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Impact of Information and Communication Technology on Healthcare in Health Centers in the West Bank - Palestine

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الاقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Impact of Information and Communication Technology on Healthcare in Health Centers in the West Bank – Palestine

أثر تكنولوجيا المعلومات والاتصالات على الرعاية الصحية في المراكز الصحية في الضفة الغربية – فلسطين

اقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وان هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب:**

Signature: **التوقيع :**

Date: **التاريخ :**

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Abbreviations

ASP	Active Server Page
CIO	Chief Information Officer
CMR	Computerized Medical Records
CPOE	Computerized Physician Order Entry
CPR	Computer-Based Patient Records
DMR	Digital Medical Record
EHR	Electronic Health Records
EMR	Electronic Medical Records
EPR	Electronic Patient Records
HIS	Health Information System
LIS	Hospital Information System
MOH	Ministry of Health
PHI	Patient Health Information
PHR	Personal Health Records
PII	Personal Identifiable Information
PMR	Patient Carried Medical Records
SMS	Short Message Service
WHO	World Health Organization
HL7	Health Level Seven International
XML	Extensible Markup Language
CDA	Clinical Document Architecture
RIM	Reference Information Model

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Abstract

Information and communication technology (ICT) is arguably the most rapidly growing segment of the world ecosystem, and it plays a major role in most of our activities, either in the work place, business, personal life …etc. One of the great benefits might be gained from ICT is improving efficiency and quality of healthcare service. This research aimed to explore the benefits which can be gained from involving ICT in healthcare sector. Furthermore, this research aimed to assess the impact of ICT on healthcare from perspectives of health workers who work in Palestinian health centers. To gain the research purpose, the researcher developed a questionnaire based on the available literature and related studies, then the researcher distributed this questionnaire on a sample of health workers in health centers. The methodology used in this research was an analytical descriptive method depending on two basic types of data (primary & secondary); primary data which obtained from distributing the questionnaire on the research sample, and the secondary which was from the literature review. To analyze the primary data and get the research results, the researcher used SPSS software version 19. This research selected the Electronic Health Record (EHR) system as a tool of ICT to be assessed in Palestine. The main variables which were directly assessed in

this research are (Time, Cost, Effort, and Safety). Results of the research showed that there is highly approval degree among the research respondents about the impact of EHR on healthcare by saving time, effort, cost, and improving safety. Depending on the research results and findings, the researcher developed a proposed model that explains the impact of EHR on healthcare. The researcher sees that the proposed model can be helpful in future researches that aim to evaluate or assess HIS such as EHR or any other tools of ICT in healthcare service. The model also gives the reader a quick understanding about the impact of EHR on healthcare.

As a final result of this research, the researcher found that implementing and using an Electronic Health Record (EHR) system in health centers can affect the healthcare service positively by the following benefits.

- Saving in Time, Effort, and Cost.
- Improving patient safety and quality of care.
- Supporting Decisions.
- Increasing efficiency.
- Increasing patient and health workers satisfaction.
- Improving health center image.

By the end of the research, the researcher set some recommendations to Palestine ministry of health and all of health centers in Palestine, and

emphasized on the importance of increasing the adoption level of EHR and other ICT tools in their centers and putting them in an integrated model. It is also recommended to increase the training and educational programs in ICT for health workers. Finally the researcher recommended that other researchers conduct further studies about the ICT in healthcare.

Chapter One
Introduction

1-1 Overview:

Without a doubt, all people agree with the importance of healthcare service in our life all over the world which must be delivered to anyone with high quality. Besides that, it is almost agreed that the information systems and communications technologies play a major role in most of our daily activities. Healthcare is a clear example of those which are affected by ICT as it could be approved later in this research. The situation in Palestine seems to be not different in term of the impacts of ICT on healthcare when it is compared with the rest of the world, but the difference is that the technology adoption in health sector is still primitive if we compare it with the developed countries.

ICT is arguably the most rapidly growing segment of the world ecosystem (Akadiri, et al., 2009). The birth of ICT as well as the increasingly rapid development of both have changed the face of the world we live in. ICT enables people to communicate with themselves around the world directly and at the same moment, and to gain access to global libraries, information resources, and numerous other benefits and opportunities. Also another great benefit gained from ICT is the improving efficiency and quality of healthcare service (Idowu, et al., 2003).

The needs for improving the efficiency and quality of healthcare service comes from the increasing of population and the high importance of

this service and its impact on human health. ICT has been identified as "a vehicle with the potential to improve the quality of healthcare systems as well as the efficiency of health workers" (Idowu, et al., 2003).

Healthcare industries current issues focus on the improvement of the quality of treatment and patient satisfaction. Information technology could be possible to improve efficiency in healthcare by using adequate systems. Information systems can improve the availability, completeness, reduce failures, and enhance the orientation of comprehensive documents (Schweiger, et al., 2007). “Over the last two decades, information technology has advanced at an unprecedented rate, growing the overall complexity of healthcare services’ production and provision” (Kostagiolas , & Zimeras, 2008).

1-2 Problem Statement

While the preparation of this research, at the first the researcher performed exploratory research and noticed -in general- that the knowledge in the importance of using ICT tools to improve healthcare between health workers in Palestine was inadequate, and this may refer to the lack of studies provided in Palestine that focus on the impact of these tools on healthcare.

As we will see later in this research, healthcare service is affected directly by using of ICT in the health centers that provide the service. In term of the above mentioned problem, there is a need to explore the

available common important ICT tools founded in the literature, which can be used to help centers to improve their healthcare process.

Empirical evidence by assess the role of ICT tools and its impact on healthcare in health centers is also needed to encourage the centers to increase the adoption of such these tools and using it in optimal usage.

As for the above mentioned statement, the research aimed to understand, analyze, and assess the using of ICT in health centers in Palestine. Also to shows the impact of the usage of it on healthcare service.

1-3 Research Questions:

The research aims to answer the following questions:

1. What is the level of using Electronic Health Record (EHR) system in Palestine?
2. What is the impact of using Electronic Health Record (EHR) system on healthcare in Palestinians health centers?
3. What are the main challenges which face health centers in implementing or using Electronic Health Record (EHR) system?

1-4 Research Objectives

Going back to the research problem statement, the researcher intended to divide the objectives of the research into two dimensions:

1. **Theoretical Objectives**

   - Prepare a theoretical framework; study and review main concepts of information and communication technology.
   - Prepare a theoretical framework; review the use of information system and communication technology in health sector.
   - Prepare a theoretical framework; review the importance and impact of using Electronic Health Record (EHR) system on healthcare.

2. **Empirical Objectives**

   - To determine the current level of using Electronic Health Record (EHR) system in Palestine.
   - Study and asses the impact of implementing and using Electronic Health Record (EHR) system on healthcare service in Palestine.
   - Explore the challenges which face health centers in implementing and using Electronic Health Record (EHR) system.

1-5 Research Importance

1- According to the Researcher

The researcher is concerned and interested in the subjects of ICT, and information systems, especially which are implemented and used in health sector, since he believes on the importance of improving healthcare service.

He considers the health information systems as a good source to improve healthcare.

The researcher anticipates from this research to enrich his practical and scientific knowledge in the research field.

2- According to Other Researchers

The researcher hopes from this research to be a good source of information and knowledge to other researchers, and also to be a trusted reference to them for their researches.

3- According to Health Centers

The research has a great importance to health centers since it makes them realize and understand the importance of implementing and using health information systems in their centers, which comes from the impact of these systems on healthcare; the major service they offer.

4- According to Palestine

The increasing of population and the importance of healthcare service in our life make this research very important to the country. Consequently, there is a need to search for methods to improve the service.

The Palestinian ministry of health is now going in implementing a heath information system in their health centers. Until now there is no single research which studied the impact of this system. This research is important for the ministry since it assesses the impact of the information

system on healthcare service, and its result may support the ministry decisions.

1-6 Research Limitations and Challenges:

ICT is a broad term which includes lots of tools that are very difficult and even might be impossible to be discussed in one research. By exploring the literature, the researcher found to some extent somewhat similarity in the impact on healthcare among most of technology tools. Since the main aim of this research is to assess the impact of using the technology on healthcare and for the previous reasons, the researcher intended to limit the research by focusing on just one tool that is Electronic Health Record (EHR) system. More details about this limitation can be founded later in the next chapter (2) of this research.

Available literature was poor with models that directly asses the impact of ICT on healthcare and this may affect the results of this research and also lower the reliability of the proposed model that will be designed by the researcher.

Political situation and Israel occupation restrictions, in addition to the internal division between Fateh and Hamas, shaped a barrier to reach health centers in Gaza, and this forced the researcher to limit the study on health centers in West Bank.

The researcher faced challenges in collecting the completed questionnaires from the employees in the sample health centers as a result

of heavy of workflow, and some of them were not interested in filling the questionnaire and said “I was busy”.

Some of private health centers have their own information systems, and rejected at the first time to distribute the questionnaire in their centers before they understood the purpose of the study. This required from the researcher to make a negotiation with the centers managers to persuade them with the importance of the study and it is also doesn’t affect their privacy or anything else.

1-7 Research Methodology

The methodology followed to gain the objectives of this research was analytical descriptive method, which is known as a method that deals with events, circumstances, and practices which actually exist and obtainable for study and measurements without any interventions by the researcher on its happenings. The researcher can interact with these situations, describe and analyze them. This research aimed to explore the role of ICT and its impact on healthcare service in Palestine.

The research depended on two basic types of dada (primary & secondary):

- **Primary data**: is the data that obtained from a structured questionnaire, distributed in health centers.

- **Secondary data**: is the data that obtained from several sources, like books, journals, internet, previous related studies or reports, and other sources and references that are related to the research subject.

1-8 Research Hypotheses

The research aims to test the following hypotheses:

- **Hypothesis One**: Statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving time (mean of Time domain less than 3.41).
- **Hypothesis Two**: statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving effort (mean of Effort domain less than 3.41).
- **Hypothesis Three**: Statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving cost (mean of Cost domain less than 3.41).
- **Hypothesis Four**: statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by improving patient safety (mean of Safety domain less than 3.41).
- **Hypothesis Five**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to gender variable.

- **Hypothesis Six**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to center type variable.

- **Hypothesis Seven**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to supervision degree variable.

- **Hypothesis Eight**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Age variable.

- **Hypothesis Nine**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Educational Level variable.

- **Hypothesis Ten**: There are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Nature of Work variable.

- **Hypothesis Eleven**: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Experience Years variable.

- **Hypothesis Twelve**: there are no statistically significant relationship at the level ($\alpha \leq 0.5$) between the perceived impacts of EHR and the adoption level.

- **Hypothesis Thirteen**: there are no statistically significant relationship at the level ($\alpha \leq 0.5$) between the perceived impacts of EHR and the perceived obstacles.

Chapter Two
Literature Review

2-1 Introduction

2-1-1 Preface

Healthcare is an important element of the public sector (Bennani, et al., 2008). It becomes clear that health sectors all around the world are "overburdened and under severe pressure " (Clemensen, et al., 2011).

The healthcare sector is currently under strong and growing pressure to collaborate and coordinate more efficiently across geographical, institutional, disciplinary and professional boundaries (Jæger & Monteiro, 2005).

There are many issues in improving the healthcare like that which is focusing on the improvement of the quality of treatment and patient satisfaction (Schweiger, et al., 2007).

2-1-2 Healthcare System

Healthcare systems can be defined as the institutions or organizations that provide for various health care treatments including equipment, residential care along with other facilities for treating the patient. But in today's world there are so many different options for health care systems available that the choice can often be very confusing (Byrnes, 2009).

WHO (2007) in a broad term defines the health system as “A health system consists of all organizations, people and actions whose primary intent is to promote, restore or maintain health”.

The health care system has changed and is continuously changing. Patients are living longer and chronic illnesses and health problems as chronic pain, obesity and diabetes 2 are increasing (Eide, et al., 2010).

Medical services are joint activities that involve a number of participants (e.g. physician, nurse, technologist, pharmacist, etc.) who work towards a common goal of providing healthcare. Clinical activity is not only a highly cooperative process, but also safety-critical, distributed over time and space, and characterized by high complexity and coordination demands (Taneva & Law, 2007).

Healthcare is characterized by the complexity (Bennani, et al., 2008), and also by a broad spectrum of different actors such as service receivers, service providers, and health insurance agencies. Patients receive services which are provided by numerous individuals and institutions and include healthcare professionals, hospitals, outpatient care services, rehabilitation services, and drug stores (Schweiger, et al., 2007).

2-2 ICT in Healthcare

Over the last decade, there were advances in ICT average. And for that they became a promising tool to develop and organize new ways of providing efficient health-care services. This has resulted in a dramatic

increase in the use of ICT applications in health care, collectively known as E-Health (WHO, 2004).

"*eHealth is the use, in the health sector, of digital data -transmitted, stored and retrieved electronically- in support of health care both at the local site and at a di*stance". (WHO, 2004)

Healthcare ICT is thought to have the potential to transform healthcare delivery and improve the quality of care (Viitanen, 2009), and it is already important in the healthcare sector for information gathering and retrieval. Furthermore, the integration of ICT and healthcare has brought a lot of potential benefits (Omary, et al., 2010) as we will see later in this chapter sec. (3-4).

2-2-1 ICT Adoption in Health Sector

The integration and assimilation of e-Health into the everyday life of healthcare workers is becoming a reality in developing as well as developed countries (WHO, 2004)

Modern ICT is being taken into usage in the Healthcare sector at an increasing pace (Suomi, 2000).

Today, hundreds of healthcare information systems are used in hospitals to serve numerous groups of healthcare professionals in their daily work with patients (Viitanen, 2009).

In spite of the global economic recession, healthcare providers are continuously investing considerable resources in healthcare ICT (Viitanen, 2009). And there are increasingly used of the technology in healthcare delivery around the world, such as internet portal and short message system (SMS) (Kahn, et al., 2010). Omary et al. (2010) support this, when he explored several of developed countries around the globe that have invested "huge amount of money for stimulating e-healthcare adoption".

2-2-2 ICT Adoption Arguments

Sequist et al. (2008) claimed that "the comprehensive use of health IT has not become widespread, and the benefits of electronic health records and other forms of health IT to improve the health of the population have not been realized", Bennani et al. (2008) agreed them and said that the adoption of such technologies in healthcare industry is still very slow, compared with other industries.

Nicola & Jarke, (1998) see from ICT as a major factor for economical and social development, but it is also still underdeveloped in many developing countries, Omary et al. (2010) here also support this and they mentioned that the developing countries are still depend on traditional healthcare setup.

2-2-3 Motivations to Increase the Adoption of ICT and the Future of Healthcare with it

The use of ICT is a part of future healthcare (Clemensen, et al., 2011), and it is likely to become more important (Marrow, 2008), moreover it is expected to have the capacity to empower patients and enable them to become active participants in their healthcare (Viitanen, 2009).

Viitanen (2009) sees from the widespread adaptation of healthcare ICT as a factor to have the potential to transform healthcare delivery and change the traditional roles and responsibilities of healthcare professionals. But the question which arises here is what are the factors that help and may also motivate to widespread and increase the adoption and usage of ICT in healthcare sector? From literature the researcher explored the following factors:-

- Continuing advances in ICT, this led to rapid increasing in the applications of computers in medicine, also get the potential to revolutionize healthcare (Kapur, 2001).
- The decreasing cost and size of sensors, monitors and other equipment (Gupta, 2006).
- The increasing bandwidth and pervasiveness of communication networks, including ad-hoc and sensor networks, opens up new opportunities for transferring medical information faster through both wired and wireless systems (Gupta, 2006).

- Patients are shortly in face to face contact with health care personal (Eide, et al., 2010).
- The availability of smallest mobile, wireless and spontaneous networkable IT devices, gives the possibility to access information systems from everywhere and at all times (Sackmann, et al., 2002). And provide excellent opportunities for low threshold counseling using situational feedback for improving patient's self management (Eide, et al., 2010).
- Today, healthcare ICT covers a wide range of systems, applications, and services targeted for a variety of users for diverse purposes of use (Viitanen, 2009).
- With increasing computerization in every sector of activity, ICTs are expected to become tools that are part of healthcare professional practice (Gagnon, 2009).
- Finally, many benefits may be obtained from ICT in healthcare as we will see later in this research.

2-2-4 Challenges Face Healthcare Sector with Adoption and Usage of ICT

There is no work in our life which is completely devoid from challenges or obstacles. This is applied to and found in adoption, implementation, or usage of ICT in healthcare. In this research, the

researcher will explore – in brief - some of what he has found in the literature of several researchers about the topic:

Many countries, both developed and developing, understand the potential benefits of embracing e-healthcare, but there are many challenges -different between countries- to be addressed prior to its adoption (Omary, et al., 2010). So the adoption seems to be "slow and problematic" (Cripps & Standing 2011).

Fortin et al. (2004) mentioned that one of the major reasons why ICT has not become widespread yet is the lack of satisfactory evaluations of these new tools. They also claimed that another major barrier to ICT applications diffusion is the poor evidence on the quality and efficacy in healthcare.

Viitanen (2009) said that the healthcare information systems are a "complex socio technical systems" and it should be understood as it is. The challenge as he defined it as the biggest risk in the development of such systems is the insufficient of understanding the complex of healthcare environments and processes. He also claims that the "new technology benefits the activities only if all participants in the different stages of the healthcare process are able to utilize the technology in an efficient and satisfactory way". Marrow (2008) is not so far from this point and he said that the “Clinical staff need to learn how to use the ICT devices that are becoming an increasingly ubiquitous part of their working environment",

this lead us to challenge of training absence. Gagnon (2009) agreed with them that the “training is a major determinant of ICT adoption by healthcare profession and influences the integration of these technologies into clinical practices". Limited training one of the factors contributing to the so far limited use of the information collected in the computerized HIS (Igira, et al., 2007).

It is obvious when talking about healthcare, it comes to our minds that there is a patient. Additionally to previous, the challenge or barrier is with involvement of the patient with certain technology, so he also must get appropriate training to getting used it (Clemensen, et al., 2011).

Continue with Clemensen et al. (2011) they pointed the following barriers when using via video communication technology:

1. Lacks of the natural flow of face-to-face communication.
2. Hesitation towards self care due to unfamiliarity with the technology.
3. Inadequate video quality and internet connections.
4. Impairments of vision, hearing, psychomotor skills, and cognitive skills.

Return to Viitanen (2009), he claimed that the "successful healthcare information system implementation in healthcare organizations appears to be a difficult task". He highlighted the main challenges related to the use of information technology in healthcare as the following:

a) The complexity of medical data.

b) Data entry problems.

c) Security and confidentiality concerns.

d) The absence of a unique national patient identifier.

e) Lack of awareness of the benefits and risks of information technology.

Omary et al. (2010) explored the challenges that the countries – either developed or developing – facing it in ICT adoption in healthcare, and it was:

1. Lack of patient unique identifier.
2. Lack of funds, low rate of Internet penetration and low bandwidth.
3. Lack of healthcare policies.
4. Lack of acceptable global standards and privacy.
5. Confidentiality and security concerns.

They proposed that the point number two especially the lack of funds was the major problem facing ICT adoption in many developing countries.

Although, a successful implementation of ICT such as Health Information System (HIS) in a developing country is very possible, it is important to realize that the circumstances in developing countries are

different from those in developed countries, which is where most of the experience of, and guidance for, implementing HIS comes from (Malik & Khan, 2009). HIS and especially hospital information systems development in developing countries has proven difficult due to organizational complexity, fragmented and uncoordinated organizational structures all maintaining their own HIS, and unrealistic ambitions (Igira, et al., 2007).

2-3 Information & Communication Technologies Impact on healthcare

2-3-1 Information Technologies in General

The information technology revolution is being described as the most important development in the history of humankind since the industrial revolution (Kapur, 2001).

Literature shows that the "information technology has advanced at an unprecedented rate, growing the overall complexity of healthcare services' production and provision" (Kostagiolas , & Zimeras, 2008).

Information systems are usually designed to serve specific purpose in a specific industry or organization where they are designated (Omary, et al., 2010).

Throughout the healthcare sector, introduction and utilization of information systems is becoming widespread (So & Park, 2011). And have a key role in patient care (Viitanen, 2009).

Healthcare is mainly an information business (Sequist, et al., 2008), and agreed that it is a very information intensive industry (Suomi, 2000; Bennani, et al., 2008; Omary, et al., 2010). Either in paper-based or digital format it depends on the existence of patient health information (PHI) that is collected whenever a patient visits a healthcare center (Omary, et al., 2010). This makes the majority of clinicians' time in gathering, recording, processing, extracting, and transmitting information (Sequist, et al., 2008). Moreover nurses need to have a competence that make them especially well suited for giving health related counseling, often in cooperation with physicians, physiotherapists, nutrition specialists and psychologists in the multi-professional team (Eide, et al., 2010). The right information needs to be provided at the right point of time, in the right quantity, at the right location, and in the right quality (Schweiger, et al., 2007).

HIS can be defined as an information system designed to manage tasks in a hospital (Omary, et al., 2010). The adoption of information systems has in several ways influenced clinical work practices (Viitanen, 2009), and it is essential for the automated processing of accumulated data and to manage patient care procedures (Sackmann, et al., 2002).

Computerized HIS is a direct computerization of the various forms and reporting structures that exists in the paper-based HIS (Igira, et al., 2007), and it can be composed of one or more software components with specialty specific extensions as well as various subsystems in medical fields such as laboratory information systems (Omary, et al., 2010).

Correct and appropriate flow of information is especially important in healthcare (Schweiger, et al., 2007).

An appropriate information and Health Information Systems (HIS) are seen as crucial to strengthen the health system (Igira, et al., 2007), and has already been shown to improve quality, enhancing disease surveillance, decreasing medication errors (Omary, et al., 2010), and supports real-time coordination of distributed hospital resources (Sackmann, et al., 2002).

2-3-2 Communication Technologies Background

New means of communication, such as smart phones and the internet have become widely available (Eide, et al., 2010).

Using communication technologies infrastructure like networks, are important to share information in the healthcare domain as well as in other sectors (Marrow, 2008). For this, many rich countries are investing heavily in the communication infrastructure of their healthcare delivery system (Viitanen, 2009).

Clinical and administrative staffs in hospitals have to deal with information about their patients from a variety of sources, and in a variety of forms (Marrow, 2008).

Different departments in hospitals have to communicate with each other and with primary care that typically provides the link between patients and the hospital (Marrow, 2008). Since the services provided can

be further broken down as there are highly specialized actors in disciplines (Schweiger, et al., 2007), this means sharing information about patients between healthcare workers (Eason, 2009).

Collaboration between individuals is important for the effective functioning of organizations. Network properties are useful when thinking about efficient ways to share information (Marrow, 2008).

Interconnecting the health facilities by a communication network has the potential to improve the public health care system (Nicola & Jarke, 1998).

Improved communication between healthcare professionals and patients has the potential to improve the citizens' health and manage their diseases (Viitanen, 2009).

The delivery of complex services, such as healthcare, involves the co-ordination of contributions from many professionals and necessitates work across many organizational boundaries (Eason, 2009). Also, "experience has shown that apart from referrals, patients that consult a health facility have stayed at a different hospital or health center at a previous time for a different reason" (Nicola & Jarke, 1998). So, coordination using good communication is needed to control the activities from several working groups involved in healthcare process, in order to provide accurate diagnoses and effective treatment for the patient (Schweiger, et al., 2007).

Communication and coordination mechanisms are direct or mediated by e-Health technologies. E-Health systems facilitate diagnosis, provide channels for communication, and allow data acquisition, processing, storage and sharing (Taneva & Law, 2007).

Nicola & Jarke (1998), see from a distributed information system as a "valuable tool for regional or countrywide disease surveillance and supervision of the public health status".

2-3-3 ICT Applications and Tools in Healthcare

2-3-3-1 Introduction

Dixit et al. (2008) classified the ICT tools used in healthcare as e-health into two distinct forms: **Synchronous communication (Real Time)** and **Asynchronous (Store and Forward)**

Synchronous (Real Ti me): Synchronous communication refers to the mode of communication where the transfer takes place simultaneously. For example; video or audio conferencing using standard phone, mobile phone, or satellite communication.

Asynchronous(Store and Forward) : A mode of communication where the transfer takes place over a period of time, or in separate time frames, not requiring the transmission to take place simultaneously. For example e-mail.

In healthcare industry, there are a lot of ICT tools or applications used in, to deliver the service. Many of these tools are integrated by default or also closed together, for example; e-mail and web portals are underused of the internet, also e-mail can be found in telemedicine. Another example, if we considered telemedicine and m-health as separate applications, not a synonyms terms of ICT usage. We found that the mobile phone is an enter tool of both.

What we can say here is that the benefits of using different tools seem to be similar and give the same impacts. Since the aim of this research is to discuss the impact of ICT in healthcare, and for the previous reason, the researcher saw to abbreviate the study and just discuss the following tools – with focusing in more details on EHR since it selected as a tool to be assessed empirically in this research- regarding of classifications or underlying, to be a preface for the next section of this chapter that will discuss the beneficial impacts.

Tools are:

1. Internet.
2. Electronic Mail (E-Mail).
3. Health Web Portals.
4. Electronic Health Records (EHR).
5. Telemedicine or Telehealth.

6. Mobile Health (M-health).

7. Mobile Phone.

2-3-3-2 Internet

Internet and computer technology will play a larger role in the future health care (Eide, et al., 2010).

The Internet and the information society are creating a new era in which information and knowledge are emerging as basic values, requiring novel management paradigms (Kostagiolas & Zimeras, 2008).

With its capacity to allow inexpensively retrieval of information anywhere, anytime, Internet is already creating strong physician-patient relationship (Omary, et al., 2010).

The Internet, with its powerful penetration and scalability, has become an increasingly popular medical information resource (Kapur, 2001). It has made once specialized information, including medical information, widely available (Kahn, et al., 2010).

There are over 100,000 Web sites worldwide with varying quality of health information that is used by consumers and professionals. Additionally, several hundred million people worldwide use the internet (Harrison & Lee, 2006); to search for health information and best practices (Alpay, et al., 2004).

The speed with which new technologies and treatments are being developed means that many clinical providers are dependent on the Internet (Harrison & Lee, 2006), to obtain information about advances in medical practice, clinical best practice guidelines, and information on rare diseases, even in physically remote areas (Kahn, et al., 2010).

For patients, self management seems to be an important feature (Eide, et al., 2010). Accessing information through Web surfing allows patients to learn more about medical conditions (Kahn, et al., 2010), but it is not sufficient for all patients (Eide, et al., 2010), since the use of internet may be affected by the type of demographic groups like age, sex, level of education, level of income,…etc. (Atherton, et al., 2010).

2-3-3-3 Electronic Mail (E-Mail)

E-mail is the most popular and straightforward form of Internet use. This form of consultation is well suited for non-emergent situations and sometimes for second consultations. Consumers can store their medical records electronically and transmit it if necessary to anyone, anywhere and at any time (Dixit, et al., 2008).

The use of email in health care is increasing (Atherton, et al., 2010), and it has the potential to enhance the professional relationship both between physician and patient, and among physicians of the same and different specialties (Kapur, 2001).It has been used for the management of

appointments and to provide test results (Atherton, et al., 2010), by transferring images and notes (Clemensen, et al., 2011)

E-mail communication can provide an opportunity for patients with Internet access to email questions and receive responses from their physicians (Harrison & Lee, 2006). Likewise, the availability of email and the Internet has allowed the general public to participate actively in their own health care (Atherton, et al., 2010).

Healthcare providers often have limited time to spend with their patients (Alpay, et al., 2004), so many patients find it convenient to consult their doctors and seek appointment using the e-mail format (Dixit, et al., 2008).

Information provided by a clinician via email or from a website recommended by a clinician can be beneficial since it is much more detailed than can be conveyed in a short consultation or a brochure. Patients can read such information in their own time and keep it for reference (Atherton, et al., 2010).

2-3-3-4 Health Web Portals

Active Server Pages (ASP) is very popular on the health web sites. With it a patient is able to interact with the web-site pages and gets an answer to his question or problem instantly. The website program analyses the data fed by the patient and gives advice regarding the necessity or urgency to see the physician (Dixit, et al., 2008).

Designing and implementing health web portals with Web-based data entry and storage, allow for large databases to be available online (Kahn, et al., 2010). And provide an all in- one medium for image, sound, and video. So we can say that it is the best method of electronic publishing (Kapur, 2001).

Health web portals are one of ways of e-health adoption that can improve the quality of care to patients (Omary, et al., 2010). And it can be defined as the using of the Internet and interfaces designed for presenting health records, where a patient's data can be transmitted to physicians, the patient at home, and other health care providers (Meingast, et al., 2006).

The changing nature of the population has led to policies seeking to reduce the dependence of healthcare activities on hospital-based care (Marrow, 2008), and get patients' involvement in their own care, whereby patients take an active role in deciding about and planning their care (Alpay, et al., 2004).

New web services and interactive interfaces can assist the process of self-care and possibly self-diagnosis in certain circumstances, giving an indication of what path to follow next, and whether to involve clinical professionals (Marrow, 2008).

With the presence of health web portals, patients can search for medical and related information hence improving their knowledge regarding healthy lifestyles, health and self treatment. Additionally,

physicians can search for health information on the web for education and research (Omary, et al., 2010).

Web information prescriptions may provide a method of obtaining high quality information on a relevant topic, e.g. smoking cessation. A Web Information Prescription is defined as a "list of validated web addresses given to a patient regarding a particular health problem so that the patient can go away and look up relevant information in their own time" (Atherton, et al., 2010).

2-3-3-5 Electronic Health or Medical Records (EHR, EMR) – General Overview

Electronic medical records, which are the most crucial component of hospital information systems, improve the accessibility of medical information and contribute to the readability and completeness of records, allowing users to search for and use information with more ease through greater integration of information (So & Park, 2011).

Many of researchers define and refer to EHR using different terms, such as computer-based patient records (CPR), computerized medical records (CMR), patient carried medical records (PMR) electronic patient records (EPR), electronic medical records (EMR), personal health records (PHR) and digital medical record (DMR) (Omary, et al., 2010).

The collection of patient health information (PHI) for paper-based or traditional healthcare setup is different from the collection when records

are in digital form. The latter is also referred to as e-healthcare. Contrary to paper-based healthcare setup where PHI is collected every time a patient visits a healthcare center, in e-healthcare physicians collect Personal Identifiable Information (PII) only once and frequently update its related medical records (Omary, et al., 2010).

It is very hard for healthcare workers, often spread between sites and organizations, to share bulky paper-based patient records but it is possible for them to access up-to-date electronic records of patients. In theory, therefore, moving from paper-based to electronic records should make possible the sharing of patient information and lead to the delivery of better coordinated care for patients (Eason, 2009).

Electronic patient records take the current paper-based documents and convert them to a digital format so they are available electronically. The records include different types of data, such as physician's notes, and clinical lab results (Meingast, et al., 2006).

Included in EHR is the information relating to a patient demographics, past medical history, progress reports, problems that the patient was or is facing, medication, laboratory data and radiology reports (Omary, et al., 2010).

Healthcare professionals use patient records as their principal information repository. In primary, secondary, and tertiary care, EHR are

used for purposes of setting objectives, planning patient care, documenting the delivery of care, and assessing the outcomes of care (Viitanen, 2009).

Theoretically, with the adoption of e-healthcare where patient's EHR are readily available anytime in e-healthcare information systems, physicians will be able to attend more patients compared to the physician working in a traditional healthcare setup (Omary, et al., 2010).

In the past the nurse would have to ring the clinic in the home community of the patient to get relevant documents faxed or read out over the phone. The electronic records have made this practice virtually obsolete (Cripps & Standing, 2011).

The electronic medical record (EMR)/ electronic health record (EHR) is becoming an integral component of many primary-care outpatient practices (Holyroyd-Leduc et al., 2011).

Today EHR is widely adopted in rich countries (Viitanen, 2009). It has been identified as the core application; as it provides electronic patients records which are input to other e-healthcare services (Omary, et al., 2010).

Several countries have implemented successful programs to promote the use of the EMR/HER within primary care, and the financial commitment by governments to support health information technology continues to grow (Holyroyd-Leduc et al., 2011).

Many developed countries, have invested considerable amounts of money in the development of electronic health record (EHR) systems and national health record infrastructure (Viitanen, 2009).

This huge investment by developed countries is motivated by the problems associated with the traditional healthcare setup such as duplication in patient's records, time wastage while preparing new records and increase in cost of delivering care due to duplication of tests and procedures. Such problems associated with the traditional healthcare setup can result in a PHI which is inaccurate, incomplete, outdated and irrelevant to physicians priority tasks and thus not helpful in healthcare management decision making (Omary, et al., 2010).

More details about EHR will be discussed later in this chapter.

2-3-3-6 Telehealth or Telemedicine

Telemedicine refers to the use of telecommunications and information technologies for the provision of healthcare at a distance (Dixit, et al., 2008). Where the healthcare provider and patient are geographically separated (Omary, et al., 2010).

Telemedicine can be as simple as two healthcare professionals discussing a case over the telephone or as complex as using satellite technology and video conferencing equipment to conduct a real-time consultation (Omary, et al., 2010).

The rapid advances in the frontiers of telecommunication and information technology gave birth to Telemedicine where medicine has merged with technology to benefit patients who does not have access to advanced health care especially for the rural and underserved populations (Dixit, et al., 2008).

Telehealth, including telemedicine, programs are feasible for the education and involvement of patients in their own illness and for motivating them to engage in self-monitoring (Clemensen, et al., 2011).

Particularly synchronous Telehealth, i.e., Tele-consultation using video-communication, allows for a dialogue between e.g., patient visiting, nurse, and expert, through which the patient becomes empowered and more actively involved in the planning of his or her care. Asynchronous Telehealth (e.g., utilizing and transferring digital images in ulcer care), on the other hand, results in easily accessible visual data that allow patients to follow the progress of their treatment, which gives a significant psychological boost (Clemensen, et al., 2011).

2-3-3-7 Mobile-Health (M-Health)

WHO (2011) defined M-Health as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices" (WHO, 2011).

Kahn et al. (2010) defined M-Health as the "use of portable electronic devices for mobile voice or data communication over a cellular or other wireless network of base stations to provide health information".

"Rapid advances in mobile technologies and applications, and the continued growth in coverage of mobile cellular networks, a rise in new opportunities for the integration of mobile health into existing e-Health services" (WHO, 2011).

Interest in the adoption of wireless and mobile technologies has recently increased in the healthcare ICT development domain (Viitanen, 2009). WHO implemented a survey to its member states and the survey found that most member states use M-Health initiatives: 83% of the 112 participating member states reported the presence of at least one M-Health initiative in country (WHO, 2011).

Mobile technology is widely used in hospitals today, and the deployment of further ICT suggests that more mobile devices will be used in the near future (Marrow, 2008).

The role of wireless infrastructure in healthcare applications is expected to become more prominent with an increasingly mobile society and the development of mobile and wireless networks (Viitanen, 2009).

2-3-3-8 Mobile Phones

Mobile phones are the most ubiquitous type of equipment in the world more than any other modern technology (Kahn, et al., 2010).

Physicians have been constantly advising their patients over the telephone sine decades (Dixit, et al., 2008).

New mobile phone technology presents possibilities for new ways of health care counseling not limited to face-to-face encounters or verbal communication (Eide, et al., 2010).

As the technologies underlying mobile phones are becoming more powerful and cheaper, the potential use of mobile phones for the delivery of healthcare services and the promotion of personal health is becoming evident (Viitanen, 2009).

In the future virtual e-health counseling through the mobile phones will be an important feature of health care (Eide, et al., 2010).

2-3-4 ICT Impact on Healthcare (Beneficial Impacts):-

ICT playing an increasingly significant role in healthcare delivery (Viitanen, 2009).

Nowadays, ICT encompass the simple use of applications ranging from simple administrative tools, or technology for assistances prevention, diagnosis, and health monitoring, it covers integrated information tools that allow secure access to personal health data, and includes complex clinical

application that support clinician in diagnosis and treatment, and support citizens in their own environment (Bennani, et al., 2008).

ICT in health is receiving reasonable attention, as their beneficial impact in the quality, access and efficacy of healthcare is getting widely recognized (Altsitsiadis, et al., 2009).

Table (2-1) summarizes the beneficial impacts of ICT in healthcare founded by several researchers:

Table (2-1): ICT Beneficial Impacts on Healthcare

Researcher	Beneficial Impact	ICT Tool
Omary et al. (2010)	• Reduce medical errors • Improve physician efficiency • Improve physician-patient relationship • Reduce cost in delivering care	• EHR • Telemedicine • HIS
Eide et al. (2010)	• Reduce the influence of the chronic illnesses	• M-health
Gagnon (2009)	• Improve information management • Improve access to health services • Improve quality of care • Improve continuity of services • Improve cost containment	• EHR • Internet • Telemedicine
Dixit et al. (2008)	• Improve health status • Reduce health care costs • Empower people • Enhance clinical care and public health services • Reduce health disparities • Better quality of care • better economy of care	• EHR • Telehealth • Health portals • Internet • Other tools
Clemensen et al. (2011)	• Reduce time spent on waiting and commuting • Gives faster diagnosis and treatment • Reduce hospitalizations and visits to the outpatient clinic.	• Telehealth
Gupta (2006)	• Improve efficiency and effectiveness	• ICT in general
Altsitsiadis et al. (2009)	• Enable better cures and better means for early detection of diseases • Improve the quality, access and efficacy of healthcare • Improve decision making • Provide the best health care under the limited budgetary conditions	• Health Decision Support Systems
Viitanen (2009)	• Improve quality of healthcare • Improve efficiency • Improve workflow • Improve productivity • Reduced experiences associated	• ICT in general

Researcher	Beneficial Impact	ICT Tool
Viitanen (2009)	with record keeping • Sharing of information among providers and patients • Provides direct access and instant updates to records • Gives more accurate and better structured clinical data and documentation, automatic sorting and summarization of data • Reduce medical mistakes • Provide continuous improvement in clinical decision making	
Nicola & Jarke (1998)	• Avoid repetition of examinations and lab tests • Saves time • Saves money	• Wireless communication
Bennani et al. (2008) Bennani et al. (2008)	• Provide fast and easy access to electronic health records at the point of need • Support diagnostic • Support surgeons in planning clinical interventions • Provide access to specialized resources for education and training • Allow radiologists the possibility to access images anywhere • Enable the extraction of information for research, management, public health or other related statistics of benefit to health professionals • Reduce errors, waste and rising healthcare costs • Allows health professionals to manage their activities more efficiently by receiving relevant timely updates, and enables them to collaborate and share their knowledge about patients, and ensure that the best coordination is provides	• ICT in general
Schweiger et al. (2007)	• Improve efficiency • Information systems can improve the availability, completeness, reduce failures , and enhance the	•Telemedicine

Researcher	Beneficial Impact	ICT Tool
	orientation of comprehensive documents • Improve satisfactions	
Akadiri et al. (2009)	• Bringing patient closers to care givers	• M-health
Sequist et al. (2008)	• Improve access to patient data, medical evidence, and clinical decision support.	• EHR
Mettler et al. (2008)	• Improve effectiveness, efficiency and quality of health services	• HIS in general
Harrison & Lee (2006)	• Increase efficiency in health care • Improve quality of care • Increase commitment to evidence-based medicine • empowerment of patients and consumers, and the development of new relationships between patients and health professionals • Remove time and distance barriers to the flow of health information	• Internet • Web portals
Kapur (2001)	• Information sharing • Decrease time • Decrease cost	• Internet

Beneficial impact can be concluded as the following points:

1. Increase efficiency and effectiveness of work.
2. Improve communication between stakeholders.
3. Improve collaboration and relationship between stakeholders.
4. Remove distance barriers.
5. Improve information and knowledge sharing.
6. Improve decision making process.
7. Decrease spending time effort.

8. Decrease cost.
9. Decrease medical errors.
10. Decrease data redundancy.
11. Improve medical researches and statistics.
12. Improve administration managements i.e. planning, training and also education.

When examining the previous points, what we can say is that all of them lead us to get final expression that ICT can improve and give better quality of healthcare in efficient way. What is also noticed is that all of points are intersected and related to each others. For example, point 1 may come from all points. Furthermore point 6 may come from points 2,3,5,11, and 12. In the same time, acquiring point 6 leads to benefit of point 9 and 8. The question arises here is this true or not? In this research, it will be discussed how these benefits are intersected and related to each others depending on the research results and findings, and put them in a conceptual model that will describe the relations between them (*See chapter four*).

2-4 Impact of Electronic Health Record (EHR) on Healthcare

Additionally to previous general overview about Electronic Health Record (EHR), which explored in section (3-3-5). This section aims to discuss the EHR in more details, also to understand it deeply, by exploring

its components and functions, benefits, and challenges to show how it can affect the healthcare service process.

2-4-1 Preface

Like any industry, healthcare industry needs to improve information utilization and productivity. Driven by this need, Information Technology (IT) has become pervasive in the healthcare industry (Chismar & Wiley, 2003).

In general, there is an acceptance that Information Technology (IT) is a highly desirable and it is a very necessary component of modern healthcare. Furthermore, there is widespread agreement that IT applications have the potential for revolutionizing the delivery of healthcare by improving the quality of clinical decisions, reducing the incidence of medication errors, and improving health outcomes (Otto, & Kushniruk, 2009).

Healthcare services organizations have invested a lot of money in the research and development of a system that can computerize patient records, thereby satisfying the information needs of care providers who deliver high-quality patient care (Tan, & Payton, 2010).

The prevalence of the Electronic Health Record (EHR), an electronic repository of an individual's lifetime information about their health status and healthcare, is increasing globally among healthcare organizations (Borycki, et al., 2009).

2-4-2 Reason for Selecting EHR Tool

The researcher has chosen EHR tool as a tool to be evaluated and assessed in this research for several reasons:

- Assessing all ICT tools in one research seems to be very hard and even impossible if the researcher wants to study all factors for each of them.
- From the exploratory research, the researcher sees that EHR is the most important and suitable tool to be assessed in Palestine.
- Many of researchers indicated and explored EHR systems as the most important tool of ICT in healthcare industry and mentioned that it has the largest impact on improving the healthcare process.
- Bar-Dayan, et al., (2013) believe that EHR is more important than other technologies in healthcare to improve the efficiency and effectiveness of healthcare providers.
- Borycki et al. (2009) considered EHR system as the most effective means of improving health care delivery and it has had a significant impact upon the quality and safety of healthcare.
- Tan, & Payton (2010) explored that the HER system is the most inclusive and important for direct patient care among other patient-centric management systems evolved in the healthcare services industry.

- Abdul (2008) indicates that “Electronic Medical Record (EMR) system, one of the ICT tools which has potential to solve many concerns and problems that the healthcare system struggling with”.

2-4-3 Definitions

EHR software can be complex. Thus the technology is known by various names, each indicating a specific vision that differs from the others (Tan, & Payton, 2010).

There are many of terms used to define the automation of medical records (return to sec. (3-3-5)). Hristidis (2009) indicated that the both terms (EMR) and (EHR) have become popular synonyms in many circles, although he distinguished between them. He considered EMR as one of several components of an EHR, and defined EHR as a global and complete record of an individual, comprising several types of information.

According to the Healthcare Information and Management Systems Society (HIMSS) in USA, they also believed that the term EHR should be assigned to a global concept and EMR to a discrete localized record (Garets, & Davis, 2006).

Tan, & Payton (2010) discussed that the EHR term has largely replaced older terms such as “computerized patient records” and “electronic medical records. He used the following definitions specified from the U.S. Department of Veterans Affairs:

Computer-based patient records (CPR) as records that are stored in decentralized hospital computer software, whereas electronic medical records (EMR) may be conceived as an enterprise wide system where patient medical histories are captured in a single repository. The EHR term has taken on an even wider connotation in that these systems are also meant to automate and streamline the clinician's workflow, besides having the ability to independently generate a complete record of clinical patient encounters, sourcing data from various care episodes over the lifetime of a patient.

Noticed from the available literature that the term computerized physician order entry (CPOE) was closely related to EHR often functioning as part of it.

A computerized physician order entry (CPOE) system is basically an automated order-entry system that captures the instructions of physicians with regard to the care of their patients. Physicians enter orders in the EHR using CPOE, which has been shown to increase patient safety and improve the quality of care. The system also provides clinical guidelines for physicians and prints summaries of visits for patients, among other services. CPOE orders are disseminated, via computer networks, throughout various parts of a healthcare services facility, such as pharmacy, laboratory, or radiology, as well as to other care providers, including nurses, therapists, and other consulting medical professional staff, who will then follow up on the orders (Tan, & Payton, 2010).

World Health Organization (WHO) didn't differentiate between the two terms (EHR & EMR) and considered them as the same. They define EHR as "An EMR/EHR is a real-time longitudinal electronic record of an individual patient's health information that can assist health professionals with decision-making and treatment. Data found in a record may include patient demographics, past medical history, vital signs, examination and progress notes, medications, allergies, immunizations, laboratory test results, radiology reports, living wills, and a health power of attorney" (WHO, 2009).

In this research, EHR term will be used in the discussion depending on the definition obtained from WHO.

The following section will attain to describe and discuss the main functions of EHR also to get more understanding about it.

2-4-4 EHR Functions and Components

From the definitions discussed before, we can get general perception or understanding about the core components of the EHR system and therefore derive the functions which can be found in it that serve the healthcare process.

Medical Record or Health Record: is a systematic documentation of a patient's medical history and care. The purpose of maintaining the health records of a patient is to allow healthcare providers access to the medical history of the patient and to serve as a basis for planning patient care,

documenting communication between the healthcare provider and any other health professional contributing to the patient's care (Hristidis, 2009).

Literature shows that there were differences in the components or function of EHR system among healthcare organizations. However, the type and extent of electronic health records vary and what one country calls an EHR may not be the same as that developed in another country (WHO, 2006).

The variation in EHR may be because of the inherent complexities of healthcare information needs or the EHR itself. These complexities make it is hard for whom in this sector to understand the product comprehensively (Walker, et al., 2005).

The EHR, which is defined as "a secure, real-time, point-of-care, patient-centric information resource for clinicians" is designed to provide point of access to patient health information where and when it is needed by medical professionals (Davis & Thakker, 2006).

Basically an EHR system has the ability to generate problem lists, document medications, and view test results (Ryan, et al., 2013).

Explored by Hristidis (2009) that the American Health Information Management Association (AHIMA) defines three essential capabilities of an EHR system as the following:

- To capture data at the point of care.
- To integrate data from multiple internal and external sources.
- To support caregiver decision making.

More importantly, the EHR allows health professionals and patients to document, communicate and integrate health information about patients (Borycki, et al., 2009).

An integrated EHR will link all electronic patient records and critical patient care systems so that patient data can be shared and disseminated among authorized clinician users (Tan, & Payton, 2010).

The EHR contains several types of patient data, such as the patient's demographic information, clinical data such as vital signs, medical history, immunizations, laboratory and radiology data, problems and progress notes, accounting and billing records, and even legal documents such as living wills and health powers of attorney (Hristidis, 2009).

The Institute of Medicine (IOM) committee in USA gives a good consideration about the core functions of EHR shown below, which could be helpful to understand the system. These functions are (IOM, 2003):

(1) health information and data **(2)** Result Management **(3)** Order Management **(4)** Decision Support **(5)** Electronic Communication and Connectivity **(6)** Patient support **(7)** Administrative Processes and Reporting **(8)** Reporting and Population Health

Tan & Payton (2010) generally defined six primary modules or components in the system, and specified it as the following:

(1) Computer-based Patient Record (CDR), which offers a comprehensive source for storing and retrieving relevant, reliable, and accurate clinical information.

(2) Clinical Decision Support System (CDSS), which provides rule-based alerts such as warning messages against potential harmful drug interactions when patients are inadvertently placed on two or more potentially interactive medications

(3) Clinical Documentation Module (CDM), which can inform the caring clinician of specific activities taken by other clinicians in managing a particular patient

(4) Computerized Physician Order Entry (CPOE), which will electronically capture the attending physician's instructions so as to help eliminate errors caused by illegible handwritten orders;

(5) Controlled Medical Vocabulary (CMV) module for ensuring that information sourced from various clinical repositories can be easily compared, making it easier to generate proper clinical rules for achieving quality patient care.

(6) Workflow Controller Module (WCM), which manages clinical care processes so that these processes may be sequenced appropriately, executed properly, and executed without omissions.

2-4-5 EHR Importance

Byrd et al. (2013) identified EHR as a key tool to improve quality in health care by maintaining validity, completeness, and timeliness of data provided from it. Moreover, Cimino (2013) proposed EHR as a means for improving availability, legibility, and completeness of patient information

Ryan, et, al. (2013) explored in their study that 92 percent of recent articles found positive results from implementation of health information technology such as EHR.

As discussed before, healthcare is very intensive data industry. Otto & Kushniruk (2009) indicated that there is a general realization amongst all stakeholders involved in the delivery of healthcare that the practice of medicine in today's environment of information overload cannot be effective without the use of technologies that facilitate and enable rapid and efficient access to relevant information.

Increased demands for electronic exchange of data have been driven by both internal and external pressures. Hospitals are comprised of a multitude of specialized departments (Tan, 2008). Moreover, healthcare system is fragmented, and patients may see multiple healthcare providers who may not know what medications are being prescribed by others. Therefore, it

would be helpful to have an integrated medical information system (Chae, et al., 2009).

Without a doubt, there is a growing need to provide the right information to the right person anywhere at anytime in today's global interconnected world. Healthcare industry has been moving toward an electronic health record (EHR) system by the growing of this need (Schvartsman, et al., 2008).

From all of the above points raised the need or importance of EHR, which its purpose is to automate and streamline the healthcare workflow by putting together in a complete record of a clinical patient encounter. Thus, it increases the physician's efficiency, and reduces costs. Moreover, the adoption of EHRs seeks standardization in the representation of clinical information (Hristidis, 2009).

2-4-6 Potential Benefits

Literature was rich in studies which identified the benefits of EHR. In this section, the researcher will give a brief exploratory about the benefits of EHR. Benefits will be more understood by the end of the chapter after exploring the impact of the system on the healthcare service process.

Ryan, et, al. (2013) explored that EHR has a great potential benefits to improve quality of care, such as it can reduce medical errors and improve communication with patients.

Health information technologies are rapidly becoming an increasingly important part of the healthcare milieu and the potential benefits of IT solutions in healthcare have been well documented in the past. Electronic health records in particular offer a wealth of benefits. The ability to capture and maintain patients' histories, examination findings, diagnoses, treatments, allergies, immunizations, and results of investigations makes it possible for health providers to quickly and easily access this potentially lifesaving information at the point of care (Otto, & Kushniruk, 2009).

By implementing an integrated EHR, a healthcare services organization is therefore expected to gain data management speed and accuracy, enhance patient safety and clinical workflow efficiencies, reduce medical errors, and control administrative and medical cost (Tan, & Payton, 2010).

Davis & Thakker (2006) identified from previous researches on EHR systems that reducing medical errors, improving quality of care, conserving physician time, sharing patient information among healthcare practitioners, and workflow efficiency as a main benefits gained from the system.

Other benefits of EHR are the improved interaction between physicians and patients, flagging of potentially harmful drug interactions, and the ability to exploit these electronic records in decision support systems and information discovery systems (Hristidis, 2009).

2-4-7 Paper Record vs. EHR

The past few decades have seen continuing cost acceleration, advancing technologies, and growing competition challenging the healthcare marketplace. To adapt, healthcare services organizations have become increasingly more eager to change from relying on traditional paper-based health data and information processing systems to newer forms of electronic health recording practices so as to ensure greater efficiencies in health data management and effectiveness in clinical decision making (Tan, & Payton, 2010).

Hristidis (2009) identified several advantages of EHR over conventional paper records. And it is:

- The costs of physically storing paper (and other media) records and centralizing them in a convenient location are highly minimized when an EHR solution is implemented.
- The poor legibility and medical errors induced by handwritten medical records is also minimized by the extensive use of terminologies, dictionaries, and abbreviations in EHR.
- Use of EHR systems improves the legibility and accessibility of medical data. It also improves the availability, timeliness, accuracy, and completeness of medical documentation.

According to Walker et al. (2005):

- Expensive, inefficient, paper-based information management processes have become unacceptable in the face of internal performance improvement and external regulatory reporting needs that are increasing steadily in complexity and scope.
- A key advantage of electronic medical records over paper is the ability of the EHR to provide users simplified lists of options, with extended lists (often including hundreds of options) a single click away.
- The EHR can make clinical documentation (e.g., operative notes) available for clinical use far more quickly than before.
- Using the EHR, physicians will be able to enter orders personally from almost any location.

The reason for wanting to change to an electronic system is important. Many persons involved in healthcare today expect to move from a paper to a paperless environment. This is a major step and has only been successfully achieved in a few healthcare institutions to date. Institutions should not focus on just going paperless. They should focus on encouraging departments and healthcare practitioners to move to an electronic system to (WHO, 2006):

- Improve the accuracy and quality of data recorded in a health record.

- Enhance healthcare practitioners' access to a patient's healthcare information enabling it to be shared by all for the present and continuing care of that patient.
- Improve the quality of care as a result of having health information immediately available at all times for patient care.
- Improve the efficiency of the health record service.
- Contain healthcare costs.

2-4-8 Main Variables Affected by EHR

In this section the researcher identifies four dimensions that could be affected by introducing EHR system in any healthcare center and explores what found in the literature about how an effective usage of the system can improve these dimensions.

2-4-8-1 Time

Patients who enter healthcare centers usually follow up sequential processes that begin with admissions, followed by seeing physician to get diagnosis, and ended by getting final medical reports and bills. Between these processes, a patient has to wait in each process until accomplishing the previous one. All of us seek to save time in any work of our life. In healthcare service, the need for saving much more time seems to be more important than any thing in our life. As observed from practice, anyone who visits a healthcare center to get medication has always the will to leave

the center as quickly as possible. At the same time he needs and tries to get much more time with the doctor. As for patients, healthcare professionals are also always hoping to accomplish their task quickly and faster as could as possible for several reasons. According to healthcare centers, saving time is a great benefit for them, and they can get advantages such as increase productivity, save money, and get good public image. The question arises here is, how an EHR system can improve the healthcare process by decreasing time? The following discussion attempts to answer this question.

As mentioned before, the healthcare system is fragmented, and the patient may see several specialists from several departments in the same healthcare center. He may also refer to different specialists in each visit, and sometimes refer to specialists in other centers.

The network benefit of EMR comes from that health centers are being able to exchange information with each other about patients (Acharya, et al., 2013). This is particularly important for patients with chronic conditions who wish to see a new specialist. It is also important for emergency room patients whose records are stored elsewhere (Miller & Tucker, 2009).

We can decompose the benefit of improved patient care promised by EMR technology into a stand-alone and a network benefit. The stand-alone benefit includes shorter hospital stays prompted by better-coordinated care

within the hospital, less nursing time spent on administrative tasks and better use of medications in hospitals (Miller & Tucker, 2009).

Schvartsman et al. (2008) explored in their study that with the existing of EHR there are less printed forms to be filled out by physicians, such as requests for exams and specialist referrals. So they can dedicate more time to patients. His study showed that waiting time for consultation and time spent at emergency departments were reduced. Furthermore, they indicated that an advantage of EHR was the access to previous medical records of patients, which is especially important, since approximately 50% of them - according to their study- have multiple appointments.

Langabeer et al. (2007) see from EHR as a good tool for standardizing the documentation of care, which can help to gain several improvements such as streamlining manual processes and eliminating paper. They indicated that this will lead to quicker acquiring data from patients, higher quality through higher completion of patient encounter forms, and improvement in the scheduling and reservation process.

Virapongse et al. (2008) claim that more than half of the medical error cases were due to diagnostic errors that also may harm patients. Most of these errors occurred because of failure to order diagnostic tests or lack of a follow-up plan. Because EHR and HIT seem to mitigate reliance on cognitive factors through clinical decision support and avoidance of errors

of omission, diagnostic errors may in turn decrease with implementation of such systems. Hence saving time by avoiding reworks the tests.

Several studies found that implementing an integrated EHR system can save time by decreasing patient length of stay in health centers (Cartmill, et al., 2012; Classen, et al., 2007; Wulsin & Dougherty, 2008; Miller & Tucker, 2009).

No one can deny the high benefit of any information system in any industry which is the high speed in retrieving stored data. Healthcare industry seems to benefit from information technology than other industries, since –as mentioned before- it is a data intensive industry. Literature in health informatics was very rich in studies talking about the benefit of EHR in storing and retrieving data with high speed and accuracy (Kuo, et al., 2007; Schvartsman, et al., 2008; Langabeer, et al., 2007; Virapongse, et al., 2008; Ash, et al., 2004)

Availability of data from previous visits and patient's medical history for immediate consultation are quicker requesting and assessment of tests and drugs (Schvartsman, et al., 2008).

2-4-8-2 Effort

When exploring the literature, the researcher noticed that most factors which affect time are the same that affect effort, but in reality if a work is easy, it is not necessary that it could be done fast. For this reason the

researcher has meant to assess the effort separately from the time even though similar factors have been used in both.

Similar to time dimension, EHR can improve healthcare by reducing effort of work through the following points:

1. Best coordination
2. Easy medical orders
3. Easy access to medical records

EHR list all medications together and keep the medication record in an easily accessible format (Kuo, et al., 2007).

The use of EHR with the option to print medication information handouts to supplement physicians' oral counseling seemed to be a feasible practice (Kuo, et al., 2007).

Some times healthcare professionals couldn't arrive their needs from data for reasons such as lost of it or sometimes it would be hard to be found or retrieved (Wulsin & Dougherty 2008). This situation increase the work effort on them since they have to recollect it, and if there is test results retest should be maintain again. EHR appears very helpful to solve this problem by providing easily, accurate, and legible information, and fast accessible to existing records (Langabeer, et al., 2007). Hence data redundancy has decreased which also mean decreasing in work effort.

Additionally EHR could help and easily healthcare service by make it standardized, so it becomes easier to gather data about the patients or any other activities in the service such gathering data for researches and surveys (Schvartsman, et al., 2008).

By sharing data among providers and retrieving data more efficiently, EHR can facilitate workflow and improve the quality of patient care and patient safety (Bar-Dayan, et al., 2013).

EHR system allows records to be easily accessed by multiple parties in health center, which is especially useful in a center where patients might see different specialists on each visit (Langabeer, et al., 2007). Information captured in EHR is useful for both patient care and population-based research (Acharya, et al., 2013).

2-4-8-3 Cost

Expected from EHR that it can improves the quality of healthcare and lower costs in. so it is essential to determine how EHR can reduce the costs in healthcare (Xierali, et al., 2013).

Literature shows clear evidence about the impact of ICT tools such as EHR on decreasing the cost and saving money in healthcare industry. Most of researchers mentioned that implementing ICT in healthcare could improve the service by reducing costs through several ways.

Alder-Miltein, et, al. (2013) believe that cost saving can be gained from implementing HER through improved billing and efficiency, reduced dictation costs, and elimination of paper.

According to Tan (2008), automating the processes of healthcare may reduce costs as less paper is generated, as fewer mistakes are made and as information is transferred faster. Also founded that EHR systems could save up to $81 billion in healthcare costs annually and improve health care quality (Hillestad et al., 2005).

The benefit, to hospitals of adopting EHR is improved quality of patient care which in turn boosts demand for a hospital, and lower administrative costs (Miller & Tucker, 2009). Furthermore Simon et al. (2007) claimed that lowering costs gained from reducing stuff needs in the healthcare center.

Cost cutting by ICT tools such as EHR could be accomplished through lowering costs related to personnel, paper storage, processing, and treatment delays; enhancing safety of patient care; reducing medical errors; and controlling quality to eliminate poor or inadequate care. And because patient data and images can be easily accessed with a click of computer mouse, physicians or other healthcare providers no longer have to search for misfiled paper records or wait for another healthcare facility to send duplicate copies (Tan, & Payton, 2010).

As we will see later in this section, the EHR system has a great impact on decreasing medical errors, and eliminating adverse drug events (ADEs). Kuo et al. (2007) consider this point as a factor that helps in saving money.

Virapongse et al. (2008) agreed with this point and they said: if medical errors were minimized through HIT, significant health care savings would occur through a reduction in tort associated costs.

Discussed before that EHR system can decrease time spending in healthcare process and therefore decrease patient length of stay. Wulsin & Dougherty (2008) see from this point as a main factor in saving cost and increase nurses and doctors productivity. Also mentioned that cost saving could be as a result of improved efficiency and quality and decreases in errors and redundancy (Wulsin & Dougherty, 2008). Moreover, Dorr et al. (2007) identified that the patient visit frequency can measures the impact of EHR on the cost.

2-4-8-4 Medication Safety

The prevention of medication errors is a leading goal among health care organizations in the pursuit of providing quality medical care (Chae, et al., 2009).

Electronic health records have great potential to improve quality and safety in health care (Simon, et al., 2007). One critical use of EHR systems is in preventive care recommendations (Hillestad et al., 2005). EHR systems can integrate recommendations for preventive services in patient

data to identify patients needs (Mehta, et al., 2013). The main benefits of using EHR systems is to reduce drug costs (such as identifying the least expensive drug within a class) and prevent adverse drug events (Bates, et al., 2003).

Schvartsman et al. (2008) indicate that health centers with EHR, is better managed the service in, and the chances for medical error can be decreased.

Langabeer et al. (2007) hypothesized that the use of electronic records can improve clinical quality and patient safety through reduction of medical and medication errors, by improved legibility that should improve communication between clinical workers.

According to Linder et al. (2007), EHR can increase the delivery of guideline-adherent care, improve quality of care through clinical monitoring, and reduce rates of medical errors.

Virapongse et al. (2008) believe that HIT can reduce adverse drug events and improve physician performance in areas such as diagnosis, preventive care, disease management, drug dosing, and drug management. They indicate that the inclusion of decision support into an EHR, physicians can be presented with the relevant guidelines from the onset of ordering treatment and may be more likely to adhere to them. In their study, found that the use of EHR can lead to fewer diagnostic errors,

improved follow-up of abnormal test results, better guideline adherence, and fewer adverse clinical events.

With fully accessible and integrated electronic patient records, and with instant access to up-to-date medical information, faulty decision making resulting from a lack of information can be significantly reduced (Ash, et al., 2004).

Likewise, computerized provider order entry (CPOE) systems and automated reminder systems can reduce errors by eliminating illegible orders, improving communication, improving the tracking of orders, checking for inappropriate orders, and reminding professionals of actions to be undertaken (Ash, et al., 2004). Moreover, EHR help professionals in healthcare by notifying them with abnormal tests and what they have to follow up with this action (Singh, et al., 2013). These benefits could be usefulness if users of the system override the reminders or alerts produced by it and take their own actions (Carspecken, et al., 2013).

HIT can provide knowledge about guidelines and safety, information about patient conditions, treatments and other pertinent characteristics, and reminders to providers at the point-of-care of important quality steps (Dorr, et al., 2007).

Kuo et al. (2007) defined in their study the following medication safety features at the point of care that can be founded in an EHR system:

1) Printable and legible prescriptions with medication instructions.

2) Space to list all medications together.

3) Easily retrievable medication records.

4) Available features to detect adverse drug-allergy, drug-drug, drug-nutrient, drug-vitamin, and drug dietary supplement interactions.

The use of EHR and other similar technologies has been hailed for their potential to decrease errors and improve patient care (Chae, et al., 2009).

2-4-9 Obstacles

Most of researchers indicated that financial factor has the most significant barrier for EHR to be implemented and widespread, since the EHR has a high initial cost.

These potential costs include the upfront costs of software and hardware installation, training and ongoing maintenance. Healthcare executives also complain about another obstacle to EHR adoption: overcoming resistance from physicians. Physicians may not perceive any personal benefits from EHR, and may instead feel that computerization increases their work time and accountability, while hampering their interactions with patients (Miller & Tucker, 2009).

Despite its many benefits, most studies show that CPOE could actually slow down the patient's care management process, increase the time

needed by physicians to complete their work, and inhibit the patient-physician interaction (Kuo, et al., 2007).

According to Schvartsman et al. (2008), they see that the main barriers to implement the electronic system are financial and technical issues.

Kaushal et al (2007) identified the following factors that could be barriers to HIT adoption or expansion:

- Lack of time to acquire knowledge about systems
- Physician skepticism
- Lack of computer skills
- Lack of technical support
- Lack of uniform standards
- Technical limitations of systems
- Start-up financial costs
- Ongoing financial costs
- Loss of productivity
- Privacy or security concerns

Borycki et al. (2009) found that effectively designed and implemented EHR (and their components) can achieve those healthcare gains outlined

earlier in this research. Alternatively, if EHR are poorly designed interfaces, such gains may be lost (Middleton, et al., 2013).

Moreover, EHR require practitioners to perform more computer entries and less handwriting, which is often opposite to practitioners in terms of being productive, a computer order entry may, for example, take twice as long as writing or dictating an order, and practitioners who are not familiar with how the EHR-embedded CPOE functions may experience anxiety, thereby finding difficulty in reviewing his or her instructions stored in the system in front of a coworker or patient (Tan, & Payton, 2010).

There is a perception that the use of the EHR system increases the time spent by clinicians on related activities, this resistance, which is based on lack of familiarity, will diminish as physicians become more proficient with computers (Bates, et al., 2003).

A major obstacle is the initial cost of HER systems, and identifying who will shoulder this investment is difficult. This barrier has been studied by many groups. For example, data entry may take additional time. The learning curve for system usage may be steep. Concern about security and confidentiality of electronic information is another issue and much work remains in the development of access security strategies (Hristidis, 2009).

Any information system (but particularly an EHR) requires a solid infrastructure that can support the software and its users. Also the user

interface must be in clear design to provide easy access to complex information (Walker, et al., 2005).

There are a number of potential scenarios in which the EHR may be unavailable. The specific design of the system determine the most frequent causes of downtime, loss of the main server, a major network outage, or power loss to an entire site (Walker, et al., 2005).

In addition to the above, resistance by some medical practitioners and health professionals generally to a change from manual to electronic documentation may be a problem in both developed and developing countries. Most health administrators and information managers are aware that it may take time to change or at least modify health practitioner behavior and attitudes (WHO, 2006).

2-5 Related Studies

Table (2-2) below, contains a general information about the studies that will be explored in this research.

Table (2-2): Related Studies

#	Author	Title	Country	Year
1	Breen et al.	Information Technology Adoption in Rural Health Clinics	USA	2010
2	DesRoches et. al.	Electronic Health Records' Limited Successes Suggest More Targeted Uses	USA	2010
3	Paula et al.	Impact on Length of Stay After Introduction of Emergency Department Information System	USA	2010
4	Chib	The Aceh Besar midwives with mobile phones project: Design and evaluation perspectives using the information and communication technologies for healthcare development model	Indonesia	2010
5	Borzekowski	Measuring the cost impact of hospital information systems	USA	2009
6	Karen et. al	Health information technology and physician perceptions of quality of care and satisfaction	Australia, Canada, Germany, Netherlands, NewZealand, UK, and USA	2009
7	Malik and Khan	Understanding the Implementation of an Electronic Hospital Information System in a Developing Country	Pakistan	2009
8	Akadiri et al.	Impact of Improved Telecommunication Services on Health Care Delivery in Nigerian Teaching Hospitals	Nigeria	2009
9	Parente and McCullough	Health Information Technology And Patient Safety: Evidence From Panel Data	USA	2009
10	Zhou et. al.	The Relationship between Electronic Health Record Use and Quality of Care over Time	USA	2009
11	Luo et al.	Acceptance of Information and Communication Technologies for Healthcare Delivery	Singapore	2009
12	Garrib et al.	An evaluation of the District Health Information System in rural South Africa	South Africa	2008
13	Welch et al.	Electronic Health Records in Four Community Physician Practices: Impact on Quality and Cost of Care	USA	2007

#	Author	Title	Country	Year
14	Hillestad et al.	Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, And Costs	USA	2005
15	Ogunbodede et. al.	Information and Communication Technology in Nigeria The Helath Sector Experience	Nigeria	2003
16	Richard	Healthcare Information Management Systems Concentration Curriculum Choices: Evaluating the CIO Perspective	USA	2003
17	Lorig	Can a back pain email discussion group improve health status and lower healthcare costs?	USA	2002

Breen et. al. (2010): Their seminal analysis uniquely invites prominent technology theories to justifiably explain that particular information technology (IT) and health information technology (HIT) services merit both heightened attention and more widespread implementation in Rural Health Clinics (RHCs) in the United States. Used this analysis to give clearer understood of why, and how, specific IT/HIT resources – including e-health services, electronic medical records, and electronic prescription ordering systems – are both relevant and justified, and why such IT/HIT services should be incorporated into RHCs. What they found that the technological theories selected for analysis have created the means to logically contend the feasibility and rationale for increased usage of the IT/HIT resources in RHCs. Concluded that RHCs would be more apt to invest in such IT/HIT so that their limitations in crucial areas of operation and service can be mitigated by the advantages offered by the technologies that can boost their performance, efficiency, and effectiveness.

DesRoches et al. (2010): The study examined electronic health record adoption in U.S. hospitals and the relationship to quality and efficiency. In this study survey was administered during March September 2008 U.S. community hospitals. The variables of the survey were created upon previous surveys by others. The study showed that the relationships were modest at best and generally lacked statistical or clinical significance. However, the presence of clinical decision support was associated with small quality gains.

The study suggested encouraging the use of electronic health records in ways that will lead to improvements in care, instead of examining just the adoption, since just the adoption is likely to be insufficient

Paula et al. (2010): The University of California implemented a study in its own academic emergency department (ED) that using an electronic emergency department information system (EDIS), which can monitor the progress of a patient visit, facilitate computerized physician order entry, display test results and generate an electronic medical record.

The study proposed that the use of such system will increase overall ED efficiency. But, successful implementation of an EDIS requires physician and staff training, experience, and fluency with the specific electronic application.

The purpose of the study was to measure the impact of the “intern learning curve” on patient length of stay (LOS) in ED over a one year period, from March 1, 2005 to February 28, 2006.

To gain the purpose of the study, authors compared the LOS for patients seen by interns on the first day of their one-month ED rotation with the LOS for patients seen on the last day of their rotation.

The study showed that there was a complete intern turnover every month, and the EDIS “learning curve” had no discernable impact on patient LOS.

What observed in this study that its purpose was not directly match the title of it “Impact on Length of Stay After Introduction of Emergency Department Information System”. But the benefit we can gain from it -as also the authors indicate in- is that the learning to use a complex, comprehensive computer-based electronic information system is not a barrier to gain the beneficial impact from it.

Chib (2010): The study examined the deployment of a mobile telephony-based system to Indonesian rural midwives, and analyzed the impacts and constraints that arise. Also by answering the following two research questions:

Q 1: Examine the benefits of mobile usage in the rural healthcare context; specifically opportunity production, capabilities enhancement, social enabling and knowledge generation.

Q 2: Examine the inter-related constraints to mobile usage in the rural healthcare context; specifically infrastructural, economic, technological, and socio-cultural factors from an organization perspective.

Both quantitative and qualitative tools were used for eliciting information.

For quantitative: a baseline survey was conducted with 223 participants in November 2006, with the final end-line survey completed in December 2007. The objective of the survey was to assess basic information about demographics, media and ICT usage, knowledge, attitudes and practices of midwifery, technological familiarity, personal efficacy, and sources of knowledge. For qualitative: Experienced moderators and interviewers were hired to conduct the in-depth interviews and focus group discussions. Survey results revealed that the respondents were of a fairly young demographic with the average age being 29 years, while 46 years was the maximum age in the all-female group. These participants required a significant amount of training and assistance to be able to perform effectively. The study indicated that the younger age group had less midwifery experience, thus the mobile phone facility could potentially have a greater impact, translating into more calls to the senior health staff. For the group as a whole, the key sources of opportunity production were that the mobile phone project would save time for work (92.4%). Respondents agreed that the mobile phone would increase

productivity (93.2%), and improve the quality of work (95%). Moreover mobile phone ease of use was a key motivation for most (92.4%) of the respondents. 90% of Midwives were confident that they could use the mobile phone to get information about midwifery, 85% agreed that it was relevant to their needs, and 70.5% felt that it would influence the way they sought medical advice.

Borzekowski (2009): measured in his study the impact of hospital information systems on hospital operating costs during the late 1980's and early 1990's. The basis for his study was a proprietary eight-year panel dataset (1987-1994) that catalogues the degree of automation at the application level for the complete census of nearly 3,000 U.S. hospitals with more than 100 beds. The study assessed whether the adoption of hospital information systems was associated with reductions in operating costs. His study showed that the adoption average of information system in hospitals increased over time. To determine the relationship between information technology and hospital costs he began the analysis with the specification of a behavioral variable cost function for hospitals, and then a model was used to specify and interpret an empirical equation. The results of the study showed that there is evidence that hospitals adopting hospital information systems applications have had lower costs, also that systems which provide decision makers newer and more tailored Information are also associated with lower costs. He said that the "cost savings seem to

arise from increasing the productivity of decision makers or from solving the hospital's agency problems".

Karen et al. (2009): The study examined the relationship between physician office information system capacity and the quality of care across seven countries. The countries were: Australia, Canada, Germany, the Netherlands, New Zealand, United Kingdom, and United States. The data used in the study was come from the 2006 Commonwealth Fund International Health Policy Survey of Primary Care Physicians Design. The main outcomes measured were: the coordination and the safety of care, the care for chronically ill patients, and the satisfaction with practice of medicine. Results*:* The study found significant disparities in the quality of healthcare between practices with low information system capacity and those with high technical capacity after controlling for within country differences and practice size. There also were significant physician satisfaction differences with the overall experience of practicing medicine by information system level. Conclusions: "For policy leaders, the seven-nation survey suggests that health systems that promote information system infrastructure are better able to address coordination and safety issues, particularly for patients with multiple chronic conditions, as well as to maintain primary care physician workforce satisfaction".

Malik and Khan (2009): The study aimed to provide a better understanding of implementing hospital information system (LIS) in developing countries sittings. The authors used in the study Pakistan

Institute of Medical Sciences (PIMS) as a case to study how they – PMIS- were successful in implementing LIS and how they overcome the hurdles faced them in the implementation. In their study they used a literature review included research papers that were directly or indirectly presented information about LIS, beside a qualitative study that carried out in PMIS, included an interviews, informal conversation, and observation. The conclusion of the study said that there are many similarities between the PMIS experience and what is seen in the literature. From this point they get a result that a successful implementation of LIS in developing countries setting is very possible.

Akadiri et al. (2009): The main objective of the study was to assess the impact of current improvement in telecommunication on health care delivery in Nigeria. Beside assessment of the current level of commitment of government/hospital managements to providing telephony services and internet services in some Nigerian teaching hospitals.

The study began with an introduction about ICT and they indicated that it is arguably the most rapidly growing segment of the world ecosystem.

Then they introduced that many industrialized countries were have a huge investment of resources into ICT in health care as a commitment to providing the most efficient and effective health care services to their teeming population.

The study classified the ICT in three components (computers, internet and telephones) and indicated that telephony is the most developed and most accessible component of ICT among the general population in Nigeria.

The study claimed that knowledge and utilization of ICT in Nigeria is still very poor among the general populace. Although of this it expected to have a significant positive impact on health care delivery in health care institutions, by revolutionary growth in the telephony industry.

A 12-item questionnaire was designed containing two-categories of questions; personalized questions and institution-related questions, and administered to survey the opinions of certain medical staff of three tertiary health care institutions. Also some random oral interviews were done to elicit more details about the actual involvement of the respective hospital management in providing telecommunication services with or without internet options. Participation was exclusively restricted to doctors who offer both out-patient and in-patient clinical services within the hospitals.

The study indicated the following major results:

- Easy communication gives improvement in the interaction between patients and physicians to achieve an optimally efficient health care system.
- Improvement in telecommunication within the hospitals is capable of improving the quality of care.

- The main area where telecommunication has had tangible impact is intra-hospital communication among various units and personnel.
- Intercommunication between patients and care givers as well as among care givers can be especially improved.
- Free intra-hospital communication increases efficiency by reducing the bottlenecks of physical contacts which delay execution of treatment plans, improvement in inter-hospital communication is also much desirable
- Ninety three percent of respondents claimed to have been using their personal GSM phones to facilitate patient care in one way or another and believed that GSM telephony has improved health care delivery. Most of them believed that patients tend to abuse the privilege of direct access to their physicians personal phones as they make frequent disturbing calls for flimsy reasons.

To gain rapid improvement in healthcare quality, the study urged the Nigerian government persist in the effort to improve national infrastructures especially in the areas of telecommunications, electricity and information and media. Also the study believed, if the introduction of other ICT component such as computer and internet in health care would be given the same attention being given to telephony, access to quality health care in Nigeria can be improved rapidly.

Parente & McCullough (2009): The study sought to estimate information technologies effect on key patient safety measures in a national sample of United States, using four years (1999-2002) of Medicare inpatient data.

The study mentioned that there was an issue for increased use of health IT to improve patient safety, arguing that it also may reduce costs by improving the efficiency of care delivery.

The study goal was to get an empirical evidence linking health IT to specific improvements in health outcomes at a national level.

Three health's IT applications were analyzed: electronic medical records (EMRs), nurse charts, and picture archiving and communications systems (PACS).

The study results showed that EMRs are the only health IT application to have a clear and statistically significant effect on patient safety. EMR use is associated with reduced infections attributable to medical care. EMRs became more effective with each passing year, which suggests that hospitals were either improving their EMR implementation or that EMR technology itself was improving.

Although of the above result, the study found that there was little evidence that health IT improved quality. However, the study indicated that there was evidence that EMRs' value grew with time. The study considered

these results encouraging and suggested that investment in health IT should be accompanied by investment in the evidence base needed to evaluate it.

Zhou et al. (2009): The study sought to examine the extent of Electronic health records (HER) usage and how the quality of care delivered in ambulatory care practices varied according to duration of EHR availability.

The study introduced that (EHRs) have the potential to advance the quality of health care by providing timely access to patients' health information, tracking patients over time to ensure that they receive guideline-recommended care, and offering decision-support mechanisms to reduce medical errors.

The study design involved two data sources: (1) a statewide survey in 2005 of physicians' adoption and use of HER, by using questionnaire tool. and (2) statewide data on physicians' quality of care as indicated by their performance on widely used quality measures, theses data based on four years of measurement (2001-2004) by others survey.

The study examined the relationship between EHR adoption and quality of care in two ways: First, examined the cross-sectional relationship between having an EHR and concurrent indicators of quality of care, then carried out a longitudinal analysis to study the trend of EHR adoption and usage as well as to examine the association between the duration of EHR usage and quality of care.

The study results showed that there was no association between duration of using an EHR and quality of ambulatory care, and in general, EHR use was not associated with improved quality of care.

Team of the study clarified that there is need to intensify the use of key HER features, such as clinical decision support, to realize quality improvement from it. Also recommended that Future studies should examine the relationship between the extent to which physicians use key EHR functions and their performance on quality measures over time.

Luo el al. (2009): The study aimed to determine the prevalence of short message system (SMS) and internet usage in patients visiting the SingHealth Polyclinics (network of 9 polyclinics provides primary healthcare services to the community in Singapore) and to measure patients' willingness, concerns and acceptance of using these technologies in healthcare delivery.

Authors of the study believe that its result would be useful in planning and implementation of ICT in primary healthcare delivery in Singapore. Also it would be useful to assess the feasibility and acceptability of future healthcare services in which providers hope to use new technologies to either lower cost or improve efficiency.

The study introduced SMS as a tool of ICT, and proposed that is increasingly used in healthcare delivery worldwide, also to facilitate or

enhance communication and exchange of information between patients and doctors or other health professionals.

Although the study was not aimed directly to examine the impact of the technologies on healthcare, the authors began in the introduction with exploring the beneficial impact of these technologies and said that "both healthcare consumers and providers can be benefit from it". The beneficial impacts they explored are:

- Save time and money
- Increase convenience and choices
- Obtain timely information
- Reduce stigma associated with certain diseases.
- Reduce health services cost, by reduce unnecessary encounters between patients and their doctors, also management of patients in isolated or remote areas would be less expensive
- Improve the quality and efficiency of health services. For example, SMS reminders increased outpatient attendance and patient satisfaction.

The authors used a questionnaire tool included 5 sections: (i) demographics, (ii) usage of SMS and internet in daily life, (iii) hypothetical scenarios of using SMS and internet in primary healthcare delivery, (iv) willingness to use SMS and internet in healthcare delivery and associated

concerns, and (v) concerns about using SMS and internet in healthcare delivery among non-users of these 2 technologies. Also to survey and gain the purpose of the study

Study results were: Among 705 patients surveyed (mean age: 54.6 years, female: 50.6%, response rate: 92%), 407 (57.7%) were SMS users and 158 (22.4%) were internet users. Two hundred and eighty-four of 412 SMS and/or internet users (40.3% of the entire sample) were comfortable with the use of these technologies in healthcare delivery.

The study showed that The main concerns associated with the use of SMS and internet in healthcare delivery were preference for in-person consultation with a doctor (23.5%), reduced patient-doctor interaction (23.0%), and increased healthcare cost (20.8%).

Garrib et al. (2008): Health information systems (HISs) aim to ensure the appropriate and effective use of resources to improve the health service performance and the health of the community.

The study evaluated the implementation of the District Health Information System (DHIS) in 10 primary health care clinics in rural northern KwaZulu-Natal within a health sub-district which had 15 fixed clinics and several mobile service points.

Semi-structured key informant Interviews were conducted with key informants in each clinic, clinic supervisors, district information officers and other primary health care and district management staff.

Raw data extracted from the DHIS software for each clinic for a 12-month period of January to December 2004 were analyzed, looking at data correctness, completeness, and consistency.

For the 12-month period under study, all facilities had submitted data monthly and had copies available in the clinic. There was no computerization of data collection and no facility for electronic submission of data in any clinic.

The study aimed to asses the data quality, the utilization for facility management, perceptions of work burden, and usefulness of the system to clinic staff. Also by assessments for missing data, data out of minimum and maximum ranges, and validation rule violations.

Study results showed that the DHIS had been implemented in all 10 clinics, and the supporting organizational infrastructure was in place. The district had developed its own mission and vision statement for information, dedicated information staff had been appointed, and there was a clearly described pathway for information flow. Furthermore Data were collected by health care workers during each consultation, using paper-based record systems, and later collated. Duplication of data collection was found in all clinics by a mean of 2.5% without given a reason for this. Twenty-five per cent of data were outside the minimum and maximum values specified for the facilities, and also No explanations were offered, and any comments appeared to have been added at the point of entry of the

data into the DHIS software. There was, however, little understanding of the usefulness of the data, or its applicability with respect to facility or programmed management. However, data quality was poor and staffs were unable to make effective use of it. There was a severe shortage of health informatics skills needed to provide the necessary support, feedback and training in information utilization.

The study finally recommended that the computerization of data collection, analysis and data transfer is often offered as the answer to health information problems, and could reduce the burden of data collation and make data more accessible and easier to analyze, also with improve the staff skills.

Welch et al. (2007): The study objective was to assess the impact of the electronic health record (EHR) on cost and process measures of quality of care.

The study introduced that health information technology (HIT) is widely seen as a way to increase the quality and lower the cost of care.

The study analyzed the impact of implementing EHRs in four community-based private practice settings, and employed a novel methodology to assess the impact on both clinical quality and costs by utilizing the database of a large managed care organization.

The study collected the outcomes data in two periods: before and after EHR adoption to see if there were changes in the outcomes the assessments can be done.

For four chronic conditions, the study results showed that the implementation of the EHR had a modest positive impact on the quality measure of guideline adherence for hypertension and hyperlipidemia, but no significant impact for diabetes and coronary artery disease.

Hillestad et al. (2005): The study at the first gave an impression that the most medical records are still stored on paper, which means that they cannot be used to coordinate care, routinely measure quality, or reduce medical errors. Also, consumers generally lack the information they need about costs or quality to make informed decisions about their care. It is widely believed that broad adoption of electronic medical record (EMR) systems will lead to major health care savings, reduce medical errors, and improve health.

The study defined the barriers to adoption EMR: include high costs, lack of certification and standardization, concerns about privacy, and disconnect between who pays for EMR systems and who profits from them.

The study aimed to estimate the current adoption of EMR systems and the potential savings, costs, and health and safety benefits in United States.

The word potential was used to mean “assuming that interconnected and interoperable EMR systems are adopted widely and used effectively.”

To estimate the current HIT adoption and related factors, the study used the data from a survey - founded in another study - as a source of the study primary data.

For the estimation of potential HIT efficiency savings. The study conducted a broad literature survey to capture evidence of HIT effects. The survey was primarily from peer reviewed literature, but it included some information from non-peer-reviewed literature. Expert opinion was used to validate some of this evidence.

To estimate the cost of adoption, a model of EMR system costs was built for hospital adoption included one-time implementation costs, such as provider downtime and hardware costs, and ongoing maintenance costs.

To estimate potential safety benefits, A spreadsheet model was used to calculate the potential adverse drug events and costs avoided as a function of hospital size and patient age, by Using medication error and adverse drug event rates from the literature

The study considered other two benefits of using EMR (disease prevention and chronic disease management), and estimated it by acquiring data from previous survey.

The study concluded that the effective EMR implementation and networking could eventually save more than $81 billion annually—by improving health care efficiency and safety—and that HIT-enabled prevention and management of chronic disease could eventually double those savings while increasing health and other social benefits.

Idowu et. al. (2003): The study identified the ICT indicators, such as mobile phones, Internet hosts and personal computers, which were used in Nigerian Teaching Hospitals. The study explored the impact of mobile phones and the Internet on the healthcare delivery system in Nigeria. The study found that only mobile phones are available in the hospitals. The instruments used were questionnaires, personal interviews and observations. The study deduced that ICT has contributed to the positive growth of health care delivery systems in Nigerian teaching hospitals. The study also showed that hospitals were lucking connectivity to the Internet and that severely impaired the quality of healthcare they provide.

Lang (2003): The study aimed to assess the evolving importance employers place on various healthcare information management system (HIMS) knowledge areas, by answering the following two questions:

1. What are the important HIMS knowledge areas from the perspective of HIMS employers (CIOs)?

2. Have the perceptions of CIOs, regarding HIMS knowledge area importance, changed over the past four years?

In attempting to answer the two research questions, the researcher of this study used a survey was developed previously in 1998 by other researcher as a model and put it in a new “electronic” version, with some adjustments on its questions and format, also piloted it in earlier study.

The study compared the acquired data by existing data founded in the 1998 study that the survey was developed from. To measure if there were any significant changes between the CIO responses from 2002 compared to 1998.

What was the most important for my thesis and found in this study that is shows that the "clinical application knowledge was mentioned as a key knowledge requirement for using IT to improve patient safety".

The study recommended that Additional research should be conducted to compare and contrast the importance of knowledge areas from the perspective of HIMS educators and recent HIMS graduates.

Lorig (2002): The study aimed to determine if the internet can be used to improve health status and healthcare utilization for people with chronic back pain

The study suggested that a simple low-cost use of the internet may improve health status and lower healthcare utilization for person with recurrent pack pain.

The study moderated a closed e-mail discussion group; included 580 participants have chronic back pain that selected randomly from people of 49 states in USA.

The study didn't found statistically significant that the use of internet can lower healthcare utilization and get potential saving, and attributed the reason for this is that because of the high utilization patterns of people with recurrent back pain. For this reason the authors of the study recommended to continue with other study with a replication group, and they said that there are many caveats and much more to be learned about the use of an internet discussion groups for persons with chronic health condition, and this is the first study investigate this delivery mechanism to their knowledge.

Chapter Three
Methodology

3-1 Research Methodology and Design

The methodology which was followed to gain the objectives of this research was analytical descriptive method, which is known as a method that deals with events, circumstances, and practices which actually exist and obtainable for study and measurements, without any interventions by the researcher on its happenings. The researcher can interact with these situations, describe and analyze them. This research aimed to explore the role of ICT and its impact on healthcare in healthcare centers in Palestine, specifically describe and analyze the impact of Electronic Health Record (EHR), and how it can improve healthcare process from Palestinian health workers perspectives. To gain this, the researcher developed a questionnaire based on the available literature and related studies. Pilot study was performed before the questionnaire distribution process; also validity and reliability test were made to ensuring the quality of questionnaire. After that questionnaire distributed and gathered, then statistical analysis accomplished to perform final report and results using SPSS 19 computer software. Finally, the researcher developed a proposed model, which describes the impact of EHR on healthcare, depending on the research results, literature, and scenarios cases from our life which were discussed with specialists from health sector.

3-2 Research Data

The research depended on two basic types of data (primary & secondary):

1. **Primary data**: which was obtained from a structured questionnaire, which was distributed and conducted with health workers employed in healthcare centers in Palestine, since the research attempted to describe and analyze their perspectives. After that the distributed questionnaires was collected and treated by making statistical analysis using SPSS software.

2. **Secondary data**: this data was used to introduce the literature review of the research, and was obtained from several sources, like books, journals, internet, previous related studies or reports, and many other resources and references that were available and related to the research. Literature review was introduced to help in preparing the research, also to understand the impact of ICT on healthcare theoretically. So the questionnaire can be designed and formatted.

3-3 Data Collection

The researcher distributed the questionnaire to the respondents by hand in several health centers around the country. In the distribution process the researchers tried to get respondents from maximum number of centers as much as possible. By beginning of the distribution the researcher was distributing the questionnaire randomly in the centers taking into account

covering almost of the targeted respondents. At this point, the researcher noticed that the response rate was fairly low; also physicians were reluctant and careless in filling the questionnaire. Because of this researcher changed his behavior in the distribution and made intensive work to get an acceptable sample size (see sec. 3-5). So he can go on to make the study. The number of questionnaire copies which were distributed was (570), (487) copies were returned, and 84 copies were canceled because they were not valid. Finally, (403) copies of questionnaire were valid and available to analysis, and this number is sufficient for this research. Now the researcher can go to the next stage.

3-4 Research Population

The research population was the health sector workforce in West Bank. According to the Palestinian ministry of health report, the number of workers who have a permanent job, either in government or nongovernment sector was (2,4519) employees, (72.6%) of them working in West-Bank, and (27.4%) in Gaza.

3-5 Research Sample

The researcher targeted workers whose nature of work was either, clinical, nursing, or paramedical. The size of sample used in the research was (403) respondents and this size is more than the acceptable, which are (378). The researcher used an internet web site (AAPOR, & AMA, 2010) to help him in determining the acceptable sample size, appendix (A)

explains the formula used by the site. Distribution of respondents will be discussed in more details in the next chapter (4).

3-6 Research Tool

Depending on what has been found in the literature, the researcher constructed a questionnaire designed from four parts as we will see below. The aim from the questionnaire is to gather and acquire the primary data that will be analyzed to gain the research purpose. The questionnaire was designed into two versions (Arabic & English), see appendix (B). Arabic version to be distributed on participants, since Arabic is the native language. And English version is to be used in the research content since, English is the research language. The questionnaire was adjusted three times before getting the final one. First adjustment was upon the supervisor request, second was upon experts opinions, and third was because the results of pilot study. The researcher discussed all adjustments with supervisor before it had been done.

3-7 Questionnaire Parts

The questionnaire was consisted of four parts:

Part One: this part of the questionnaire included a description of the research objectives and its importance. Also this part assured participants of the confidentiality of the information, and encouraged them to participate in the study.

Part Two: this part of the questionnaire was put to collect demographic information about respondents including (gender, age, Educational Level, and others).

Part Three: this part consisted of five items constructed in close-ended statements with (yes) or (no). This part was put to determine the adoption level of EHR in health centers.

Part Four: this part consisted of (20) items constructed in close-ended statements on five- Likert scale in which (5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree). The items were classified into four domains (Time, Effort, Cost, Safety) with five items for each domain. This part was put to assess the impact of EHR on healthcare from the respondents perspective.

Part Five: this part consisted of five items constructed in close-ended statements on five- Likert scale in which (5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree). This part was put to describe the obstacles faces the EHR implementation and usage.

Part Six: this part was left as a space given to respondents to specify if there are additional notes that the questionnaire didn't cover.

From the first pilot study, the researcher found that the research questionnaire tool was unreliable and not valid, and the reason was because the statements in it were not fully understood from all participants. Thus, adjustments on the questionnaire were maintained to make it more clear

and understandable for participants, and then another pilot study was performed on different participants. Below the researcher discusses the pilot study in more details.

3-8 Pilot Study

In this research the researcher made two pilot studies on (20) respondents in each study from two health centers. In the first one the reliability test was low and indicated that some of statements in the questionnaire were not understood for respondents as the same also some were incomprehensible. For this interviews with people work in health field were made to identify the places where the questionnaire was not understood or incomprehensible. Potential adjustments on the questionnaire were maintained and the lack of clarity was resolved. After that the researcher performed a second pilot study and the result of reliability test on it was acceptable as it will be seen below. The two pilot studies were excluded from the research sample.

3-9 Validity

The reviewed literature shapes the basement of the questionnaire construction. Parallel with all construction stages, the researcher was reviewing the questionnaire and discussing it with the supervisor to ensure that he was going into the right way. Discussions were about: repeated questions, clarity of the questions, order of the questions, and if the questions are directed the participants toward a specific alternative. The

researcher also sent the questionnaire to several experts and arbitrators with a letter to get their opinions and recommendations, See appendices(C ,D).

3-9 Reliability

To ensure the reliability of the questionnaire, the researcher used Cronbach coefficient alpha method which is one of the most popular reliability statistics in use today that determines the internal consistency or average correlation of items in a survey instrument to test its reliability (Reynaldo, & Santos, 1999). Table (3-1) shows that the results of Cronbach alpha test is (0.750) and the entire questionnaire variables are above 70 %, thus it is acceptable. Therefore the questionnaire is reliable and could be redistributed. Hence, the researcher began the survey.

Table: (3-1) Cronbach Alpha Test

Domain	Cronbach's Alpha
Time	0.773
Effort	0.724
Cost	0.737
Safety	0.715
Obstacles	0.713
Total	0.750

3-10 Statistical Analysis:

Statistical Package for Social Science (SPSS) version 19 was used for data analysis.

The researcher used the following statistical analysis:

- Mean, Frequency and Percentage tables: this analysis performed to describe the research sample.
- Person Correlation Coefficient: to test the correlation between the research variables.
- Independent Samples T Test: to test if there are statistical differences between means of two variables.
- One- Way ANOVA Tests: to test if there are statistical differences between means of three variables or more.
- LSD Post Hoc test: to specify the differences between means.
- Cronbach's Alpha: to test the reliability of the questionnaire.

3-11 Ethics

Ethical standards were maintained during this research by considering the following:

- Recommendation letter from university was sent to ministry of health and to some private centers that requested it.

- Formal letters were sent to experts and arbitrators asking them to arbitrate the research questionnaire (see appendix D).
- Confidentiality was maintained all the time.
- Researcher avoided mentioning any name of health workers who participated in the study, also names of centers that workers are employed in.
- There were no threats of job loss or penalty for those health workers who declined to participate.
- There were no threats on the image of health centers that the researcher visited and make distribution in.

3-12 Research Limitations

- Workers in health centers specially physicians were almost of the time busy and have intensive work in healthcare delivery services. This tired the researcher and took much more time from him in waiting the respondents, and the time was on his job account.
- Some of health centers in private sector refused to participate with the study and others refused without recommendation letter from the university. This wasted the researcher time, also resulted in decreasing the size of sector participation.
- Most of respondents who in centers that still don’t have any function of the system or the system are newly implemented in, were reluctant

or refuse to answer the questionnaire at the first time, since they were believed that the purpose of study is to evaluate an existed system, and this required from the researcher to explain the purpose of study to them to understand and accept to hand the questionnaire.

- The nature of work in health centers is very different from other organizations where the employees have special office and could be found in almost of time. Healthcare workers are almost out of door; this was very hard to the researcher to collect the distributed questionnaire. As a result much of questionnaires had been lost because of this reason.

Chapter Four
Analysis and Results

4-1 Introduction

By using SPSS computer software this chapter will explore the detailed descriptive statistical analysis for the data acquired from the questionnaire that was distributed on the research sample. Furthermore, the chapter explores, analyzes, and discusses the research results which also obtained from the distributed questionnaire. Moreover, this chapter shows the result of the research hypothesizes testing. Finally, at the end of the chapter, the researcher set a proposed model that may help in future researches, and also to get a quick understanding about the impact of EHR on healthcare.

4-2 Demographic and Descriptive Analysis

The first part of the questionnaire is the demographic variables which contain the personal information that related to the respondents. Furthermore, this information is different between the respondents in the research sample. The following discussion, analyzes the first part of the questionnaire to describe the demographic distributions of the respondents and to show the differences between them.

Gender

The respondents in the research sample were divided into two genders (male and female). As shown in the following Table (4-1), the number of male respondents was 204, and female was 199. The percentage of two genders approximately equal and closed together, also these percentages are consistent with Palestinian population structure (MOH, 2011).

Table (4-1): Distribution of Gender

Gender	Frequency	Percent	Cumulative Percent
Male	204	50.6	50.6
Female	199	49.4	100.0
Total	403	100.0	100.0

Age

The research divided age variable into four groups as shown in Table (4-2). The table shows the details of respondents' age distribution in the research sample. What is noticed from the table that the highest percentage of the respondents was in age group (20 – 30) and the percentage are decreasing with the upper age groups to be the lowest in the group (more than 51 years old). These results can be explained by two factors. *First*, health sector in Palestine is highly grew in the past few years which means a high new employments from a recent graduated students, this point approved by the ministry of health annual report 2011 which shows that the size of workforce in health sector has been doubled in the time period 2000-2010. *Second*, employees within old age are either retired or

promoted to higher managerial position to benefit from their experience, which means new employments are needed to fill the vacant jobs.

Table (4-2): Distribution of Age

Age	Frequency	Percentage	Cumulative Percent
20 – 30	185	45.9	45.9
31 – 40	138	34.2	80.1
41 – 50	64	15.9	96.0
More than 51	16	4.0	100.0
Total	403	100.0	100.0

Educational Level

The research classified the respondents upon their educational attainment into three educational levels (diploma, bachelor, and master and higher), as shown in the following table (4-3). The table shows the distribution details of the educational levels in the research sample. The highest percentage was from "Bachelor" degree and the lowest from "Master and higher". The researcher couldn't find any national survey to compare it with this distribution. But he believes that this distribution is consisted with the reality of education in Palestine.

Table (4-3): Distribution of Educational Level

Education level	Frequency	Percentage	Cumulative Percent
Diploma	139	34.5	34.5
Bachelor	217	53.8	88.3
Master and higher	47	11.7	100.0
Total	403	100.0	100.0

Center Type

The respondents were either employed in government or private health center. The following table (4-4) shows the distribution details which are upon the center type. As shown in the table, the percentage of those in governmental centers is higher than whom in the private. This refers to that the ministry of health is considered as the largest operator for the human cadres in Palestine (MOH, 2011).

Table (4-4): Distribution of Center Type

Center Type	Frequency	Percent	Cumulative Percent
Governmental	310	76.9	76.9
Private	93	23.1	100.0
Total	403	100.0	100.0

Nature of work

The research targeted three groups of respondents according to their nature of work. These groups and its distribution details are shown in the following table (4-5). Lowest percentage was to whom that their nature of work is medical, and the highest was to whom their nature of work is nursing. This distribution refers to that the nurses were have more available time to be contacted than the doctors. Similarly to the nurses those who work in paramedical departments, but their number was less than of them and this made the percentage of the nurses is the highest.

Table (4-5): Distribution of Work Nature

Nature of work	Frequency	Percent	Cumulative Percent
Medical	66	16.4	16.4
Nursing	202	50.1	66.5
Paramedical	135	33.5	100.0
Total	403	100.0	100.0

Experience Years

The following Table (4-6) shows how the respondents in the research were distributed according to their experience period in their work. Also the table shows the intervals which was used to group them through. As noticed from the table, the percentage of the respondents who have high experience period is lower than the percentage of respondents who have low period. This result approves what been found in the age distribution table (4-2), which showed that the young respondents are the highest.

Table (4-6): Distribution of Experience years

Experience	Frequency	Percent	Cumulative Percent
less than 1 year	88	21.8	21.8
2-5 years	94	23.3	45.2
6-10 years	85	21.1	66.3
11-15 years	58	14.4	80.6
16 and more years	78	19.4	100.0
Total	403	100.0	100.0

Supervision Degree

The following Table (4-7) shows the number of respondents whom have a supervision degree and the others whom do not have. The table shows that approximately one third of the respondents have a supervision degree and the rest of them do not have. And this is considered as a rational distribution.

Table (4-7): Distribution of Supervision Degree

Supervision	Frequency	Percent	Cumulative Percent
Yes	120	29.8	29.8
No	283	70.2	100.0
Total	403	100.0	100.0

General Impression

The following Table (4-8) shows the respondents general impression about the impact of EHR on healthcare, and shows that the majority of them are agree with that has positive impact.

Table (4-8): Distribution of General Impression

Impression	Frequency	Percent	Cumulative Percent
Positive Impact	298	73.9	73.9
Negative Impact	19	4.7	78.7
No Impact	22	5.5	84.1
Don't Know	64	15.9	100.0
Total	403	100.0	100.0

The results of analysis the demographic data appear the following facts:

- The percentage of male respondents (50.6%) was approximately equals that in female (49.4%).
- The highest percentage of respondents is young (20 – 30 years old) who from 45.9% from all.
- The highest percentage of respondents (53.8%) has bachelor degree.
- The majority of respondents (76.9%) were employees in governmental health centers.
- The highest percentage of respondents work in nursing departments who from 50.1% from all.

- The highest percentage of respondents experience years is (2 – 5 years) who from 45.2% from all.
- The highest percentage of respondents (70.2%) doesn't have supervision degree.
- The majority of respondents (73.9%) gives a general impression that the EHR has positive impact on healthcare

4-3 EHR Adoption Level

The respondents in the research were belong to several health centers which are distributed between private and government sector. These centers are different in the adoption level of EHR. The researcher used the following scale that shown in Table (4-9) to examine the adoption level in the centers and to describe the distribution of the respondents according to the adoption level.

Table (4-9): Adoption Level Scale

Score	Description	Level
0	No system	0%
1	System with one function	20%
2	System with two functions	40%
3	System with three functions	60%
4	System with four functions	80%
5	Full functions system	100%

The following Table (4-10), shows the distribution of respondents upon the adoption level of EHR system in the centers they are employed in.

Table (4-10): Distribution of Adoption Level

Adoption Level	Frequency	Percent	Cumulative Percent
0.00	168	41.7	41.7
1.00	16	4.0	45.7
2.00	13	3.2	48.9
3.00	71	17.6	66.5
4.00	135	33.5	100.0
Total	403	100.0	100.0

Table (4-10) shows that there are 168 respondents, (around 41.7% of all respondents), who belong to centers that still until now don't adopt any function of EHR system in. Furthermore, it is noticed from the table that there is no any respondent who belongs to center adopt a system with its full functions.

Results:

- Percentage of health centers that don’t have any function of EHR system is high.
- There is no center which has full adoption level of the system. All centers that have the system are partially adopting its functions.
- The maximum adoption level is 80%.
- The research couldn’t determine the adoption level in Palestine since the questionnaire was targeted to health workers in health centers. And to determine the adoption level in the country, we need to survey all the centers and the questionnaire should be targeted to the centers not to the workers.

4-4 EHR Impact

Questionnaire part three attempted to examine how EHR can affect on healthcare. This part divided into four sections (domains) which are **(Time, Effort, Cost, and Safety).** Each domain has five paragraphs related to it, and had been developed to measure the respondents perception for that domain. The following will analyze and discuss each of these domains, also testing hypothesizes are related to. From all of this, the researcher developed an explanation model by the end of each discussion, to be collected at the end in one model that could be helpful to more understanding the research results.

4-4-1 Time

This section attempts to analyze, discuss, gives findings, and test hypothesis that related to time domain.

Analysis

The following Table (4-11) explores the analysis of means, standard deviations and the given approval degree for the paragraphs in questionnaire part three – section one **(Time)**. This analysis shows the perception of respondents in the research sample toward the impact of EHR on healthcare, by saving time in the service provided in health centers. As shown in the table (4-11) the research sample perceived a high degree approval that the EHR saving time in healthcare process. Rank column in the table shows that the highest perceived degree in the research sample

was in paragraph 4, followed orderly in paragraphs 1, 2, 3, and the lowest degree was in paragraph 5. All means in this section were approximately closed together.

Table (4-11): Statistics of domain (Time)

#	Paragraph	Mean	Std. Deviation	Rank	Approval Degree
1	Speed up data exchange and transfer between departments	4.37	0.74	2	Very high
2	Speed up medical orders process	4.14	0.87	3	High
3	speed up patient information acquiring	4.11	0.92	4	High
4	Speed up access and return to medical records	4.48	0.66	1	Very high
5	Physicians can dedicate more time to patients	3.45	1.13	5	high
	Total	4.11	0.63		high

Hypothesis Test

Time section in the questionnaire was set to test the **Hypothesis One** which said “statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving time (mean of time section less than 3.41).

As discussed above the time section approved with high degree by mean 4.11 and it is greater than degree of neutrality which is 3.4.

Result: hypothesis one is rejected and accepts that there is an impact of EHR on healthcare and it is improving it by saving time.

Further Discussion

The most important thing when searching for a tool that could be helpful in saving time in healthcare process is if this tool will provide the patient to get his medication faster than without the tool, and will not make him wait a long time until some processes are completed. In many situations, the time seems to be a very important factor in healthcare service, and sometimes a few minutes could be a main reason for losing the patient or saving his life. The following illustrative case gives more understanding. *Illustrative Case*: Assume a patient entered the emergency department and he has lost a lot of his blood caused by car accident. Simply in this case the patient must be provided by appropriate quantity of blood defined by physicians. But before that, a physician has to know the patients' blood type to continue with the medication process. Traditionally, a blood test to determine his blood type should be done before going on to provide him with the needed units of blood. Assume also that there is no blood bank in the health center or not all blood types are available or also the quantity is not enough. In this situation, the center has to look for volunteers. Finding volunteers doesn't mean that the problem solved. Blood tests should be also made on them to see if their blood types match with patient blood or not. Physician ordered the test, laboratory received it, the physician still waiting the results, and the patient is suffering and may die now. Now, imagine a health center with an EHR system. By one mouse click, full historical information about the patient could be obtained

momentarily. But some one may say here what if the center doesn't have historical information about the patient? It is enough to say that the system will speed up the test ordering and retrieving the lab results. Respondents in this research approved this with high degree. From all of above, we see how patient safety is highly affected by the time factor, and it was improved by speeding up the time in the medication process. As a result, EHR can improve patient safety by saving time in healthcare processes, thus increasing the quality of care. Additional results on safety will be discussed later in this chapter by analysis the (Safety) domain.

Additionally for above, and by taking a closer look to the results in Time dimension, we can deduce from the paragraphs in it that the EHR by its impact in saving the time in healthcare process will lead to more productivity among health workers. This also gives us an indication that health centers will gain a cost reduction, thus increasing the efficiency in the center.

Findings

There is an impact of EHR on healthcare and it is improving it by saving time. And saving time in healthcare may lead to: increase patient safety, increase productivity, reduce cost, and increase the efficiency and quality of care. Other researcher like (Wulsin & Dougherty 2008; Dan, 2011; Miller & Tucker, 2009; Simon, et al., 2007; Langabeer, et al., 2007; Ash, et al., 2004; Taylor, et al.,2005) agree with these findings, see also

Table (2-1) in chapter Two. From these findings the researcher proposed and developed the following model shown in Figure (4-1)

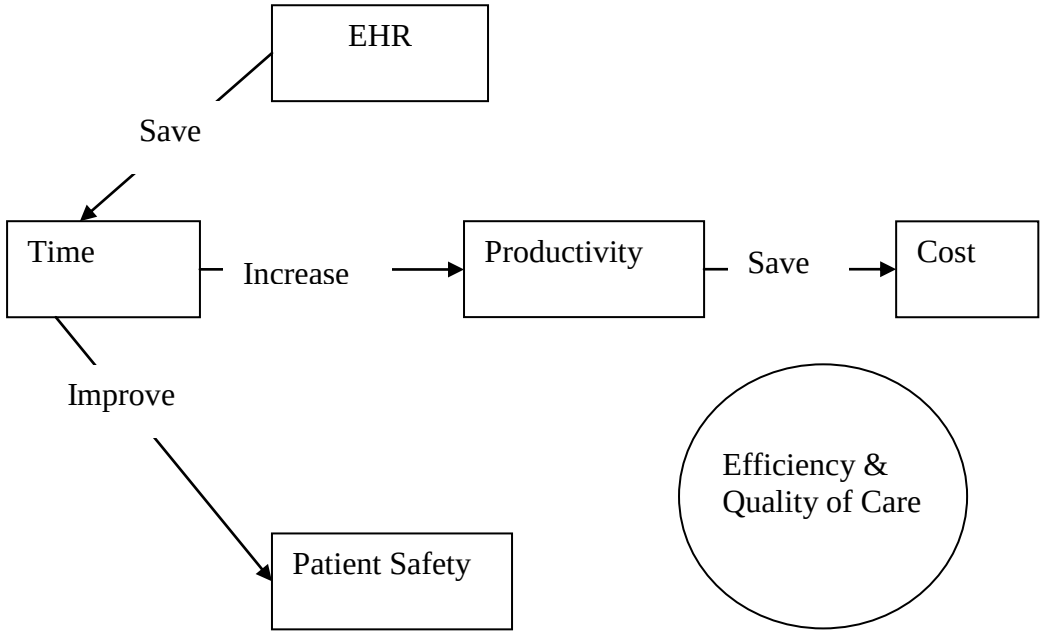

Figure (4-1): impact of saving time in healthcare by EHR system

4-4-2 Effort

This section attempts to analyze, discuss, gives findings, and test hypothesis that related to effort domain.

Analysis

The following Table (4-12) explores the analysis of means, standard deviations and the given approval degree for the paragraphs in questionnaire part three – section two **(Effort)**. This analysis shows the perception of respondents in the research sample toward the impact of EHR on healthcare by saving effort in healthcare centers. As shown in the table

(4-12) the research sample perceived a very high approval degree that the EHR saving effort in healthcare centers. Rank column in the table shows that the highest perceived degree in research sample was in paragraph 3, followed orderly in paragraphs 1, 5, 2, and the lowest degree was in paragraph 4. All means in this section were approximately closed together with very high degree, except that in paragraph 4 the degree was high.

Table (4-12): Statistics of domain (Effort)

#	Paragraph	Mean	Std. Deviation	Rank	Approval Degree
1	Easy communication and coordination between departments	4.34	0.71	2	Very high
2	Easy medical orders requests	4.24	0.80	4	Very high
3	Easy up access and return to medical records	4.47	0.62	1	Very high
4	Helps in surveys and medical research	4.14	0.80	5	high
5	Helps in preparing reports and statistics	4.27	0.73	3	Very high
	Total	4.29	0.58		Very high

Hypothesis Test

Effort section in the questionnaire was set to test the **Hypothesis Two** which said “statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving effort (mean of effort section less than 3.41).

As discussed above the effort section approved with very high degree by mean 4.29 and it is greater than degree of neutrality which is 3.4.

Result: Hypothesis Two is rejected and accepts that there is an impact of EHR on healthcare and it is improving it by saving effort.

Further Discussion

In a simple meaning of our daily life, it is considered that easy tasks can be accomplished quickly. But this is not true at all also with computerized tasks. Absolutely the computer is very fast, but the work with it might be hard, especially if the system is new or the users are unskilled. Since the results in effort domain showed a very high approval among respondents that the EHR easy tasks and saves efforts and as it is previously discussed that it speeds up accomplishing it. From this we can say that saving efforts by EHR can be considered as a factor that leads to saving time in healthcare activities.

Return to the previous case, it is clearly understood how the EHR can save efforts in the healthcare process. Effort which is needed to perform the blood test is eliminated by the easy access to the stored data from other departments. This point is highly approved from respondents in this research, and also the point of medication ordering process. By giving the data in an easily accessible format, data redundancy and test duplication can be also eliminated or decreased, and this surely leads to cost reduction, as we will see also later in Cost domain discussion.

Now let’s introduce a more sophisticated case. On September-2012, Jenin government hospital received about 90 patients in one day, and they were having the same symptoms. It was easy to the hospital to discover that all of these patients were from the same village and of the same age. And it was also easy to notice this case since the period is very short. In this case there was no need to maintain a survey or perform a research, and because of the simplicity of the case, the investigation didn’t exceed two days to give the final result that these patients were students in one school and they were suffering from food poisoning caused by polluted water that the students drank in the school. The case at all was resolved in maximum of three days.

Everyday we are listening about new disease or virus. Imagine that there is a new virus entered in Palestine and it hasn’t discovered yet. This virus may threaten the country by epidemic if it is widespread and isn’t discovered at an early stage. If the spreading of this virus was slowly, like one or two infected patients entered the health center every week or every month and their lab test were abnormal, how health centers will notice that so an action can be taken to deal with, and overcome this problem? Here rising the importance of the EHR. As found in the literature, EHR can improve follow-up of abnormal test results (Virapongse, et al., 2008), support public health disease surveillance and reporting (WHO, 2009), and alerts professionals of actions to be undertaken (Ash, et al., 2004).

From this, EHR can be considered as a decision support system. Besides that, it is helpful -as approved from respondents in this research- in surveys and medical research, and also in preparing reports and statistics. As a result from above, the researcher deduced that simplifying the healthcare processes and making the data more easily to be accessed can help in decision making, and without a doubt increasing patient safety. In other words, EHR has an impact on healthcare by improving patient safety through supporting decision making.

Findings

There is an impact of EHR on healthcare and it is improving it by saving effort. And saving effort in healthcare may leads to: saving time, improve decision making, and thus improve patient safety. Other researcher like (Kuo, et al., 2007; Dan, 2011; Miller & Tucker, 2009; Schvartsman, et al., 2008; Langabeer, et al., 2007) agree with these findings, see also Table (2-1) in chapter Two. From these findings, the researcher proposed and developed the following model shown in Figure (4-2)

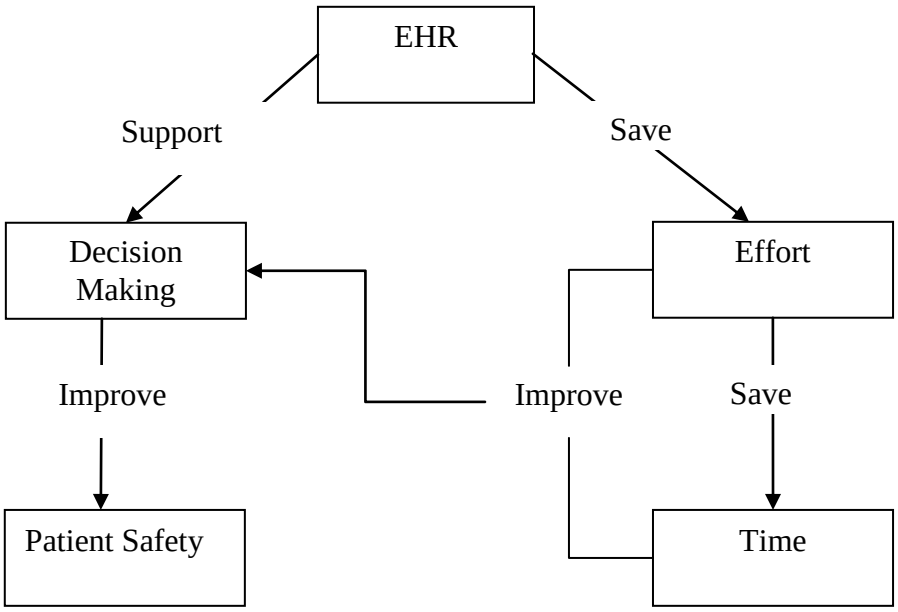

Figure (4-2): Impact of saving Effort in healthcare by EHR system

4-4-3 Cost

This section attempts to analyze, discuss, gives findings, and test hypothesis related to cost domain.

Analysis

The following Table (4-13) explores the analysis of means, standard deviations and the given approval degree for the paragraphs in questionnaire part three – section three **(Cost)**. This analysis shows the perception of respondents in the research sample toward the impact of EHR on healthcare by saving cost in healthcare centers. As shown in the table (4-13) the research sample perceived a high degree approval that the EHR save cost in healthcare centers. Rank column in the table shows that the highest perceived degree in the research sample was in paragraph 2,

followed orderly in paragraphs 1, 5, 3, and the lowest degree was in paragraph 4. Noticed from the table that degree in the paragraphs 4 and 5 was moderate which also means that the respondents' perceptions were in neutral range and they couldn't to decide if there is an impact or not according to these paragraphs. This may refers to the heavy work on the health workers (respondents), which make them more intent to accomplish their tasks rather than follow up patients' medication flows.

Table (4-13): Statistics of domain (Cost)

#	Paragraph	Mean	Std. Deviation	Rank	Approval Degree
1	Reduce medical tests redundancy	3.97	0.96	2	high
2	Reduce paper usage	4.33	0.81	1	Very high
3	Reduce patient length of stay	3.37	1.11	4	moderate
4	Reduce average of patient visits	3.23	1.08	5	moderate
5	Reduce medical errors	3.56	1.05	3	high
	Total	3.69	0.71		high

Hypothesis Test

Cost section in the questionnaire was set to test the **Hypothesis Three** which said "statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by saving cost (mean of effort section less than 3.41).

As discussed above the cost section approved with high degree by mean 3.69 and it is greater than degree of neutrality which is 3.4.

Result: Hypothesis Three is rejected and accepts that there is an impact of EHR on healthcare and it is improving it by saving cost.

Further Discussion

As previously discussed, EHR helps in reducing time in healthcare process and this is by default will lead to decrease patient length of stay. Moreover, when we talking about patient length of stay, this is not mean just the time that patient sleep in the health center, also this time is not controllable and affected directly with patient health status. What the research was looking for here is the time for acquiring a new data or returning to previously stored during the medication process. So the researcher set that EHR can decrease patient length of stay depending on time and effort domains analysis, and ignored respondents' perception for this point. Recent study by (Cartmill, et al., 2012) also proved this empirically and the result of his study showed that EHR reduced the time of patient length of stay.

According to patient visits average there was no evidence that EHR can decrease it. But the researcher believes that, if the EHR was nationally full implemented with all of its functions using improved telecommunication, this will give patient the ability to access on his medication profile at any time any where he want, thus he don't need to

visit health center in some cases i.e. request lab results or diagnosis report. More appropriate for this point than stand alone EHR, is to adopt other tools of ICT such as Telehealth and Health Web Portals see chapter two sec. (3-3-4,6). What can be learned here is that, improved communications integrated with EHR system are both together have potential benefit in increasing the efficiency in healthcare industry, also by reducing distance barriers between health centers and patient, or between centers themselves. Other researcher like (Chae, et al., 2009; Wulsin & Dougherty 2008; Dan, 2011; Miller & Tucker, 2009; Schvartsman, et al., 2008; Taylor, et al.,2005) agree with these findings, see also Table (2-1) in chapter Two. By these additions to the research results, the researcher proposed and developed the following model shown in Figure (4-3).

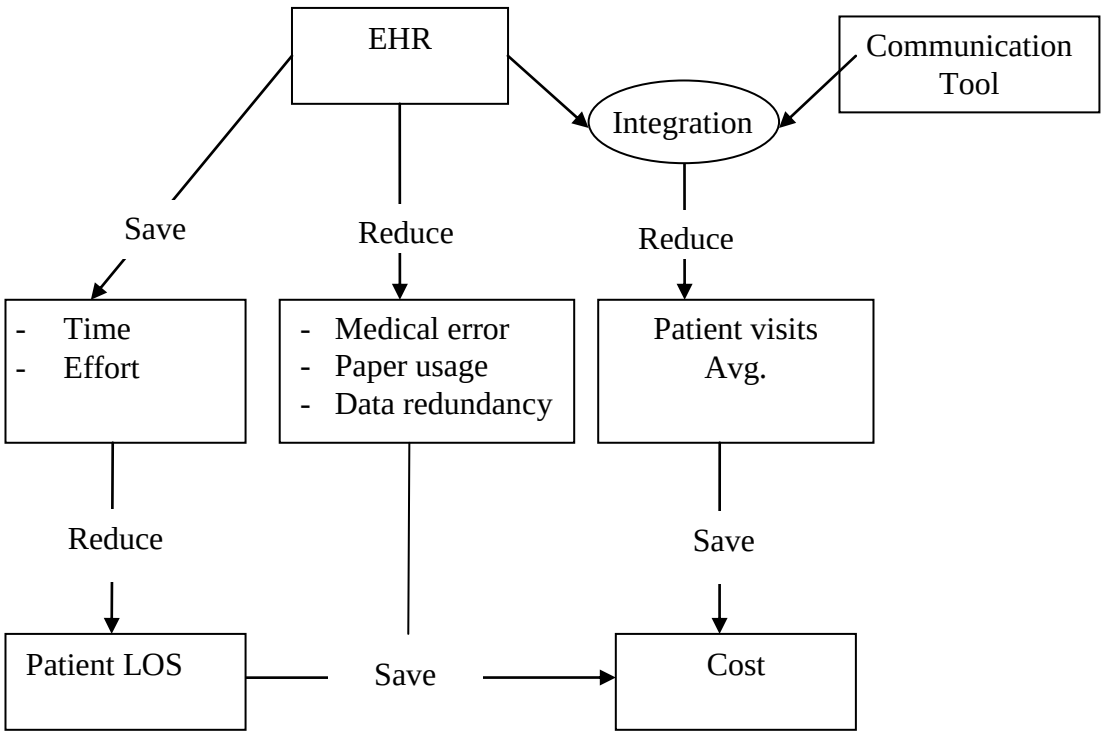

Figure (4-3): Impact of EHR system on Cost.

4-4-4 Safety

This section attempts to analyze, discuss, gives findings, and test hypothesis related to safety domain.

Analysis

The following Table (4-14) explore the analysis of means, standard deviations and the given approval degree for the paragraphs in questionnaire part three – section four **(Safety)**. This analysis shows the perception of respondents in the research sample toward the impact of EHR on healthcare by improving patient safety in healthcare centers. As shown in the table (4-14) the research sample perceived a high degree approval that the EHR improve patient safety in healthcare centers. Rank column in the table shows that the highest perceived degree in the research sample was in paragraph 2, followed orderly in paragraphs 1, 3, 5, and the lowest degree was in paragraph 4. The first two paragraphs have a very high degree and their means were approximately closed together. The latest three paragraphs have a high degree and their means were approximately were closed together.

Table (4-14): Statistics of domain (Safety)

#	Paragraph	Mean	Std. Deviation	Rank	Approval Degree
1	Helps in maintaining complete medication information about patient	4.27	0.76	2	Very high
2	Provide space to list all medications together	4.33	0.71	1	Very high
3	Helps in giving patient appropriate medication	3.50	1.02	3	high
4	Reduce adverse drug events	3.44	1.13	5	high
5	Better guideline adherence through reminding professionals of actions to be undertaken	3.48	1.11	4	high
	Total	3.80	0.71		high

Hypothesis Test

Safety section in the questionnaire was set to test the **Hypothesis Four** which said "statistically, there is no high degree of perception among respondents about the impact of EHR on healthcare by improving patient safety (mean of safety section less than 3.41).

As discussed above the safety section approved with high degree by mean 3.80 and it is greater than degree of neutrality which is 3.4.

Result: Hypothesis Four is rejected and accepts that there is an impact of EHR on healthcare and it is improving it by improving patient safety.

Further Discussion and findings

It was clear from the paragraphs in this domain of how EHR can improve the patient safety and get the appropriate medications. However, when a patient achieved an appropriate medication without any medical error, all of whom involved in the process can gain benefits from that. The patient in addition of getting a safe medication he will be more satisfied for the services he received. With increasing patient satisfaction the public image of health center will be improved. Furthermore, with eliminating medical errors, health workers will not face legal claims from patients. Also time, effort, and cost can be decreased. Other researcher like (Kuo, et al., 2007; Chae, et al., 2009; Wulsin & Dougherty 2008; Schvartsman, et al., 2008; Langabeer, et al., 2007; Dorr, et al., 2007) agree with these findings, see also Table (2-1) in chapter Two. From all of above, the researcher proposed and developed the following model shown in Figure (4-4).

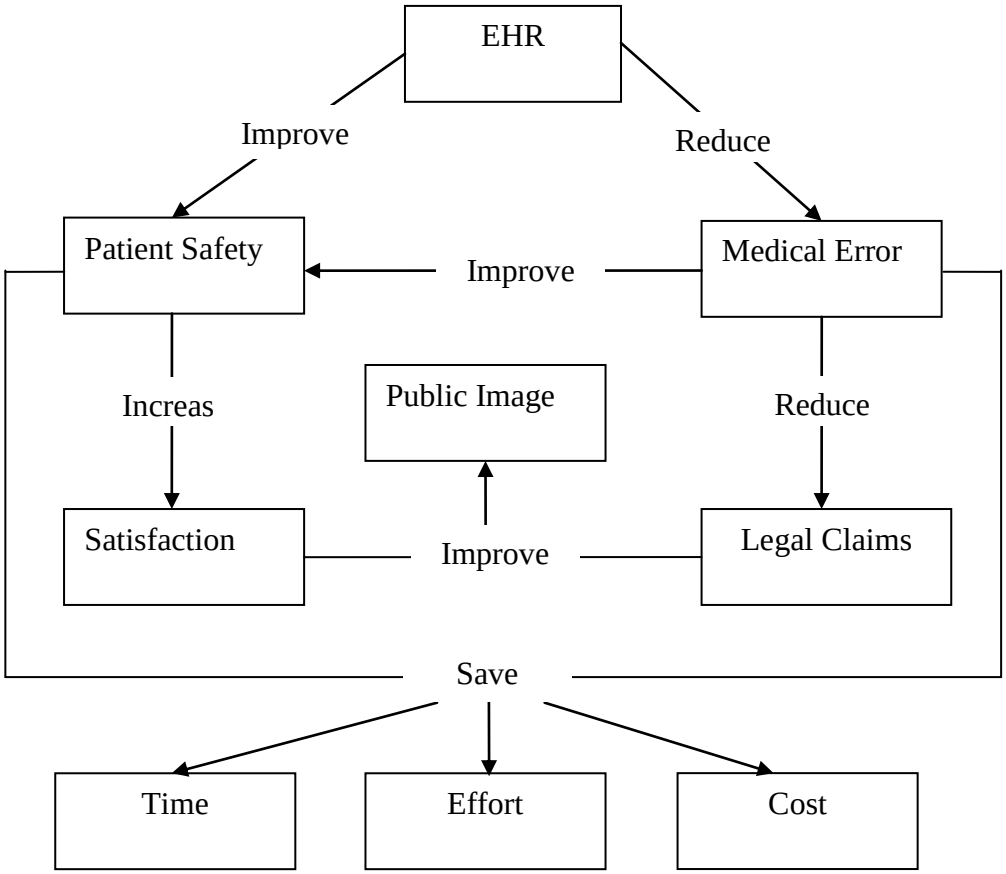

Figure (4-4): impact of improving patient safety in healthcare by EHR system

All Domains

The following Table (4-15) concludes previous findings and shows that EHR was perceived as a tool that affects healthcare by improving it in healthcare centers with high approval degree. The highest degree was in the Effort domain, followed orderly in Time, Safety, and the lowest degree was in Cost domain.

Table (4-14): Statistics conclusion of all domains

Domain	Mean	Std. Deviation	Rank	Approval Degree
Time	4.11	0.63	2	High
Effort	4.29	0.58	1	Very high
Cost	3.69	0.71	4	High
Safety	3.80	0.71	3	High
Total	3.97	0.54		High

4-5 Obstacles

The following Table (4-16) explores the analysis of means, standard deviations and the given approval degree for the paragraphs in questionnaire part four. This analysis shows the perception of respondents in the research sample toward the obstacles face healthcare centers from using EHR system. The table indicates that the most obstacles face the health centers which has a high degree is the availability and suitability of computers. The other obstacles were having less impact and gets moderate degree, which also means that respondents neither agree nor disagree (Neutral) with these obstacles. The researcher refers this to that these obstacles related to the EHR system itself, and as seen result before that the maximum of respondents are belong to health centers without any function of the system.

Table (4-14): Statistics of domain (Obstacles)

Paragraph	Mean	Std. Deviation	Rank	Approval Degree
Available computers not suitable	3.45	1.13	2	High
Available computers not enough	3.86	1.02	1	High
System interface not comfortable	3.04	1.07	3	Moderate
System impose additional work tasks	3.03	1.22	4	Moderate
System need long time to be learned	2.95	1.13	5	Moderate
Total	3.26	0.78		Moderate

4-6 Hypotheses Testing

Previously, hypotheses from one to four were tested, and the remained will be tested in the following.

Hypothesis Five: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to gender variable. To test this hypothesis, the researcher conducted independent t-test and the results of this analysis are shown in the following Table (4-15).

Table (4-15) indicates that there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to gender variable in all domains.

Result: Hypothesis Five is accepted for all the research domains.

Table (4-15): Results of T-Test according to Gender variable

Domain	Male (N = 204)		Female (N = 199)		t	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		
Time	4.13	0.651	4.09	0.62	0.610	0.54
Effort	4.32	0.57	4.26	0.58	0.126	0.26
Cost	3.63	0.70	3.76	0.71	-1.852	0.06
Safety	3.78	0.68	3.83	0.73	-0.661	0.50
Obstacles	3.25	0.80	3.28	0.76	-0.481	0.63

Hypothesis Six: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to center type variable. To test this hypothesis, the researcher conducted independent t-test and the results of this analysis are shown in the following table (4-16).

Table (4-16) indicates that there are statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to center type variable in all domains except safety domain.

Result: Hypothesis Six is rejected for all the research domains and accepted only for safety domain.

Respondents in private sector were more agree than government with the impact of EHR on time, effort, and cost. Where as respondents in governmental were more agree with the obstacles.

Table (4-16): Results of T-Test according to Center Type variable

Domain	Governmental (N = 310)		Private (N = 93)		t	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		
Time	4.06	0.65	4.26	0.53	-2.608	0.00*
Effort	4.26	0.60	4.40	0.49	-2.094	0.03*
Cost	3.64	0.72	3.85	0.65	-2.473	0.01*
Safety	3.80	0.69	3.81	0.76	-0.084	0.93
obstacles	3.34	0.78	3.02	0.73	0.443	0.00*

* Statically significant at ($\alpha \leq 0.05$).

Hypothesis Seven: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to supervision degree variable. To test this hypothesis, the researcher conducted independent t-test and the results of this analysis are shown in the following table (4-17).

Table (4-17) indicates that there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to supervision degree variable in all domains.

Result: Hypothesis Seven is accepted for all the research domains.

Table (4-17): Results of T-Test according to Supervision Degree variable

Domains	Yes (N = 120)		No (N = 283)		t	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		
Time	4.05	0.61	4.13	0.64	-1.143	0.25
Effort	4.22	0.59	4.32	0.57	-1.532	0.12
Cost	3.73	0.63	3.67	0.74	0.708	0.47
Safety	3.75	0.72	3.83	0.70	-0.995	0.32
Obstacles	3.17	0.79	3.30	0.77	-1.555	0.12

Hypothesis Eight: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Age variable. To test this hypothesis, the researcher conducted One Way ANOVA Test and the results of this analysis are shown in the following table (4-18).

Table (4-18) indicates that there are significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Age variable in the domains (Cost and Safety). To know in favor of whom the differences are related, LSD Post Hoc Test was conducted. Table (4-19) shows the results of using LSD Post Hoc Test for the domain Cost, and table (4-20) shows the results for the domain Safety.

Table (4-18): Results of One Way ANOVA Test according to Age variable

Domain	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Time	Between Groups	2.349	3	0.783	1.933	0.12
	Within Groups	161.600	399	0.405		
	Total	163.949	402			
Effort	Between Groups	1.944	3	0.648	1.934	0.12
	Within Groups	133.680	399	0.335		
	Total	135.624	402			
Cost	Between Groups	4.187	3	1.396	2.771	0.04*
	Within Groups	200.957	399	0.504		
	Total	205.144	402			
Safety	Between Groups	9.492	3	3.164	6.520	0.00*
	Within Groups	193.645	399	0.485		
	Total	203.138	402			
Obstacles	Between Groups	1.372	3	0.457	0.747	0.52
	Within Groups	244.283	399	0.612		
	Total	245.655	402			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-19) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Cost domain due to Age variable, (20-30) and (31-40) in favor of (20-30).

Table (4-19): Results of using LSD Post Hoc for comparing the means in the domain Cost according to Age variable

Age	20-30	31-40	41-50	More than 50
20 – 30		0.20454*	0.02791	-0.13459
31 – 40			-0.17663-	-0.33913
41 – 50				-0.16250
More than 51				

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-20) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to Age variable, (20-30) and (31-40) in favor of (20-30).

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to Age variable, (20-30) and (41-50) in favor of (20-30).

Table (4-20): Results of using LSD Post Hoc for comparing the means in the domain Safety according to Age variable

Age	20-30	31-40	41-50	More than 50
20 – 30		0.27633*	0.34522*	-0.05791
31 – 40			0.06889	-0.33424
41 – 50				-0.40312*
More than 51				

* Statically significant at ($\alpha \leq 0.05$)

Result: Hypothesis Eight accepted for the research domains Time, Effort, and obstacles and rejected for domains Cost and Safety.

Hypothesis Nine: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Educational Level variable. To test this hypothesis, the researcher conducted One Way ANOVA Test and the results of this analysis are shown in the following Table (4-21).

Table (4-21) indicates that there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Educational Level variable in all domains.

Result: Hypothesis Nine is accepted for all the research domains.

Table (4-21): Results of One Way ANOVA Test according to Educational Level variable

Domain	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Time	Between Groups	2.348	2	1.174	2.905	0.05
	Within Groups	161.602	400	0.404		
	Total	163.949	402			
Effort	Between Groups	0.743	2	0.371	1.102	0.33
	Within Groups	134.882	400	0.337		
	Total	135.624	402			
Cost	Between Groups	0.469	2	0.235	0.459	0.63
	Within Groups	204.675	400	0.512		
	Total	205.144	402			
Safety	Between Groups	0.217	2	0.109	0.214	0.80
	Within Groups	202.920	400	0.507		
	Total	203.138	402			
Obstacles	Between Groups	1.761	2	0.880	1.444	0.23
	Within Groups	243.894	400	0.610		
	Total	245.655	402			

* Statically significant at ($\alpha \leq 0.05$)

Hypothesis Ten: There are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Nature of Work variable. To test this hypothesis, the researcher conducted One Way ANOVA Test and the results of this analysis are shown in the following table (4-22).

Table (4-22) indicates that there are significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to nature of work variable in the domains Time, Cost, Safety and Obstacles. To know in favor of whom the differences are related, LSD Post Hoc Test was conducted. Table (4-23) shows the results of using LSD Post Hoc Test for the domain Time, Table

(4-24) for Cost, Table (4-25) for safety, and table (4-26) shows the results for the domain Obstacles.

Table (4-22): Results of One Way ANOVA Test according to Nature of Work variable

Domains	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Time	Between Groups	6.278	2	3.139	7.963	0.00*
	Within Groups	157.672	400	0.394		
	Total	163.949	402			
Effort	Between Groups	0.746	2	0.373	1.106	0.33
	Within Groups	134.879	400	0.337		
	Total	135.624	402			
Cost	Between Groups	16.494	2	8.247	17.486	0.00*
	Within Groups	188.651	400	0.472		
	Total	205.144	402			
Safety	Between Groups	6.684	2	3.342	6.805	0.00*
	Within Groups	196.454	400	0.491		
	Total	203.138	402			
Obstacles	Between Groups	11.616	2	5.808	9.926	0.00*
	Within Groups	234.039	400	0.585		
	Total	245.655	402			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-23) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Time domain due to nature of work variable, between medical and paramedical in favor of paramedical
- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Time domain due to nature of work variable, between nursing and paramedical in favor of paramedical

Table (4-23): Results of using LSD Post Hoc for comparing the means in the domain Time according to Nature of Work variable

Nature of Work	Medical	Nursing	Paramedical
Medical		-0.15410	-0.35441*
Nursing			-0.20032*
Paramedical			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-24) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Cost domain due to nature of work variable, between medical and nursing in favor of nursing
- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Cost domain due to nature of work variable, between medical and paramedical in favor of paramedical
- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Cost domain due to nature of work variable, between nursing and paramedical in favor of paramedical

Table (4-24) : Results of using LSD Post Hoc for comparing the means in the domain Cost according to Nature of Work variable

Nature of Work	Medical	Nursing	Paramedical
Medical		-0.34512-*	-0.60323*
Nursing			-0.25811*
Paramedical			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-25) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to nature of work variable, between medical and paramedical in favor of paramedical.
- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to nature of work variable, between nursing and paramedical in favor of paramedical.

Table (4-25): Results of using LSD Post Hoc for comparing the means in the domain Safety according to Nature of Work variable

Nature of Work	Medical	Nursing	Paramedical
Medical		-0.16733	-0.36889*
Nursing			-0.20156*
Paramedical			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-26) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Obstacles domain due to nature of work variable, between medical and paramedical in favor of medical.
- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Obstacles domain due to nature of work variable, between nursing and paramedical in favor of nursing.

Table (4-26): Results of using LSD Post Hoc for comparing the means in the domain Obstacles according to Nature of Work variable

Nature of Work	Medical	Nursing	Paramedical
Medical		0.06712	0.40680*
Nursing			0.33968*
Paramedical			

* Statically significant at ($\alpha \leq 0.05$)

Result: Hypothesis Ten is rejected for the research domains Time, Cost, Safety and Obstacles, accepted only for the domain Effort.

Hypothesis Eleven: there are no statistically significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Experience Years variable. To test this hypothesis, the researcher conducted One Way ANOVA Test and the results of this analysis are shown in the following table (4-27).

Table (4-27) indicates that there are significant differences at the level ($\alpha \leq 0.5$) among respondents' means due to Experience Years variable only in the domain Safety. To know in favor of whom the differences are related, LSD Post Hoc Test was conducted. Table (4-28) shows the results of using LSD Post Hoc Test for the domain Safety

Table (4-27): Results of One Way ANOVA Test according to Experience Years variable

Domains	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Time	Between Groups	1.824	4	0.456	1.119	0.34
	Within Groups	162.125	398	0.407		
	Total	163.949	402			
Effort	Between Groups	1.582	4	0.395	1.174	0.32
	Within Groups	134.043	398	.337		
	Total	135.624	402			
Cost	Between Groups	2.144	4	0.536	1.051	0.38
	Within Groups	203.001	398	0.510		
	Total	205.144	402			
Safety	Between Groups	6.348	4	1.587	3.210	0.01*
	Within Groups	196.790	398	0.494		
	Total	203.138	402			
Obstacles	Between Groups	5.230	4	1.307	2.164	0.07
	Within Groups	240.425	398	0.604		
	Total	245.655	402			

* Statically significant at ($\alpha \leq 0.05$)

The following Table (4-28) shows that:

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to Experience Years

variable, between (less than 1 year) and (2 - 5) in favor of (less than 1 year).

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to Experience Years variable, between (less than 1 year) and (11 - 15) in favor of (less than 1 year).

- There are significant differences at the level ($\alpha \leq 0.5$) among respondents' means in Safety domain due to Experience years variable, between (less than 1 year) and (more than 16 year) in favor of (less than 1 year).

Table (4-28): Results of using LSD Post Hoc for comparing the means in the domain Safety according to Experience years variable

Experience	Less than 1	2-5	6-10	11-15	More than 16
Less than 1		0.22369*	0.16219	0.26317*	0.37634*
2-5			-0.06150	0.03947	0.15265
6-10				0.10097	0.21415
11-15					0.11317
More than 16					

* Statically significant at ($\alpha \leq 0.05$)

Result: Hypothesis Eleven is accepted for all the research domains except the domain Safety.

Hypothesis Twelve: there are no statistically significant relationship at the level ($\alpha \leq 0.5$) between the perceived impacts of EHR and the adoption

level. To test this hypothesis, the researcher conducted Pearson correlation test as shown in Table (4-29).

From Table (4-29) below, observed that there is negative relationship between the adoption level of EHR and the perceived impacts. As a result, the perceived impacts were decreasing with the increasing in the adoption level. From this result, the researcher indicates that the respondents employed in centers have a system, were less agree about the overall impact of the system in improving the healthcare, than who still don't have it. The last open question in the questionnaire was very useful to the researcher to make the below explanation about this result, by understanding respondents additional notes.

Table (4-29): Pearson correlation test between Impact Domains and Adoption Level

		Impact	Adoption Level
Impact	Pearson Correlation	1	-0.310*
	Sig. (2-tailed)		0.000
	N	403	403
Adoption Level	Pearson Correlation	-0.310*	1
	Sig. (2-tailed)	0.000	
	N	403	403

* Statically significant at ($\alpha \leq 0.05$)

Although there are heath centers adopt a system, was noticed during the research that these system are still new and the period of adoption is

short. Which also means that the workers in the centers are working in processes are different from that was usually dealing with in their daily work before the system. Nature of human doesn't like to change his habits or to change his work process he is dealing with for along of time. Workers in any organization may feel with fear to lose their job when an automation system is implemented, since they may believe that the system is to replace them. They also may believe even if they still in their job, the fear for them is that they may wouldn't be able to deal with the system or using it because lack of their technical skills, and all of this threats their job.

From the above the researcher refers the reason that workers in health centers whom have a system were less agree about EHR benefits, might came from resistance to change.

Another reason may refer to the system itself. If the system was poorly designed, or has many bugs, this will leads to disruptive results and undoubtedly creates dissatisfaction among the workers especially if they are unskilled to deal with technical problems, also with the absence of technicians. Since that, centers must maintain a careful evaluation for the current system they adopted, to see if the less satisfaction for their workers comes from this point or no. beside that, technician should be available all time to deal with technical problems.

If the infrastructures in the centers are poor or not adequate to the system, for example: sudden electricity power loss and sometimes extend

for along time, or week local area network (LAN), this will lead to results similarly to the previous point, even if the system was in high quality.

Final result: Hypothesis Twelve rejected, and accepted the alternate that there is relationship between the perceived impacts of EHR and the adoption level, and the relationship is negative.

Hypothesis Thirteen: there are no statistically significant relationship at the level ($\alpha \leq 0.5$) between the perceived impacts of EHR and the perceived obstacles. To test this hypothesis, the researcher conducted Pearson correlation test as shown in the following Table (4-30):

Table (4-30): Pearson correlation test between Impact Domains and Obstacle Domain

		Impact	**Obstacles**
Impact	Pearson Correlation	1	-0.095
	Sig. (2-tailed)		0.058
	N	403	403
Obstacles	Pearson Correlation	-0.095	1
	Sig. (2-tailed)	0.058	
	N	403	403

Results in the Table (4-30), indicate that there is negative relation, but it is not statistically significant. Thus, hypothesis thirteen is accepted. In other word, the obstacles don't negatively affect on the perceived impacts of EHR on healthcare. So we can say that the EHR beneficially

affect healthcare regarding of obstacles existence. But this result may be changed if other obstacles will be conducted in further researches.

4-7 Conclusion

In this chapter we saw how the respondents in the research sample were distributed according to their demographic variables. Also the chapter explored the statistical analysis of the research sample. As a result of the research, we can say that implementing an Electronic Health Record (EHR) System in health centers; can affect healthcare service positively by the following benefits. See also model Figure (4-5):

- Saving in Time, Effort, and Cost.
- Improving patient safety and quality of care.
- Decision supporting.
- Increase efficiency.
- Increase patient and health workers satisfaction.
- Improve health centers image.

By the end of this chapter, and depending on the previous findings, the researcher set the factors affected by EHR system in one model shown in Figure (4-5), which combining all previous proposed models together. The researcher hopes from this model to be a good tool for future researches in evaluation and assessment of HIS such as EHR or any other

tools of ICT in healthcare service. Also this model gives readers a quick understanding about the impact of EHR on healthcare.

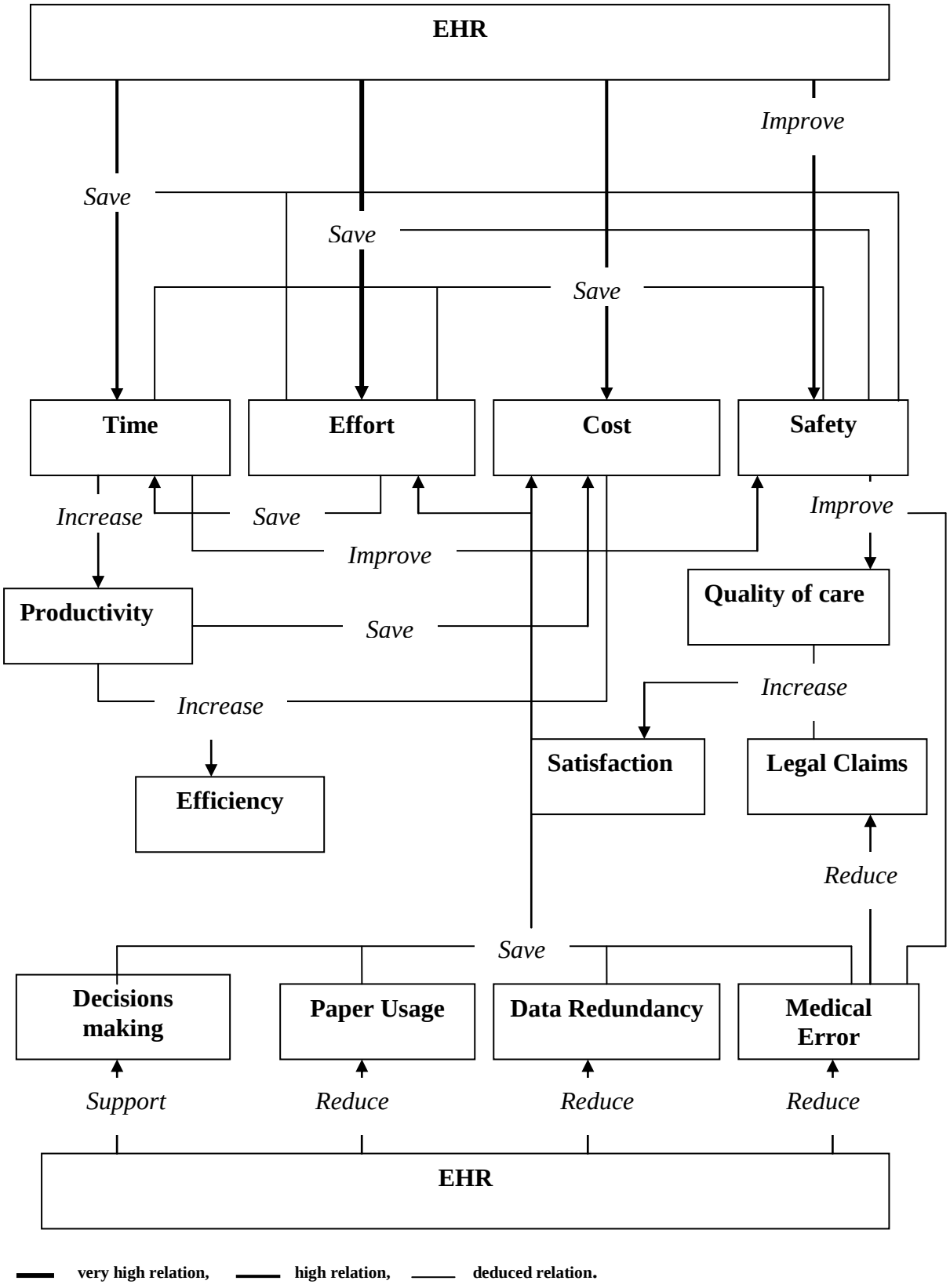

Figure (4-5): Model of EHR Impact on Healthcare

Chapter Five
Proposed Model

5-1 Introduction

Results of this research showed that health workers in Palestine health centers were agree with the benefits which EHR system offer to healthcare sector. Also this research found that almost of health workers in Palestine are employees in centers who have no function of EHR in. Furthermore, the relation between EHR adoption level and perceived benefits was negative. This enforce the researcher to search for a solution that can help the Palestinian health centers to increase their adoption level and usage of EHR system, also to improve their services by EHR beneficial impacts which were discussed before in this research. Moreover, Health centers in Palestine should intense their efforts to establish new committee or organization between them with main objective for looking to invent new technologies or approaches such as EHR to maintain, interoperable and shared health data.

We see in the research results how the adoption level was unequal between the research respondents. Furthermore, the adoption level of EHR seems low, and this may refers to high initial cost, lack of knowledge, workflow challenges, and lack of interoperability (Wright, et al., 2013). These results gave the researcher an indication that health centers in Palestine don't build their system depending on scientific or international standard. Which also mean difficulties in sharing data and acquire an

integrated system around the country and more difficult to communicate the system with the rest of the word (Omary et al., 2010). In other meaning, although the workers perceived the beneficial impact of EHR system and some of health centers are partially implementing functions of it, this is not lead to benefit from these impacts in the centers. Here the researcher will try to provide a proposed model that can help to improve the situation in Palestine. See Figure (5-1). By moving from isolated software systems in health centers towards solutions which are support a continuous and secure medical process including multiple healthcare stakeholders.

5-2 Model Building Discussion

This section will discuss the proposed model building steps and issues the researchers see that the health centers in Palestine have to follow them when developing the EHR system to maintain an interoperable and secured system.

Step 1: Standardize EHR Functions

Kumar et al. (2012) claims that in any health center the EHR is unique and it is generated for every citizen. It means that the structure of EHR and their content or functions may vary. This could be an obstacle for sharing health data between distributed systems (Beard, et al., 2012).

The specific content of a medical record may vary depending on the specialty and location of the healthcare provider (Dunlop, 2007). It usually contains the patient’s identification information and other demographics,

the patient's health history, and the patient's medical examination findings. In addition, a medical record may include laboratory test results, prescribed medications, list of allergies. (Malmberg, et al., 2012).

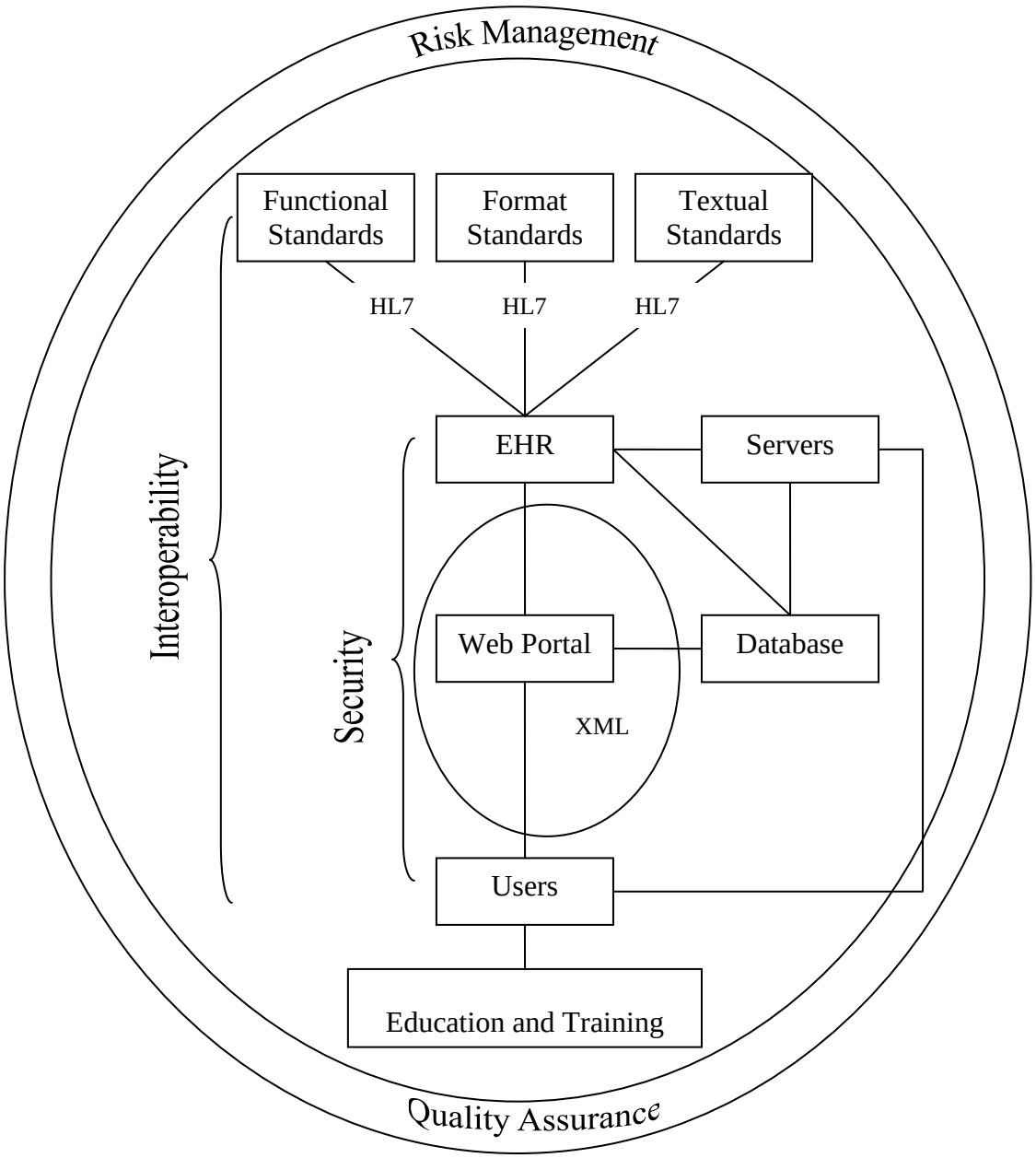

Figure (5-1): Proposed Model for Interoperable and Secured EHR in Palestine

The results of this research showed that health centers in Palestine not equal in adoption level of EHR and the adoption level is not mature yet. So the centers should have begin with new development of their own EHR system until arrive the maturity functional adoption level. More important in EHR development is that all centers have to standardize the components or functions of the system among them. Health centers can refer to HL7 EHR functional model as a good source to standardize their systems functionality. Researcher also discussed the EHR functions in much more details previously in Ch. 2 Sec. 4.

HL7 EHR Functional model definition is a "jointly balloted international standard which provides a reference list of functions and associated conformance criteria that would be broadly applicable to health care" (HL7, 2012).

Standardized EHR functions among health centers systems is not necessarily means that these systems are integrated together and each system of them can interact or exchange data with the others. For this reason health centers in Palestine have to look for standards when developing their systems to avoid the conflicts between distributed systems so each of them can interact and exchange data among the others efficiently and without error.

Step 2: Sharing EHR

Explored early in this research that healthcare sector is fragmented and patient may see different specialists from different departments in the same health center or also from different health centers. To achieve the beneficial impacts of EHR which are perceived among respondents in this research, health centers also in Palestine have to share patient records all together and this could improve accessibility of the patient record (Rao, et al., 2012), so clinicians can acquire patient's demographic or medical information without the limitations of time or site (So & Park, 2011).

In an interactive environment, there is a need to look at the information sharing amongst healthcare systems. Healthcare professionals whenever they require all the relevant patient medical data in an appropriate format must be available to them. The prediction is that in future there would be an interoperable information exchange in the form of EHR (Rao, et al., 2012).

Health centers in Palestine can share their data by establishing centralized relational database accessed through shared health web portal by internet. Having an access to a range of different EHRs over the internet has the potential of improving the integration into health centers who goes towards improving patient care and the quality of health data for use by them (Varlamis, 2007). To obtain this there are several issues -as will be discussed below- should be maintained, mainly important an appropriate data and technology infrastructures, interoperability, and security issues.

Step 3: Build Infrastructure

To maintain the previous step an appropriate technology infrastructure should be obtained to implement the EHR system (Joaquin, et al., 2010, Juma, et al., 2012). Technology infrastructure refers to how hardware and software work together to deliver EHR functionality to users. Like any computer system, EHR is built around input-processing-output-storage model of hardware with operating system and application software.

Explored previously in the literature review of this research is that healthcare industry is data intensive. Also these data may different from other industry and need a specialty in thinking with the storage process of EHR and the storage media that will be used to store it.

Storing Electronic Health Records

Palestinian health centers have to address the storage technology of electronic health records. As for manual medical records, the electronic health record needs to be maintained in an accessible media for future retrieval for patient care data. They should identify whether previous health records will be scanned and included as part of the system, how they will be stored, and if the system will include emergency attendances.

Type of media will be used to store the EHR

When developing a strategy for storage, it is important to remember that speed and backup are important considerations as it must fully support

continuous and instantaneous access to data. Secondary storage also needs to be considered. An EHR system stores huge amounts of data and decisions need to be made on the type of storage device to be used. The better-known devices are magnetic tape, hard disk systems, and optical disks(CD/DVD). As a conclusion the following issues should be address on storage:

- Storages should be secured and safe from any physical hazards.
- Control policy should be clarified for equipment and media to control accessing to it.
- A contingency plans with a process of continuous secondary or back-up copy should be in place to overcome system down or failure.
- A plan should be in place for the transfer of electronic health records to new media before the new media destructs the old.

The need to access EHR at any time and anywhere by www requires utilizing several technologies (Varlamis, 2007). Armstrong, et al., (2009) have developed a framework for deploying shared EHR through health web portal and it is segmented into three essential components: 1) the Internet, or remote user access layer, 2) the Perimeter Network, or middle firewall security and authentication layer, and 3) the EHR Network, the internal servers hosting EHR applications and databases (Armstrong, et al., 2009).

1. Internet Component

The Internet component represents remote user computer systems. Users may be using an operating systems such as Microsoft Windows which is the most popular and the users are familiar with in Palestine, and using any web browser, since that the system has to be compatible with all web browsers, because the researcher noticed in daily life also in his work that almost of users around the country are vary in preferred browser to used by.

2. Perimeter Network Component

The Perimeter Network component represents the security and authentication layer, and is situated between an external firewall and an internal firewall, and requires each user to have a username and password to login. Health centers can benefit from Terminal Services (TS) Gateway Server which is a Microsoft feature in Windows Server versions that provides connectivity via Remote Desktop Protocol (RDP) over Hypertext Transport Protocol Secure (HTTPS) using port 443 or Secure Sockets Layer (SSL) (Microsoft, 2013). This essentially means that users login to a remote desktop on the server and interact with software applications running on that desktop

3. Internal Network Component

The Internal Network component represents the secured network where the Terminal Servers, database server, user account server, and web

server are located. These servers are situated behind the Internal Firewall and are not accessible except through the firewall and authentication services. The security framework limits what a user has access to when they login so that systems cannot be compromised, and in the Windows environment the implementation of Group Policies limit and manage the terminal servers so that user desktops are self-contained, i.e. each user has their own desktop and user file space on the server when they are interacting with electronic health records.

Infrastructures issues

- High speed Computers processors with adequate RAM: to maintain efficiency in dealing with data.
- Valid license for the operating systems: to assure acquiring what available and needed updates.
- High speed broadband line: to speed up data utilities.

Step 4: Maintain Interoperability

By taking a close look into EHR functions, we observe that each of its function can be considered as a separated system. Also healthcare sector is fragmented managerially and geographically. From this point rises the need to integrate these systems together.

Integration in general can be explained as a process of bringing the systems or services together. The traditional definition of integration emphasize on interoperability (Rao, et al., 2012).

Recently Healthcare Information and Management Systems Society (HIMSS) defined interoperability as "the ability of health information systems to work together within and across organizational boundaries in order to advance the health status of, and the effective delivery of healthcare for, individuals and communities" (HIMSS, 2013).

Dogac, (2012) Said that interoperability is important in the E-Health domain and it can impact on healthcare positively by decreasing cost, improving quality of care, and supporting decision by being able to share life long EHRs of patients among different healthcare providers.

To be interoperable health centers are need to standardize the data-level within EHR (Ghitza, et al, 2013). Furthermore, the lack of standardization, hinders interoperable use and requires a great deal of work on translations among the internal representations which can be transmitted to and understood by another healthcare system (Dogac, et al, 2011; Garde, et al., 2007; Dogac, 2012).

What we can say here is that standardization is the major step required from health centers to maintain interoperability and for sharing and classifying healthcare data with respect to quality and ability (Kumar et al., 2012; Rao, et al., 2012).

Defined before that health centers in Palestine should maintain the EHR system functions depending on agreed standards such are that provided from HL7. Here also other standards issues are needed to be followed when developing the EHR to gain interoperability among the EHR functions and also with the other EHRs or systems. The major issues will discussed here are EHR format standards, and EHR textual information standards.

EHR Format Standards

There are many standards relating to specific aspects of EHR format. Traditionally, medical records have been written on paper and kept in folders. These folders are typically divided into useful sections, with new information added to each section chronologically as the patient experiences new medical issues. The EHR system has changed the format of health records (Joanne, 2007). Furthermore, the format of EHR has a major impact on its exchange and interoperability among various healthcare providers (Hristidis, 2009).

Hristidis, (2009) explored that many organizations have been worked to develop standards for representing, storing, and exchanging EHRs among heterogeneous systems. From the beginning of this chapter the researcher select the HL7 EHR Functionality Model to be as standard for EHR functions and components. Continue with HL7, the HL7 organization develops Conceptual Standards i.e., HL7 Reference Information Model

(RIM) (HL7, 2012), Document Standards i.e., HL7 v3 CDA (HL7, 2005), Application Standards i.e., HL7 Clinical Context Object Workgroup (CCOW) (HL7, 2010), and Messaging Standards i.e., HL7 v2.x and v3.0. HL7 messages (HL7, 2011) are used for interchange between hospital and physician record systems and between EHR systems and practice management systems. HL7 specifies a message model for exchange of text-based medical data, and is currently widely used for intra institution data exchange.

The HL7 RIM is the grammatical specification of HL7 messages, constituting the building blocks of the language entities and the relationship among them. RIM can be represented as a network of classes, expressed using a notation similar to Unified Modeling Language (UML). In addition to that, the HL7 RIM also provides a set of classes to define a communication infrastructure.

Textual Information and data Standards

Some of the most prominent EHR standards cover the basic structure and textual information contained in the record. A prominent standard in this category is HL7 version 3 CDA, which is described below.

The HL7 version 3 CDA is an XML-based markup standard intended to specify the encoding, structure, and semantics of clinical documents, such as discharge summaries and progress notes, for the purpose of

electronic exchange (HL7, 2005). Hristidis, (2009) explored the main characteristics of the CDA standard are:

- ***Persistence***: The clinical documents exist in an unaltered state for a period defined by local and regulatory requirements.
- ***Stewardship****:* A clinical document is maintained by an organization entrusted with its care.
- ***Authentication****:* The clinical records are intended to be legally authenticated.
- ***Context****:* The clinical document specifies its own default context.
- ***Wholeness****:* Authentication of a clinical document applies to the whole instance and the full context. Also, it is a complete and persistent set of information including text, images, sound, and other multimedia content.
- ***Human readability****:* A clinical document is human-readable.

Step 5: Maintain Security

Security issue concern with protect the EHR from unauthorized usage so the storage and transmission of the EHR should be guarded by security measures. Since any patient may expect that no unauthorized party will be able to read his or her medical records (Wainer, et al., 2008). The security of transferred medical data is a high priority issue to be considered when designing of medical information systems like EHR (Varlamis, 2007).

When information is available electronically, it opens the door for hackers to access the records as well as those who are authorized (Meingast, 2006). By law, custom, and patient expectation, private health information is protected. Beyond this, there are also significant healthcare motivations to protect private health information. To instill trust, patient personal health information must be treated as confidential and private. To be useable, patient medical information must be protected from unauthorized modification (Blobel & Davis, 2005).

Nettleton & Gough, (2003) identified that industry standard for computer security having the following characteristics:

- **Authentication**: To determine whether users are who they say they are. Typically, a user enters a user name and password that is authenticated against a previously stored user name and password.
- **Authorization**: To determine which users are allowed access to the system. Typically, a system administrator with access to security controls grants authorization access to all other users.
- **Privacy**: To prevent the observation and snooping that results in a breach of confidentiality or people becoming aware of more than what they need to know.
- **Data integrity**: To determine whether data have been altered, by whom and when, and whether the person was authorized is what data integrity means.

Step 6: Education and Training

One of the most crucial issues when preparing to introduce a major change in any organization is the training and education of users of the system. The change from a manual medical record system to an electronic health record system is a major change and many people need to be thoroughly trained if the change is to be successful.

Resistance to change or hesitancy in electronic documentation needs to be addressed and although some staff may still be reluctant, they may be willing to become involved. It is important to gain that all staff understand how the system will function and be confident with.

Step 7: Risk Management

A risk management strategy should be in place to address any foreseeable barriers to the implementation of an EHR. Elements of this strategy may include plans to:

- Ensure adequate funding is available to provide the source applications, hardware infrastructure and implementation resources with a funding/financial management plan in place to incorporate ongoing needs.
- Ensure sufficient skilled resources, both human and technical, are available to provide program management during implementation and to give on-going support

- Develop and implement a strategy to promote the benefits of the proposed EHR to consumers and healthcare providers such as brochures or a newsletter to keep personnel up-to-date with developments

Step 8: Quality

Make quality assurance for the system by preparing evaluation plan to ensure that the system adopted correctly and according to defined standards and also giving the beneficial impacts which are expected from it.

Chapter Six

Recommendations and Further Studies

6-1 Recommendations

Based on the research findings, and after exploring the impact of ICT specially EHR system on healthcare and defining the obstacles facing health centers with implementing or using the system. The researcher has seen to set the following recommendations:

- EHR should be adopted as a national system shared between all health centers around Palestine.
- Centers who have a system should maintain careful evaluation for the system they have.
- Health centers have to encourage their workers to use the system. And also they have to maintain an educational programs to increase awareness between them.
- Technologies, such as EHR, need to be appreciated and accepted by both healthcare administrators and practitioners before it can significantly affect the performance of healthcare centers.
- Centers that intent to adopt EHR have to prepare a good plan to make the adoption more efficiently. Also it is it is helpful for them to assess the technology acceptance and intention to use before they precede the adaptation.

- To whom they haven't any situation regarding to the system and not intent to adopt it yet, it is the time now to begin intention and plan to adopt it.
- To whom they actually implement the system. More additional training programs would be helpful for them to increase the efficiency obtained from it. Also it's helpful for them to encourage system users to depend on the system in all of their daily tasks.
- The EHR system should be adopted in full functionalities to get the highest beneficial impacts.
- Ministry of health in Palestine must take action to develop and adopt a notional EHR system shared between all healthcare stakeholders around the country.
- Improvement in ICT infrastructure should be maintained in health sector, also to get the highest efficiency and quality of care.
- To get more benefit health centers have to realize that the EHR system should be supported and integrated with other ICT tools.
- Researchers in Palestine should increase the research efforts in the filed of ICT in healthcare.

6-2 Further Studies

- Prepare plans for centers they are intent to adopt the EHR system.

- Assess the intention and acceptance to whom they intent to adopt the EHR system.
- Evaluate the current infrastructure in Palestine and define the improvements needs.
- Prepare a study to define the current adoption level of EHR in Palestine. Also other ICT tools.
- Compare the situation in Palestine with other similar developing countries
- Study the gaps between the situation in Palestine and other developed countries.
- Make study to discover if there is another ICT tool could be more efficient in Palestine.
- Study if there is a relationship between the impact of EHR and usage period and if the impact is changing over time or not.
- This research indented directly to beneficial impacts of ICT, so it is important as a same in further studies to study if there are harmful impacts.
- Other ICT tools should be assessed and evaluated in separated study for each.

- Further studies should emphasize on the actual assessment of the current systems, to get empirical evidence about its impact on healthcare.
- It is recommended to maintain further studies that assess the impact of ICT on administrative tasks in health centers.
- Study how the EHR affect the privacy of patient data and what are the security concerns should be undertaken when implementing the system.

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Appendices

Appendix A: sample size formula

Sample Size Formulas for our Sample Size Calculator

Here are the formulas used in our Sample Size Calculator:

Sample Size

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)
p = percentage picking a choice, expressed as decimal
(.5 used for sample size needed)
c = confidence interval, expressed as decimal
(e.g., .04 = ±4)

Appendix B: Questionnaire (Arabic version)

بسم الله الرحمن الرحيم

استبانة حول

أثر نظام السجل الصحي الإلكتروني على الرعاية الصحية

الأخت الفاضلة / الأخ الفاضل

السلام عليكم ورحمة الله وبركاته،،،،،،

أضع بين أيديكم هذه الاستبانة وهي إحدى المتطلبات الدراسية للحصول على درجة الماجستير في تخصص الإدارة الهندسية في جامعة النجاح الوطنية.

يسعى الباحث من خلال هذه الاستبانة إلى معرفة مدى تطبيق نظام السجل الصحي الالكتروني في المراكز الصحية العاملة في الضفة الغربية والتعرف على أثر النظام على الرعاية الصحية في تلك المراكز بالإضافة إلى التعرف على أهم المعوقات التي تحد من انتشار واستخدام مثل هذه الأنظمة.

وحيث أني أؤمن بأنكم خير مصدر للمعلومات المطلوبة، و أعهد بكم الاهتمام والاستعداد لمؤازرة الأبحاث العلمية التي تهتم بخدمة مجتمعنا وتطويره، لذا توجهت إليكم وكلي أمل في أن أجد التعاون المطلق من قبلكم وذلك من خلال الإجابة على أسئلة الاستبانة.

أرجو من حضرتكم التكرم بقراءة كل فقرة بعناية ووضع إشارة (X) أمام الاختيار المناسب من وجهة نظركم، للوصول إلى نتائج دقيقة وموضوعية. ثقوا تماما أني حريص على عدم إظهار هوية المجيب عن الاستبانة وإني أتعهد بالمحافظة على السرية التامة وعدم استخدام أي معلومة في أي مجال غير مجال البحث العلمي.

شاكراً لكم حسن تعاونكم

الباحث : سعيد محمد ابراهيم

القسم الأول : الخصائص الشخصية

1- الجنس:
[ ] ذكر [ ] أنثى

2- العمر:
[ ] 30-20 [ ] 40-31 [ ] 50-41 [ ] 51 فأكثر

3- المؤهل العلمي :
[ ] دبلوم [ ] بكالوريوس [ ] ماجستير فأعلى

4- المركز الصحي الذي تعمل فيه:
[ ] حكومي [ ] خاص

5 - طبيعة عملك :
[ ] طبيب [ ] ممرض [ ] مهن طبية مساندة

6- مدة الخدمة:
[ ] سنة وأقل [ ] 2-5 سنوات [ ] 6-10 سنوات [ ] 11-15 سنة [ ] 16 فأكثر

7- لديك درجة إشرافية (مثل: مدير، رئيس قسم، ... الخ)
[ ] نعم، وهي :..... [ ] لا

8- بشكل عام أثر استخدام نظام السجل الصحي الالكتروني على الرعاية الصحية
[ ] يؤثر إيجابا [ ] يؤثر سلبا [ ] لا يؤثر [ ] لا أعرف

القسم الثاني : مدى تطبيق نظام السجل الصحي الالكتروني

المجال	الفقرة	نعم	لا
التطبيق	يطبق المركز نظام محوسب لتسجيل المعلومات الصحية المتعلقة بالمريض		
	يطبق المركز نظام الكتروني لإصدار الأوامر الطبية وطلب الفحوصات		
	يطبق المركز نظام محوسب لإدخال نتائج الفحوصات وإرسالها الكترونيا		
	يطبق المركز نظام التذكير الالكتروني (تذكير بموعد الدواء أو إجراء فحص)		
	يطبق المركز نظام محوسب لتحديد وإعطاء الوصفات الطبية		

القسم الثالث : أثر استخدام نظام السجل الصحي الإلكتروني على الرعاية الصحية

المجال	الفقرة	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
الوقت	يسرع عملية نقل البيانات بين الأقسام					
	يسرع عملية تنفيذ الأوامر الطبية وإجراء الفحوصات والتحاليل					
	يسرع عملية تعبئة النماذج واستيفاء المعلومات من المراجعين					
	يسرع عملية الوصول والرجوع إلى السجلات الطبية					
	يمنح الطبيب وقت أطول ليكرسه مع المريض					
الجهد	يسهل عملية الاتصال والتنسيق بين الأقسام					
	يسهل عملية إصدار الأوامر الطبية مثل طلب الفحوصات والتحاليل					
	يسهل عملية الوصول والرجوع إلى السجلات الطبية					
	يساعد في إجراء المسوحات والأبحاث الطبية					
	يساعد في إعداد التقارير والإحصائيات					
التكلفة	يساهم في الحد من تكرار الفحوصات الطبية					
	يساهم في الحد من الاستخدامات الورقية					
	يساهم في تقليل زمن مكوث المريض في المركز					
	يساهم في تقليل معدل زيارات المريض الى المركز					
	يساهم في تقليل الأخطاء الطبية					
العلاج الآمن	يساعد على احتواء المعلومات الطبية الكاملة عن المريض					
	يوفر إمكانية استعراض جميع العلاجات التي تلقاها المريض في آن واحد					
	يساعد في تحديد الدواء المناسب للمريض					
	التحذيرات التي يصدرها النظام تساهم في الحد من إعطاء الدواء الخاطئ للمريض					
	يزيد في الالتزام بالعلاج من خلال إعطاء تذكيرات بمواعيد الدواء أو إجراء فحوصات معينة					

القسم الرابع : معيقات استخدام نظام السجل الصحي الالكتروني

المجال	الفقرة	موافق بشدة	موافق	محايد	غير موافق	غير موافق بشدة
معيقات الاستخدام	أجهزة الحاسوب المتوفرة غير مناسبة					
	عدد أجهزة الحاسوب المتوفرة غير كاف					
	واجهة النظام غير مريحة للاستخدام					
	يشكل النظام المحوسب عبء إضافي					
	النظام بحاجة الى وقت طويل لتعلمه					

- يرجى ذكر أي ملاحظة تريد إضافتها والتي قد أغفلتها الاستبانة أو لم يعطها الباحث حقها من وجهة نظرك.

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شاكراً لكم حسن تعاونكم

الباحث : سعيد محمد ابراهيم

Appendix B: Questionnaire (English version)

Part One: Demographics

1- sex:
[ ] male [ ]female

2 -Age :
[ ] 20- 30 [ ] 31-40 [ ] 41-50 [ ] 51 and more

3 -Education Level:
[ ] Diploma [ ] Bachelor [ ] Master and higher

4 -Center you work in is :
[ ] governmental [ ] private

5 – Your nature of work :
[ ] Medical [ ] Nursing [ ] Paramedical

6 -Experience period:
[ ] less than on year [ ] 2-5 years [ ] 6-10 years [ ] 11-15 years
[ ] more than 16 years

7 -do you have supervision degree (ie. Manager, head quarter, etc)
[ ] Yes [ ] No

8 -in general the impact of electronic health record on healthcare
[ ] positive impact [ ] negative impact [ ] no impact

[ ]don't know

Part Two: Adoption level of electronic health record system

Domain	paragraph	Yes	No
Adoption level	The center has a system to register and acquire patients data		
	The center has a system to set medical orders and lab requests		
	The center has a system enable lab results to be entered and returned electronically		
	The center has an electronic reminder system		
	The center has a system used in diagnosis and in giving medications		

Part Three: Impact of Electronic Health Record System on Healthcare

	Paragraph	Highly Agree	Agree	Neutral	Disagree	Highly Disagree
Time	Speed up data exchange and transfer between departments					
	Speed up medical orders process					
	speed up patient information acquiring					
	Speed up access and return to medical records					
	Physicians can dedicate more time to patients					
Effort	Easy communication and coordination between departments					
	Easy medical orders requests					
	Easy up access and return to medical records					
	Helps in surveys and medical research					
	Helps in preparing reports and statistics					
Cost	Reduce medical tests redundancy					
	Reduce paper usage					
	Reduce patient length of stay					
	Reduce average of patient visits					
	Reduce medical errors					
Safety	Helps in maintaining complete medication information about patient					
	Provide space to list all medications together					
	Helps in giving patient appropriate medication					
	Reduce adverse drug events					
	Better guideline adherence through reminding professionals of actions to be undertaken					

Part Four: Obstacles facing Electronic Health Record System

	Paragraph	Highly Agree	Agree	Neutral	Disagree	Highly Disagree
Obstacles	Available computers not suitable					
	Available computers not enough					
	System interface not comfortable					
	System impose additional work tasks					
	System need long time to be learned					

Please set any additional notes you see that questionnaire didn't mention it.

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Thanks

Researcher: Sa'id Ibrahim

Appendix C: Arbitrators and experts who reviewed the questionnaire

Name	Organization Name
Dr. Mohammad-Hisham Jaber	Al-Najah University
Dr. Husam Araman	Al-Najah University
Dr. Ayham Ja’ron	Al-Najah University
Dr. Rabeh Morrar	Al-Najah University
Dr. Nedal Abdelgaphor	Alquds Open University
Dr. Abdelkarim Qasem	Alquds Open University
Dr. Sa’id Alhammoz	Ministry of Health
Dr. Jawad Albitar	Ministry of Health

Appendix D: letter for arbitrators

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية
كلية الدراسات العليا
تخصص الإدارة الهندسية
التاريخ : / / 2012

حضرة الدكتور :.....المحترم،،،

السلام عليكم ورحمة الله وبركاته ،،،

الموضوع :تحكيم استبانه

يقوم الباحث بإجراء دراسة ماجستير ميدانية بعنوان " أثر تكنولوجيا المعلومات والاتصالات على الرعاية الصحية في المراكز الصحية – الضفة الغربية" وتهدف هذه الدراسة إلى تحديد واقع استخدام نظام السجل الطبي الالكتروني في المراكز الصحية العاملة في الضفة الغربية وتقييم أثره على الرعاية الصحية في تلك المراكز، وذلك لاستيفاء متطلبات الحصول على درجة الماجستير في تخصص الإدارة الهندسية من كلية الدراسات العليا في جامعة النجاح الوطنية.

وبهدف إعداد وتطوير الإستبانه، فقد استند الباحث إلى أدبيات الدراسة وما ورد في الدراسات السابقة، إلى جانب المقاييس المقرة من منظمة الصحة العالمية، وبالإضافة إلى الخبرة الشخصية.

إن خبرتكم الطويلة في هذا المجال وثقة الباحث بكم جعلته يضع استبانه الدراسة المرفقة بين أيديكم للوقوف على صحة وصدق فقراتها وكذلك مدى صلاحيتها وملاءمتها. وتهدف الإستبانة إلى:

1- استكشاف واقع استخدام نظام السجل الطبي الالكتروني في المراكز الصحية
2- استكشاف مدى دعم ومساندة إدارات المراكز للنظام
3- قياس أثر النظام على الرعاية الصحية من الجوانب التالية:
   - الوقت
   - الجهد
   - التكلفة
   - أمن وحماية المريض
4- معرفة أهم المعومات التي تواجه النظام

يتطلع الباحث إلى ملاحظاتكم وأرائكم النيرة التي ستكون ذات تأثير كبير في إخراج الإستبانة بشكل يتسم بالمنهجية العلمية وتحقيق الأهداف المرجوة منها، وذلك بإجراء تعديلات أو إضافات أو ملاحظات ترونها مناسبة وتثري هذه الإستبانة.

شاكرين لكم حسن تعاونكم
وتفضلوا بقبول فائق الاحترام والتقدير

الباحث
سعيد محمد ابراهيم
0599-756964

جامعة النجاح الوطنية

كلية الدراسات العليا

أثر تكنولوجيا المعلومات والاتصالات على الرعاية الصحية في المراكز الصحية في فلسطين

إعداد

سعيد محمد ابراهيم

إشراف

د. بكر عبد الحق

قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في برنامج الادارة الهندسية بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس- فلسطين .

2013

أثر تكنولوجيا المعلومات والاتصالات على الرعاية الصحية في المراكز الصحية في الضفة الغربية– فلسطين

إعداد

سعيد محمد ابراهيم

إشراف

د. بكر عبد الحق

الملخص

من الممكن القول أن قطاع تكنولوجيا المعلومات والاتصالات هو القطاع الأسرع نموا في النظام العالمي، ويلعب دورا مهما ورئيسي في أغلب الأنشطة التي نقوم بها، سواء في مكان العمل، التجارة، وسائر الأمور في حياتنا اليومية والشخصية. من الفوائد العظيمة التي يمكن جنيها من تكنولوجيا المعلومات والاتصالات هو أنها تحسن من جودة وفعالية خدمة الرعاية الصحية. هدف هذا البحث إلى استعراض الفوائد التي يمكن الحصول عليها من خلال استخدام تكنولوجيا المعلومات والاتصالات في القطاع الصحي. إضافة إلى ذلك, هدف هذا البحث إلى تقييم أثر تكنولوجيا المعلومات والاتصالات على الرعاية الصحية من وجهة نظر العاملين في المراكز الصحية في فلسطين. لتحقيق أهداف البحث، قام الباحث بتطوير استبانة معتمدا بذلك على الأدبيات المتوفرة والدراسات السابقة, ومن ثم قام بتوزيع هذه الاستبانة على عينة من العاملين في المراكز الصحية. استخدم الباحث في هذا البحث المنهج الوصفي التحليلي معتمدا على نوعين أساسيين من البيانات (أولية و ثانوية)، البيانات الأولية والتي تم الحصول عليها من خلال توزيع الاستبانة على عينة البحث، والبيانات الثانوية والتي تم الحصول عليها من خلال مراجعة الأدبيات. لتحليل البيانات الأولية والحصول على النتائج استخدم الباحث برنامج SPSS الإصدار 19. حدد البحث نظام السجل الصحي الالكتروني كأداة في تكنولوجيا المعلومات والاتصالات ليتم تقييمها في فلسطين. المتغيرات الرئيسية التي تم تقييمها مباشرة في هذا البحث هي (الوقت، الجهد، التكلفة، الأمان). أظهرت نتائج البحث بأن هنالك درجة عالية من الموافقة بين المستجيبين في عينة البحث حول أثر السجل الصحي الالكتروني على الرعاية الصحية، من

خلال توفير الوقت والجهد والتكلفة وتحسين الأمان في العلاج. بالاعتماد على نتائج واستنتاجات البحث، قام الباحث بتطوير نموذج مقترح يوضح أثر السجل الصحي الالكتروني على الرعاية الصحية. يرى الباحث أن النموذج المقترح يمكن أن يكون مفيدا في الأبحاث المستقبلية والتي تهدف إلى تقدير أو تقييم نظم المعلومات الصحية مثل السجل الصحي الالكتروني، أو أي أداة أخرى من أدوات تكنولوجيا المعلومات والاتصالات المستخدمة في الخدمة الصحية. بالإضافة إلى أن النموذج يعطي القارئ فهم سريع حول أثر السجل الصحي الالكتروني على الرعاية الصحية.

كنتيجة نهائية لهذا البحث. وجد الباحث أن تطبيق واستخدام سجل صحي الكتروني في المراكز الصحية، يمكن أن يؤثر ايجابيا على الرعاية الصحية من خلال الفوائد التالية:

- توفير الوقت والجهد والتكلفة.
- تحسين جودة الرعاية وأمان المريض.
- دعم القرارات.
- زيادة الفاعلية.
- زيادة رضا المرضى والعاملين في الصحة.
- تحسين صورة المركز الصحي.

في نهاية البحث قام الباحث بوضع بعض التوصيات لوزارة الصحة الفلسطينية وجميع المراكز الصحية في فلسطين وشدد على ضرورة زيادة مستوى التبني لنظام السجل الصحي الالكتروني والأدوات الأخرى من تكنولوجيا المعلومات والاتصالات في تلك المراكز ووضعها جميعها في نموذج متكامل. هذا وقد أوصى الباحث أيضا بزيادة البرامج التدريبية والتعليمية في مجال تكنولوجيا المعلومات والاتصالات للعاملين في الصحة. وفي النهاية أوصى الباحث بعمل المزيد من الدراسات حول تكنولوجيا المعلومات والاتصالات في الرعاية الصحية.