and hardware consultancy, respectively.

- **Computers:** A personal computer will be needed for the managerial and official works of this project. A usual personal computer will cost around € 800.

- **Office equipments**: A printer will be needed for the paper works of the project. A common laser printer will cost around € 300.

Running Costs

- **Technical support**: A contract for the technical support of the system will be signed to rectify the problems that the technical team will not be able to handle. This is especially needed for the beginning of the pilot phase when the university technical team is not quite familiar with the system. This support will be secured through a contract for 6 month that will cost € 200 per month.

- **Mobile bills**: The mobile bills in Iran are issued bi-monthly. They include a fixed amount of subscription fee which is around € 2 and a variable amount of call or SMS costs. Special limitations should be imposed to prevent these PDA phones to be used for any purposes other than reporting notifiable diseases. Given five SMS per day and ten minutes of cellular call per week for each PDA phone, the monthly cost will calculated around € 12 per month. An additional monthly subscription fee of € 2 will be added to this amount. There will be 10 active PDAs in districts and one the province center which will receive the messages and calls. The twelfth PDA will not be used routinely, but kept as redundancy.

- **Depreciation:** This project will not have any depreciation cost.

Other Costs

- **Miscellaneous:** No miscellaneous cost has been identified for this project but there should be some limited budget available to the project manager to cover any unforeseen expenses.

According to this information, the operating cost of the project by quarters of the year 2007 and 2008 are calculated in Table 2.

Table 2: The operating cost of the project by quarters of the year 2007 and 2008.

Period Covering: (Q1) 2007 - (Q1) 2008

OPERATING EXPENSES	(Q1) 2007	(Q2) 2007	(Q3) 2007	(Q4) 2007	(Q1) 2008	Total
General and Administration						
Salaries and wages	300	300	300	300	300	1,500
Meeting	600					
Supplies	200		100			300
Travel	200					200
Training			400			400
Rent and lease expenses	450	450	450	450	450	2,250
						-
Total General and Administrati	€ 1,750	€ 750	€ 1,250		€ 750	€ 4,650
Technical and Equipment						
Hardware		8,200				8,200
Software		5,000				5,000
Mobile phone contract		6,000				6,000
Consultancy		3,000				3,000
Computers	800					800
Office equipment	300					300
Total Technical and Equipmen	€ 1,100	€ 22,200	€ -		€ -	€23,300
Running Costs						
Technical support			100	600	500	1,200
Mobile bills				420	420	840
Depreciation						-
Total Running Cost	€ -	€ -	€ 100		€ 920	€ 2,040
Other Expenses						
Interest expenses						-
Miscellaneous expenses						-
Total Other Expenses	€ -	€ -	€ -		€ -	€ -
Total Operating Expenses	€ 2,850	€ 22,950	€ 1,350	€ -	€ 1,670	€29,990

Budgeting

The main financial resource of this project will be the Yazd Medical University. Also there are other organizations that should be contacted and asked for financial support. The following is the list of these organizations and how they will support the project:

WHO: The Health Metrics Network is a global partnership founded by the WHO to strength country health information systems in order to generate timely and accurate data for decision-making at country and global levels. It evaluates the

country proposals for eligibility to receive a funding from US$ 50’000 – 500’000 (HMN 2006).

MOHME: The Department of Research and Technology of the MOHME is responsible for coordinating and supporting the implementation of IT projects in the medical universities in Iran. This department has financial resources to support the IT projects which meet their criteria.

E-Health Research Center: The E-Health Research Center was founded three years ago to study on innovative electronic solutions for improving health care. This center will fund the projects which will be approved by the research committee of the center. Knowing the fact that the director of this center reports directly to the Minister of Health and Medical Education reveals the potential power and strategic role that this center has.

The Management and Planning Organization (MPO): To encourage the governmental organizations to improve their performance by moving towards e-solutions, the MPO in each province has allocated special budget for the qualified IT projects. An expert is responsible for evaluating and assessing the IT projects in a set of governmental organizations in the province. This person should be consulted for approving the proposal and allocating proper funding for implementation.

Yazd IT Council: This council is responsible for organizing and coordination of all IT related affairs in the province, both in the public and the private sector. Each year this council allocated a special budget for implementing IT projects in governmental organizations which have applied and their proposal has passed the approval steps.

Cost-benefit Analysis

The Information Technology like many other new technologies is costly, but its benefits and capabilities make people and organizations pay this cost. Although this technology offers different solutions for almost any situation in the field of

health care, a question should always be answered: “Is it efficient?” In this section the cost effectiveness of this project is briefly discussed.

Specific benefits

The specific benefit of this project is providing a quick 2-way communication platform for exchanging data both from the peripherals to the center and vise versa. This capability meets the ultimate goal of improving timeliness and reliability of the notifiable disease reports. As these diseases have a large impact on public health status of every country, they attract a special attention of policy makers and authorities of health sector in different levels. Information systems have a very important role in preventing, identifying and controlling of the communicable diseases. This role would be more significant in case of outbreaks, like what happened to SARS and Bird Flue in 2005. The other problem of the current information systems of the Iranian health system like many other countries is the unilateral flow of information from the end point health care providers to the central policy makers, which is not acknowledged or appreciated most of the times. One of the advantages of this project is providing the possibility of information dissemination among health professionals in a very effective and efficient way. So it is clear that the main benefits of this project will be intangible and can not come to calculation.

Savings

In addition to the specific benefits which were mentioned, this project has tangible benefits also that are listed below:

- RedReducing cost of phone calls for immediate reporting of the new cases of notifiable diseases. As these reports should be communicated from districts to the province center, the cost of long distance calls will apply that is relatively high. That will be more significant when comparing regular reporting of the cases by human speech over a long distance call to sending an SMS by a mobile phone.

- ucing the workload of the health professionals in DHCs by eliminating the burden of weekly reports of these diseases. As described earlier, the communicable disease officers are supposed to send the weekly report of new cases of notifiable diseases in their district to their associates in the Province Health Center of Yazd. This includes the whole process of making reports out of their paper-based registry, typing the report and corresponding.

- Reducing the workload of the communicable disease officers in the Disease Control and Prevention Office (DCPO) in the Province Health Center of Yazd. After receiving the weekly reports of each district, they should check, aggregate and analyze the information to make a clear picture of current situation of infectious disease in the province. Consequently they should relay these reports to their counterparts in the Center for Disease Control and Prevention (CDCP) in the MOHME. In this project all the process of receiving, storing, and aggregating data will be done very quickly and the provincial reports will be prepared automatically.

- The cost of papers, official correspondence and archiving the paper reports will be eliminated also.

This project will be more justifiable when considering it as a platform for developing many other applications to address other problems and shortages of the current information systems of the province health system.

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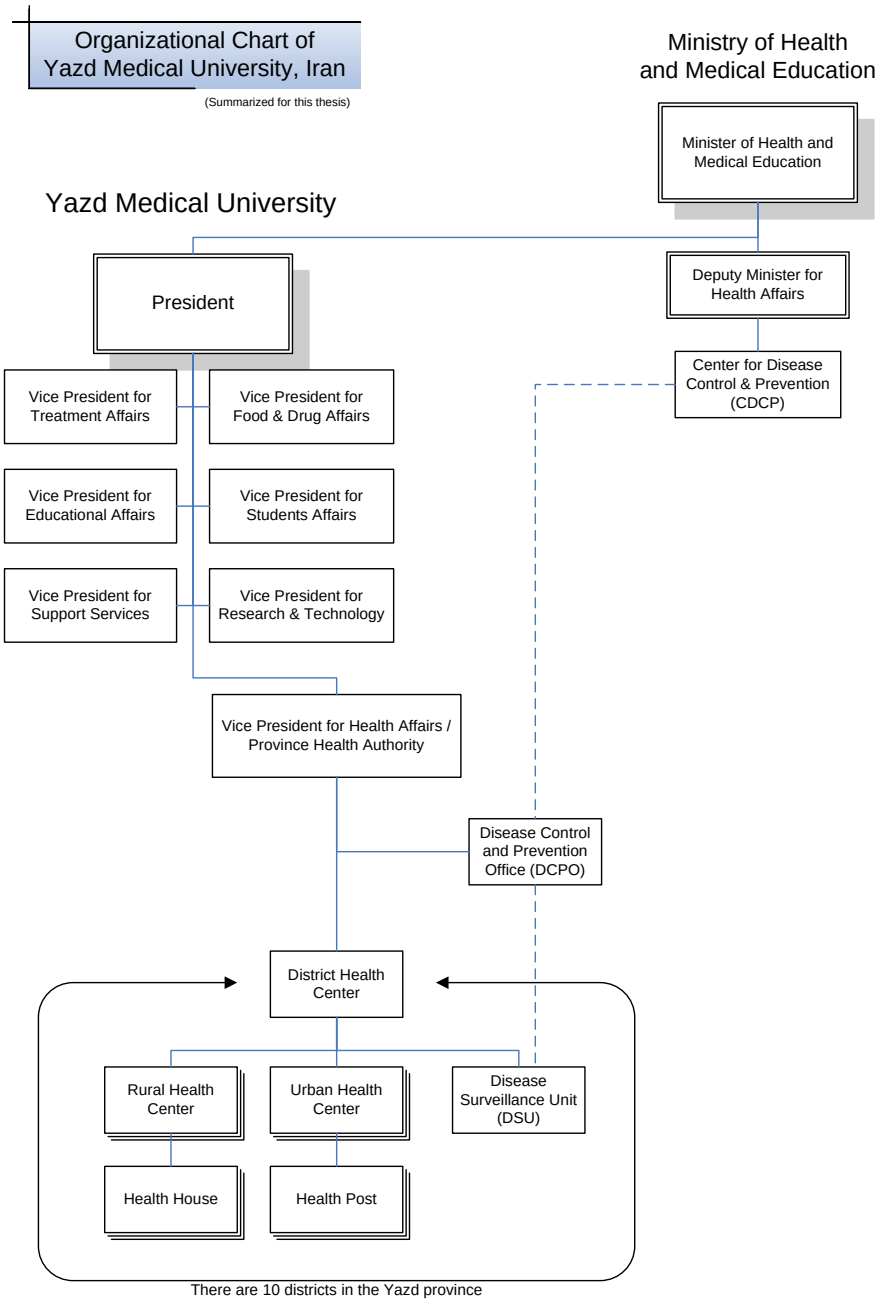
Annexes

Annex I. List of National Notifiable Diseases in Iran

Acute flaccid paralysis
AIDS
Bone and cartilage malignancy
Breast cancer
Crimean-Congo haemorrhagic fever (CCHF)
Cholera
Diphtheria
Epilepsy
Gonococcal infections
Hepatitis
Leprosy
Leukemia
Malaria
Malignant melanoma
Measles
Meningococcal infections
Mumps
Mycoses
Neonatal tetanus
Osteomyelitis
Pertusis
Plague
Rabies
Relapsing fever
Rubella
Severe Acute Respiratory Syndrome (SARS)
Syphilis
Tetanus
Tuberculosis
Yellow fever

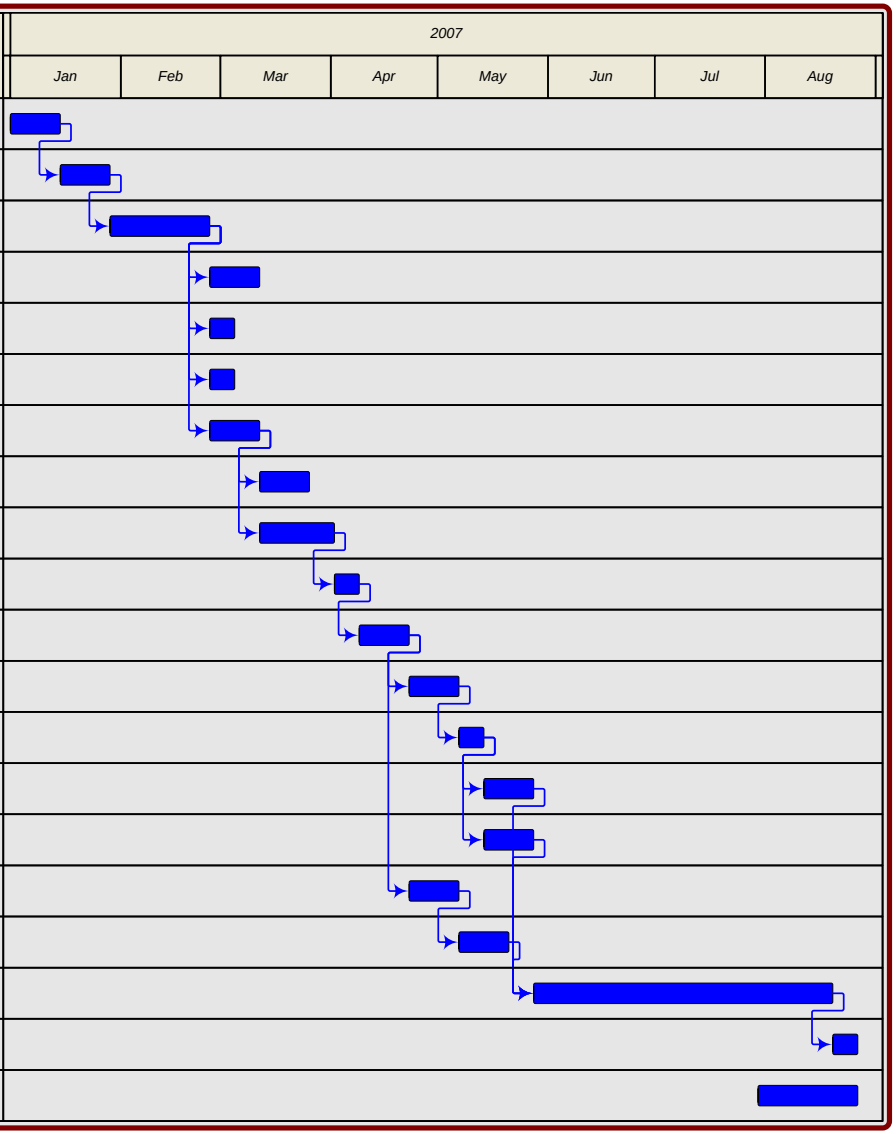
Annex II. Yazd Medical University Organization Chat



Note:

In Iran, the medical university in each province is responsible for all health affairs of the population under coverage.
The province of Yazd is one of 30 provinces of Iran, which is divided into 10 districts.
The Province Health Center of Yazd supervises 10 district health centers which cover 51 urban health centers and 41 rural health centers in this province.

ID	Task Name	Start	Finish	Duration
1	Presenting the Proposal to the YMU	1/1/2007	1/14/2007	2w
2	Organizing the Steering Committee	1/15/2007	1/28/2007	2w
3	Getting Approval from MOHME	1/29/2007	2/25/2007	4w
4	Negotiating legal issues with MOHME	2/26/2007	3/11/2007	2w
5	Reporting the Plan to WHO-EMRO	2/26/2007	3/4/2007	1w
6	Introducing the Plan to MPO and the IT Council of the province.	2/26/2007	3/4/2007	1w
7	Introducing the Plan to the University Managers and IT Committee	2/26/2007	3/11/2007	2w
8	Negotiating Legal Issues at YMU	3/12/2007	3/25/2007	2w
9	Introducing the Plan to the Province and District Health Centers	3/12/2007	4/1/2007	3w
10	Organizing the Exec. And Tech. Team	4/2/2007	4/8/2007	1w
11	Adapting the Workflow Algorithm to the New Situation	4/9/2007	4/22/2007	2w
12	Negotiation Technical Issues with MOHME-CDC	4/23/2007	5/6/2007	2w
13	Identifying Software Requirements	5/7/2007	5/13/2007	1w
14	Determining the Software Specification	5/14/2007	5/27/2007	2w
15	Determining the Hardware Specifications	5/14/2007	5/27/2007	2w
16	Developing a Feedback System	4/23/2007	5/6/2007	2w
17	Identifying Other Needed Facilities	5/7/2007	5/20/2007	2w
18	Ordering/Purchasing Software, Hardware and Other Facilities	5/28/2007	8/19/2007	12w
19	Training of the PDA Users	8/20/2007	8/26/2007	1w
20	Evaluating the Current Situation	7/30/2007	8/26/2007	4w



Annex III: Preparation Pase Timetable

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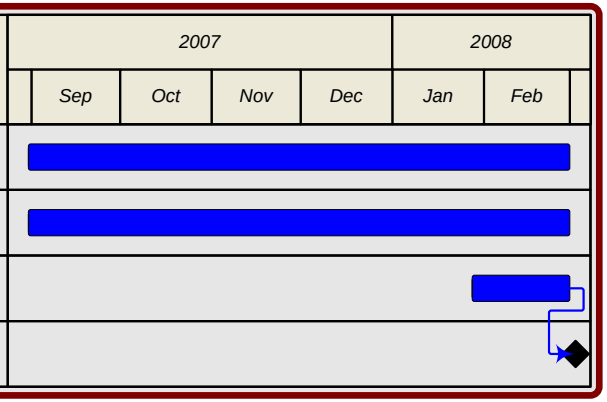
ID	Task Name	Start	Finish	Duration
1	Running Pilot Phase	8/31/2007	29.02.2008	26,2w
2	Monitoring the Project	8/31/2007	2/29/2008	26,2w
3	Evaluating the Project after 4 Months	1/28/2008	2/29/2008	5w
4	Switching to the PDA-based System	3/3/2008	3/3/2008	0w



Annex IV: Pilot Phase Timetable