Are healthcare organizations in the developing countries ready for the information-driven healthcare?

A case study in the Arabian Gulf.

هل مؤسسات الرعاية الصحية في البلدان النامية على استعداد للرعاية الصحية القائمة على المعلومات؟

دراسة في الخليج العربي

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Abstract

It's not a secret that the healthcare industry is in transition. Countries worldwide are striving to achieve healthcare system reform to provide more affordable and better care for individuals and population. Additionally, to reduce waste and overall health care expenditure over the time.

It's become a must to have more coordinated, patient-centered and more efficient care delivery systems. Therefore, it is required to have industry consolidation by merging all entities involved in healthcare (e.g., patients, healthcare providers, payers, pharmacies, and laboratories) to form more integrated health systems. Healthcare systems that facilitate the accessing and sharing of health information, as well as to allow subsequent analysis of health data.

Information technology plays a central role in achieving efficiencies and enhancing care delivery to meet these multi-faceted demands. This can be achieved by facilitating the flow of patient data throughout an expanding community of care, while also securing the information and rigorously protecting patient privacy.

Integrated health systems can be achieved through a range of information technologies such as electronic health records and other clinical applications, data repositories, analytic tools, telehealth and connected biomedical devices. Most importantly, those solutions must rest on a foundation of technology, data and security standards that ensures confidentiality of personal health information.

The dissertation will provide an integrated roadmap of the current and rapid changes in healthcare that are occurring in the advanced world. Then will apply this roadmap to the current status of healthcare system in a developing country to highlight the opportunities and risks.

Keywords:

Health Care Reform, Health information Technology (Health IT), Health Informatics, Electronic Health Records (EHRs), Information-driven healthcare, Health Information Exchange (HIE), Interoperability.

الملخص

البلدان في جميع أنحاء العالم تسعى لاصلاح منظومة الرعاية الصحية بها. وذلك لتقديم رعاية صحية أفضل وذات مستوى عالى من الجودة والامان سواء للموطنين او المقيميين بها. وتشجيع انماط الحياة الصحية والعمل على الحد من انتشار الأمراض والأوبئة. وخفض الفاقد وتقليل الإنفاق على الرعاية الصحية بشكل عام على المدى البعيد.

ولتحقيق هذه الأهداف يجب التنسيق بين جميع الأطراف ذات الصلة بمنظومة الرعاية الصحية. فيجب التنسيق بين الحكومة والسلطات التشريعية والسكان و مقدمى الرعاية الصحية و شركات التأمين الصحى و الصيداليات والمختبرات وغيرها من الجهات. ويجب بناء نظام صحى متكامل على مستوى الدولة لتسهيل عملية تجميع وتبادل المعلومات الصحية بين هذه الجهات. وذلك لمساعدة كل من مقدمى الرعاية والمرضى وصانعى القرار على اتخاذ قرارات مستنيرة تعتمد على المعلومات والحقائق. وتحليل هذه البيانات على المستوى الوطنى مما يساعد على معرفة الاتجاهات الصحية للسكان والتنبؤ باى مخاطر صحية قد تهدد الصحة العامة وبالتالى وضع الخطط لمنع هذه التهديدات والإستعداد للحالات الطارئه والتعامل معها بشكل اكثر كفاءة.

تكنولوجيا المعلومات يمكن ان تلعب دورا محوريا فى تحقيق هذه الأهداف. حيث ان تسجيل البيانات والملفات الصحية بشكل الكترونى يؤدى الى سرعة وتسهيل استرجاع هذه البيانات فى الوقت المناسب. ايضا البيانات المسجلة الكترونيا يمكن تبادلها بسولة بين الجهات المختلفة وبالتالى تحسين الكفاءة فى تقديم الرعاية الصحية وذيادة التنسيق بين مقدمى الرعاية.

يمكن الوصول الى اصلاح نظام الرعاية الصحية والى نظام صحى متكامل من خلال بناء شبكة معلومات صحية على المستوى الوطنى تضم جميع الأطراف ذات الصلة بالمنظومة الصحية. واعتماد تكنولوجيا المعلومات الصحية فى مخلتف المؤسسات الصحية مثل السجلات الصحية الالكترونية, انظمة الرعاية الصحية عن بعد, السجلات الصحية الشخصية والأجهزة الصحية المتنقلة. ولتحقيق التكامل بين هذه النظم يجب ان تخضع كلها لنفس المعايير التقنية ويجب الحفاظ على أمن وخصوصية المعلومات الصحية.

يقدم هذا البحث صورة متكاملة لاصلاح نظام الرعاية الصحية فى الولايات المتحدة الأمريكية كواحدة من اكبر الدول فى العالم المتقدم. ويقترح البحث خريطة طريق ونموذج لاصلاح النظام الطبى. ثم تطبيق خريطة الطريق والنوذج المقترح على الوضع الحالى فى دولة الأمارات العربية المتحدة لتسليط الضوء على الفرص والمخاطر. وابداء بعض المقترحات والحلول لكل من الحكومة ومؤسسات الرعاية الصحية والشركات العاملة فى مجال تكنولوجيا المعلومات لتحسين الوضع الحالى.

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LIST OF ABBREVIATIONS

U.S.   United States of America

NAS   National Academy of Sciences

IOM   Institute of Medicine

NAE   National Academy of Engineering

NRC   National Research Council

HHS   The United States Department of Health and Human Services

NCQA   National Committee for Quality Assurance

JCAHO   Joint Commission on Accreditation Healthcare Organizations

CMS   Centers for Medicare and Medicaid Services

MMA   Medicare Prescription Drug Improvement and Modernization Act

CBO   Congressional Budget Office

NCVHS   National Committee on Vital and Health Statistics

HIPAA   Health Insurance Portability and Accountability Act

EHRs   Electronic Health Records

HITECH   Information Technology for Economic and Clinical Health

PPACA   Patient Protection and Affordable Care Act

HIT   Health Information Technology

FDA   Food and Drug Administration

FDASIA   Food and Drug Administration Safety and Innovation Act

mHealth   Mobile Health

PHRs   Personal Health Records

eRx   Electronic Prescribing

HIE   Health Information Exchange

CDSS   Clinical Decision Support Systems

NHIN	Nationwide Health Information Network
DoD	Department of Defense
VA	Department of Veterans Affairs
HRSA	Health Resources and Services Administration
RECs	Regional Health Information Technology Extension Centers
HITRC	Health Information Technology Research Center
OCR	Office for Civil Rights
NIH	National Institutes of Health
AHRQ	Agency for Healthcare Research and Quality
CDC	Centers for Disease Control and Prevention
NCHS	National Center for Health Statistics
CPOE	Computerized Physician Order Entry
MoH	Ministry of Health
DHA	Dubai Health Authority
HAAD	Health Authority – Abu Dhabi
PBM	Pharmacy Benefit Management
eReferral	Electronic Referral Transaction

Chapter 1: Introduction

1.1 General Introduction

Nations worldwide at different levels of economic development are striving to achieve healthcare system reform to provide more effective, more efficient, and better care for the whole population (Frenk, 1994).

According to a report published by the Institute of Medicine (IOM, 2012), despite the advances in science, healthcare are facing major challenges. These challenges include: healthcare system complexity, medical errors, high costs, variable quality, administrative inefficiencies, and lack of coordination of care.

The advances in science have improved the capability of the healthcare system to better understand the causes of diseases and the ability to treat the diseases. In the same time, healthcare complexity has increased due to the variety of the available options of diagnostic, treatment, and care management. Advances in genetics is one of the prominent example of this complexity, which offer unprecedented opportunities for personalized and tailored treatments.

Healthcare system complexity added new stresses on physicians and patients as they will have more information to take into consideration and more decisions to make. Often, these decisions are neither straightforward nor easy and comprise varying tradeoffs, options, risks, and benefits. Additionally, patients lack the information needed to make decisions as they often not receiving clear information on options and trade-offs of the treatments for their condition. Moreover, this complexity have the potential to increase the human errors that can result in poorer outcomes, patient harm, and malpractice claims..

Modern healthcare complexity creates new challenges. The pace at which the new knowledge is generated outstrips individual physician capability to read, remember, and manage the information that can guide clinical practice. Consequently, healthcare quality, outcomes, and safety can be adversely impacted.

In addition, administrative complexity including the fragmented financing and complicated workflows can exacerbate the challenges posed by the clinical complexity described above. Complicated and inefficient workflows, can waste physician's time and delay the caring for the patients, raise costs and patient outcomes will be adversely impacted. Additionally, managing a

large number of different health insurance plans is adding more administrative burden on physicians and can adversely impact continuity of care.

Furthermore, unnecessary services, inefficient delivery of services, excess administrative expenses,high prices, medical fraud, and missed prevention opportunities are leading to unsustainable growth rate of healthcare expenses. Therefore, divert the major resources from necessary care. Consequently, decrease the improvement in the quality of care and health generally.

All the above characteristics of the existing healthcare system, demonstrate that there are shortcomings and inefficiencies in gathering health information to develop the knowledge. Additionally, There is deficiency in translation of this knowledge into medical evidence to guide the medical decision making in the point of care. Consequently, all this contribute to a big reservoir of missed opportunities, harm, and waste.

Therefore, there is a need for healthcare reform. There is a need for a new healthcare system that aligns the researches, analytics, incentives, culture of continuous improvement, and partnerships among healthcare providers and patient. New healthcare system that helps to produce and use a real-time knowledge in a clear and understandable format. Moreover, help clinicians and patients as partners to make informed clinical decisions, and achieve improvement in the effectiveness and the efficiency of care.

According to IOM (2012) report, the new health system should realize seven critical imperatives:

1. Avoid medical errors.
2. Reduce disparities in health care access.
3. Accelerate spread of knowledge.
4. Promote consumer role.
5. Foster data protection and privacy.
6. Promote public health and readiness to public health threats.
7. Improve use of resources.

The advances in information technology, computing and telecommunication have the potential to improve healthcare. And this can be achieved by:

- Facilitating the generation of knowledge and the reach to this knowledge to guide the clinical practices and medical-decision making.
- Increasing real-time access to health information where and when needed.
- Improving communication among physician and patient, and assisting them in managing chronic diseases.
- Improving the capability to capture care delivery process, public disease surveillance, and financial data.

One study stated that the use of Computerized Physician Order Entry (CPOE) has the potential to decrease drug adverse events by 41 percent. In addition, another study projected that the use of CPOE has decreased the overall medication error rates by almost 81 percent (IOM, 2012).

The dissertation illustrates the transformation that is currently happening in healthcare system in the developed world, first by literature review that demonstrates healthcare system reform in the United States of America (U.S)

The literature review highlights the major steps, changes, and initiatives done by the U.S. to achieve healthcare system reform nationwide. In particular, setting strategy and goals for connected health, adoption of health information technology, and establishing a framework for standards and interoperability.

The dissertation proposes a model and roadmap for the transformation journey from the traditional healthcare system to the information-driven healthcare. The purpose of information-driven healthcare is to deliver the right information at the right time and to the right people. Consequently, the information-driven healthcare will facilitate informed decision-making, allow patients and their families to be more engaged in their healthcare. Additionally, It will support coordination of care, reduce healthcare expenditure over the time, and improve population health and wellness.

Finally, the proposed model and roadmap will be applied to the current status of health care system in the United Arab Emirates (UAE) as a developing country. I will highlight the opportunities and risks and to what extent healthcare system in UAE are ready to that transformation.

1.2 Motivation

UAE (as well as other countries in the Arab world and the rest of the world) aspires to have better health for its citizens and residents. The different health authorities in UAE started since few years to take a lot of initiatives toward health care system reform such as e-Claims, Pharmacy Benefit Management (PBM), e-Prescription (eRx), and Electronic Referral Transaction (eReferral).

The Dubai Health Authority (DHA) (2013), announced the vision of the Dubai Health Strategy 2013-2025. The strategy was recently approved by His Highness Sheikh Mohammad Bin Rashid Al Maktoum, Ruler of Dubai, and Vice-President and Prime Minister of the UAE. The strategy would seek to deliver four main objectives: quality, easy access to health services, prevention and awareness, and investment and competitiveness.

The Health Authority – Abu Dhabi (HAAD) (2014), announced the Healthcare Sector strategic plan for the next 5 years for the Emirate of Abu Dhabi. Dr Mugheer Khamis Al Khaili, chairman of HAAD said, "Today we enter a new phase in the healthcare sector as we aim to take it to the next level of advancement. The foundation is set and it is now time for innovative and better quality services. We will be working with both private and public sectors to ensure implementation of the initiatives,". Moreover, Al Khaili added, "The Healthcare sector is a top priority in the Abu Dhabi Government agenda and we look forward to deliver the set outcomes as we move towards achieving Abu Dhabi's vision 2030,".

For this objective, HAAD have identified seven key areas or priorities. Among these priorities "E-Health" programme that aims to create a health information platform to facilities health information exchange between healthcare providers. Therefore, Facilitate the other health priorities that include; continuum of care, improving quality of healthcare, ensuring value for money, emergency preparedness, and wellness and prevention of disease.

Decision makers in UAE announced their visions and strategies which cope with the healthcare reform ambitions worldwide. Therefore, it is the right time to evaluate the current status for health information platform and to learn from other countries' that achieved a lot of advances in healthcare reform.

1.3 Research Questions

The aim of conducting this study is to answer the following research questions:

1. Is there a simple roadmap that can guide the transformation of a healthcare system to be information-driven?
2. To what extent healthcare system reform has dependencies on Health Information Technology?
3. What is the current status of healthcare transformation in the UAE?

1.4 The Research Approaches Employed

To find the answers for the research questions, literature review, building conceptual model, and case study were employed where a survey was conducted. The study iteratively passes through several stages which Identify, literature review, building the model, methodology, analysis, discussion and closure. A detailed description of the research method is given in a further chapter.

1.5 Contributions

The contributions of this dissertation, include:

- Exploring the healthcare system reform in the advanced world and in particular in the U.S. to provide an integrated roadmap of the current and rapid changes in healthcare that are occurring in the advanced world.
- Building a model for healthcare system reform to simplify healthcare reform process and make it easy to understand.
- Apply this model to the current status of healthcare system in United Arab Emirates as one of the developing countries to highlight the opportunities and risks.
- Suggesting some recommendations for the government and other entities that can help to enhance the current status.

Chapter 2: Methodology

2.1 Study design

According to (Hoepfl, 1997), qualitative research can be generally defined as a research that can generates findings which cannot be produced by statistical measures or any other way of quantification. Quantitative researchers looking for causal determination, forecasting, and to generalize the findings while qualitative researchers looking for the understanding, illumination, and the extrapolation of the similar situations. Thus, a different type of knowledge will be generated from the qualitative and the quantitative analysis.

Qualitative analysis is challenging and requires creativity from the researcher to categorize the raw data into meaningful, logical categories to examine the topic in a holistic fashion. Additionally, the researcher is responsible to build a conceptual model to ensure that sufficient data are exists to support the interpretation. Moreover, the conceptual model should be translated into a story line to find an easy way to communicate the interpretation and the whole topic to others.

According to Creswell (2003), mixed methods approach also can be used to collect both qualitative and quantitative data to provide better understanding of research problem. The research begins with a general survey to generalize the results to a population. In a second phase, detailed qualitative and open-ended interviews can be used to collect detailed insights from the participants.

In this research, mixed methods approach used and the research passes through several stages which are Identify, methodology, research, building the model, analysis, discussion and closure. See Figure 1.
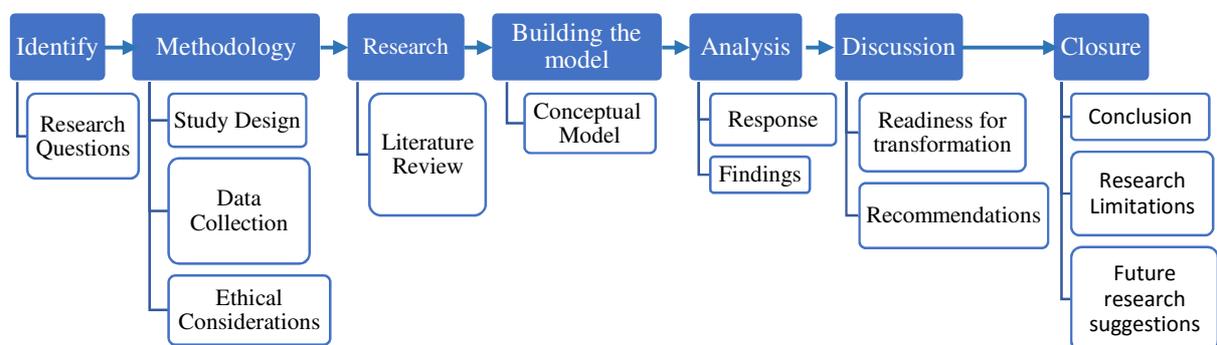
Figure 1 - Research Stages

2.1.1 Review of literature

To answer research questions, the research started with review of literature to answer the first and the second questions. The review of literature aims to demonstrate the healthcare reform that are happening in the advanced world. In addition, to illustrate how health information technologies can support the transformation journey.

Moreover, the literature review concentrates on healthcare reform in the U.S. as one of biggest developed countries that are striving to achieve health system reform. In particular, It focus on U.S. efforts and actions related to healthcare reform since 2000 and onward such as changes in regulations, initiatives, and federal Health IT strategic plans.

The research were started by identifying search keywords such as: healthcare reform, healthcare transformation, electronic medical records, personal health records, health information technology, and health informatics. Then during the whole study, many other key words used to find the resources in specific topics covered in this research.

The main search method used is online search through Google Scholar and electronic libraries such as Edinburgh University E-Library, PubMed, Health Affairs, and ScienceDirect.

The criteria for articles selection were based on the following:

- Most of articles should be published between 2000 and onward.
- Articles should be cited by many other publications.
- Journal should have high ranking.
- Official reports should be published on government official websites.

Finally, search results filtered many times to find the most relevant articles to the research topic which can be books, journal articles, official reports and publications, online newspapers and websites. Then, these resources were cited in the different chapters of the research. The total number of resources selected are 157 most of them are journal articles, official publications and reports, and the total number of references that cited in this research are 75.

Mendeley Reference Manager (Mendeley) used to manage research papers and citation. Mendeley is a very helpful free reference manager recommended by The British University in Dubai (BUiD). Mendeley is desktop and web program for managing and sharing research papers and citation and it is also available for mobile devices.

2.1.2 Building the model

After the extrapolation and the good understanding for the healthcare reform experience in the United States. It was necessary to build a model to simplify the process of health system reform for the readers.   In addition, to provide a roadmap for any developing country seeking for healthcare reform and want to benefit from the advanced countries experiences. Full details of the model are discussed in Chapter 4

2.2 Data Collection

Building the model made it easy to identify what data should be collected to evaluate the current status of health IT implementation in the different healthcare providers' organizations and the status of health technology infrastructure in U.A.E. Survey and official publications and reports review are the main tools used to collect data.

2.2.1 Survey Design

The survey designed to capture a comprehensive status of health information technologies (Health IT) that are currently implemented in the United Arab Emirates. To evaluate the current status and to know to what extent healthcare system in UAE are ready to move from the isolated systems in the different healthcare organization to a fully integrated and interoperable systems. Interoperable systems that can share and exchange health information freely while securing health information privacy and security. Consequently, achieve healthcare reform and provide more affordable and better care for individuals and population

The survey designed and published online using online survey tool (SoGoSurvey) available at "http://www.sogosurvey.com". The survey consist of nine sections, are:

Section 1:

This section contain questions about participants contacts/job information (participant name, contact no., email, and job level) and general information about the organization (organization name, organization type, specialty, sector, and locations in U.A.E cities)

Section 2:

This section contain questions regarding EHRs adoption in health care providers organization, availability of onsite IT staff, and number of branches in each organization.

Section 3:

This section should be answered only by organizations that are not implementing EHRs and have all paper medical records only (Online survey will move automatically to this section depending on user answer and it will be end of survey).

This section contain questions about the most top barriers that preventing these organizations from adopting EHRs, Their intentions and future implementation plans.

Section 4:

This section should be answered only by organizations that are having EHRs and have all medical records in electronic format or mix electronic/papers (Online survey will move automatically to this page depending on user answer).

This section contain questions about the most top reasons encouraged these organizations to adopt EHRs, whether these organizations are adopting telehealth technologies or no, and percentage of operating budget dedicated to health IT.

Section 5:

This section contain questions about adoption status of EHRs functionalities to improving quality, safety, and efficiency and reducing health disparities.

Section 6:

This section contain questions regarding adoption status of EHR functionalities to engage patients and families in their care.

Section 7:

This section contain questions related to implementation status of EHR functionalities to improve care coordination, population and public health through health information exchange.

Section 8:

This section contain questions related to Interoperability and standards such as which medical coding sets are implemented in each U.A.E city, data content/structure standards. In addition, questions regarding the format that health data are recorded in (Structured or unstructured data). Moreover, questions about availability of broad band internet connection, and readiness of integration between the different systems such as EHRS, PHRs, wearable health devices, and e-claim portals.

Section 9:

This section contain questions about the adoption of health information privacy and security protections in healthcare providers organizations. Additionally, to ask whether these organization are informing patient about any disclosure of health information, and about how their health data will be used and shared, and about health information segmentation.

For full details about survey questions and survey sample. See Appendix F

2.2.2 Targeted Populations

The targeted Population are healthcare organizations (Hospitals, Medical centers, and Clinics) in U.A.E, from both private and public sectors. The main targeted populations are information technology staff and management team in these organizations.

2.3 Ethical Considerations.

This study conducted with full respect for confidentiality and anonymity of the respondents and non-disclosure for the real names of organizations or participants. The participants' responses were treated with full respect and confidentiality. Only questions related to the topic of study were asked to avoid participants' resistance to answer the questions, and pre-testing done to ensure that the survey questions are appropriate.

Participation in this study was voluntarily and to ensure confidentiality, participants' names were optional to provide and invitations sent by emails to participants to complete the survey.

Furthermore before commencing the survey, dissertation supervisor approval obtained after the confirmation that there is no need to obtain any further permissions or consents from the British University in Dubai (BUID) before starting the survey.

Chapter 3: Literature Review

This Chapter aims to answer the first two of research questions. First section, will answer the first question and will demonstrate the healthcare reform that occurring in U.S. as one of biggest countries in the advanced world. In addition, will highlight the major steps, putting the strategies and changes in regulations to achieve healthcare care system reform.

Second section, will answer the second question and will show how healthcare system reform can be acheived through the adoption and the meaningful use of Health Information technology. Additionally, will discuss the major steps, Federal Health IT Strategic Plans from 2011 to 2024, and the major initiatives done by the U.S. in this regard.

3.1   Healthcare Reform

This section tries to answer the first research question and will demonstrate the transformations that are currently happening in healthcare sector. More specifically, will focus on the healthcare reform efforts and events in the United States of America since 2000 onward.

3.1.1   Prologue

According to Reinhardt et al. (2002), based on the Organization for Economic Cooperation and Development (OECD) health data obtained in 2002. OECD compare the health care systems of eight members countries from total thirty members (United States, Canada, Germany, Japan, France, New Zealand, Australia, and United Kingdom). OECD shows that healthcare expenditure ratio of the gross domestic product (GDP) in U.S. is the greatest among the eight counties during the period from 1990 to 2000. In 2000, healthcare total expenditure is 13 percent of the GPD in U.S and 7.3 percent in United Kingdom (as illustrated in Figure 2) . In addition, per capita healthcare expenditure in U.S in 2000 is $4,631 which is more than twice the median of healthcare spending for all 30 OECD countries.
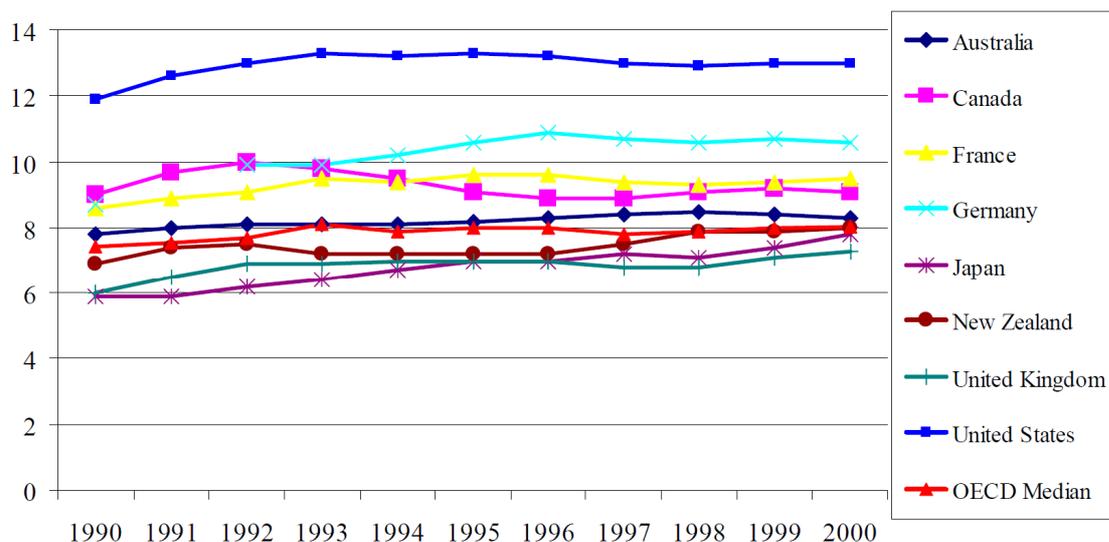
Figure 2 - Percentage of GDP Spent on Health Care from, 1990-2000

(Reinhardt, Hussey and Anderson, 2002, p.11)

In 2000, one of seven Americans (about 41 million of the population) doesn't have public or private health insurance coverage, and individuals out-of-pocket sharing in U.S is the highest among all countries. In addition, in U.S. less than half of the Americans receiving public health insurance while 92 percent in Germany and 100 percent of all population in the other six counties having public health insurance covered by the governments. Moreover, in U.S only 12 percent of population having pharmaceutical insurance coverage while 50 percent in Canada, 92 in Germany and 100 percent of whole population in the other five countries.

Starfield (2000) argues that, U.S health care have many deficiencies despite of the high cost of the medical care. There are more than 40 million American without health insurance. In addition, almost from 20 to 30 percent of the patients are receiving undesirable or improper care. Moreover, about 44 to 98 thousands patients dying annually due to a medical errors, and as many as 20% to 30% of patients receive contraindicated care. Furthermore, U.S healthcare have low ranking as 15th among 25 developed and industrialized nations as confirmed by World Health Organization (WHO).

To enhance the performance of the healthcare in U.S., many efforts and events done toward healthcare reform. Accoring to Honoré et al. (2011), In 1994 the public health functions steering committee established by the united states department of health and human services (HHS). The

main goal of the commite is to work on developing a national strategies to improve the system of the public health.

Accoring to Honoré et al. (2011), then later arose many calls for a new heath system to improve the quality of the delivered services in all healthcare sectors including the public health. In 1998, under the late U.S. President Bill Clinton, an important report was published that named "Quality First: Better Health Care for All Americans". The report advocated for a national pledge for improving the quality in all healthcare sectors, and place goals to direct the strategic national decision making.

The major starting point done by the Institute of Medicine (IOM). According to Baker (2001), IOM took a decision to commence a program on the healthcare quality in U.S., in 1998 IOM formed its Committee on the Quality of Healthcare. The main mission for the committee was to establish a new strategies to achieve a substantial enhancements in the quality of healthcare services. In another word, the main aim is redesign of the health care system.

The committee published two historic reports: First report, "To Err is Human: Building a Safer Health System". The report released in 1999 and focused on the issue of patient safety. Before the report it was not usual for the U.S. media to make the healthcare stories as headline for its news. Until the IOM first report reframed the medical errors as one of the main chronic threats affects the Americans' public health such as AIDS, breast cancer and car accidents.

Then in 2001, the IOM committee released the second report "Crossing the Quality Chasm: A New Health System for the 21st Century". The second report was more comprehensive as it makes clear that patient safety is a part of a more larger picture for healthcare quality. In addition, the report addressed strategies not only for enhancing healthcare delivery systems, but also for the processes and structures of healthcare organizations.

The next section will explain the major stages in U.S healthcare reform

3.1.2   Crossing the Quality Chasm: A New Health System for the 21st Century - 2001

(Berwick, 2002) explained the underlying framework for the second report that IOM committee released "Crossing the Quality Chasm: A New Health System for the 21st Century". The underlying logical framework analyzed the required changes in the American healthcare system at four levels: (Level A) the experience of patients and communities; (Level B) the functioning of

small units of care delivery or "microsystems"; (Level C) The functioning of the organizations that host or support microsystems; (Level D) the environment of payment, accreditation, policy, regulation, and other such factors.

3.1.2.1 Aims for Improvement

The committee defined six aims of improvement that should guide all efforts toward health care system reform in U.S., these aims are:

1. Safety, patients should be safe while receiving care in healthcare organizations.
2. Effectiveness, healthcare system should deliver best health care services for the patients through knowledge-based care that use the best scientific and clinical information.
3. Patient- centeredness, health care should respect patients' choices, preferences, specific needs, and social and cultural context.
4. Timeliness, reducing delays and waiting times for both patients and caregivers.
5. Efficiency, reducing waste and total cost of healthcare.
6. Equity, reduce health disparities based on ethnic and racial.

3.1.2.2 Level A required changes: experience of patients and communities:

The basic change in level A is the improvement for the American nation's intended goals from self-satisfaction to aims that are more obvious, bold, comprehensive, espoused uniformly and patient centered. IOM committee went more far than the technical qualities of misuse, underuse and overuse, by tying more closely the quality related issues to cost, patients' experiences and social justice. At the same time the committee recognized that achieving new levels of performance will require changes far beyond the goals setting. Thus, the committee recommended the changes at the three others levels.

3.1.2.3 Level B required changes: microsystems of care delivery

Microsystems are the small units of work that actually deliver the healthcare services to the patient and where the quality that experienced by the patient done or lost, such as emergency department' night shift. The committee confirmed that accomplishing the six goals for improvement will require redesigns of microsystems. Therefore, recommended three comprehensive principles for the microsystems redesign that care should be patient-centered, knowledge-based and systems-minded.

Patient-centered care, such type of care respects the personality, ethnicity, values and information demands of each patient. The main idea is to give the patients control of their own care and to customize the care according to the individual desires, demands and circumstances. Additionally, patient-centered care offer transparency with accountability of care system.

Knowledge-based care, such type of care uses the best clinical and scientific information while delivering the service to the patient. The committee had found that the existing care is not reliable enough to use the best science and the best-known practices. Because the lack of the information systems that enable the use of that knowledge.

Systems-minded care, Such type of care presume liability for cooperation, integration and acting efficiently across organization's traditional boundaries, role and discipline. Systems-minded care is mainly concerned with patients with chronic diseases, those needs more care across the time and space.

The IOM committee in the Quality Chasm report suggested a framework to improve the efficiency of microsystems consist of ten simple new rules. The current and new ten rules of microsystems are concluded in Table 1

Rules	Current	New
1	Care delivery is based originally on face-to-face visits.	Care delivery is based on continued care relationships.
2	Care is driven by professional autonomy.	Patients' needs and preferences drives the Care.
3	Care controlled by professionals.	The source of care control is the patient.
4	Information is a record	Knowledge is shared freely
5	Experience and training is the base for decision making.	Evidence is the base for decision making.
6	"Do no harm" is an individual responsibility	Safety is a property of the care system
7	Secrecy is necessary.	Transparency is necessary.
8	Healthcare system simply reacts to patients' needs.	Patients' needs. are predicted
9	Cost decreasing is desirable.	Waste reduction is desirable
10	Professional roles have Preference over the system.	Physicians' collaborations is a priority.

Table 1 - Microsystems current and new rules

The IOM Quality Chasm report mentioned that the ten new rules should be implemented by the microsystems to move toward achieving the six aims for improvements. The quality of the organizations is measured by their ability to encourage the microsystem to achieve the aims.

Hence, IOM committee found a major gap in the current healthcare system quality due to healthcare providers those are not likely to encourage such changes.

3.1.2.4 Level C required changes: healthcare organizations.

The IOM committee in the Quality Chasm report mentioned that healthcare organization need improvement in six areas at least to ensure the flourish in microsystems:

1. More sustainable systems depend on best clinical practices should become an organizational standards, rather than the ordinary and traditional systems.

2. Information technology should be used effectively to improve the access to the available information and to support caregivers in the clinical decisions making.

3. Skills and knowledge of the workforce in healthcare organizations need more investment and development strategies of human resources those strongly-supported by those organizations.

4. Teamwork should be supported to accomplish the work more efficiently.

5. To enhance the healthcare services delivery for patients especially for patients with the chronic diseases, more coordination and collaboration of care. Coordination of care should be there among the different organizations those deliver the care to the patient.

6. Healthcare organization should have more informative and wide-range of the indicators that measure the outcomes and performance, especially the indicators those related to the six aims for improvement.

The IOM committee in the Quality Chasm report proposes different approaches like workshops to realize state-of-the-art systems at the organizational level such as information technology systems and workforce development systems. In addition, to make the scientific evidence more beneficial and can be accessed by both patients and physicians. Moreover, to eliminate the paper based clinical data before the decade ending and to build the infrastructure for a modern healthcare system.

3.1.2.5 Level D required changes: health care environment.

After IOM committee recommendations regarding healthcare organizational changes. The committee brought directly to the external environment in which healthcare organizations are working. And discussed the changes in many areas such as regulations, financing, litigation, social policies, professional education and accreditation.

The IOM committee focused primarily on financing and suggested to have more flexibility to remove the barriers in the current imperfect payment systems that affect the improvement in the delivered care. Additionally, the committee suggested redesigns for the current system of accreditation, professional education, regulation and litigation to realize sustainable improvements in healthcare delivery.

IOM committee recommended that American's national healthcare improvement agenda at the four mentioned level from level A to level D, should be applied first to a set of population those have multiple chronic conditions.

Among what called as priority conditions those representing the major health status burdens in the population. As mentioned by Parekh and Barton (2010) that, almost 65% of healthcare total spending is directed to almost 75 million Americans that representing almost 25% of united states population.

The IOM committee suggested that about fifteen of such priority conditions to be chosen by the Agency for Healthcare Research and Quality (AHRQ). And that will shape a primary list of targets for action.

3.1.2.6 Implementation hurdles and the future

There are many Obstacles exist to implement the changes mentioned in the Quality Chasm report, these are:

- U.S. healthcare aims are fluctuating and conflicting among the stakeholders. Therefore, in the final report "Quality first: better health care for all Americans", the commission recommended that the public advisory council for health care quality should be created. The council aims to provide ongoing national leadership, identify national aims and specific objectives for improvement, and track the progress in achieving those objectives and aims (Industry., 1998).

- Wide changes are required in the existing processes of care quality measurement and reporting to link the quality of the provided care to improvement aims.

- The systematic changes anticipated by the quality chasm report require national strategy that can lead the changes. In addition, changes in leadership as both nonclinical/ clinical leader of healthcare are not prepared to lead such type and scale of systemic change.

- Low national investment in the redesign of healthcare system, thus more investments are required.

- Lagging information infrastructures and very old, unsafe, wasteful and unhelpful medical records those are existing require a radical redesigning. Thus, it's very important to have a national goal and development program for healthcare information technology.

- Current legal climate incites secrecy and fear which need to be changed. compensation for the victims of the medical harms are important steps toward the new healthcare system culture that is safe, open, transparent, and honest regarding its performance and defects.

- The existing regulations related to professional licensing, Accreditation and others although it ensures stability but also it can restrain the required improvements and changes in healthcare. Unless, the reconsideration for procedures and rules that reinforce the changes in the traditional systems and behaviors.

- The existing and traditional professional training received by healthcare professionals not providing the desired skills and knowledge that can support the requested changes in work system. Committee designates "cooperation" as a major professional value.

Finally the "Quality Chasm report" strength came from its overall view for the new healthcare system. The report shows that changes and quality improvements should happen first in regulations, organizations, microsystems. Then, it will have a series of effects on patients, reducing disability and suffering and health maintenance.

Healthcare environments quality can be measured by its capacity to help healthcare organizations. The quality of healthcare organizations can be measured by its ability to support microsystems to provide health care with high quality and achieve the six aims for improvements.

3.1.3   Medicare Modernization Act (MMA) - 2003

As stated by both Doherty (2004) and Moon (2004), U.S. president George W. Bush signed into a federal law in December 2003 "The Medicare Prescription Drug Improvement and Modernization Act (MMA)". MMA legislation took effect on 1st of January 2006.

MMA provides coverage for outpatient prescription drug for seniors and handicapped. Therefore, providing more help to millions of Medicare recipients specially those beneficiaries with humble income and high cost of drugs. In addition, MMA increases the role of the private insurance by providing new incentives and more competitive fee structure for reimbursement. Furthermore, encouraged the private plans to cover the severe care services (Biles, Dallek and Nicholas, 2004).

(Bach and McClellan, 2005) stated that, the blueprint for MMA developed by the Centers for Medicare and Medicaid Services (CMS). MMA main aims are: First, to assure that all beneficiaries are receiving affordable drug coverage with high level of quality. Second, ensure continual access to drugs needed by patients suffering from chronic diseases.Third, creating a more transparent and competitive marketplace that can provide a wide range of benefits to the beneficiaries. Congressional Budget Office (CBO) estimated that the legislation may cost $400 billion over 10 years but later CMS gave higher estimation of $530 billion over 10 years (Doherty, 2004).

MMA aimed to support the implementation of e- prescribing by creating the standards to increase the interoperability of such systems, and giving the permission for third-parties to fund the implementation of electronic prescribing. Implementation of e- prescribing aims to improve health outcomes, and reduce overall healthcare cost. Additionally, can be a good start toward the implementation of more enhanced electronic health records (EHRs) systems that can support health reform (Bell and Friedman, 2005).

According to Buntin et al., (2006), the current high-cost and low-quality healthcare resulted from the failure of the existing health insurance system to incentivize the consumers to shop for services that provide better health outcomes and to use the care in a wise way. Thus, it is necessary incentivize the consumers to efficiently manage their own healthcare. In addition, to encourage more engagements of market forces or moving toward Consumer-directed healthcare (CDHC). Consequently, That can help in cost control and enhancing both health outcomes and quality of care and support health care reform.

Feldman et al. (2005) stated that, CDHC supported by MMA by approving a new type of consumer-directed health plans called a health savings account (HSA). HSA is a tax-advantage account coupled with high yearly deductible in which both employees and employer can share the cost.

3.1.4 Health Information Technology for Economic and Clinical Health (HITECH) - 2009

According to Blumenthal (2010), President Obama's administration in 2009 enacted Health Information Technology for Economic and Clinical Health (HITECH) as a part of the American Recovery and Reinvestment Act. HITECH authorizes the federal government to provide an incentive to physicians, hospitals and other healthcare providers for the meaningful use of certified, qualified electronic health records (EHRs). Therefore, the purpose is to use the EHRs in ways

expected to improve care and not only the adoption of such systems. HITECH Act contain many initiatives of EHRs Adoption and health information exchange (as illustrated in Figure 3 - The HITECH Framework).
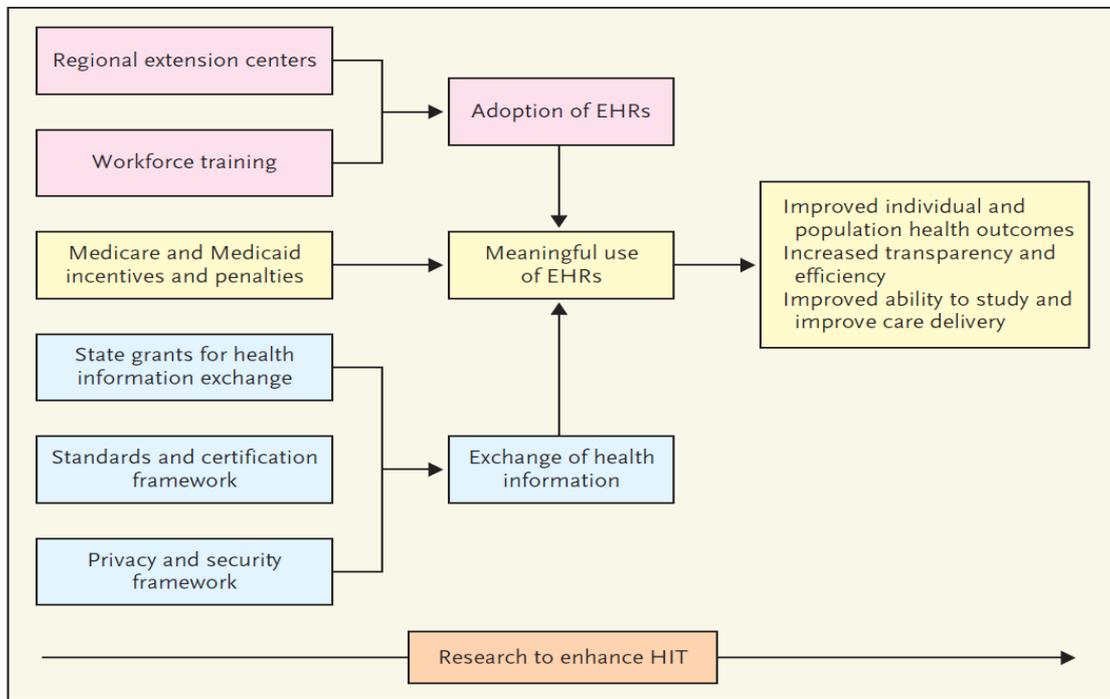
Figure 3 - The HITECH Framework

(Taitsman, Grimm and Agrawal, 2013, p.384)

There are four main goals of enacting HITECH act:

3.1.4.1 Defining what is the meaningful use of EHRs

The Department of Health and Human Services (HHS) defined the meaningful use of EHRs as to achive five healthcare goals:

- Enhance the efficiency, safety, and quality of the provided care whilst decreasing disparities.
- Foster the engagement of patients and their families in the care.
- Promote health and wellbeing of the people.
- Improve the coordination of care.
- Foster the security and privacy.

3.1.4.2 Foster and rewarding the meaningful use

HITCH provides support to healthcare providers to overcome the main obstacles they are facing while trying to adopt Health Information Technology (HIT) such as:

- Financial resources needed to buy, implement, and maintain the EHRs

To overcome this problem HITECH establish the Medicare and Medicaid EHR Incentive Programs. The incentive program will allow eligible hospitals, professionals and other healthcare providers to receive financial incentive to implement, upgrade and demonstrate meaningful use of certified EHRs. In the same time, HHS established standards and criteria that EHRs must meet in order to be "certified.". Thus, help healthcare providers to ensure that they are purchasing technology that can support them attain meaningful use and make them eligible for the incentive.

- Lack of technical experience to choice the proper EHR system and use it efficiently to improve care.

To overcome this issue HITECH assigned about $650 million to establish up to 70 Regional Health Information Technology Extension Centers (RECs). RECs established to advice healthcare provider regarding the EHRs they can buy and support them to become meaningful EHRs users.

- The lack of the infrastructure required for the secure exchange of health information among the different providers and the patients.

To overcome this issue HITECH authorized The Office of the National Coordinator for Health Information Technology's (ONC) to create the Nationwide Health Information Network (NHIN). NHIN aims to facilitate communication and sharing of health information between the different parties all over the U.S.

3.1.4.3 Foster the trust in HIT systems by ensuring security and privacy

Patient's health information privacy and security should be assured while it is stored in EHRs systems or any other repositories, or during data exchanges for healthcare or research purposes. The Health Insurance Portability and Accountability Act (HIPAA) in 1996 requires many legal security requirements for health data exchange. In Addition, regulated its disclosure to assure patient privacy and health information security. Then, HITECH expanded HIPAA privacy protections by requiring increases in the penalties for the different categories of violations.

Furthermore, requires informing the victim about the violation (Taitsman, Grimm and Agrawal, 2013).

3.1.4.4   Foster continued HIT innovation.

The DHHS has striven to avoid any requirement that may slow down the innovation in the dynamic health information technology sector. Moreover, the ONC approved a research program of $60 million intended to foster the advances in the capabilities of the HIT and its and usability.

Finally, HITECH Act authorized about $30 billion to increase EHRs' adoption and as incentive finance for eligible healthcare providers and hospitals those meet the requirements of "meaningful-use". Meaningful-use requirements and criteria designed to improve quality and efficiency of care. Meaningful-use Prgram has three implementation stages with increasing requirements: Stage 1 (Data capturing and sharing) started in 2011; Stage 2 (Advanced clinical processes) depending on when participants begin in the Medicaid program; Stage 3 (Improved outcomes) will start in 2016. Hospitals will be exposed to incremental financial penalties in case of their failure to meet stage 1 criteria (DesRoches, Charles and Furukawa, 2013).

3.1.5   Patient Protection and Affordable Care Act (PPACA) – 2010

Both Manchikanti et al. (2011) and Manchikanti & Hirsch (2012) state that the U.S. president Obama in 23rd of March 2010 signed the Patient Protection and Affordable Care Act (PPACA) or for short (ACA). PPACA is a comprehensive legislation representing the most important health care system reform in U.S.since the legislation of Medicare and Medicaid in 1965. President Obama said, "after a century of striving, after a year of debate, after a historic vote, health care reform is no longer an unmet promise. It is the law of the land." (Manchikanti et al., 2011, p.E36).

PPACA know as Obama's Health Care Reform , and commonly called ObamaCare. The legislation splitted into ten titles and includes many provisions those focus on the expansions of health insurance coverage, healthcare expenditures controlling and improving healthcare delivery system. Some of these provisions became active starting from June 21, 2010 and the majority became effective in 2014 and onward.

Essentials of PPACA includes:

3.1.5.1 Mandates

The law made it mandatory for all the citizens of the U.S and all the legal residents to have health insurance with approved-level. The mandatory insurance is similar to the traditional plans but with more focus on preventive care or they will pay a financial penalty. These penalties will be paid also by the employers that have more than 50 employees and don't cover their employees with health insurance. In addition, penalties will be paied by employers offer coverage but the employees have to pay too much for insurance cost sharing. These penalties will be used as a source for funding for the cost of PPACA.

3.1.5.2 Subsidies

The Legal mandates will force too much of the Americans to buy health plans while they may not be able to afford that. Therefore, PPACA designed subsidies to support those people to meet that mandate and buy health insurance. Subsidies will be based on family's income and size only and will remove the others requirements created by the existing regulations.

3.1.5.3 The new requirements of Insurance industry

The current business model of insurance industry will be changed due to the new requirements enacted by the PPACA.

- As per these new requirements health insurers are requested to provide insurances policies to everybody want to apply or renew the current policy regardless the enrollees' health status. Therefore, remove the limitations of pre-existent conditions, and difference in rates of small group. Additionally, this will reduce what known as "Adverse selection" where peoples will not buy insurance plans only when they are sick and with standard rate as before.

- Also part of the new requirements is that insurance industry should spend for healthcare and activities those can improve the quality of care. Spend ration should be at least 80% of insurance premiums collected from individuals and small groups and 85% collected from large groups. Thus, both the value for consumers and the accountability of health insurer will be increased.

- Also PPACA contain new provisions to control the processes of insurance premiums increases to prevent the unjustified increases.

The overall effects of subsidies, mandates and new insurance industry requirements will provide health insurance access for about 34 million additional Americans. Thus, by 2019 the number of uninsured individuals expected to be decreased to approximately 23 million (Manchikanti et al., 2011).

3.1.5.4 Changes in the practice of medicine

PPACA made many changes in Medicaid program, clinician reimbursement and incentives which will have a direct impact on physicians practice and will foster the enhancement in healthcare organizations and care delivery. In addition, PPACA established Centered Outcomes Research Institute (PCORI) that will compare different medical treatments and interventions to determine what treatments are most effective. Moreover, PPACA established the Independent Payment Advisory Board (IPAB) with the main task of reducing the cost of Medicare without affecting coverage or quality.

3.1.5.5 PPACA and Public Health

According to Majette (2011), PPACA contains provisions those creates a framwork to healthacre system refom in U.S. that concentrate on wellness, prevention and public health. PPACA established the National Prevention, Health Promotion and Public Health Council (National Prevention Council) and Public Health Fund (Prevention Fund).

National Prevention Council and funds are important because of its compliance with the norms of international health and human right related to the actions should be taken by the countries to protect population health. In addition, its consistency with the 6 main recommendations of IOM report "The Future of the Public's Health in the 21st Century" which published in 2002. The report recommentations was regarding how to provide better protections for the Americans puplich health and the improvement for the system of the public health. These recommendations are:

1. The adoption of a publich health approach that take into consideration the varied determinants of health.
2. Make the public health infrastructure more strong and sustainable.
3. Building a strategy that would engage all government agencies in improving health outcomes.

4. The development of accountability system that ensure the availability and the quality of the public health services.

5. Performance measurement, continuous quality improvement and decision making based on scientific evidence.

6. Facilitating and enhancing the communication within the system of public health.

In 2010 IOM noted that to improve the Americans health significantly. U.S. should focus on preventing illness and health promotions and not only focusing on improving effectiveness and efficiency of the primary care delivery system. According to GOSTIN et al. (2011, p.1792) , preventative interventions that target the environment, behavior, and socioeconomic factors accounts for almost 80% of the decreasing of mortality and sickness, whilst clinical-care accounts for 20% only.

3.1.5.6 National Strategy for Quality (NSQ)

The PPACA calls to create a national quality strategy and a comprehensive strategic plan to improve patient health outcomes, population health and delivery of health care services. NSQ have three main aims and six priorities (US Department of Health and Human Services, 2011).

NSQ set three broad national aims to assess and guide national, state and local efforts for healthcare quality improvement

- Better Care: make healthcare more accessible, reliable, patient-centric and safe which will lead to overall Improvement in the quality of care.

- Healthy People/Healthy Communities: Improving the health of all Americans through the delivery of care with higher quality. In addition, promoting at all levels health and wellness by robust partnerships among all stockholders from the individuals, healthcare providers and community resources.

- Affordable Care: decrease quality healthcare cost for families, individuals, government and employers.

NSQ adopts six priorities based on broad community input and engagement, and best practices. These priorities are potentially to quickly boost effectiveness of the provided care and improve health outcomes for all U.S populations. These priorities are:

- Making care safer through decreasing the harm from healthcare-related errors.

- Ensuring that individuals and family are engaged with healthcare providers in care management and decisions making.
- Promoting effective coordination and communication between healthcare providers to provide seamless care with lower-cost and higher quality.
- Promoting more effective practices to prevent and treat the main causes of illness and mortality by focusing on cardiovascular disease as start.
- Working with communities to improve the public health by fostering the best practices which enable healthy living.
- Making quality care more affordable for families, individuals, governments and employers by creating new models of healthcare delivery.

These 6 priorities can be accomplished only by the energetic engagement of patients, physicians, healthcare providers. Since those different stakeholders are having different needs which may affect the path each will take to achieve these six priorities. Thus, NSQ should ensure the consistency with the broad national aims and priorities. Moreover, NSQ should work with all stakeholders to establish a certain quantitative goals and measures for each of these priorities.

3.1.6   Food and Drug Administration Safety and Innovation Act (FDASIA) – 2012

According to Kramer & Kesselheim (2012), The Food and Drug Administration Safety and Innovation Act of 2012 (FDASIA) is a piece of American regulatory legislation signed into law by President Barack Obama in 2012. FDASIA gives the United States Food and Drug Administration (FDA) the authority to collect user fees from the manufacturers of medical-devices and pharmaceutical. The fees will be collected while submitting applications to evaluate their new products by the FDA. Then these fees will be used to fund the premarketing review process for innovative medical devices and drugs. First, these fees can be used to facilitate the approval process for the new drugs those classified as a breakthrough therapy. Second, these fees can be used to facilitate the processes and reducing time required to bring the new innovative medical devices to market.

FDASIA requested the FDA to make a strategic framework within one and half year for information technology regulation to protect patient safety, foster innovation and avoids duplication in regulatory. In addition, FDA established a program for the evaluation of device-

recall to reduce its negative impact on public health. Furthermore, FDASIA aims to facilitate the generic drugs' approval and in the same time ensure the drug safety.

3.1.6.1 Mobile medical applications

According to Barton (2012), FDA in July 2011 issued a draft guidance regarding the regulation of mobile medical applications. Mobile medical applications include software installed in mobile device that makes the mobile platform act as accessories to a regulated medical device, or transform the mobile platform to act as a regulated medical device.

With the pervasive of the mobile devices such as smartphones, smartwatches, tablet devices, point-of-care, wearable health devices. Many mobile medical applications developed to help both healthcare providers and patients to manage the care. These applications may expose the public health to potential risks if misused. Therefore, FDA issued a draft guidance regarding the regulation of mobile medical applications to guide the development of those application to mitigate the potential risk and foster its potential benefits.

According to Yetisen et al. (2014), FDA in September 2013 issued the final guidance which differentiate between the mobile medical applications that will fall under regulations and other application that will not be subject to the regulation. Only the applications that aim to transform the mobile devices into a regulated medical device will be covered by the regulation. Additionally, the main focus will be on applications that may have a great risk on patients if misused. Application subject to the regulation listed in (Table 2).

Applications functionality	Example	Consideration
As an extension of approved medical device including displaying, storing, analysing, or transmitting patient specific data	Display of medical images X-rays and MRI, graphic data such as EEG waveforms, bedside monitors	High risk Good resolution of the screen is extremely important in certain cases like X-ray/MRI as lower resolution may affect clinical decision negatively
Applications that convert a mobile platform into a medical device	Converting phone/smart watches into urine-analysers or glucometers	High risk
	Attachment of transducers to make stethoscopes, spirometers	Readings may directly affect the clinical decisions; therefore apps need to be extremely accurate. Marketing claims will also determine whether products fall under the regulatory regime or not.
Applications/websites diagnosing & recommending treatment options on the basis of patient specific input	Prognosis of the disease, treatment options, dosage calculators	Medium risk The geographic region is very important. If a drug is not available over the counter and patient needs a prescription then its low risk. However, if any such program miscalculates a serious condition to be a minor one then it may be lethal for the patient.
Apps for general health applications & education purposes	BMI calculators, heart rate monitors	Low risk
	Thermometers, medication reminders, personal health record systems, body fat calculators	Marketing claims are critical for products to be placed in general health benefits category which is a very low risk, most health applications for mass public consumption are likely to fall under this category. The FDA does not intended to regulate medical text books and various student aids for examination preparation.

Table 2 - Mobile medical application subject to FDA regulatory oversight

(Yetisen et al., 2014, p.834)

3.1.6.2 Authorization for next-generation of human genomic sequencer

According to Collins & Hamburg (2013), FDA authorized the marketing of the next-generation genomic sequencer with high-throughput (Illumina's MiSeqDx). Thus, allowing the use and development of new multitudinous genome-based tests. With the advances in genomic sequencing technologies now human genome sequencing process can be done within a day and with cost less than $5000. Moreover, sequencing accuracy has been improved significantly which will allow a significant transform in clinical care, patient engagement and researches.

Pharmacogenomics is one of the most promising area that can benefited from the genetic information to choose the optimal drug at the right dosage for each patient. To facilities such personalized medicine, genomic information should be stored in EHRs so it can be retrieved and used by physicians when needed to guide drug prescribing. In addition, physicians should be trained to interpret the genomic data into meaningful information for their patient to get their full engagement in making decisions based on information.

3.2 Health Information Technology (HIT)

Health information technology (health IT) or (HIT) involves the secure collection and the exchange of individuals' health information electronically. HIT has the potential to foster healthcare reform and achieve the improvements in care, efficiency, and population health. This can be achieved by improving the quality of health care, decrease paperwork, prevent medical errors, reduce health care costs, expand access to affordable health care, and empower individuals.

Health IT including many technologies such as personal health records (PHRs), Electronic Prescribing (eRx), electronic health records (EHRs), Health Information Exchange (HIE), Clinical Decision Support Systems (CDSS), Disease Registries, Telehealth devices, remote medical monitoring devices, and mobile health applications.

3.2.1 Federal Health IT Strategic Plan 2011 – 2015

The recent legislations in the U.S. established national agenda and allocated huge resources for health IT to realize the potentials enhancements in healthcare efficiency, delivery of care, and population health. In 2009 The HITECH Act committed billions of dollars for the U.S. health care system for the adoption and the meaningful use of health IT to promote health and wellbeing of

individuals and population. Additionally, In 2010 the Affordable Care Act (ACA) acknowledges health IT as a leading enabler to healthcare transformations.

In June 2008 the first Federal Health IT Strategic Plan was published under Public Health Service Act. HITECH Act requires to update and republish that plan to take into considerations the rapid changes in health IT and its policy. The Office of the National Coordinator for Health Information Technology (ONC) (2011) engaged the public and the private sectors to prepare the updated plan based on the federal health IT strategy.

The federal health IT strategic plan 2011-2015, has five main goals that strive to improve the healthcare system and the population health through the adoption of the information technologies. These five goals will be dicussed in the next section and startegy map shown in (Figure 4), and full list of Goals, Objectives, and Strategies illustrated in Appendix E
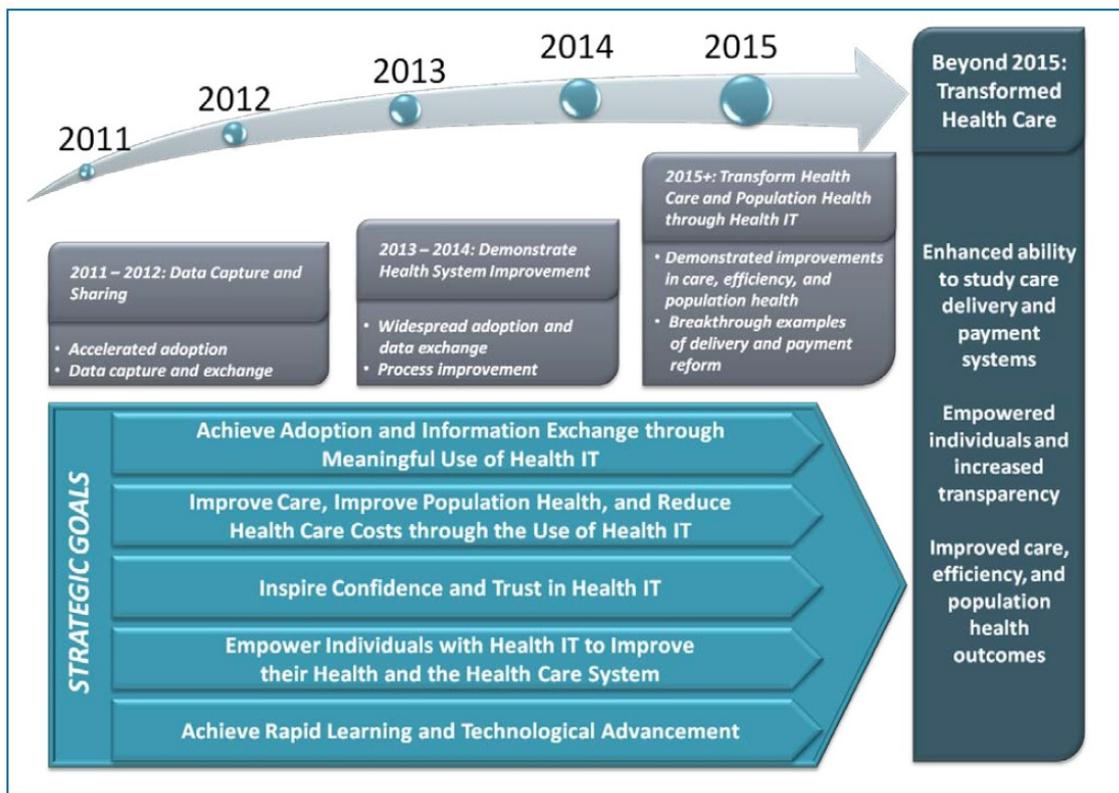
Figure 4- Federal Health IT Strategic Plan 2011-15

(ONC, 2011, p.5)

I. Achieve Adoption and Information Exchange through Meaningful Use of Health IT

The first priority to realize the potentials of health IT is to adopt EHRs and ensure the meaningful use nationwide and widespread health information exchange (HIE). Therefore, healthcare providers will be required to demonstrate progressively rigorous "meaningful use" of technology over time.

According to CMS (2010), Meaningful use as specified by HITECH act have 3 components : First, using certified EHRs meaningfully. Second, using certified EHR technology for health information exchange to improve quality of care. Third, using certified EHR to submit clinical quality measures(CQM).

The focal point of the federal health IT strategy over period from 2011 to 2015 is the "Meaningful use" which seek to achieve nationwide adoption of EHRs, health information exchange, and then enhance health outcomes. More specifically,with emphasis on two main areas: First, defining what is the meaningful use of the certified EHR technology. Second, fostering the accomplishment of meaningful use through Medicare and Medicaid EHR Incentive Programs and through grant programs. CMS Medicare and Medicaid EHR Incentive Programs Milestone timeline illustrated in Appendix B

There are three federal objectives to achieve the Adoption of EHRs and HIE through Meaningful Use of Health IT:
   A. Accelerating the adoption of EHRs
   B. Facilitate HIE to support the meaningful use of EHRs
   C. Support the adoption of health IT and HIE for public health and populations those have unique needs

Objective A: Accelerating the adoption of EHRs

   1. Financial incentives for the adoption and the meaningful use of a certified EHRs

HITECH act allocated $27 billion incentive payments over 10 years for eligible professionals (EP), eligible hospitals and critical access hospitals (CAHs) under Medicare and Medicaid incentive program. The purpose of the incentive program is to encourage the national wide adoption and meaningful use of certified EHRs to realize the potential enhancements in care delivery (Blumenthal and Tavenner, 2010).

Blumenthal (2011) state that, CMS developed the final rule of defining the stage one meaningful use criteria and its related incentive programs. Stage 1 emphasis on determining which data should be captured and stored in EHRs. The later stages will focus on the meaningful use of EHRs, as stage 2 would focus on enhancing the clinical processes of care and stage 3 would focus on the improvements in the outcomes.

To receive an EHR incentive payment, healthcare providers have to show that they are meaningfully using their EHRs. Meaningfull use acheived by meeting thresholds for a number of objectives (Core, Menu) and submit Clinical Quality Measures (CQMs) (See Table 3). For more details, Full list of stage 1 and stage 2 Objectives are listed in (Appendix C).

CQMs, are tools that help measure and track the quality of health care services provided by healthcare providers. These measures use data that demonstrate providers' ability to deliver high-quality care or relate to long term goals for quality care. All providers must select CQMs from at least 3 of the 6 key health care policy domains recommended by the HHS's National Quality Strategy. These domains are: Care Coordination, Patient Safety, Patient and Family engagement, efficient use of healthcare Resources, Population and Public Health, and Clinical Processes/Effectiveness

Stage 1: Objectives and Measures Reporting	Stage 2: Objectives and Measures Reporting
Eligible professionals must meet: o 13 required core objectives o 5 menu objectives from a list of 9 Total of 18 objectives o 6 total CQMs (3 core or alternate core, and 3 out of 38 from additional set)	**Eligible professionals must meet:** o 17 core objectives o 3 menu objectives from a total list of 6 Total of 20 objectives o 9 out of 64 total CQMs.
Eligible hospitals and CAHs must meet: o 11 required core objectives o 5 menu objectives from a list of 10 Total of 16 objectives o 15 CQMs	**Eligible hospitals and CAHs must meet:** o 16 core objectives o 3 menu objectives from a total list of 6 Total of 19 objectives o 16 out of 29 total CQMs

Table 3 - Stage 1 vs. Stage 2 "meaningful use" criteria

2. Supporting healthcare providers in the adoption and the use of a certified EHRs

HITECH Act grants amount of $720 million over four-year to establish the regional Extension Center (REC) Program to build 62 centers in all U.S. states. All the resources and staff of these centers will be dedicated to help healthcare providers to adopt certified EHRs and become a meaningful users. In addition, to determine and share information related to best practices regarding the adoption of EHRs, providers support, and the meaningful use.

3. Workforce training to support the implementation and the use of health IT technologies

HITECH allocated $118 million to train more than 50,000 new qualified health IT professionals working in 12 important roles related to the adoption and the maintenance of EHRs. Therefore, to meet the expected increase in the demand for the professionals in health information technology.

4. The Inclusion of the meaningful use in medical education and professional certification

The federal government will foster and collaborate with the medical education and professional certification bodies to incorporate the meaningful use of EHRs into medical education and certification.

5. Establish certification process and criteria for EHRs that can fulfil the meaningful use requirements

In order for eligible hospitals, eligible professionals, and critical access hospitals to be qualified for CMS EHR Incentive Programs. They should first implement certified EHR technology with certain criteria aligned with the meaningful use requirements.

ONC worked together with the National Institute of Standards and Technology (NIST) to set up the EHRs certification processes and certification criteria. The certification criteria defined standards, implementation specifications, and capabilities of EHR technology required to achieve the first stage of the meaningful-use. The certification criteria will persist in further development with second and third stages of meaningful use.

6. Communicate the benefits of achieving meaningful use and the value of EHRs

HHS is conducting outreach programs to support efforts that aim to attain meaningful use and to share evidence and best practices on the use of health IT to improve health. The main audience for outreach programs are primary care providers. The outreach strategy have four goals:

- Increase the awareness of healthcare providers regarding the benefits and availability of EHRs and other different health IT.
- Educate healthcare providers for security protections and privacy issues related to the adoption of EHRs and health IT.
- Foster healthcare providers to adopt EHRs and other health IT and participate in federal programs such as CMS EHR Incentive Programs.
- Educate healthcare providers and increase their knowledge of health IT services and products, to help them to get benefited from health IT.

7. **Aligning all federal programs to foster the adoption and the meaningful use of certified EHRs**

HHS aims to foster eligible providers to adopt and become meaningful users of EHRs. In addition, It's also plans to do the same for the non-eligible providers through putting a stringent requirements to health information exchange. Consequently, help the providers are not eligible for the incentive programs to implement HIT and participating in HIE.

HHS recommends to establish The Federal Health IT Taskforce to overcome the existing fragmentation of Federal HIT programs, responsibilities, and coordinating mechanisms. Therefore, providing more coordination among Federal agencies involved in Federal HIT activities and aligning all programs to encourage the adoption of certified EHRs and use it meaningfully.

8. **Support new payment models in private sector to encourage providers to achieve meaningful use**

The federal government is going to encourage the private sectors efforts having the potential to extend the adoption of health IT and achieve the meaningful use objectives. Furthermore, encourage the new payment models that rely on HIE and coordination of care.

9. **Improve EHRs usability**

The federal government is cooperating with researchers and industry to enrich the usability of EHRs. EHRs usability can be considered as a key hurdle for the adoption and the meaningful use of the EHRs. ONC collaborating with private sector to foster the gathering of the information related to usability. Then share it with consumers and vendors through truthful means to improve EHRs usability, increase the competition and reducing the cost.

Objective B: Facilitate HIE to support the meaningful use of EHRs

While the first stage of the meaningful use concentrating on the adoption of health IT and collecting patients' data in structured format. The next stages will give more care for interoperability and HIE and remove the geographies' barriers among the different parties involved in healthcare. Therefore, patient health record will be available for all parties in realtime to support medical decision making.

With growing requests, the government should insure the readiness of the infrastructure and standards required for health information exchange. Thus, the government will work to foster and enhance the existing models of HIE instead of constructing from scratch new national infrastructure. Consequently, the government will find the gaps and the barriers which may hinder HIE and then will develop plans to overcome them.

1. Foster and enhance the existing business models that support health information exchange

There are many existing sustainable models for HIE already available which is a part of U.S. national health IT strategy to build an interconnected health system through NHIN

1.1. The Nationwide Health Information Network (NHIN)

According to ONC (2010), NHIN is broadly defined as the set of specifications, standards and policies that enable the secure exchange of health information over the Internet. NHIN provides a foundation for HIE across diverse entities, within communities and across the country. In addition, NHIN Exchange is the first community that implemented these standards, specifications and policies in production.

NHIN aims to enable health information to follow the patients everywhere to support the clinical decision-making and to use health information not only for direct care but also for further goals such as enhancing the health of population.

Organizations that participate in the exchange are accountable for the privacy and security of the patient data by signing the Data Use and Reciprocal Support Agreement (DURSA). Additionally, they are obligated to have measures in place to protect the data. DURSA is a comprehensive, multiparty legal agreement that outlines the roles and responsibilities of exchange participants.

NHIN has identified a set of standards-based Web Service Interfaces those will allow the secure communications between different systems over the Internet. Therefore, NHIN will tie together health information exchanges (HIEs), pharmacies, integrated delivery networks, labs, government, providers, payers and other stakeholders into a network of networks.

One of the distinguishing characteristics of a health care system which participates in the NHIN is the acquisition of an OID or an organizational identifier. The OID, issued by the ONC, allows the individual health care system or vendor to receive and send messages to trusted entities within the NHIN.

NHIN connected a diverse set of federal agencies and private organizations that need to securely exchange electronic health information (See Figure 5). These entities include:

- Centers for Disease Control and Prevention (CDC)
- Centers for Medicare and Medicaid Services (CMS)
- Community Health Information Collaborative (CHIC)
- Department of Defense (DoD)
- Department of Veterans Affairs (VA)
- HealthBridge
- Kaiser Permanente
- Marshfield Clinic
- MedVirginia
- Regenstrief Institute
- Social Security Administration (SSA)
- Southern Pines Women's Health Center
- Indian Health Service (IHS)
- National Cancer Institute (NCI)
- Federally Qualified Health Centers (FQHCs)
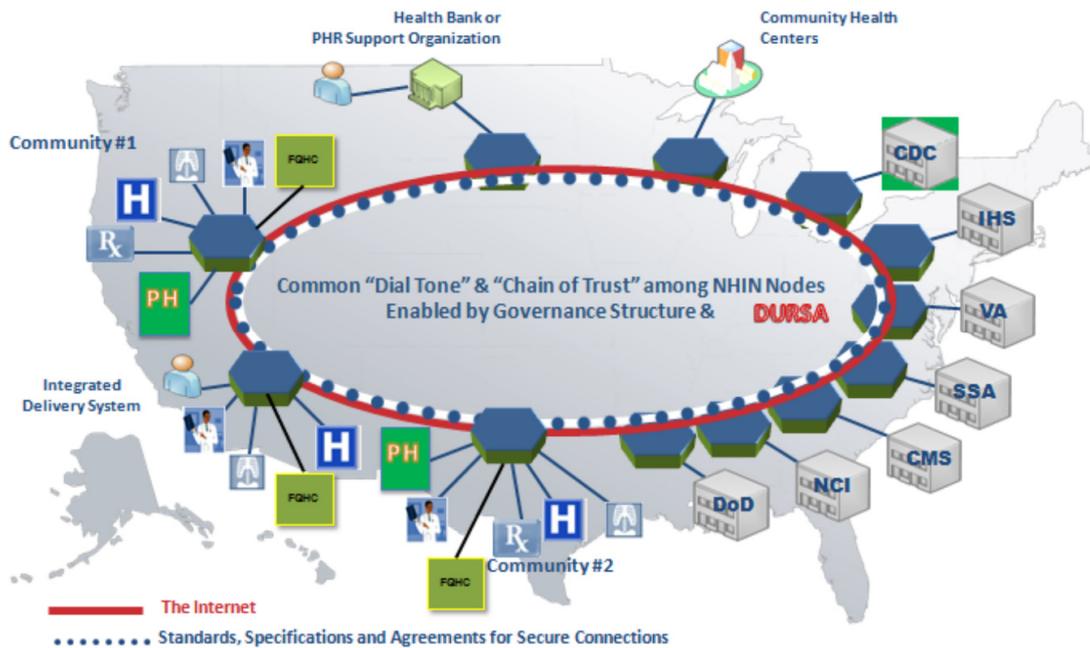
Figure 5 - Nationwide Health Information Network (NHIN)

(ONC, 2010, p.6)

1.2. Direct protocol

According to Williams et al., (2012), healthcare providers and patient today are most likely sharing critical health information by fax, mail, or phones. Therefore, health information may will not be available at the right time to support decision making, and also privacy and security will be hardly to maintain.

ONC in 2010 initiated Direct Project as a part of the broad nationwide strategy to connect healthcare organizations through NHIN. Direct protocol is a secure, standardized, and simple way that can be used to send encrypted structured health information over the Internet securely to trusted recipients and relying on e-mail protocols that are widely adopted.

Figure 6 - Direct Abstract Model is illustrating that, Health Information Service Provider (HISP) is responsible for packaging messages' contents. Then securely transfer the encrypted health information between the sender and the receiver. HISP is a logical concept that contains particular services which are required for Direct Project exchange.
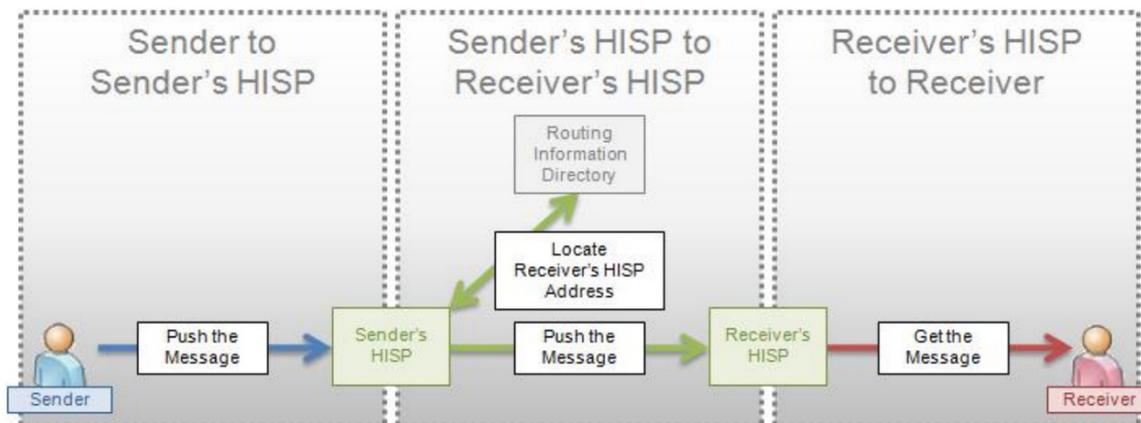
Figure 6 - Direct Abstract Model

(Directproject.org, 2010)

Direct work as the following:

First, From Sender to Sender's HISP

-   Sender who initiates a message can uses his/her EHR system to generate message contents (e.g., a clinical summary) and send the message to the Direct Project address of the receiver (similar to email address) .

-   EHR system authenticates to establish its identity to a HISP, then it encrypts and sends (pushes) the message including the clinical summary to Sender's HISP.

Second, From Sender's HISP to Receiver's HISP

Sender's HISP will locate Receiver's HISP, then message will be pushed to the Receiver's HISP to be delivered to the intended recipient.

Finally, From Receiver's HISP to Receiver

-   IF the receiver of the message doesn't have an EHR system but is using e-mail software that supports Direct protocol and can handle secure and encrypted messages. Then, email software will authenticates to the Receiver's HISP and gets the message in the inbox.

-   Another scenario, message can be received automatically and without any human intervention. For example, if the receiver is using PHR system that can "listen" for the incoming messages and direct it automatically to the receiver patient's health records.

There are standards that support these behaviors, Including:

- Message content is packaged using Multipurpose Internet Mail Extensions (MIME), with optional use of integrating the Healthcare Enterprise (IHE)'s Cross-Enterprise Document Media Interchange integration profile (XDM).
- Confidentiality and integrity of the content of messages is handled through S/MIME encryption and signatures.
- Authenticity of the message's sender and receiver is established with X.509 digital signatures.
- Routing of messages is handled through Simple Mail Transport Protocol (SMTP).

1.3. State Health Information Exchange Cooperative Agreement.

To foster the expansion of health information exchange within and among 56 different U.S. states. ONC initiated in March 2010 The State HIE Cooperative Agreement Program with total investment of $548 million (Kuperman, 2011).

This program aims to encourage the use of services, policies and standards required to achieve the pervasive health information sharing and exchange between healthcare providers, pharmacies, laboratories, and public health agencies.

Healthcare organizations should have broadband Internet access to be able to participate in the electronic exchange of health information. Nevertheless, the high cost of telecommunications services may prevent the rural health care providers from the participation in HIE. To overcome this problem Federal Communications Commission (FCC) approved to spend about $400 million yearly under The Rural Health Care Pilot Program. This fund aims to help connecting rural healthcare providers through the construction of a nationwide broadband network dedicated to healthcare. Therefore, help healthcare providers to provide a world-class healthcare services to the patients regardless where they are living, through the use of communications technology.

1.4. Standards and interoperability framework (S&I framework)

ONC collaborates with other U.S. federal agencies to develop a standards and interoperability framework (S&I framework). S&I framework aims to harmonize and reduce disparities in the existing vocabularies and terminology standards. Therefore, help to reduce costs and foster the spread of health information exchange and interoperability among the federal agencies and different health organizations.

The S&I framework will support three different types of standards which aim to support health information exchange and improve interoperability, these are:

1. Transport standards, these enable the secure HIE between different providers or systems.

2. Content standards, allow the packaging of date in a useful way for the provider to facilitate data interoperability among different providers.

3. The S&I framework in order to realize semantic interoperability at the level of individual data elements will identify value sets, terminology standards and vocabulary.

OBJECTIVE C: Support the adoption of health IT and HIE for public health and populations with unique needs

1. **Foster health information exchange between public health agencies and providers by using certified EHR technology.**

ONC collaborating with different federal agencies to make sure that meaningful use of certified EHRs are supporting the demands of public health agencies. In addition, among the objectives of stage one of Meaningful, the electronic submission of immunization registries, lab reporting, and syndromic surveillance to public health agencies. Taken together, will foster information exchange between the providers and different health agencies before, during, and later to an incident. Therefore, support public health readiness and response in both emergency and routine situations.

2. **Promote health IT that can track health disparities and reduces them.**

To realize the nationwide adoption and the meaningful use of certified EHRs, the governmental initiatives should include the providers that are facing difficulties to adopt and use EHRs. RECs will cooperate with groups representing minority and underserved providers on both the local and national levels and develop tailor-made solutions and best practices to help these providers. In addition, ONC is working to find better ways to identify, monitor and measure disparities in HIT adoption to allocate the resources to reduce the adoption disparities in those areas which have great disparities.

Moreover, HRSA Health Disparities Collaboratives (HDC) created to support primary health care practices transformation to enhance the provided care for all population and reduce health

disparities. HRSA's Tele-health Network Grant Program are funds the Tele-health networks to increase the number of locations using Tele-health technologies. Therefore, address the gaps in access and healthcare services quality. Tele-health uses telecommunications and information technologies such as wireless communication and videoconferencing to assist long-distance healthcare.

II. Improve Care, Population Health, and Reduce Health Care Costs through the Use of Health IT

The Affordable Care Act aims to transform the healthcare system in the U.S. so the system will concentrate on care improvements rather than concentration on transactions, reduce healthcare cost, and improve population health. The pervasive adoption of Health IT and the meaningful use of EHRs is essential step to achieve that transformation and its goals. To achieve the second goal of Federal Health IT Strategic Plan 2011-2015, the government of the U.S. has four objectives:

A. Improve health system performance through more sophisticated uses of EHRs and other health IT
B. Using EHR-generated reporting measures for better efficiency, care, and population health
C. Demonstrate health IT-enabled reform of clinical practices, payment structures, and population health management
D. encourage new approaches that use health IT in research, public health, and national health security

OBJECTIVE A: Improve health system performance through more sophisticated uses of EHRs and other health IT

1. Find and implement best practices that use health IT including EHRs to improve healthcare, efficiency, and population health

The Medicare and Medicaid EHR Incentive Programs creates a basic Health IT and HIE foundations. Those foundations paves the way to healthcare providers for further improvements that will support health reform. RECs with support of The Health Information Technology Research Center (HITRC) program are working to make available to healthcare providers the tools and the best practices. Therefore, help healthcare providers to improve health outcomes and redesign the clinical care through the implementation of more sophisticated Health IT and the meaningful use of EHRs.

ONC created the health IT Regional Extension Center (REC) program to assist and provide information regarding the best practices to healthcare providers. Therefore, foster the efforts for the adoption and usage optimization of EHRs to improve the value and the quality of the healthcare delivery system (Lynch et al., 2014).

HITRC responsible for gathering information related to the effective practices and support the collaboration among RECs and with relevant stakeholders. HITRC aims to Identify and share best practices in EHR adoption, effective use, and provider support. In addition, HITRC will help to change clinical workflows and integrate EHRs, medication reminder systems, patient registries, and Clinical decision Support Systems (CDSS). Consequently, HITRC will help to achieve better clinical decision support and improve the care system to become proactive and focus on prevention and the improvement of care management.

2. Reducing burden and cost for payers, providers, and government health programs

For the future EHRs meaningful use stages, HHS supposed to suggest actions that can streamline the administrative processes and reduce healthcare costs.

Transition from (ICD-9-CM) to (ICD-10-CM/PCS)

HHS approved in January 2009, modifications to HIPAA Administrative Simplification medical data code set standards related to inpatient procedure coding and medical diagnosis. Under the new rules in October 2013, payers, healthcare providers, and other healthcare organizations should shift to the using of International Classification of Diseases, Tenth Revision, Clinical Modification, Procedure Coding System (ICD-10-CM/PCS) Instead of using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) in HIPAA-covered transactions.

According to Sanders et al. (2012), U.S. has been using the ICD-9-CM coding system for almost 30 years but the ICD-9-CM codes become outdated in finding patterns of the clinical care, and lack the details required to evidence-based medicine practices. With the increase of medical procedures and improvements in medical technology, the specificity level required in procedural codes and diagnostic is growing.

Transition to ICD-10-CM/PCS offering an opportunity for hospitals, physicians, payers, and healthcare organizations to enhance the documentation of medical procedures for billing purposes and reducing the number of unpaid claims. In addition, using ICD-10-CM/PCS will improve the utilization of patients data that will help in medical errors reduction, enhancing the quality of care,

enhancing the reporting of quality data, and increase the precision of claims payments. Moreover, ICD-10-CM/PCS has the potential of enhancing public health surveillance data that used for research and treatment, and reducing healthcare cost over time.

OBJECTIVE B: Using EHR-generated reporting measures for better efficiency, care, and population health

1. Electronic Measures (e-measures)

As requested by PPACA, HHS created In March 2011 the National Quality Strategy that emphasis on six priorities those having the potential to promptly enhance the effectiveness and improve healthcare outcomes for the populations. Thus, HHS works to create definite measureable goals and develop e-measures those will gather and report data for each priority through EHRs.

ONC will collaborate with other federal organizations to create specifications, standards, and EHRs certification criteria that should simplify gathering and reporting of e-measures. e-measures will be harmonized by S&I framework with other standards that support health data gathering and HIE. Imbedding e-measures within EHRs will help healthcare providers to monitor and evaluate their own performance.

National Quality Strategy demonstrated that performance in the six priorities (Patient engagement and experience, clinical care, community and population health, coordination of care, efficiency and cost, and safety) should be addressed, tracked, and enhanced. Measures should be captured at three levels (community/ population, facility/ group, and individual physician). In addition, results of the performance should be calculated and send feedback for each level. National Quality Strategy aims to have a common platform for these measurements which will fulfill the needs of healthcare providers, payers, and policy makers. This can be realized by the use of interoperable Health IT systems and the next generation of EHRs (Conway, Mostashari and Clancy, 2013).

Quality measurement is the centerpiece of healthcare improvement. Quality measures usually was prepared manually relying on administrative records, consumer surveys, and paper charts and was consuming time. With widespread adoptions of EHRs it becomes possible to automate quality measurement data gathering and reporting. Stage 1 of meaningful use of the certified EHRs includes the submission of fifteen clinical quality measures. Additionally, HHS recommended to transform 113 paper-based clinical quality measures to e-measures (Garrido et al., 2014).

OBJECTIVE C: Demonstrate health IT-enabled reform of clinical practices, payment structures, and population health management

ONC seeks not only to support the adoptions of EHRs but also seeks to realize the potentials benefits beyond that adoption that should lead to care improvement, efficiency, and enhance population health.

1. Beacon Communities

According to McKethan et al. (2011), ONC decided in May 2010 to provide $250 million as fund to Beacon Community Program. Beacon Communities include 17 communities varying in population from below 5000 to above 2 million which are spread all over the U.S.

Beacon Community Program has two main goals. First, to illustrate that health information technology can enhance efficiency, quality and reduce the cost of care. Second, encourage the participants to implement innovative health IT solutions and share experience, evidence, and ideas with other communities around the united states. The main findings from beacon communities will be extended to a national scale and provide guidance for State HIE programs, RECs, and meaningful use anticipated objectives.

2. Align health IT initiatives and payment and clinical reform pilots

The PPACA act approved a lot of innovative programs such as medical home pilots and bundled payment pilots which use payment reforms to improve coordination, equity, efficiency, and quality of care. Health IT is an important tool that support these projects through performance measurements, HIE, and communications between patients and healthcare providers (Finkelstein et al., 2011).

OBJECTIVE D: encourage new approaches that use health IT in research, public health, and national health security

The Affordable Care Act (ACA) allocated a lot of resources to improve public health and prevention. Centers for Disease Control and Prevention (CDC) authorized funds with total amount of $42.5 million to support a project named Strengthening Public Health Infrastructure for Improved Health Outcomes. CDC aims to support local, territorial, and state public health departments and improve its capacities to deliver better public health services and ensure the realization of public health objectives.

Health information technology can play a crucial role in supporting public health goals and national health security. In the course of a public health emergency, health IT can assist care continuity for the affected population through facilitating HIE for emergency care. In addition, during natural disasters health information for the impacted population can be retrieved easily if it's recorded electronically. Thus, avoiding the bad influences of destroying paper records in such circumstances.

CDC programs are integrating with NHIN to support HIE across states boundaries, and providing public health agencies with public tools for disease prediction, surveillance, and immediate consciousness.

1. The National Electronic Disease Surveillance System (NEDSS)

According to Lenert & Sundwall (2012), healthcare providers participating in EHRs meaningful use incentive programs to receive incentive payments should exchange specific types of data with the public health system. Data should be exchanged include: syndromic surveillance, immunization data and notifiable illness reporting. On the other hand, IT systems in public health agencies are not ready and lack the abilities required to receive and exchange these data. Cloud computing can be the suitable solution that can support the IT systems in public health departments to realize the potential benefits from HIE of public health related data.

CDC provides the states with Web-based access to a cloud based public health system that can be customized as per the needs of each state. This system entitled the National Electronic Disease Surveillance System (NEDSS) Base System. NEDSS Base System software is using Software as a Service (SaaS) approach, and hosted in CDC datacenter as a private cloud.

NEDSS was created to integrate and replace existing CDC surveillance systems. The existing systems including: HIV/AIDS reporting systems, National Electronic Telecommunications System for Surveillance (NETSS), vaccination programs, and tracking systems for tuberculosis and other infectious diseases. Historically, such systems have been isolated from one another due to differing data standards, legacy systems, patient privacy concerns and a lack of tools for information exchange. To address these issues, NEDSS designers created a Base System as a platform that state agencies and health care providers could use to integrate public health surveillance systems data and process in a secure environment.

The NEDSS framework contains a set of specifications that comprises databases, hardware, software and data format standards. CDC is in charge of maintaining and expanding NEDSS at the center of the U.S. Public Health Information Network (PHIN). The CDC mandates clinics, hospitals, physicians, laboratories and state health agencies all adopt NEDSS standards. Therefore, the accuracy, speed, viability, and standardization of data about diseases are improved.

NEDSS report to public health departments the patient visits for particular diseases and monitors laboratory results to detect increased frequency of certain conditions. NEDSS enabled the electronic data to be communicated automatically. Thus, epidemiological investigations are initiated much more quickly and reporting time for communicable diseases has shortened from about 24 days to 3 days, with a 300% growth in the number of laboratory reports to public health.

With NEDSS's enhanced communications, reliable information and automated data exchange. Public health departments and other stakeholders will have timely and accurate insight into the state of the nation's health. Therefore, a better and healthier life will be achieved for all Americans.

2. **The Electronic Medical Records and Genomics (eMERGE) Network**

According to Newton et al. (2013), EMRs originally designed to help both patients and care givers through the documentation of patients' visits, clinical, and billing data. In fact, EMRs record a lot of clinical phenotype data which have a specific attribute such as blood type, the incidence of particular illness, or the response to a medicine. Thus, EMRs can be used as a source of information for genetic research.

eMERGE created and funded by National Human Genome Research Institute (NHGRI). The primary goal of the eMERGE Network is to develop, propagate, and apply research approaches that combine DNA biorepositories with electronic medical record systems (EMRs) for widely, abundant-throughput genomic research.

According to Kho et al. (2013), Genome-wide association studies (GWAS) need precise classification of disease phenotypes to sustain accurate statistics. eMERGE strive to identify whether the routine clinical care date recorded by EMRs can determine disease phenotypes with appropriate negative and positive predictive values for GWAS applications.

A reseach done to analyze EMR data gathered from five different eMERGE study sites (Mayo Clinic, Group Health, Vanderbilt, Northwestern, and Marshfield Clinic). These data used to

predict cases having 1 of 5 different disease phenotypes (cataracts, dementia, cardiac conduction defects, and type 2 diabetes, and peripheral arterial disease). Each site has a separate DNA biorepository that contain biological samples used for genotyping and linked to the EMR system by a unique research identifier.

Some EMR systems in these sites are capturing and storing data in unstructured format (free text documents). While other sites having a mix of free text notes and structured date (as text data or numeric data) that have a predefined format complies with the requirements of the Meaningful Use. Natural Language Processing (NLP) tools used to extract structured data from the free text documents as required by phenotype recognition algorithms.

The research results showed that five disease phenotypes identified with positive predictive values from 73 percent up to 98 percent and the negative predictive values of from 98 percent up to hundred percent. The main stream of EMRs captured key information (laboratory tests, medications, diagnoses) used for phenotypes identification was in a structured format. The natural language processing (NLP) is an important tool to enhance the rates of case identification. Incentives and efforts to increase the adoption of interoperable EMRs can significantly expand the clinical data availability for genetics research.

III. Inspire Confidence and Trust in Health IT

EHRs and health IT offer great potential to enhance patient safety and support healthcare providers to practice safer and provide care more effectively. In fact, this can be achieved only when patients and healthcare providers feel confident and have the trust that the proper protections (processes, policies, and laws) are there in place to keep their health information private and secure. In addition, accountability should be there when any violations occur.

Privacy and security are the foundation of building the trust, and a must-have element that is necessary to achieve the meaningful use and to realize the value of health IT. Protecting the security and the privacy of health information, and assure the safe use of health IT are among the government core responsibilities. Therefore, the government should review and update constantly the regulations, Policies, and procedures that related to health information privacy and security.

The government have three main objectives to "Inspire Confidence and Trust in Health IT" are:
    A. Protecting the availability, integrity, and confidentiality of health information

B. Inform individuals about their rights and increase transparency of using protected health information

C. Enhance effectiveness and safety of health IT

OBJECTIVE A: Protecting the availability, integrity, and confidentiality of health information

Health IT are speedily evolving, thus the federal agencies should ensure that privacy and security policies involving guidance and regulations are keeping pace with advances in health IT. In particular, regulations and guidance related to the processes of gathering, storing, managing, and exchanging health information,

ONC is collaborating with other federal agencies to address privacy related issues that rising from the developing means of gathering and analyzing health information and HIE over the Internet. As a first step and as obligated by the HITECH Act, Office for Civil Rights (OCR) is working on new rules that will modify the existing HIPAA Privacy and Security Rules. These rules are including:

- Enforcing direct liability on healthcare organizations for obedience to particular provisions of the HIPAA Privacy and Security Rules.

- Establishing new limitations to restrict the selling of the protected health information.

- Putting impregnable limitations on the disclosure of health information for fundraising and marketing.

- Increasing translucency in regard to health information sharing.

- Giving individuals more control over their EHRs

In Addition, OCR also issued rules that is obligatory by the HITECH Act. The new rules define the circumstance under which the covered bodies must inform patients, HHS, and in a certain cases the media, about disclosure of the protected health information.

To gain the trust of both patients and providers in health IT and HIE, they should be assured that security and privacy related regulations are exist and will be enforced. The HITECH Act gives more power to OCR's civil enforcement of HIPAA Security, Privacy, and disclosure notification Rules. This happened through the definition of four new categories of violations and increase significantly the corresponding penalties that can reach up to $1.5 million as a maximum.

Moreover, OCR are conducting a periodic audits to assure and improve the compliance with the HIPAA Privacy and Security Rules. OCR has received above 77 thousands complaints related to the privacy violation of health information. In addition, OCR investigated above 27 thousands of the received complaints, and corrective actions has been taken for more than 18 thousands of these cases. (Taitsman, Grimm and Agrawal, 2013).

Both ONC and OCR are working to make sure that certified EHRs are facilitating compliance of healthcare providers with HIPAA Security Rules requirements. The certified EHRs should have the following capabilities:

- Keep health information secure and encrypted
- Access control rules that enable only authorized persons to access the EHRs
- Having audit logs for specific actions
- Idle user should be logged out automatically after a certain time

ONC has collected large feedback through the Federal Health IT Task Force to guide the directions of the federal policies related to security and privacy issue. HHS is working to address the following key policy areas at a minimum:

- Individual should has the choice whether to participate in HIE or no.
- Access controls and transparency for EHR data exchange.
- Security, including authentication for both patient and provider and de-identification of personal health information.
- Health information's Integrity.
- Secondary uses of health information for research, public health, and quality improvement.

Some patients may consent to exchange some of but not all their personal health information (data segmentation). For example, patients may not like to share their health information related to substance abuse treatment, but can like to share other health information to realize the benefits of the electronic sharing for health information.

According to Tai & McLellan (2012), Information stored in EHRs may be segmented into very tiny elements or sections (e.g. Radiology report, a diagnostic evaluation, a laboratory test). Access to each section or element can be defined by the patients according to the level of protection they may define for each information element. Thus, data segmentation technology may allow for the different segments of the EHRs to be controlled by various privacy policies.

For example, "core vital information" such as vital statistics related to the medications and health conditions that may be critical for patient life's saving should be shared between all healthcare providers without a written consent from the patient. In the same time, tough penalties should be applied for the disclosure of these information for purposes not related to the delivery of care. Moreover, to protect confidentiality and privacy patient may select not to share with insurers and healthcare providers other health information that are less critical but important.

ONC and the Substance Abuse and Mental Health Services Administration (SAMHSA) are working to develop electronic consent privacy policies with regard to data segmentation, and to be used in the Nationwide Health Information Network (NHIN). Additionally, ONC will review and assess its workforce curriculum and materials to ensure that future health IT professionals are aware of the best practices and privacy and security requirements and assure compliance with these policies.

OBJECTIVE B: Inform individuals about their rights and increase transparency of using protected health information

To gain consumer trust in health IT including EHRs, patients must be informed about using and sharing of their health information. Moreover, patients must be notified with any disclosure for their personal health information. OCR and ONC are collaborating over a two-year period to execute outreach and education strategy that aims to inform patients about how their health information is protected, used and shared. In addition, to inform patients how they can practice their rights under the HIPAA Privacy Rule. Furthermore, to advise them about the best practices to protect the privacy of health information that are generated and maintained by EHRs.

HHS has created an online resource center to facilitate individuals' access to HHS policies related to gathering, using, and exchanging the personally identifiable health information. In addition, the security and privacy requirements for all organizations those are collecting and maintaining health information.

OBJECTIVE C: Enhance effectiveness and safety of health IT

Agency for Healthcare Research and Quality (AHRQ) supports health services researches that create new knowledge, combine and spread best evidence and providing health IT tools that have

positive impact on the quality of healthcare. Current initiatives address patient safety, clinical decision support, quality measurement, patient centered care, and workflow and usability issues.

IV.   Empower Individuals with Health IT to Improve their Health and the Health Care System

Health IT is crucial for both shifting toward more patient-centric care and empowering individuals to manage their health and to be more engaged in treatments and health decisions.

Because of the rapid evolving of consumer technologies, it becomes more familiar for individuals to use health IT to interact with their health information. Therefore, it becomes necessary for clinical practices to be integrated with individual use of health IT outside the boundaries of healthcare organizations.

To achieve the ultimate goal of moving toward patient-centric care, the government should support healthcare providers to empower individuals with health IT and foster clinical practices to get benefited of consumer-generated health information. To empower Individuals with Health IT, the government have three main objectives are:

- Engaging individuals with health information technology.
- Accelerating healthcare providers and individual access to their electronic health information in a usable and reusable format.
- Integrating clinical applications with consumer health IT and patient-generated health information to support patient-centric care.

While HIPAA Privacy Rule gives the right to individuals to access their health information. ONC is encouraging EHRs vendors to add more features that allow the patients through the use of consumer e-health tools to access and download their health information. e-health tools Include PHRs, secure mHealth application installed on smart phones, and mobile devices. In fact, it is very necessary that personal health data should not be only downloadable but it should be also in a format that is reusable by other applications. Thus, allow the interactions between the EHRs and patient-specific external education resources.

Meaningful Use EHR Incentive Program, in the first stage, requires healthcare provider to send after each clinical visit to the patient a clinical summary. In addition, to send a soft copy of the patients' health information during three days from their request. Moreover, to provide the patients

with patient-specific education resources . Stage 2, requires healthcare provider to allow the patients to access, download, and exchange their health information with a third party. Additionally, to increase the use of secure messaging for the communication between the patients and care providers.

The Blue Button initiative

The Blue Button is a web-based feature that enables patients to view and download a soft copy of their health information (e.g., medications, allergies, lab test results, radiology reports, medical history, etc.) from different sources (e.g., health care provider (hospitals, clinicians, nursing home, health insurance companies, drug stores or a laboratories).

Then patients can use these health information to Keep track of their child's vaccination, make sure that their information is complete and accurate. In addition, using medical history in emergency cases and to seek a second opinion or while changing the insurance company. Moreover, integrate these data with consumer apps and tools that help them to set and achieve personalized health goals. Finally, share these information with health care providers, and trusted caregivers or family members (healthit.gov, 2014).

According the federal health IT strategic plan progress report issued by ONC (2013), ONC is required to lead a nationwide efforts that aim to foster Blue Button adoption and usage. Almost 88 million Americans are using Blue Button to access some of their claims or clinical data and Blue Button have been downloaded more than 1.5 million times.

V.   Achieve Rapid Learning and Technological Advancement

To achieve this goal the government has two main objectives: First, create a learning health system which support research, quality, and population health. Second, promoting research and innovation in health IT.

1. Learning health system (LHS)

According to Friedman et al. (2010), The main goal of the learning health system is to collect healthcare data from different sources. In addition, analyze this data and transfer it into knowledge that can be used immediately. LHS have the potential to minimize the time between the new knowledge creation and the use of this knowledge in the clinical practice to be 17 months, or even weeks instead of the usually-quoted 17 years.

LHS will make the right information available to support a given medical decision. Whether it is related to treatment efficacy for a single patient, forecasting the outbreak of a pandemic disease, or taking a decision to commence a research and production of a new medications.

LHS will use the existing infrastructure, requirements, and policies created to support meaningful use of certified EHRs and will develop them to support a system that can learn which require a more sophisticated methods of information exchange. The wide adoption of EHRs will generate a huge amounts of health information in electronic format that will be used originally to support healthcare delivery. In addition, these information can be used for a second trusted and secured purpose by generating knowledge from these information which can be used in the clinical practice in a short time. Therefore, accelerate the health care reform.

Part of the success of LHS is depending on the number of the selected participating organizations that gathering and using a plenty amount of healthcare data. Beside the initial group participating from the federal partners, the government will encourage more partners from federal organizations and private sector to participate in LHS. Thus, the Future partner in LHS would include private and public healthcare providers, payers, additional federal agencies, medical communities, Health Information Exchanges, registries, and behavioral health practices (See Figure 7**Error! Reference source not found.**).
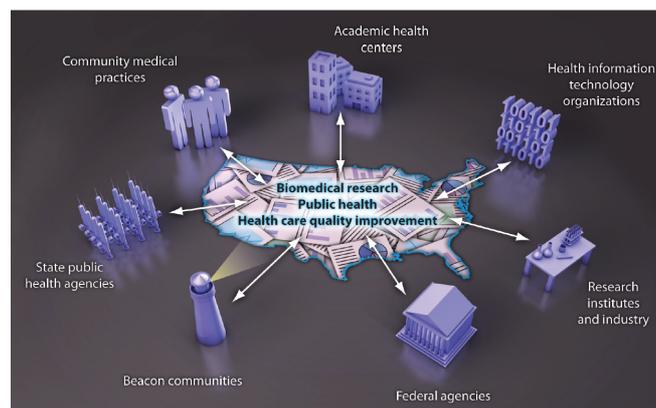
Figure 7 - Nationwide Learning Health System

(Friedman, Wong and Blumenthal, 2010, p.57cm29)

According to a report published by IOM (2012), healthcare today are facing three major challenges requires the change. These challenges are unsustainable cost increases, the rising complexity of modern health care, and outcomes below the system's potential. The report defined the main

characteristics of the new LHS which should align the researches and informatics, partnerships between patient and healthcare providers, culture and incentives. Additionally, LHS will help to generate and use a real-time knowledge and achieve improvement in the efficiency and effectiveness of care (See Table 4).

Science and Informatics

- **Real-time access to knowledge**—A learning health care system continuously and reliably captures, curates, and delivers the best available evidence to guide, support, tailor, and improve clinical decision making and care safety and quality.
- **Digital capture of the care experience**—A learning health care system captures the care experience on digital platforms for real-time generation and application of knowledge for care improvement.

Patient-Clinician Relationships

- **Engaged, empowered patients**—A learning health care system is anchored on patient needs and perspectives and promotes the inclusion of patients, families, and other caregivers as vital members of the continuously learning care team.

Incentives

- **Incentives aligned for value**—In a learning health care system, incentives are actively aligned to encourage continuous improvement, identify and reduce waste, and reward high-value care.
- **Full transparency**—A learning health care system systematically monitors the safety, quality, processes, prices, costs, and outcomes of care, and makes information available for care improvement and informed choices and decision making by clinicians, patients, and their families.

Culture

- **Leadership-instilled culture of learning**—A learning health care system is stewarded by leadership committed to a culture of teamwork, collaboration, and adaptability in support of continuous learning as a core aim.
- **Supportive system competencies**—In a learning health care system, complex care operations and processes are constantly refined through ongoing team training and skill building, systems analysis and information development, and creation of the feedback loops for continuous learning and system improvement.

Table 4 - Characteristics of a Continuously Learning Health Care System

(IOM, 2012, p.18)

Figure 8 shows IOM vision in how health information collected from care delivery and researches will be captured systematically to generate the knowledge and the evidence that will guide the medical decision making. Which should be combined with changes in culture, financial incentive, continuous feedback. In addition to engagement for individuals and healthcare providers, and leadership that is commitment to the goals of a continuously learning healthcare system.

There are many Initiatives done by federal entities to foster LHS such as FDA's Sentinel Initiative, it is an electronic national system created to help FDA to track safety of medical devices, biologics, vaccines, and drugs after reaching the market. CDC also created the National Environmental Public Health Tracking Network. Which integrating data related to hazard, exposure, and health that collected from local, state, and national sources , to show that how hazardous substances can cause the diseases and how that can be prevented.

Lesson should be learned from federal and private sector initiatives to propose policies and technologies that can be adopted on a nationwide scale. As much as members participating in LHS as much as the LHS will be valuable and as more knowledge will be created and shared between the different entities and make a positive impact on researches and clinical practices.
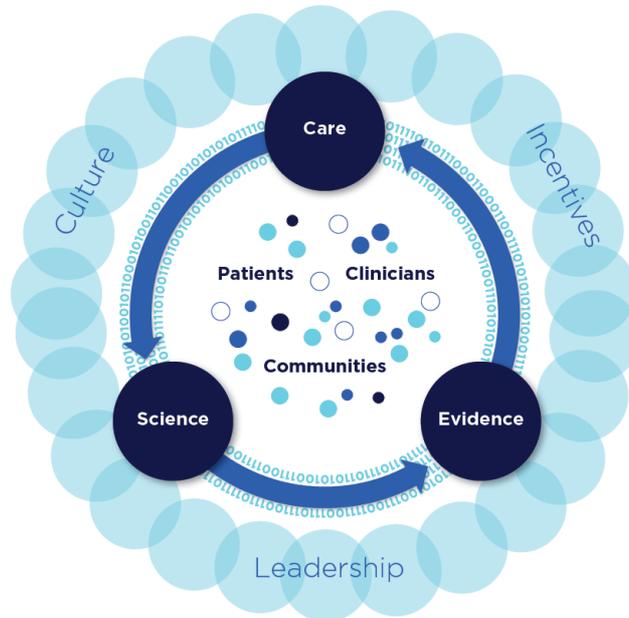
Figure 8 - LHS schematic vision

(IOM, 2012, p.19)

2. Promoting research and innovation in health IT

Facilitate health data access while insuring security and privacy protections is the key governmental mechanism to foster the innovation and demonstrate health IT value to the public. High quality and rich data are key components to build a valuable applications to both healthcare providers and individuals. HHS through the Community Health Data Initiative (CHDI) makes many valuable and large data sets related to the performance of healthcare system available for developers from both public and private sectors to support innovation.

The federal government is committed to support research and innovation in Health IT. More specifically, in areas that having great potential for improving individuals and populations health. This happen either through the direct funds or through open challenge grants and innovation prizes.

2.1. Research initiatives

2.1.1. Strategic Health IT Advanced Research Projects (SHARP)

ONC established SHARP program under HITECH Act, it is a four-year program to fund patient-centered cognitive support, health IT security, secondary use of EHR data, and network platform architectures.

2.1.2. The Query Health Initiative

Collaboration between public and private sector that enable population-level health queries throughout the nation and across various platforms. This initiative aims to facilitate data research and advanced analysis, while safeguarding security and privacy of health data for the individuals.

2.1.3. The HIT Trailblazer States project

Connecting states and facilitating the sharing of the tools and best practices related to federal work on measures of clinical quality, standards, and other tools that foster improvements in health care quality.

2.1.4. The National Learning Consortium (NLC)

Gathering the lessons learned and leading practices collected through ONC's outreach programs (e.g., RECs, State Health Information Exchange, and Beacon Communities). Then organizing and representing them to healthcare providers seeking to adopt Health IT.

2.1.5. The Federal Communications Commission (FCC) Experimental Licensing Program

Aims to streamline testing processes for the new wireless health IT products, to speed up the times needed by the new technologies to reach the market.

2.2. Health IT Prizes and Challenges

Through innovation prizes and dynamic grant competitions, HHS encouraging the private sector to innovate in health IT to address some of the biggest challenges facing the healthcare. Then widen the adoption of these innovations.

2.3. Health IT Innovation

2.3.1. The Partnership for Patients

Seeks to decrease the 30-day hospital readmissions by 20%, and decrease the preventable hospital-acquired conditions by 40%, by the end of 2013.

- The Challenge of Discharge Follow-Up Appointment, strive to decrease hospital readmissions through developers' engagement to create applications that streamline post-discharge follow-up appointment scheduling.
- The Challenge to ensure the Safe Transitions from Hospital to Home, developers have created applications that empower caregivers and patients to communicate discharge information with healthcare providers and manage the next steps in their care.

2.3.2. The national Million Hearts initiative

Engaging private sector and Federal partners to design and apply strategies that aims to prevent 1 million strokes and heart attacks over 5 years.

- As part of this challenge, five U.S. cities started initiatives that encourage and deploy the winning application, which allow consumers to early detect their risk for cardiovascular disease. In addition, motivate them to achieve a more precise risk assessment and manage their heart health.

2.3.3. The Reducing Cancer among Women of Color App Challenge

This challenge seeks to develop a mobile application that help minority and underserved women to fight and prevent cancer.

3.2.2 Progress toward the adoption of a nationwide health system

According to 2014 progress report issued by ONC (2014), The health IT infrastructure in U.S. has grown to be more flexible and resilient. In addition, EHR adoption among physicians and hospitals has increased significantly since HITECH Act. Moreover, significant advances in health information exchange has been achieved.

1. **Adoption of EHR Technology**.

    1.1. Adoption among physicians

    - The ratio of physicians those are using any EHRs (EHRs that not containing billing records), has increased from 18% in 2001 to be 78% in 2013 (See Figure 9).

    - The ratio of physicians those are using a basic EHRs, has increased from 11% in 2006 to be about 48% in 2013 (See Figure 9).

- The ratio of primary care office-based physicians reported having a basic EHR system in 2013 was 53 %

1.2. Adoption among hospitals

- The ratio of hospitals adopted at least a basic EHRs, has increased from 12% in 2009 to 59% in 2013 (See Figure 9).

- The ratio of hospitals adopted a certified EHRs, has increased from 72% in 2011 to 94% in 2013 (See Figure 9).

- In 2013, 89% of Critical Access Hospitals (CAHs) used an EHR system, and 49% planned to upgrade or implement a new EHR within a year.

1.3. Adoption Among Federally-Qualified Health Centers

- In 2012, about 90% of health centers had adopted a EHRs, and half had adopted a basic EHRs.

1.4. Eligible hospitals and professionals paid under the EHR Incentive Programs

- As of June 2014, 75% of eligible professionals (403,000+) and more that 92% of eligible hospitals (4,500) including CAHs, have received incentive payments through the EHR.
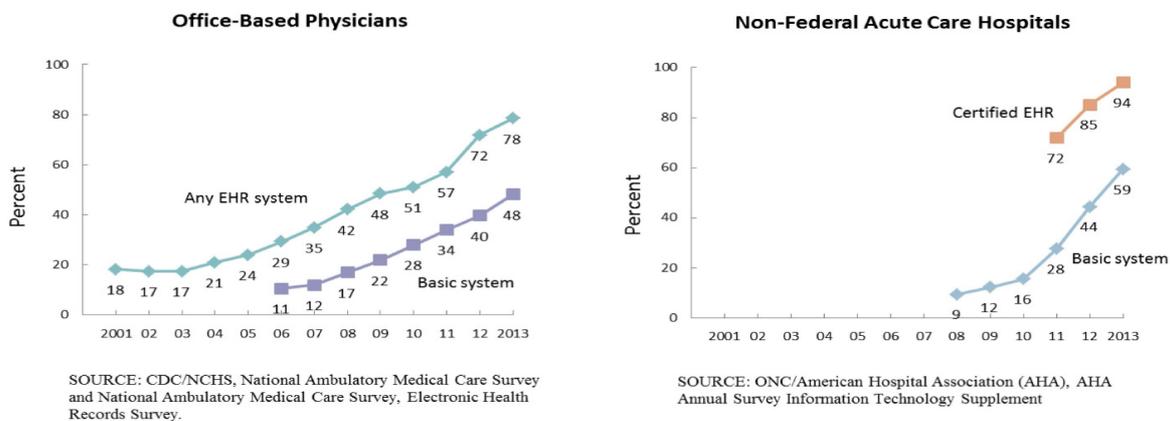
Figure 9 - Adoption of EHRs

(ONC, 2014a, p.12)

2. Health information exchange and interoperability

Electronic health information exchange (HIE) enables both patients and care providers to access and share securely the vital health information when need. Which is important to improve quality of care, improve population health, and decrease per capita costs. For the effective HIE, the shared

health information should be interoperable. Interoperability, means that two or more IT systems or components, can exchange information and will be able to use the exchanged information. HHS emphases on establishing standards and policies to smooth three main forms of exchange, comprising:

- Directed exchange, sharing of electronic health information securely among two known and trusted parties to support coordination of care.
- Query-based exchange, the capability to find or request patient information electronically from other healthcare providers. Regularly used for unplanned care.
- Consumer-mediated exchange, enable the patients to collect and control the use of their health information among healthcare providers.

2.1. HIE Among Physicians

- In 2013, more than 69% of physicians reported the ability to order lab tests electronically and above 77% are able to view lab results electronically. In addition, about 42% provide their patients the ability to access online, download, or transfer information from their medical record (as required by Stage 2 of the EHR Incentives Programs).

- The ratio of prescriptions sent electronically by physicians was 57% in 2013, which is a fourteen-fold increase since 2008.

- In 2013, 70% of physicians use an EHR to e-prescribe on the Surescripts Network, with a 63% increase since 2008 (See Figure 10).

- The ratio of the pharmacies that actively e-prescribing on the Surescripts Network, increased from 76% in 2008 to 96% in 2013, with 20% increase.
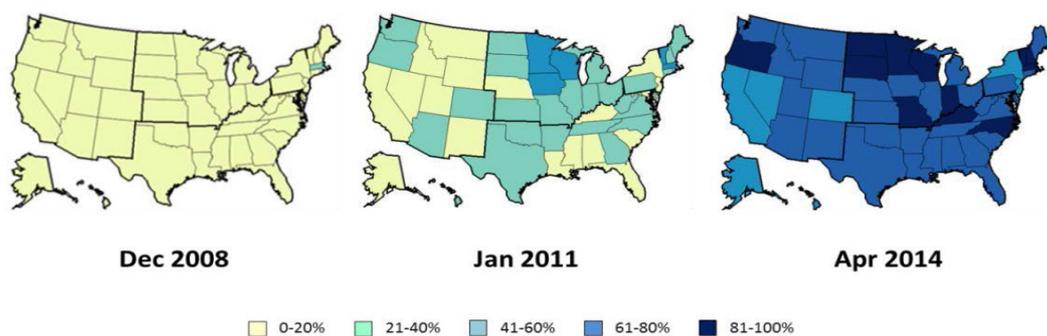
Figure 10 - Percentage of physicians using EHRs for e-prescribing, by state, April 2014

(ONC, 2014a, p.26)

2.2. HIE Among Hospitals

- In 2013, about 55% of hospitals shared radiology reports and 57% shared laboratory results electronically with any providers outside of their system.

- In 2013, about 42% of hospitals shared clinical care summaries and 37% shared medication lists with any providers outside of their system. With 68% increase in clinical care summaries exchange and 76% increase medication lists exchange since 2008.

- In 2013, more that 60% of hospitals exchanged patients' health information electronically with any other providers outside their organization. With 51 increase since 2008.

- In 2013, about 57% of hospitals exchanged patients' health information electronically with ambulatory providers outside their organization.

- Hospitals used different forms of exchange. About 41% used direct exchange to send and receive secure electronic messages containing patient's health information outside their system. In addition, 51% used query-based exchange to query patient health information electronically from others sources outside their systems.
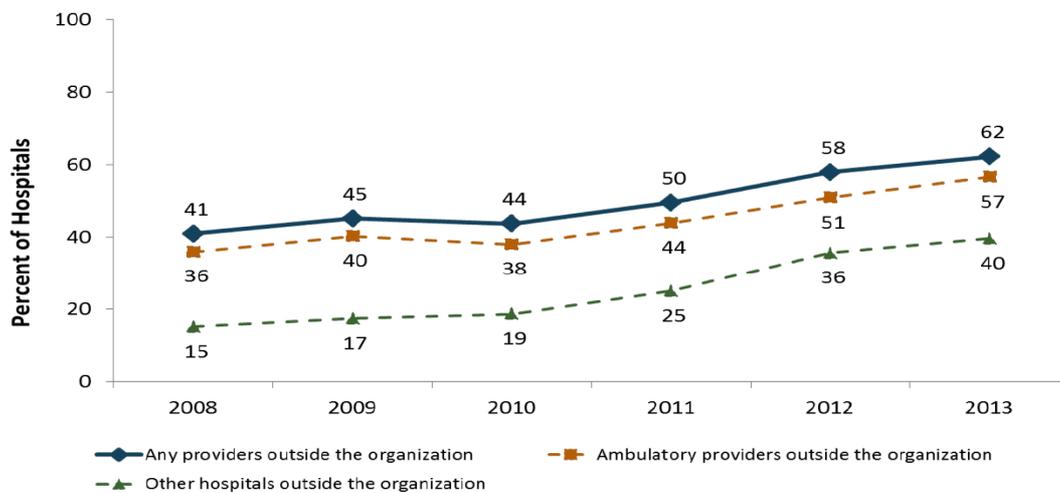
SOURCE: ONC/American Hospital Association (AHA), AHA Annual Survey Information Technology Supplement

Figure 11 - Percent of non-federal acute care hospitals that electronically exchanged health information with outside providers and hospitals: 2008-2013.

(ONC, 2014a, p.27)

2.3. HIE Among Clinical Laboratories

Integrating laboratory test results as structured data into certified EHRs is a core requirement for eligible professionals and hospitals under Stage 2 of the EHR Incentive Programs.

- About 67% of clinical laboratories reported the ability to send test results in structured format to an ordering practitioner's EHR.

- In 2012, about 58% of test results that were processed by independent laboratories and hospitals were sent electronically to ordering practitioners.

3.2.3 Federal Health IT Strategic Plan 2015 – 2020

According to ONC (2015), since 2011 big changes occurred in health IT ecosystem. As of June 2014, about 92% of the eligible hospitals and more that 403 thousand (75%) of the eligible professionals have received incentive payments from the EHR Incentive Programs. In addition, with the advances and innovation that occurred in mobile health applications and other health technologies. All that created a big demand to share health information seamlessly across different providers, location, information system and platforms, or other boundaries. Additionally, encouraged others providers that are not participating in the EHR Incentive Programs to collect, share, and use interoperable health information.

The Federal Health IT Strategic Plan 2015-2020, is building on the previous plan and articulate the federal health IT priorities and values that shaping the landscape of the future. The plan will strive to promote the different methods and approaches that will enhance health IT capacity to improve the well-being of the individuals and realize broad care and health goals.

The plan have five main goals, the first two goals will focus on expanding the collection and sharing of health information electronically and securely whereas protecting patient privacy. The other goals will emphasis on creating the environment that will enable health information interoperability between individuals, health care providers, researchers, and public health agencies. Therefore, improve the health of individuals and population, healthcare, while reducing the costs (See Figure 12). Full list of the Goals and objectives of The Federal Health IT Strategic Plan 2015-2020 are listed in Table 5.

While the new plan will continue work to increase the widespread adoption of health IT. More efforts will be required to include new sources of information and methods to spread knowledge more quickly, efficiently, and securely. Therefore, collaboration is required from all entities including healthcare providers, payers, technology developers, public health organizations, and research institutions.

Additionally, constant outreach to all stakeholders that will be involved in the Plan's development and implementation will allow the Plan to progress. Moreover, new or adapted methodologies to policies and federal activities will be required.

ONC also is working to advance the use of interoperable health information through the development of a public Nationwide Interoperability Roadmap. Interoperability is a shared component of this Plan, and implementation of the Interoperability Roadmap will be essential to advance the Plan's goals.
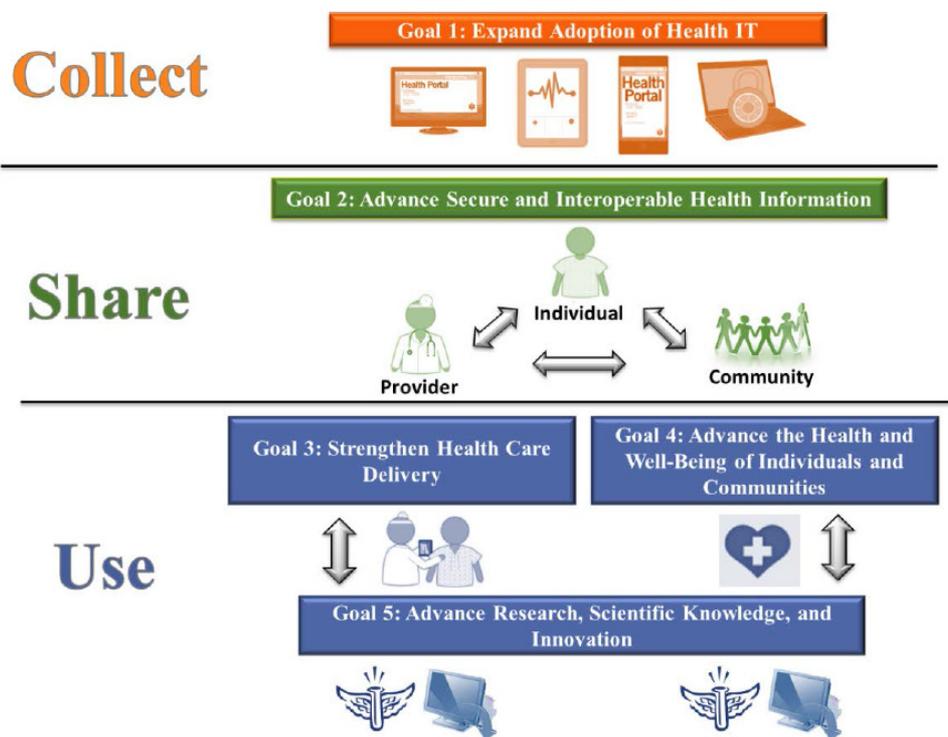
Figure 12 - The Federal Health IT Strategic Plan 2015-2020

(ONC, 2015, p.5)

	Goal	Objective
Collect	**Goal 1:** Expand Adoption of Health IT	• **Objective A:** Increase the adoption and effective use of health IT products, systems, and services • **Objective B:** Increase user and market confidence in the safety and safe use of health IT products, systems, and services • **Objective C:** Advance a national communications infrastructure that supports health, safety, and care delivery
Share	**Goal 2:** Advance Secure and Interoperable Health Information	• **Objective A:** Enable individuals, providers, and public health entities to securely send, receive, find, and use electronic health information • **Objective B:** Identify, prioritize, and advance technical standards to support secure and interoperable health information • **Objective C:** Protect the privacy and security of health information
Use	**Goal 3:** Strengthen Health Care Delivery	• **Objective A:** Improve health care quality, access, and experience through safe, timely, effective, efficient, equitable, and person-centered care • **Objective B:** Support the delivery of high-value health care • **Objective C:** Improve clinical and community services and population health
Use	**Goal 4:** Advance the Health and Well-Being of Individuals and Communities	• **Objective A:** Empower individual, family, and caregiver health management and engagement • **Objective B:** Protect and promote public health and healthy, resilient communities
Use	**Goal 5:** Advance Research, Scientific Knowledge, and Innovation	• **Objective A:** Increase access to and usability of high-quality electronic health information and services • **Objective B:** Accelerate the development and commercialization of innovative technologies and solutions • **Objective C:** Invest, disseminate, and translate research on how health IT can improve health and care delivery

Table 5 - Federal Health IT Goals and Objectives

(ONC, 2015, p.8)

3.2.4   A Shared Nationwide Interoperability Roadmap 2014 – 2024

According to ONC (2014b), The three broad national aims of better, more affordable healthcare, and better health of population can be achieved only with a flexible and strong health IT ecosystem. System that supports decision-making, transparency, inform payment reform. In addition, reduce waste and redundancy, enhance information access and expand care beyond clinical setting boundaries. Such infrastructure can lead to more effective and efficient systems, scientific improvement, and a sustainable improving health system. Therefore, empower individuals, customize treatment, and speed up the cure of illness.

During the past decade, U.S has achieved significant improvements in digitizing the healthcare delivery system. On the other hand, this significant advancement has created an increasing demand for interoperability that not only supports the continuity of care, but also supports health in general. An interoperable health IT ecosystem will make the right data available at the right time and to the right people.

By 2024, healthcare providers, individuals, researchers, and communities should have a set of interoperable health IT services and products. Thus, enable the healthcare system to learn continuously and promote the aim of improved healthcare. Learning Health System (LHS) should enable improved population health, lower health care costs, empower the consumers, and motivate innovation. Additionally, LHS should enable the individuals to securely share electronic health information with health care providers for informed shared decision-making that will support patients' health and wellness.

Health IT ecosystem that is interoperable should also support the critical public health functions such as disaster response, real-time disease surveillance, and data aggregation for research and value-based payment. In addition, rewards the higher quality care, not necessarily the higher quantity of care. ONC is figuring out how interoperability can be achieved collectively across the health IT ecosystem (See Figure 13)
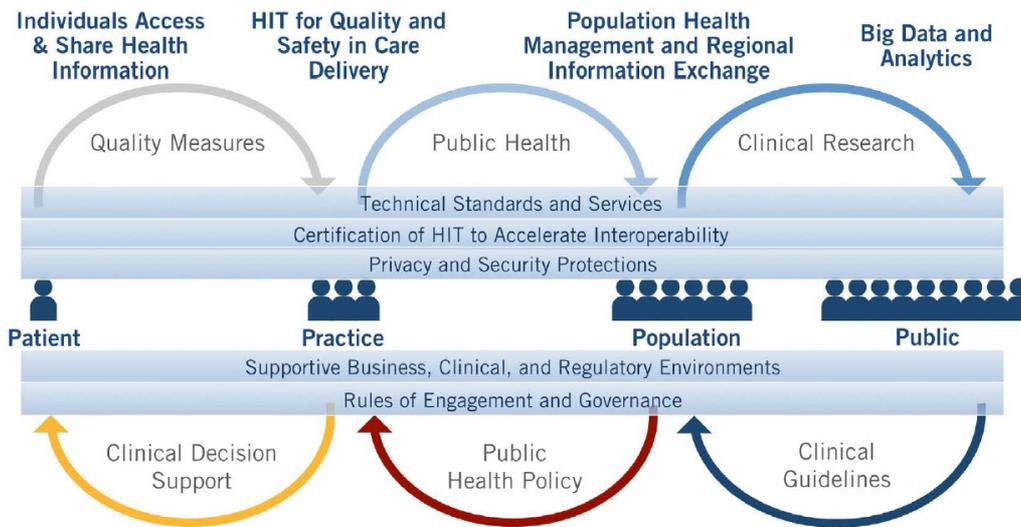
Figure 13 - The Health IT Ecosystem as a Learning Health System

(ONC, 2014b, p.2)

ONC developed a shared roadmap to interoperability that proposing key near-term actions and milestones for three, six, and ten year goals (See Table 6)

Stakeholder	2014-2017	2017-2020	2020-2024
Individual	• Send, receive, find, and use electronic health information	• Electronically contribute to and correct their health information; access shared care plans in standardized electronic format • Increased access to longitudinal health information	• Regularly track and share electronic information from wearable, implantable, biometric medical devices • Increased access to longitudinal health information
Provider	• Send, receive, find and use the common MU data set for all patients • Receive electronic notifications when individuals are admitted to or discharged from inpatient care	• Increased granular access to specific health information when/where needed • Automated tools that effectively use electronic clinical data from multiple sources for quality improvement and decision support across care continuum • Seamless remote monitoring and care for through remote devices	• Increased access to longitudinal health information • Care tailored precisely to each individual based on information about environment, occupation, human services, genomic data, cutting edge research evidence, etc.
Population & Public (Community and state level)	• Information contained in the common MU data set aggregated across communities for population health and quality measurement • Research community accesses aggregations of EHR data in pilots • Notifications based on relevant information are shared seamlessly between EHRs and public health	• Clinical and administrative data normalized and aggregated across communities to support broad scale value-based payment models • Research community accesses aggregations of standardized EHR data for ongoing research • Public health and other clinical registries receive and make available broad suite of standardized data for use by authorized individuals	• Research community has access to large aggregations of standardized genomic and device data for research purposes • Public health better contains outbreaks and proactively manages disasters with electronic information from many sources

Table 6 - Health IT Ecosystem Goals

(Erica Galvez, 2014, p.9)

To achieve these goals the shared agenda will focus on five critical interdependent building blocks for a nationwide interoperable health IT infrastructure as illustrated in Table 7

Interoperability Roadmap Building Blocks	LHS Requirements
Rules of engagement and governance	A. Shared governance of policy and standards that enable interoperability: Nationwide interoperability across the diverse health IT ecosystem will require stakeholders to make collective decisions between competing policies, strategies, standards in a manner that does not limit competition. Maintaining interoperability once established will also require ongoing coordination and collaborative decision-making about change
Supportive business, clinical, cultural and regulatory environments	B. A supportive business and regulatory environment that encourages interoperability: Rules that govern how health and care is paid for must create a context in which interoperability is not just philanthropic, but is a good business decision. C. Individuals are empowered to be active managers of their health: A learning health system is person-centered, enabling individuals to become active partners in their health by not only accessing their electronic health information, but also providing and managing electronic health information through mobile health, wearable devices and online services. D. Care providers partner with individuals to deliver high value care: Providers work together with patients to routinely assess and incorporate patient preferences and goals into care plans that achieve measurable value for the individual and the population.
Privacy and security protections for health information	E. Ubiquitous, secure network infrastructure: Enabling an interoperable, learning health system requires a stable, secure, widely available network capability that supports vendor-neutral protocols and a wide variety of core services. F. Verifiable identity and authentication of all participants: Legal requirements and cultural norms dictate that participants be known, so that the context and access to data and services is appropriate. This is a requirement for all individual and organizational participants in a learning health system regardless of role (individual/patient, provider, technician, hospital, health plan, etc.) G. Consistent representation of permission to collect, share, and use identifiable health information: Though legal requirements differ across the states, nationwide interoperability requires a consistent way to represent an individual's permission to share their electronic health information, including with whom and for what purpose(s). H. Consistent representation of authorization to access health information: When coupled with identity verification, this allows consistent decisions to be made by systems about access to electronic health information.

Interoperability Roadmap Building Blocks	LHS Requirements
Certification and testing to support adoption and optimization of health IT products and services	I. Stakeholder assurance that health IT is interoperable: Stakeholders that purchase and use health IT must have a reasonable assurance that what they are purchasing is interoperable with other systems.
Core technical standards and functions	J. Consistent Data Formats and semantics: Common formats (as few as necessary to meet the needs of learning health system participants) are the bedrock of successful interoperability. Systems that send and receive electronic health information generate these common formats themselves or with the assistance of interface engines or intermediaries (e.g., HIOs, clearinghouses, third-party services.) The meaning of electronic health information must be maintained and consistently understood as it travels from participant to participant. Systems that send and receive information may or may not store standard values natively and therefore may rely on translation services provided at various points along the way. K. Standard, secure services: Services should be modular, secure and standards-based wherever possible. L. Consistent, secure transport technique(s): Interoperability requires transport techniques that are vendor-neutral, easy to configure and widely and consistently used. The fewest number of protocols necessary to fulfill the needs of learning health system participants is most desirable. M. Accurate identity matching: Whether aggregated in a repository or linked "just in time," electronic health information from disparate sources must be accurately matched to prevent information fragmentation and erroneous consolidation. As a learning health system evolves, more than individual/patient-specific information from health records will be matched and linked, including provider identities, system identities, device identities and others to support public health and clinical research. N. Reliable resource location: The ability to rapidly locate resources, including individuals, APIs, networks, etc. by their current or historical names and descriptions will be necessary for a learning health system to operate efficiently.

Table 7 - Business and Technical Requirements for a Learning Health System

(ONC, 2014c, pp.23–24)

Chapter 4: Building the Model and the Roadmap

In this section, I will propose a model and the roadmap to achieve a nationwide fully integrated healthcare system based on the literature review done in Chapter 3. Then later will apply the proposed model and the roadmap to the current status of the health system in The United Arab Emirates to highlight the opportunities and risks.

4.1 Information-Driven Healthcare Proposed conceptual Model

"Information is the lifeblood of modern medicine. Health information technology (HIT) is destined to be its circulatory system. Without that system, neither individual physicians nor health care institutions can perform at their best or deliver the highest-quality care" (Blumenthal, 2010, p.382).

The proposed conceptual model consist of the three core stages of the transformation journey from the isolated, fragmented systems to a connected then a fully integrated and interoperable systems. Core stages surround by the building blocks that are necessary to achieve and support that transformation (See Figure 14).
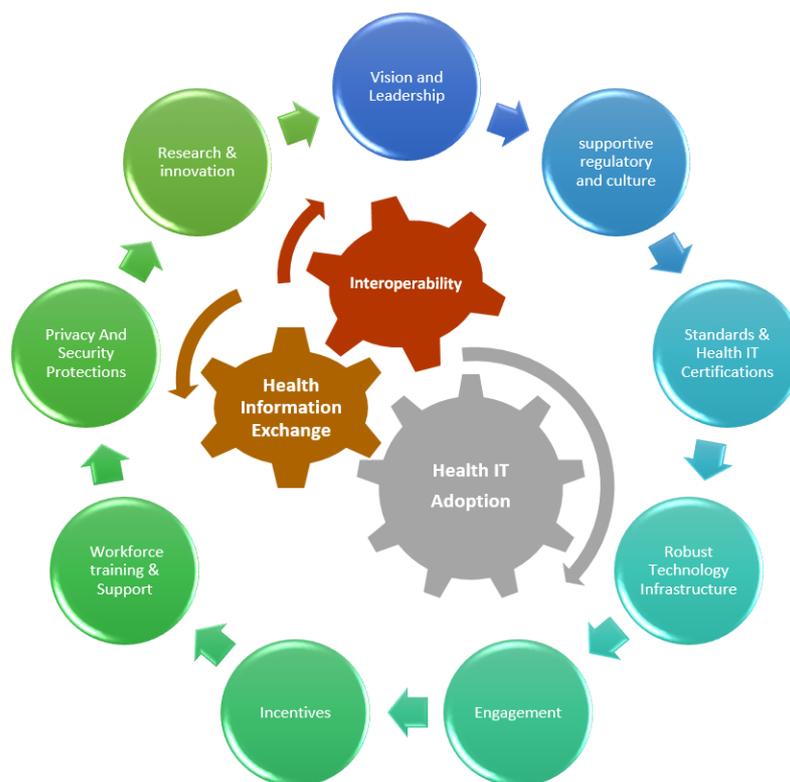
Figure 14 - Information-Driven Healthcare conceptual model

4.1.1 Core Stages

The three core stages (Health IT Adoption, Health Information Exchange (HIE), and Interoperability) are represented in the model with the "Gear" shape because it's interrelated. In fact, we can't reach to Interoperability without HIE, and HIE can't be done in the real-time without the adoption of Health IT and recording the information in structured electronic format.

1. Health IT Adoption

First, individual' health records should be digitized and recorded in structured electronic format and can be accessed securely and used easily. Thus, EHRs and other health IT technologies should be adopted nationwide. In addition, these systems should be used meaningfully and in an efficient way to improve care and not only to adopt such systems.

2. Health Information Exchange

The automation of the manual clinical process and digitizing health records will pave the way to move to the next stage from isolated and fragmented systems to the connected systems. Health information should be shared to remove the geographies boundaries among the different parties involved in healthcare (e.g., patients, healthcare providers, pharmacies, Payers, and laboratories). Therefore, health information will be available at the right time to foster individual' engagement, support the medical decision-making and improve the coordination of care.

Additionally, health information should be exchanged for the Secondary uses with the related parties (e.g., public health organizations, disease registers and researches). Therefore, enhance public health surveillance, preventing illness and promote population health. In addition, that will support in predicting, avoiding, and reacting to public health threats, adverse events, and reportable diseases. Moreover, HIE will help to extract the knowledge and the evidence that will guide the medical decision making. Clinical quality measures should be submitted by healthcare providers to the national health related organizations to ensure that the healthcare system is delivering safe, effective, efficient, patient-centered, equitable, and timely care.

Health information that are recorded in electronic format can be exchanged electronically within the same system or network. In addition, it can be exchanged with others entities in different networks through encrypted messages or any other way. However, human interaction will be

required unless all systems are recoding data in same format/ structure and follow the same standards.

3. Interoperability

Interoperability mean that the capability of a product or system to work and communicate with other products/ systems without requiring special human efforts. Therefore, health information can be flowed from system to another in a way similar to the blood flow in the circulatory system.

Health information can be aggregated from wearable devices, home health monitoring devices, EHRs, patient generated health data, e-prescriptions, e-claims, public health systems, disease registers and research institutions. Thus, such interoperable health IT ecosystem will make the right data available at the right time and to the right people. Consequently, That will facilitates informed decision-making, supports coordinated health management, allows patients to be more engaged in their healthcare. In sum, that will help to improve the overall health of the population, and reduce healthcare cost over the time.

Individual, can send, receive, find, and contribute electronically through web-portals, mobile devices, and PHRs to correct their health information. Thus, patient and their families will be active partners in their health and care.

Healthcare provider, can access specific health information where/when needed. Caregivers will be able to use electronic clinical data collected from multiple sources for decision support and quality improvement. In addition, seamless the remote care and monitoring for patients' health through remote devices. Moreover, care can be tailored precisely to each patient based on information about environment, occupation, genomic data, and cutting edge research evidence.

On population and Public level, the electronic information aggregated from many sources can be analyzed. Therefore, enable public health organizations to predict any possible outbreaks and proactively manage the disasters.

Research institutions, will have access to large collections of standardized data related to clinical practices, devices and genomic analysis. Data Mining (Predictive Analytics, Big Data) can be used to provide a new kind of evidence to drive actions. In addition, predictive modeling can help to identify patterns in a population's health in order to prospectively determined individual risk scores. Therefore, achieve good outcomes for individual patients and for patient populations.

To achieve Interoperability all Health IT products and systems should talk the same language. This can be possible by the implementation of standards and unifying terminology and vocabulary, content and format, secure transport techniques, and ubiquitous, secure network infrastructure.

4.1.2   The building blocks

1. Vision and Leadership

To reach anywhere first destination should be identified. Therefore, before building the healthcare IT infrastructure, objectives should be clear and unified nationwide. Moreover, all parties including the government, public and private sector, and the public should cooperate and committed to achieve that objectives

2. Supportive regulatory and cultural

Regulatory and business barriers that may prevent the data flow should be removed and/or reduced. The government should collaborate with healthcare providers, consumers, payers, technology developers, and any others to foster health information exchange that can improve the care. In addition, Funding and policies should be migrated to create the clinical and business imperative for electronic health information exchange and interoperability.

Moreover, individuals' culture should be changed and they should be informed about their rights and about the benefits of the access and the use of health information.

Healthcare providers' culture should be changed, care should be patient-centered rather than physician-centered. In addition, decision making should be based on evidence rather than physicians' experience. Moreover, knowledge should be extracted from health information and should be shared freely to direct the clinical practice instead of just capturing and recording health data and keep it in electronic soils. Furthermore, payment culture should be changed from fee-for-service to global, value-based systems.

3. Standards & Health IT Certifications

A. Standards

Technical standards should be defined and should strictly followed by the different health IT products and systems while capturing, recording, and exchanging health information at all levels. Standardized data formats are the way in which electronic health information is structured or

packaged so that one system can use the information that is sent by another system. For instance, when sending system is using a consistent data format that is expected by and known to the receiving system. Therefore, The receiving system will be able to receive and process the received information automatically and without any need for human intervention and without any time-consuming.

The core technical standards required to achieve the interoperability are:

1) Terminology and vocabulary

That are unique to healthcare, universally understood, and often purpose-specific. For example codes to represent lab tests cannot be also used for medications. For example, RxNorm codes used for medications and medication allergies. Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT) codes used for problems or conditions. CVX codes used for immunizations. Logical Observation Identifiers Names and Codes (LOINC) used for laboratory tests.

2) Content/structure standards

Usually unique to healthcare, provide unity and consistency in data representation. Therefore, drive data to a semantic level that provides consistent meaning across multiple systems. In addition, these standards are often purpose-specific and designed to represent data related to clinical workflow. Thus, content standard that used for a referral to a specialist would not be used for electronic prescribing. These standards include: Consolidated Clinical Document Architecture (C-CDA), and Health Level 7 (HL7) v2.

3) Transport standards

Commonly used standards and not designed to be used only for healthcare, and they are used to connect two or more parties together regardless the data would be transported (e.g., SMTP, S/MIME)

4) Security standards

Commonly used standards and not unique to healthcare, and can be applied in different ways to meet the a certain data protection requirements (e.g., X.509 Public Key Infrastructure Certificate).

5) Standards for Services

Typically represent technical infrastructure and usually used to smooth the connection between different systems. For example, Application Programming Interfaces (APIs) that enable different systems to interact and talk to each other.

B. Health IT Certifications

Certification is necessary to ensure that health IT products and systems are following the standards. In addition, to certify that health IT systems and products has the capability to interoperate with different data sources. Moreover, EHRs certification is necessary to ensures that the certified EHRs have the necessary functionalities, capabilities, and the security necessary to achieve the meaningful use.

4. Robust Technology Infrastructure

To achieve interoperability and to have a fully integrated health system, robust technology infrastructure should be there nationwide. In addition, this infrastructure should be compatible with the national vision, objectives, and governed by clear standards of health information exchange and interoperability.

The government should work to foster and enhance the existing health information exchange models instead of constructing a new national infrastructure from scratch. Therefore the government should find the gaps and the barriers which may obstruct health information exchange and then should develop the plans to overcome them.

Additionally, all healthcare organizations and individuals should have broadband Internet access to be able to exchange health information electronically. However, the high cost of this services may prevent this participation. Thus, the government can subsidize the broadband internet or try to reduce the cost.

5. Engagement

Leadership commitment toward main goals and objectives, combined with changes in culture, financial incentive, and continuous outreach, feedback and engagement to all stakeholders. All that will provide the community with a better understanding of the national direction to improve healthcare, individuals and population health, and research through gathering, sharing, and using of interoperable health information.

6. Incentives

The high cost of buying, implementing, and maintaining the EHRs and other Health IT is one of the major factors that can prevent healthcare providers from the adoption of such technologies. Therefore, the government should establish incentives programs that can reduce the burdens on healthcare providers to adopt EHRs.

At the same time, this incentives should be combined with the condition of the meaningful use of such technologies to ensure that the use of these technologies will lead to improvements in the quality and efficiency of care. Additionally, EHRs should be certified to make sure that these technologies are compliant with the standards required for the meaningful use and interoperability. Moreover, penalties should be there for the providers will not achieve the meaningful use, as incentives and financial penalties are the crucial factors that can influence the decision to adopt EHRs.

7. Workforce training and support

To achieve substantial improvements in efficiency, care, and population health through the adoption of health IT. The highly skilled IT professionals should be available to facilitate the adoption and the maintaining of these technologies. Therefore the government should assist the universities and higher education institutions to establish health informatics education programs, competency exams, and publicly available curriculum.

In addition, the government should establish support centers nationwide to give direct support to healthcare providers in the selection, implementation, upgrade, and the meaningful use of Health IT. These support centers should share information related to best practices regarding the adoption of EHRs and other health IT. In particular, for the providers that may have lower rate of health IT adoption such as public and rural hospitals, community health centers, and small practices.

It's very important to establish community of practice programs that illustrate how health IT can enhance quality, efficiency, and reduce the cost of care. In addition, to encourage the participants to implement innovative health IT solutions and share ideas, experience, and evidence with others across the county. Moreover, the main findings from these communities should be prolonged to a national scale and provide guidance for health information sharing programs, support centers, and health IT meaningful use projected objectives.

8. Privacy And Security Protections

Privacy and security concerns related to health information may be a barrier toward the adoption of health IT and health information exchange. Therefore, patient's health information security and privacy should be assured while storing these information in EHRs or any other repositories. In addition, it should be guaranteed while health information exchanged among providers, patients, pharmacies, payers, and other entities for healthcare or for secondary uses such as research purposes.

Protecting the privacy and security of health information, and assuring the safe use of health IT are one of the core responsibilities of the government. There are many actions to ensure privacy and security of health information, including:

- The government should review and continuously update the Policies, procedures, and regulations that are related to health information security and privacy. This is necessary to keep pace with the expanded demands for health information exchange that is required to achieve the reform in health system.
- Educating healthcare providers for privacy and security issues regarding the adoption and the use of EHRs and health IT.
- Review and assess health IT workforce training materials and curriculum to make sure that future professionals are aware of the best practices and security and privacy requirements. In addition, to ensure the compliance with these policies.
- Make sure that healthcare providers are implementing adequate security and privacy protections for the health information of their patient (i.e., HIPAA Privacy and Security Rules).
- To gain the trust of consumer in EHRs and other health IT, individuals must be informed about how their health information will be used and shared. Moreover, they must be notified about any disclosure for their personal health information.
- Educating consumer regarding the benefits of health information exchange and the steps can be taken by them to protect their own data.
- With the expanding in health information exchange, it is very important to make continues outreach for all stakeholders (the government, healthcare providers, patients, payers, health

IT developers and vendors), to inform everyone about their responsibility in protecting health information.

- The patient should have the choice to select which part of their health information can be shared.

- Make sure that all parties are implementing security standards during collecting, storing, using, and exchanging health information.

9. Research & innovation

The government should be committed to support research and innovation in Health IT domain especially in these areas that have great potential to improve the health of populations and individuals. To do that the government should review any requirements or regulation may prevent the innovation. Moreover, the government should foster the advances in Health IT by funding the researches directly or through innovation prizes to the private sector. Thus, that will help to address some of the major challenges that are facing the healthcare then adopt these innovations on the national scale.

Chapter 5: Analysis

5.1   Response

The survey invitation was sent via e-mail to 36 of IT and management staff those are working in different organizations that providing health care such as hospitals, medical centers, and clinics. The total number of participant are 22 organizations, with participation rate of sixty-one percent. 16 of them from the private sector, 1 semi-government, and 5 from government organizations (See Chart 1).

In addition, the survey published online on one of the most professional networking websites (LinkedIn). The survey published in many Linkedin groups that having members from healthcare professionals and Health IT professionals in U.A.E. However, unfortunately the participation from these groups was very weak and number of participants was two only. Moreover, their responses deleted, because one of them was duplication for an existing response, and the other participant was CEO (Chief Executive Officer) of a teleradiology organization and not healthcare provider.
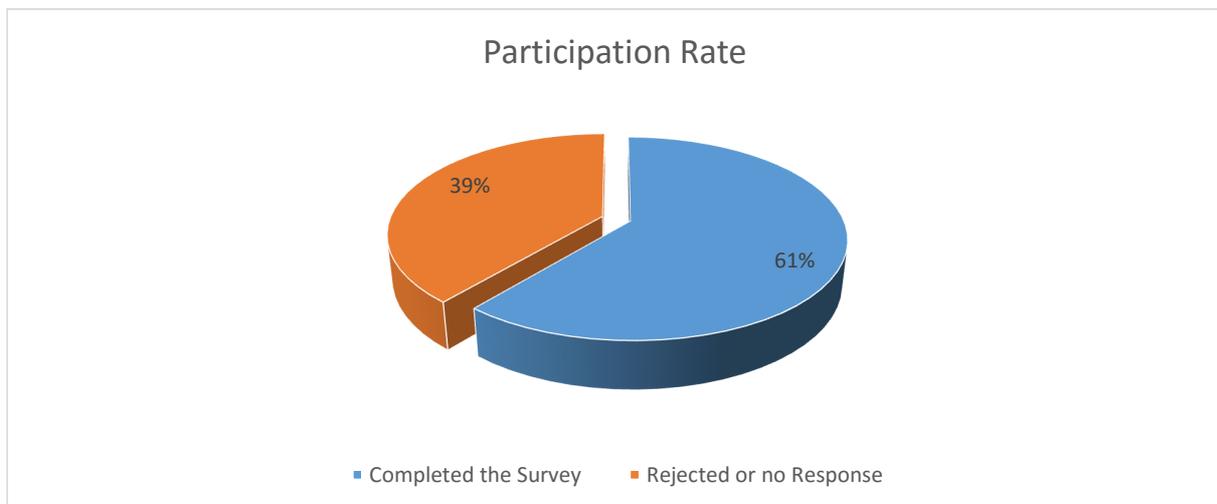
Chart 1 - Participation Rate

5.1.1   Who completed the survey

Fifty percent of surveys were completed by IT Managers. In the same time, 36% complete by Administrators/Directors (the key decision-makers on Health IT adoption and implementation), and 14% completed by other admin and medical staff (See Chart 2).
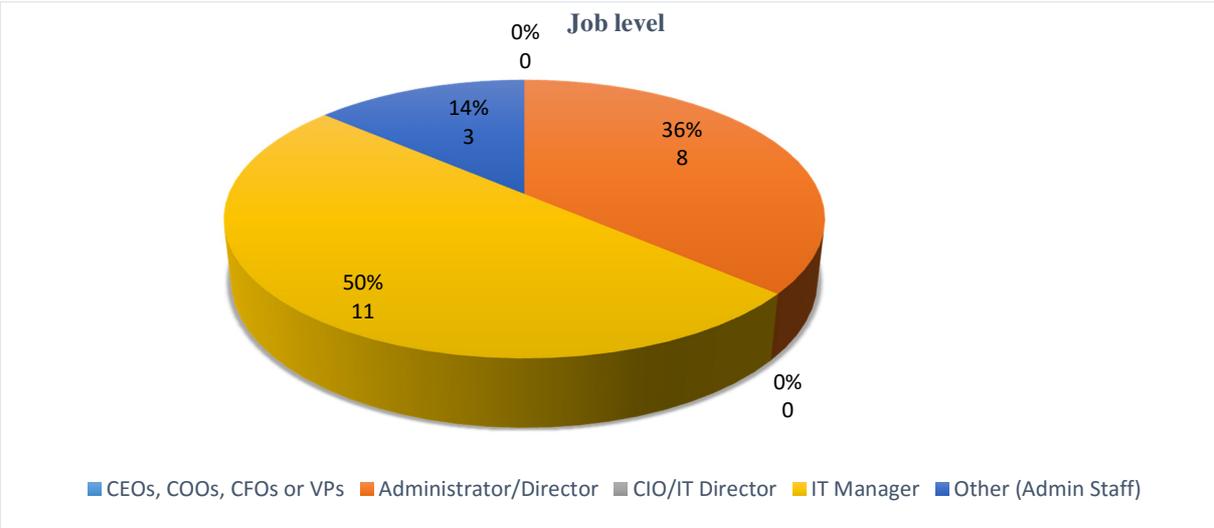
Chart 2 - Who Completed the Survey

5.1.2 Participation by sector

Total number of healthcare providers that completed the survey are 22 healthcare providers (16 from private sector, 1 semi-government, and 5 government organizations). These organizations having 60 branches among them 41 (68%) private (Hospitals, Clinics, and Medical Centers), only 1 (2%) semi-government hospital, and 18 (30%) government hospitals (See Chart 3).

	No. of healthcare providers	No. of branches	Abu Dhabi	Al Ain	Ajman	Dubai	Fujairah	Ras Al Khaimah	Sharjah	Umm Al Qaiwain
Private	16	41	19	5	0	16	0	0	1	0
Semi-Government	1	1	1	0	0	0	0	0	0	0
Government	5	18	10	2	1	1	1	1	1	1
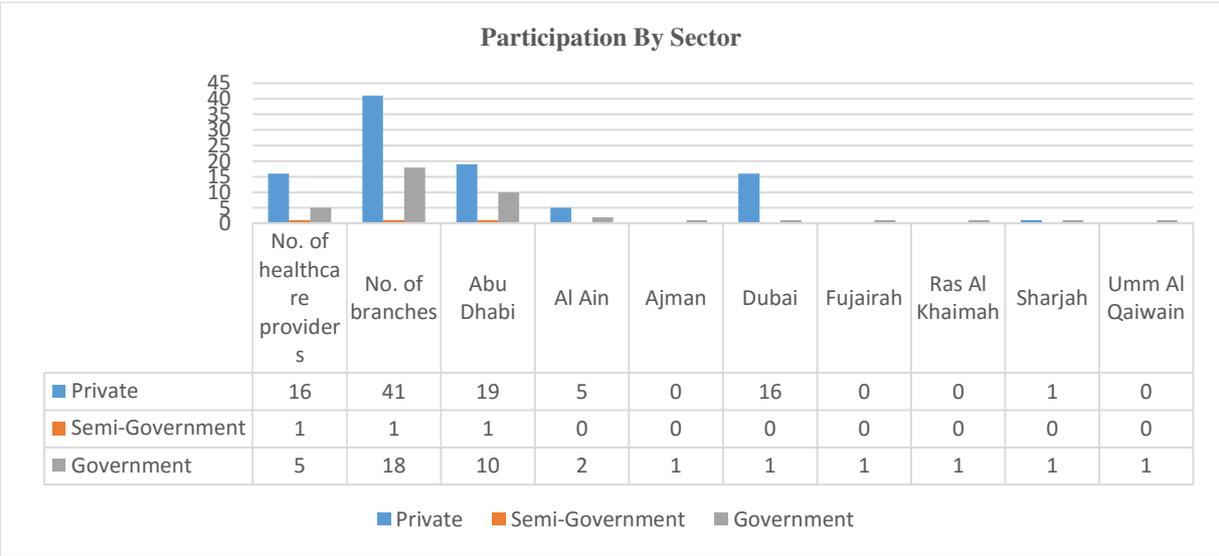
Chart 3 - Participation by Sector

5.1.3   Participation by city

Fifty percent (30 out of 60) of the total number of branches (Hospitals/ Clinics/ Medical Centers) that completed the survey are located in Abu Dhabi (The capital of U.A.E). Followed by 17 out of 60 or 28% of the total number of branches of participating organizations are located in Dubai. Therefore 78% of the branches of the organizations that participated in the survey are located in the two main U.A.E cities (Abu Dhabi, Dubai).

The remaining 13 branches that representing 22% of the total number of organizations' branches are distributed over the remaining U.A.E cities. Thus, the study covered all the cities of the United Arab Emirates (See Chart 4).

Participation by city

	No. of healthcare providers	No. of branches	Abu Dhabi	Al Ain	Ajman	Dubai	Fujairah	Ras Al Khaimah	Sharjah	Umm Al Qaiwain
■ Private	16	41	19	5	0	16	0	0	1	0
■ Semi-Government	1	1	1	0	0	0	0	0	0	0
■ Government	5	18	10	2	1	1	1	1	1	1
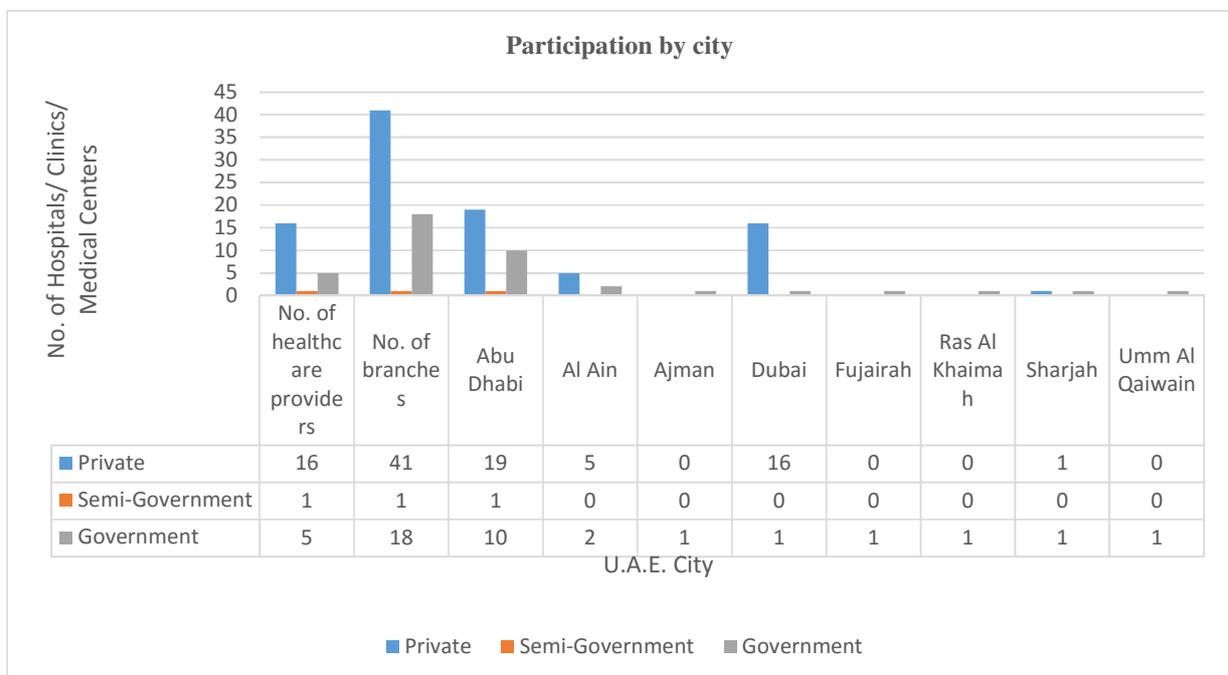
Chart 4 - Participation by city

5.1.4   Multiple Service Locations

Fourteen out of twenty two (64%) of organizations that responded to the survey indicated that they provide healthcare services at single location. On the other hand, 23% of the total number of

organizations are providing their services in 2 to 5 branches, and the remaining organizations own between 6 to 20 locations or branches (See Chart 5).
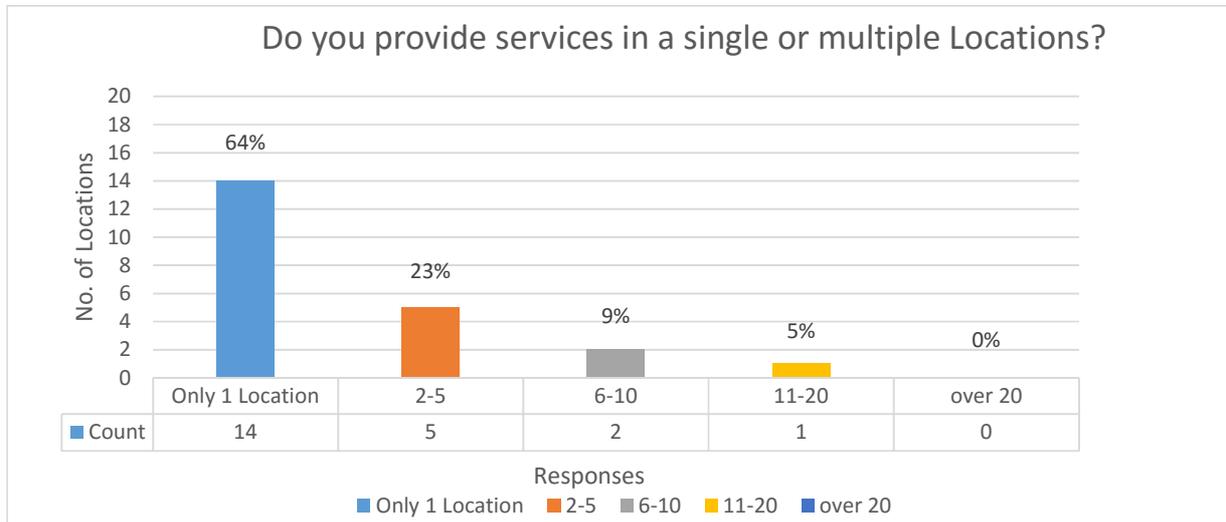
Chart 5 - Service Locations

5.1.5 Provided Services (Specialties)

All of respondents from healthcare providers from all sectors are having multi-specialty and provide more than one type of treatment service. Except only one from private sector that is providing single type of treatment services (Eye Clinic). See Chart 6.
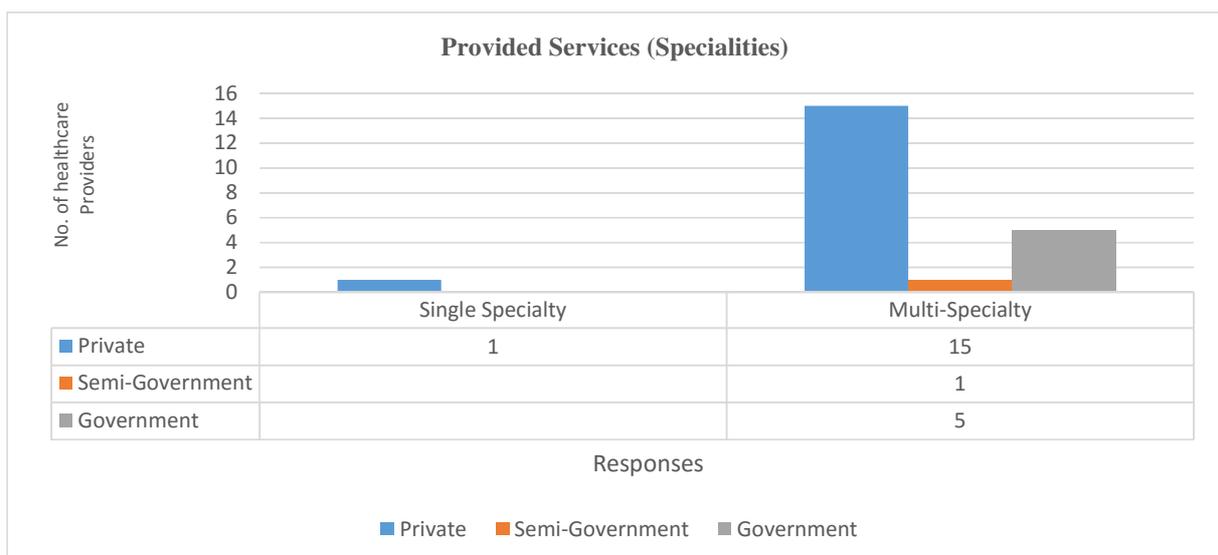
Chart 6 - Range of Services

5.1.6   Onsite Information Technology Staff

Most of the participants, 18 out of 22 representing 82% of survey respondents indicate that they do have onsite IT staff. However, only 4 organizations that representing 18% of the respondents indicate that they do have a contract for IT services, although they do not have onsite IT staff (See Chart 7).
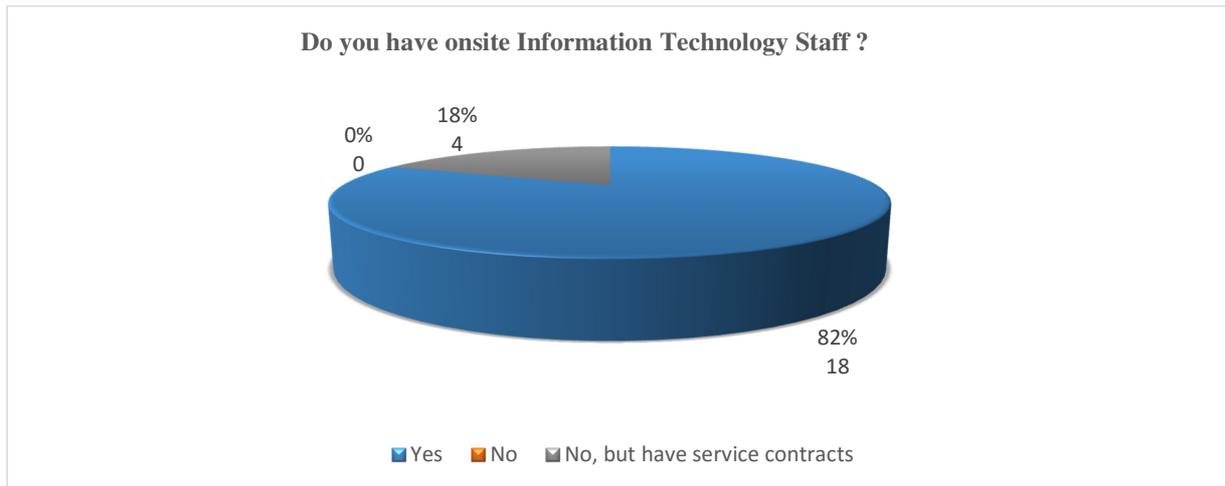
Chart 7 - Onsite Information Technology Staff

5.2   Health IT Adoption

5.2.1   Adoption of EHRs

Most of the survey respondents (18 out of 22 or 82%) of healthcare providers indicate that they are adopting EHRs, and all or part of their patients' health records are recorded in electronic format. However, only 7 of them indicate that all patient health information are recorded electronically, and 11 organizations having mix of electronic and paper medical records.

Only 4 organizations (18%), indicate that they do not have electronic records and all patients' medical record as still paper records (See Chart 8). These organization are the same 4 organizations indicate that they do not have onsite IT staff. Therefore, the trained workforce from Information Technology (IT) professionals is essential for Health IT implementation. Moreover, all these organization are from private sector and all of them are small-size medical centers or clinics
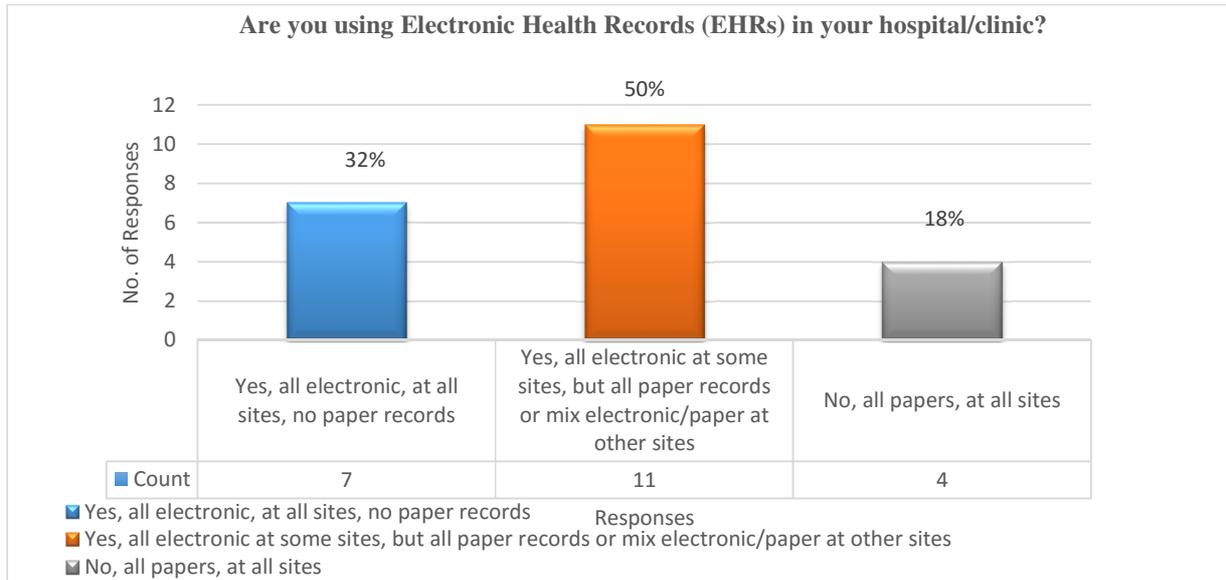
Chart 8 - EHRs Adoption

5.2.2   Adoption of Telehealth

Half of the twenty two organizations responded to the survey, already implemented or planning to implement other health IT such as Telehealth. Three of them already adopting telehealth, one from each sector (Government, Semi-government, and Private). In addition, the remaining eight do have plan to implement, among them 5 from the private sector and 3 from government.

In the same time, the other half or 11 organizations are not implementing telehealth, seven of them indicate that they do not have any plan, while the other 4 organizations did not respond to the question (See Chart 9).
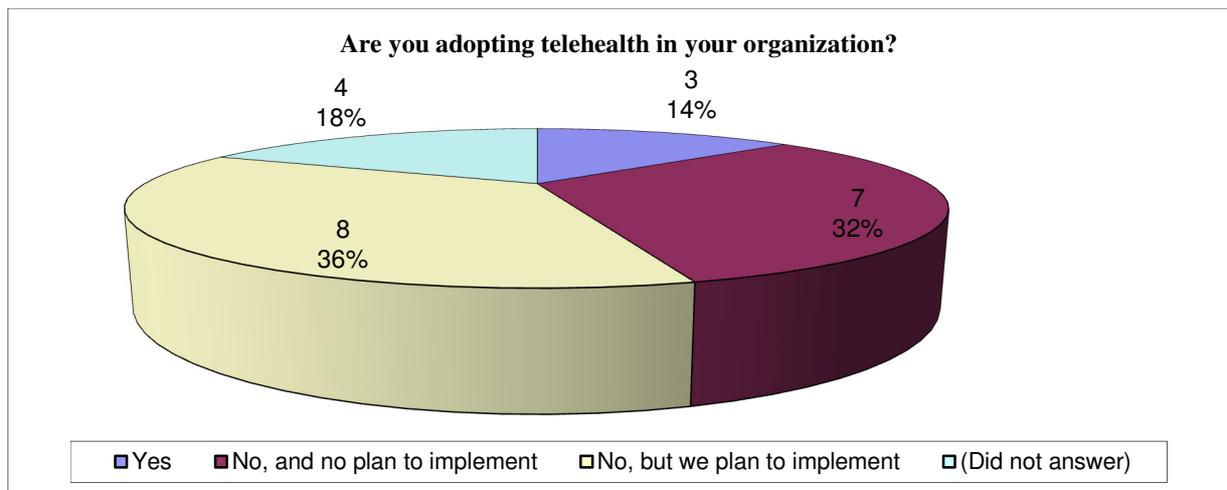
Chart 9 - Adoption of telehealth

5.2.3   Healthcare Providers (not adapting EHRs)

5.2.3.1   Intention/ Plan to implement EHRs

Half of the four organizations that are not implementing EHRs don't not have any intention or plan to implement health IT in the future. However, the other half intending and have plan to implement EHRs within 2 years (See Chart 10 and Chart 11).

Do you intend to use Electronic Health Records in your hospital /clinic?

2
50%

2
50%

☐ Yes ☐ No
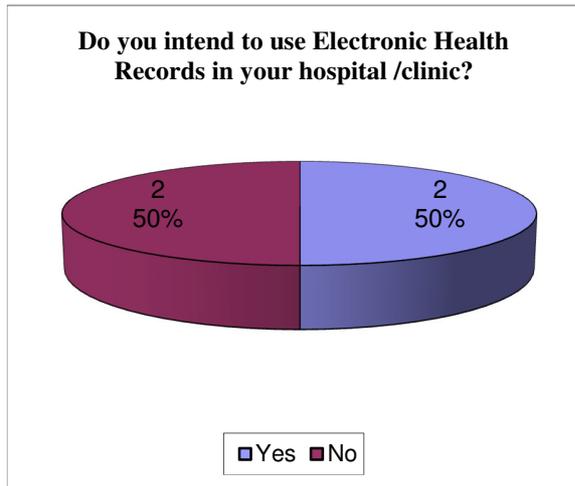
Chart 11 - Intention to implement EHRs

When you will adopt and utilize EHRs?

2
50%

2
50%

☐ less than a year   ☐ 1 – 2 years
☐ 3 or more years   ☐ I don't know
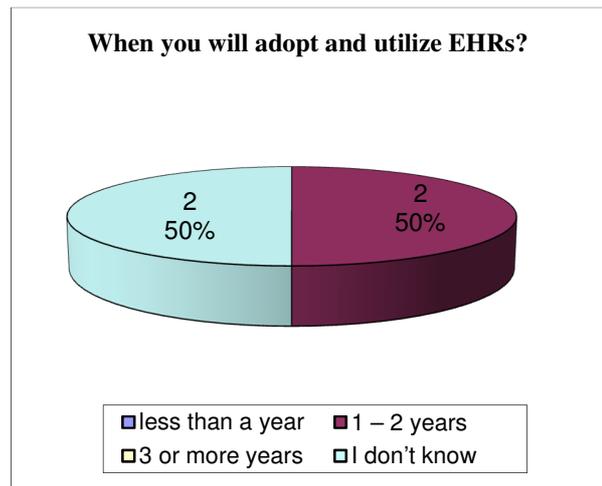
Chart 10 - Paln to implement EHRs

5.2.3.2   Top 5 reasons preventing EHRs implementation

Organizations that are not implementing EHRs was asked to select the top 5 reasons preventing them to implement EHRs system. All of them indicate that cost of purchasing a system is the most important reason. Followed by lack of dedicated staff to implement and maintain the system which selected by 75% of these organization. Additionally, other reasons selected by 50% of these organizations such as: concern regarding maintaining quality of care for my patients, don't know how to select the proper system, and Lack of trained staff to implement and maintain the system. Finally 25% of them selected other different reasons (See Chart 12).

Please select the top 5 items from the list below, according to what is preventing you from adopting and utilizing EHRs for your practice.

	100%
□ I do not understand the benefits/value of EHRs	0.00%
■ Not comfortable using a computer	25.00%
■ Lack of internet access	0.00%
■ Concern regarding maintaining quality of care for my patients	50.00%
■ Too many choices of EHRs available in the market	25.00%
■ Too few choices of EHRs available in the market	0.00%
■ Don't Know how to select the proper system	50.00%
■ Cost of purchasing a system	100.00%
■ Annual maintenance cost	50.00%
■ Privacy and security	0.00%
■ lack of dedicated staff to implement and maintain the system	75.00%
■ Lack of trained staff to implement and maintain the system	50.00%
■ Lack of patient awareness	25.00%
■ I don't want to Implement EHRs	25.00%
■ Other (please specify)	25.00%

Chart 12 - Reasons preventing EHRs implementation

5.2.4   Healthcare Providers (adapting EHRs)

5.2.4.1   Top 3 reason behind adopting EHRs

Organizations that are implementing EHRs from all sectors (Private, Semi-government, and Government) was asked to select the top most important three reasons that encouraged them to take the decision to implement EHRs. 76% of these organization indicate that improve organizational operations and capture data to improve reporting capabilities are the top most important 2 reasons. Followed by Ability to communicate with other healthcare providers to coordinate care which selected by 65% of these organizations. At the same time, about half of

private organizations indicate that, improve billing and collections is one of the most important reasons affects their decision to invest and implement EHRs (See Chart 13).

Please select the top 3 items from the list below, according to what is most important to you when adopting and utilizing EHRs for your practice.

Capture data to improve reporting capabilities (e.g. population health, quality…)	76%
Improve billing and collections	35%
Position the organization for growth and expansion	41%
Improve organizational operations	76%
Ability to communicate with other healthcare providers to coordinate care	65%
Maintain a competitive advantage	24%

Chart 13 - Reasons behind EHRs Adoption

5.2.4.2 Percentage of Operating Budget Dedicated to Health IT

Only 22 percent of the eighteen organizations that are implementing EHRs, indicate that they are dedicating more that 5% of the organizations operational budget to health information technology. Whilst, the remaining organizations are dedicating less than 5 percent or not dedicating fixed percentage, and health IT budget is prepared and approved as per the actual needs (See Chart 14).

What is the percentage of operating budget dedicated to adopt health information technology in your organization?

	0%	0% to 1%	1.1% to 2%	2.1% to 3%	3.1% to 4%	4.1% to 5%	>5%	(Did not answer)
No. of responses	1	1	3	5	1	2	4	1

Legend:
- 0%
- 0% to 1%
- 1.1% to 2%
- 2.1% to 3%
- 3.1% to 4%
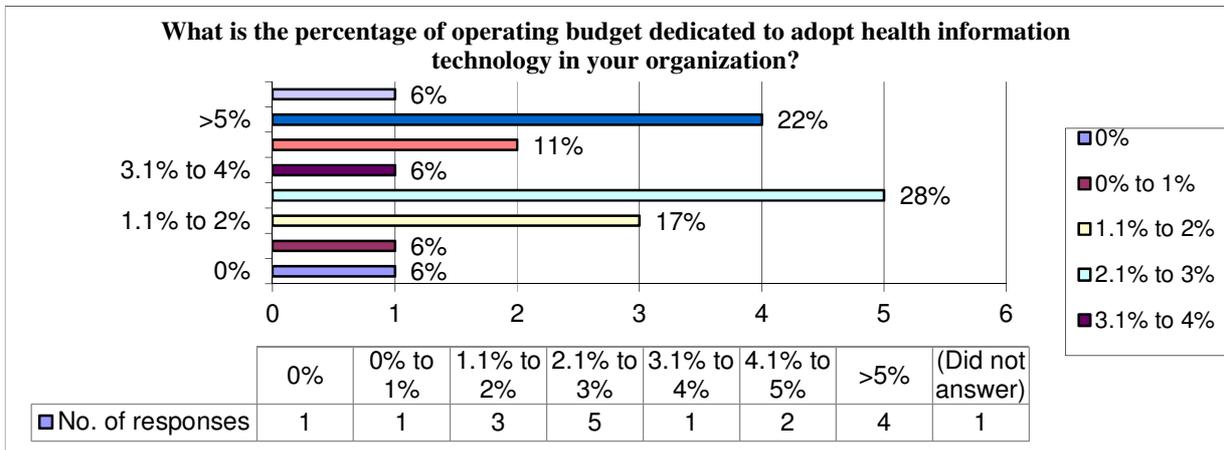
Chart 14 - Budget dedicated to Health IT

5.3 Adoption of EHRs functionalities to improve quality, safety, and efficiency and reducing health disparities

This question aims to capture the current status of the implemented EHRs in different healthcare organization from all sectors in UAE. EHRs functionalities that can improve efficiency, safety, quality and reduce health disparities. These functionalities including: providing health care team access to comprehensive patient health data, using Computerized Provider Order Entry (CPOE), applying clinical decision support at the point of care, and others.

Almost all of the eighteen healthcare organizations that adopting EHRs, are implementing or planning to implement EHRs core functions such as: recording patient demographics, record and chart changes in vital signs, maintain active medication list, use computerized provider order entry (CPOE) for prescription and laboratory orders, maintain list of current and active diagnose, maintain an active medication allergy list, and Implement drug formulary checks. In addition, about 94% are recording laboratory results as structured data. Moreover, about 78% are able to generate lists of patients by specific conditions and generate and transmit e-prescriptions electronically (See Chart 15).

EHRs functionalities that fully implemented in one/all units

| Functionality	Implemented in one/ all units
Send reminders to patients for preventive/follow up care	67%
Generate lists of patients by specific conditions	78%
Laboratory results are recorded as structured data	94%
Implement at least one clinical decision support rule	67%
Record smoking status for patients ages 13 or older	72%
Record and chart changes in vital signs	100%
Maintain an active medication allergy list	94%
Maintain active medication list	94%
Maintain list of current and active diagnoses	94%
Report clinical quality measures electronically	50%
Recording Patient demographics	94%
Implement drug formulary checks	94%
Generate and transmit e-prescriptions	78%
Implement drug-drug/drug-allergy interaction checks	61%
Computerized Provider Order Entry (CPOE) For…	94%

Chart 15 - EHRs functionalities that fully implemented in one/all units

However, the implementation ratio of clinical decision support functionalities are less than others functions. 67% of the organizations that are adopting EHRs are implementing at least one clinical decision support rule. In addition, 22% do not have and do not plan to implement clinical decision support functionalities. Moreover, only 61% are implementing drug-drug interaction checks and drug-allergy interaction checks, and 22% do not have and do not plan to implement (See Chart 15 and Chart 16).

Only 50% of healthcare providers indicate that they are reporting clinical quality measures electronically to any entity outside their organization. On the other hand, 33% indicate that they do not have this capability in their EHRs and also they do not plan to implement. For full responses see Table 8

Response with "no implementation and no specific plans

Category	No implementation and no specific plans
Send reminders to patients for preventive/follow up care	17%
Generate lists of patients by specific conditions	17%
Laboratory results are recorded as structured data	6%
Implement at least one clinical decision support rule	22%
Record smoking status for patients ages 13 or older	28%
Record and chart changes in vital signs	0%
Maintain an active medication allergy list	0%
Maintain active medication list	0%
Maintain list of current and active diagnoses	0%
Report hospital clinical quality measures electronically	33%
Recording Patient demographics	0%
Implement drug formulary checks	0%
Generate and transmit e-prescriptions	6%
Implement drug-drug/drug-allergy interaction checks	22%
Computerized Provider Order Entry (CPOE) For…	0%

■ No implementation and no specific plans

Chart 16 - Responses with "no implementation and no specific plans"

	Fully implemented in all units		Fully implemented in at least 1 unit		Began implementation or resources identified		No implementation and no specific plans		Total no. of Responses
	No. of responses	Ratio	No. of responses	Ratio	No. of responses	Ratio	No. of responses	Ratio	
Computerized Provider Order Entry (CPOE) For prescription and Laboratory orders	16	89%	1	6%	1	6%	0	0%	18
Implement drug-drug/drug-allergy interaction checks	10	56%	1	6%	3	17%	4	22%	18
Generate and transmit e-prescriptions	12	67%	2	11%	3	17%	1	6%	18
Implement drug formulary checks (Check electronically if prescribed drugs are in formulary or preferred drug list)	14	78%	3	17%	1	6%	0	0%	18
Recording Patient demographics	16	89%	1	6%	1	6%	0	0%	18
Report ambulatory/ hospital clinical quality measures electronically to any entity outside your organization	6	33%	3	17%	3	17%	6	33%	18
Maintain an up-to-date problem list of current and active diagnoses	15	83%	2	11%	1	6%	0	0%	18
Maintain active medication list	17	94%	0	0%	1	6%	0	0%	18
Maintain an active medication allergy list	16	89%	1	6%	1	6%	0	0%	18
Record and chart changes in vital signs	18	100%	0	0%	0	0%	0	0%	18
Record smoking status for patients ages 13 or older	11	61%	2	11%	0	0%	5	28%	18
Implement at least one clinical decision support rule related to specialty or a high priority hospital condition along with the ability to track compliance with that rule at the time of care	9	50%	3	17%	2	11%	4	22%	18
Laboratory results are recorded as structured data	16	89%	1	6%	0	0%	1	6%	18
Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research or outreach	13	72%	1	6%	1	6%	3	17%	18
Send reminders to patients for preventive/follow up care	12	67%	0	0%	3	17%	3	17%	18

Table 8 - Adoption of EHRs functionalities

5.4 Engage patients and families in their care

Provide patients and their families with timely access to health data, knowledge and tools to make informed decisions and to be able to manage their health.

5.4.1 Provide patients with an electronic copy of their health information

10 out of 18 or about 56% of the respondents identified that they are able to provide patients with an electronic copy of their health information (including: diagnostics test results, medication lists, problem list, and medication allergies) upon request. Additionally, 33% indicated that the option already there but not in use. However, eleven percent indicated they are unsure if they do have this option in their EHRs (See Chart 17).
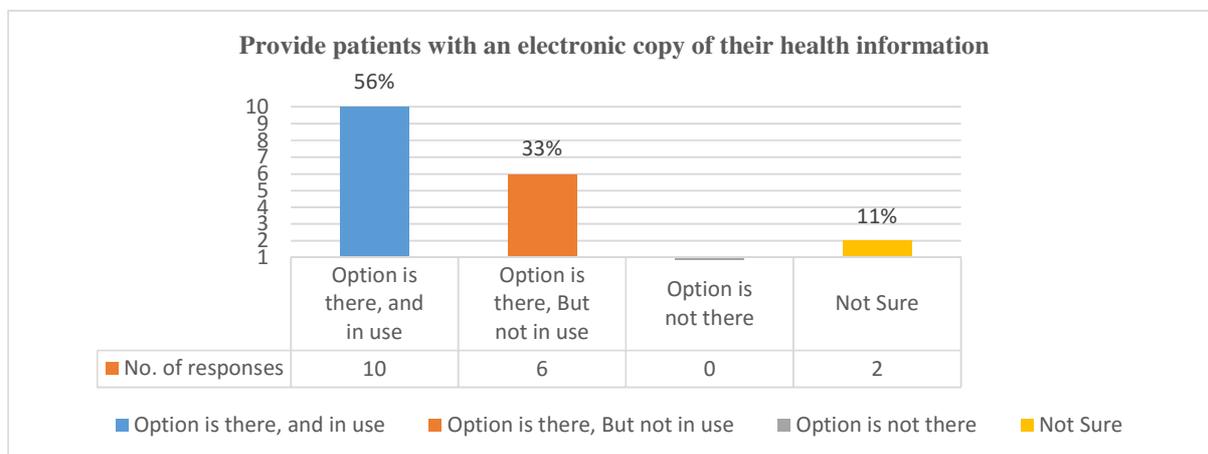

Chart 17 - Provide patients with an electronic copy of their health information

5.4.2 Provide patients with timely electronic access to their health information

Only 6 out of 18 or 33% of respondents identified that they can provide patients with timely electronic-access to their health information through patients' portals or any other way. In addition, 28% indicated that they do have the option but not in use. On the other hand, thirty-nine percent of the respondents identified that they do not have this facility or they are not sure if they have it (See Chart 18).

Provide patients with timely electronic access to their health information, through patients' portals or any other way

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
	33%	28%	22%	17%
No. of responses	6	5	4	3

■ Option is there, and in use ■ Option is there, But not in use ■ Option is not there ■ Not Sure
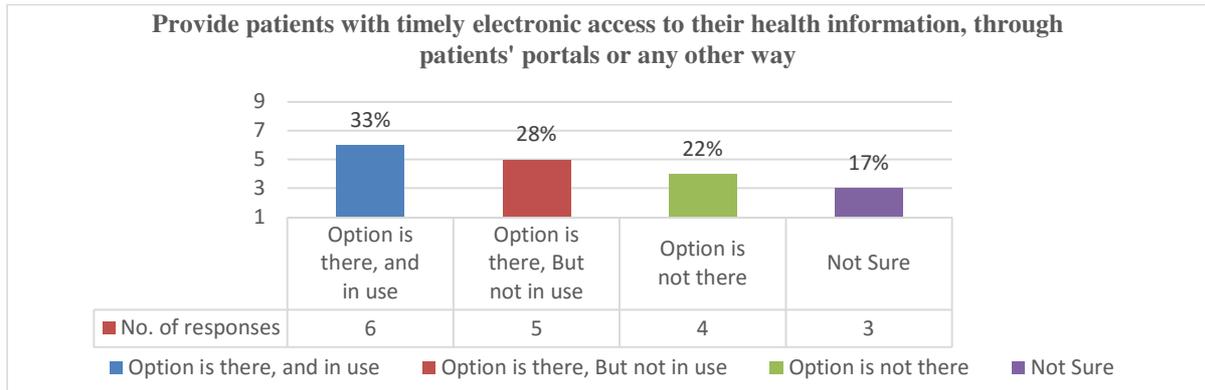
Chart 18 - Patients' electronic access to their health information

5.4.3 Use EHR to identify patient-specific education resources and provide patient with these resources

Forty-eight percent of the respondents identified they are currently providing patient-specific education resources if appropriate. Additionally, 28% indicate that they do have this option in their EHRs but option are not in use. However, twenty-eight percent of the respondents identified that they do not have this option or they are not sure if they have it (See Chart 19).

Use EHR technology to identify patient-specific education resources and provide those resources to the patient

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
	44%	28%	17%	11%
No. of responses	8	5	3	2

■ Option is there, and in use ■ Option is there, But not in use
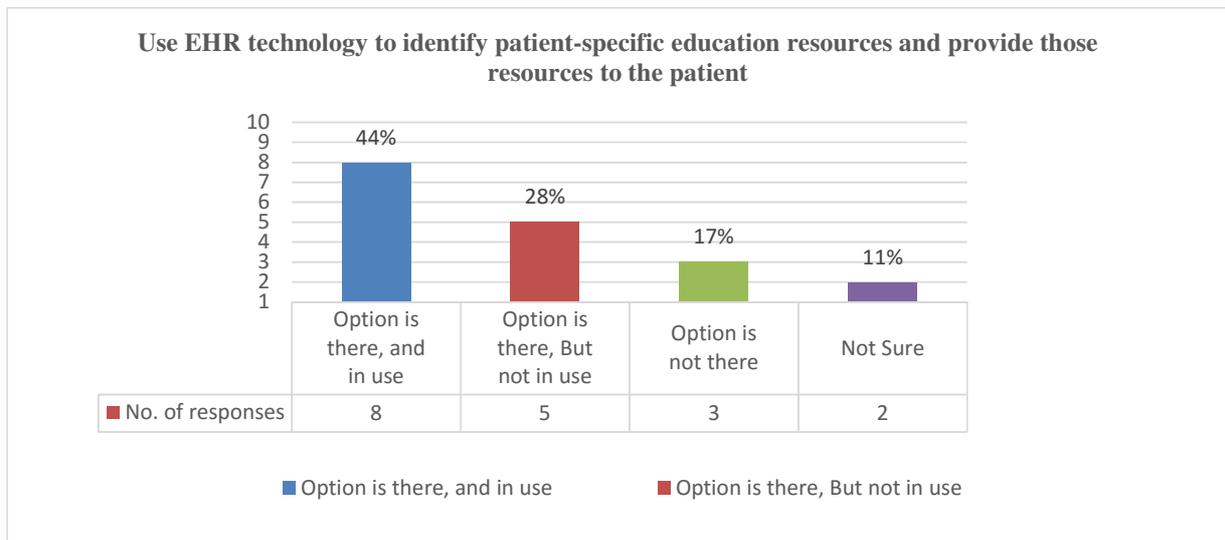
Chart 19 - Provide patient-specific education resources

5.5   Health Information Exchange

Exchange health information electronically among healthcare providers, patients, and public health agencies to improve coordination of care and improve population and public health.

5.5.1   Improve coordination of care

- **Medication reconciliation**

Twelve out of eighteen or about 67% of respondents indicated that they can perform medication reconciliation, when receiving a patient from another provider or believes an encounter is relevant. This happen to ensure that medication information in the chart in EHRs are accurate all the times. In addition, about 6% identified that they do have this option but option are not in use. Whilst, Twenty-eight percent indicate that they do not have this option or they are not sure if they have it (See Chart 20).
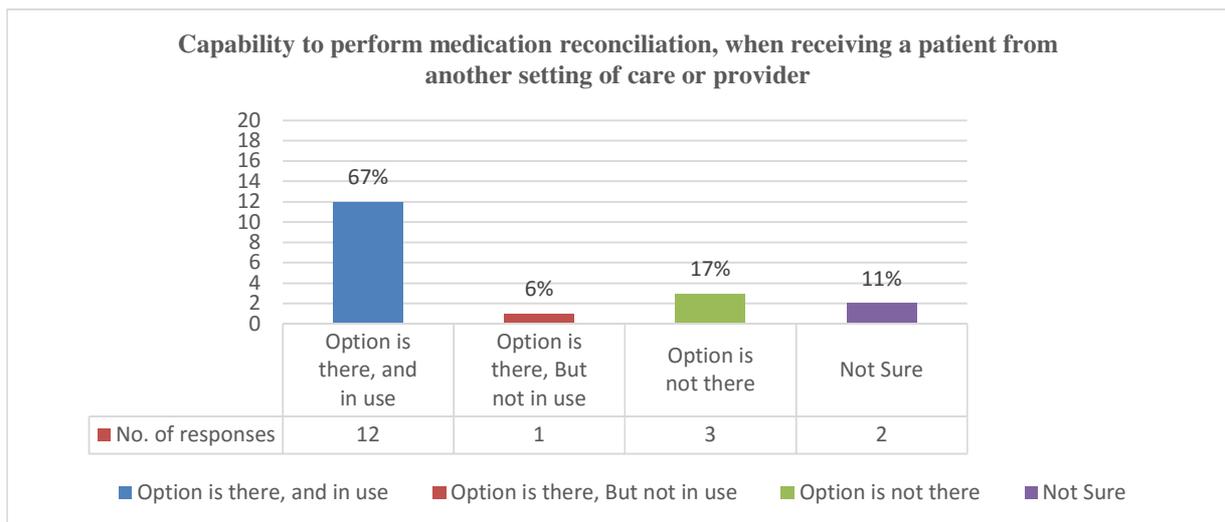

Chart 20 - Capability to perform medication reconciliation

- **Exchange health information electronically with other healthcare providers outside the organization**

Eleven out of eighteen or about sixty-one percent of the respondents point to that they currently can exchange key clinical information electronically with other providers/ Hospitals and patient-authorized entities outside their organization. Key clinical information include: discharge summary, diagnostic test results, problem list, procedures, medication list, and medication allergies. Additionally, about 17% identified they do have this option but option are not in use.

However, Twenty-three percent indicate that they do not have this option or they are not sure if they have it (See Chart 21).

Capability to exchange key clinical information electronically with other providers/ Hospitals and patient-authorized entities outside your organization

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
No. of responses	11	3	3	1

61%   17%   17%   6%

■ Option is there, and in use   ■ Option is there, But not in use   ■ Option is not there   ■ Not Sure
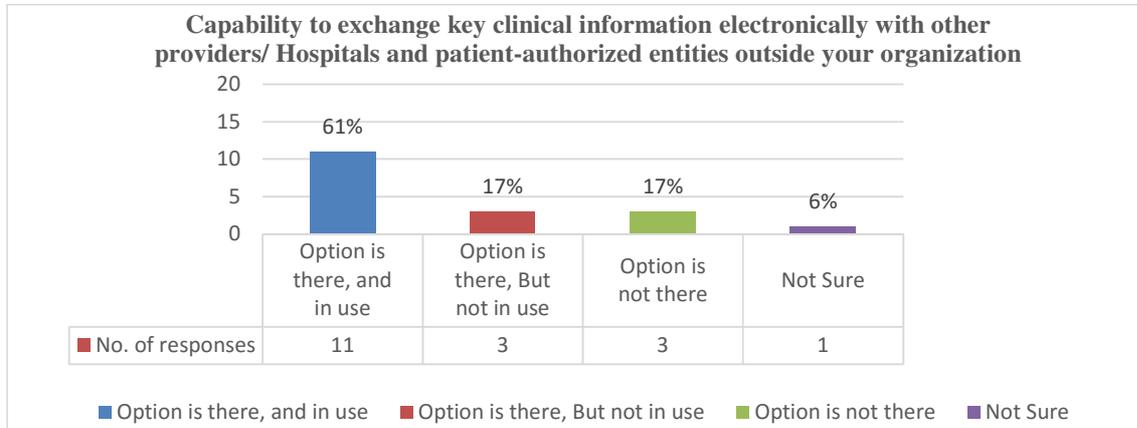
Chart 21 - Exchange health information electronically among Providers

- **Exchange health information electronically with other providers inside the same organization**

About sixty-one percent (61%) of the respondents identified that they currently can exchange health information electronically with other providers/ Hospitals inside their organization. In addition, about 11% identified they do have this option but option are not in use. Whilst,Twenty-eight percent of respondents indicated that they are not sure if they have this option or they do not have it (See Chart 22).

Capability to exchange health information electronically with other hospitals/ clinics inside your organization

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
No. of responses	11	2	4	1

61%   11%   22%   6%

■ Option is there, and in use   ■ Option is there, But not in use   ■ Option is not there   ■ Not Sure
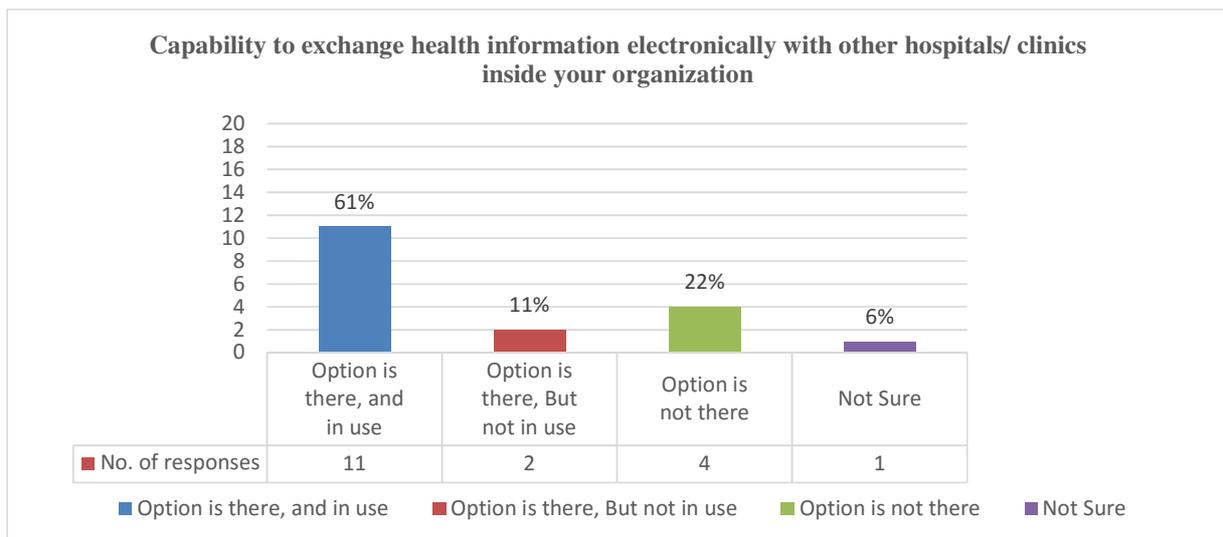
Chart 22 - Exchange health information electronically within the same organization

5.5.2 Improve population and public health

- **Submit data to immunization registries**

Submitting data to immunization registries throughout the community makes historical immunization data available easily for healthcare providers and other institutions such as schools. Additionally, will help to keep patient vaccinations records up to date. Therefore, improve public health by reducing vaccine-preventable diseases and reducing over-vaccination.

Nine out of eighteen or 50% of respondents indicates that they can submit data electronically to immunization registries now. In addition, 28% indicated that option is available but not in use. On the other hand, Twenty-two percent indicated that option is not available in their EHRs (See Chart 23).

	Capability to submit electronic data to immunization registries or Immunization Information Systems			
	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
No. of responses	9	5	4	0
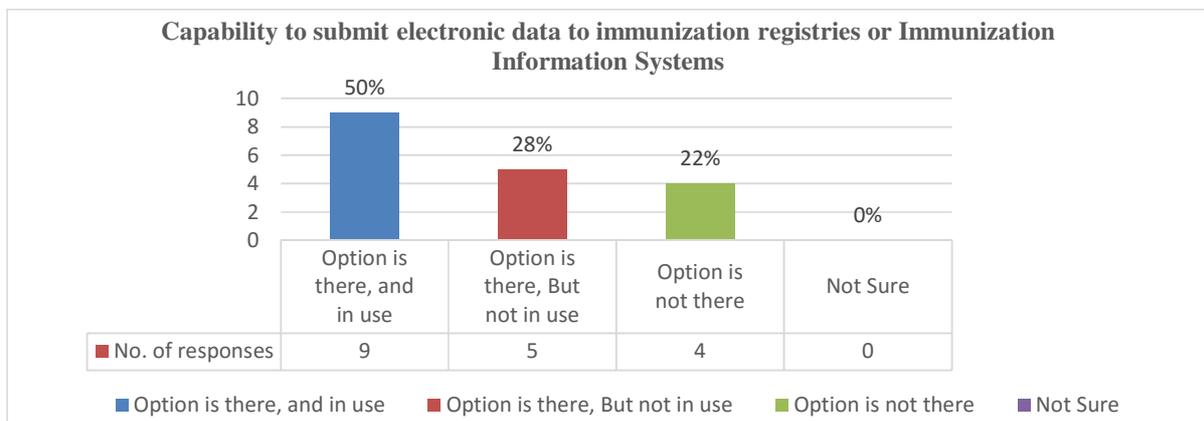
Chart 23 - Submit data to immunization registries

- **Submit syndromic surveillance data to public health agencies**

Submitting syndromic surveillance data to public health organization will help to improve population health at the national level. Large public health databases are used for epidemiologic analyses. Therefore, help public health decision makers to monitor and mitigate public health threats.

Eight out of eighteen or about 44% of respondents indicated that they are able to submit syndromic surveillance data to public health organizations. Additionally, 11% indicated that their system do have this option but they are not using it. Whilst, forty-five percent of the respondents indicated that their current system do not have the option or they are unsure whether option is there or no (See Chart 24).

Capability to submit electronic Syndromic Surveillance Data to Public Health Agencies

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
No. of responses	8	2	5	3

Option is there, and in use ■ Option is there, But not in use ■ Option is not there ■ Not Sure
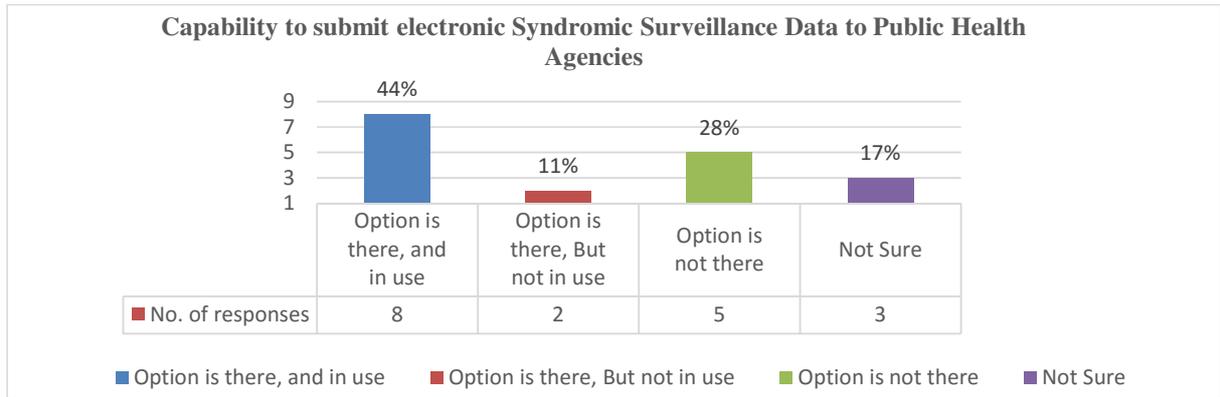
Chart 24 - Submit syndromic surveillance data to public health agencies

- **Submit reportable laboratory results to public health agencies**

Electronic reporting of laboratory results to public health agencies will improve the completeness of data that are necessary to identify disease outbreaks at the right time and track disease trends over time.

About forty-four percent (eight out of eighteen) of respondents identified that they are submitting electronically to public health organizations the reportable laboratory results data. In addition, 28% indicated that are not submitting such data although they can do with their current EHRs. However, twenty-eight percent point to that they cannot submit these data electronically with their current systems or they are unsure (See Chart 25).

Capability to submit electronic data on reportable laboratory results to public health agencies

	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
No. of responses	8	5	3	2

■ Option is there, and in use ■ Option is there, But not in use ■ Option is not there ■ Not Sure
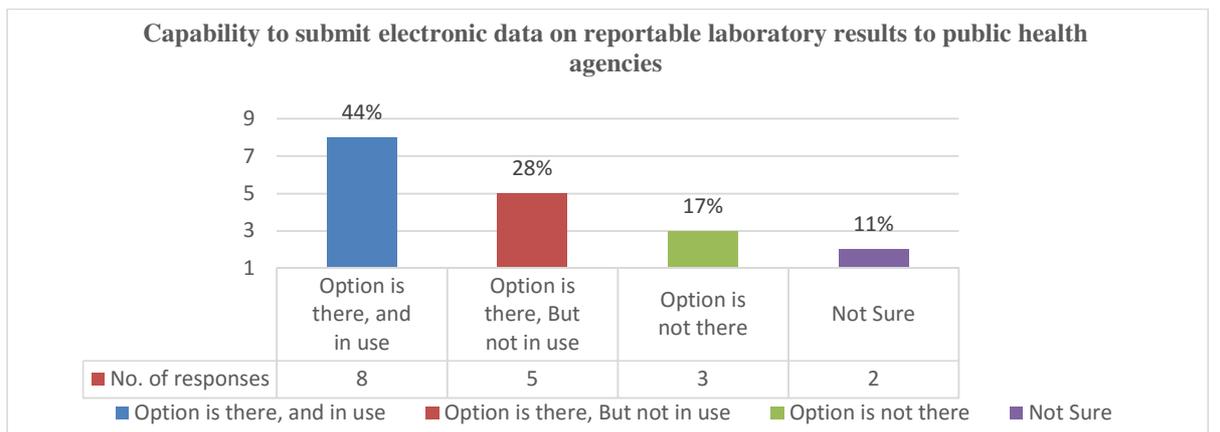
Chart 25 - Submit reportable laboratory results to public health agencies

5.6 Interoperability and standards

5.6.1 Terminology and vocabulary

The eighteen healthcare providers that are adopting EHRs was asked to identify which medical coding sets/terminology are in use in each of UAE cities.

Table 9 constructed from their responses as the following, If any organization indicates that they are using the mentioned coding set in any city therefore the intersection between the coding set and city will be "1". Alternatively, if no one from particular city select specific coding set then the intersection between the coding set and city will be "0", which mean that nobody from the respondents is using this coding set in this city.

It's clear that not all cities in U.A.E are implementing same coding systems. Therefore, different terminologies and vocabulary are in use in the different emirates. For example CPT (Current Procedural Terminology) are in use in all emirates. However, ICD-9 CM (International Classification of Diseases - Clinical Modification) is in use only in Abu Dhabi and Al-Ain. Furthermore, ICD-10 CM (International Classification of Diseases - Clinical Modification) are in use in Dubai, Ajman and Fujairah but not in use in Abu Dhabi and Al-Ain (See Table 9).

	Abu Dhabi	Al Ain	Ajman	Dubai	Fujairah	Ras Al Khaimah	Sharjah	Umm Al Qaiwain
CPT (Current Procedural Terminology)	1	1	1	1	1	1	1	1
HCPCS (Healthcare Common Procedure Coding System)	1	1	0	1	0	0	0	1
Drugs (Greenrain Drug Codes)	1	1	0	0	0	0	0	0
ICD-9 CM (International Classification of Diseases - Clinical Modification)	1	1	0	0	0	0	0	0
ICD-10 CM (International Classification of Diseases - Clinical Modification)	0	0	1	1	1	0	0	0
DRG (Diagnosis Related Groupings System)	1	1	1	1	0	1	0	0
LONIC (Logical Observation Identifiers Names and Codes)	1	1	0	1	1	0	0	0
CDT (Code on Dental Procedures and Nomenclature)	1	1	0	1	1	0	1	0
DDC (Dubai Drug Code)	1	1	1	1	0	0	0	0

Table 9 - Terminology and vocabulary by city

5.6.2 Data content/structure standards

Only 7 out of 18 or about 39% of respondents indicate that they are adopting Clinical Document Architecture (C-CDA) standards, among them 4 from government sector and 3 from private sector. Therefore, four out of five or 80% of respondents from government sector are adopting C-CDA , while only 3 out of 13 or about 23% from non-government organizations adopting C-CDA. In addition, 11 out of 18 or 61% of respondents most of them from non-government healthcare organization indicate that their EHRs are compatible with Health Level 7 (HL7) and can send and receive HL7 messages (See Chart 26).

Select from the list below, data content/structure standards that your systems are using or compliant with

	Clinical Document Architecture (C-CDA)	Health Level 7 (HL7)	Other (please specify)
No. of responses	7	11	0

■ Clinical Document Architecture (C-CDA) ■ Health Level 7 (HL7) ■ Other (please specify)
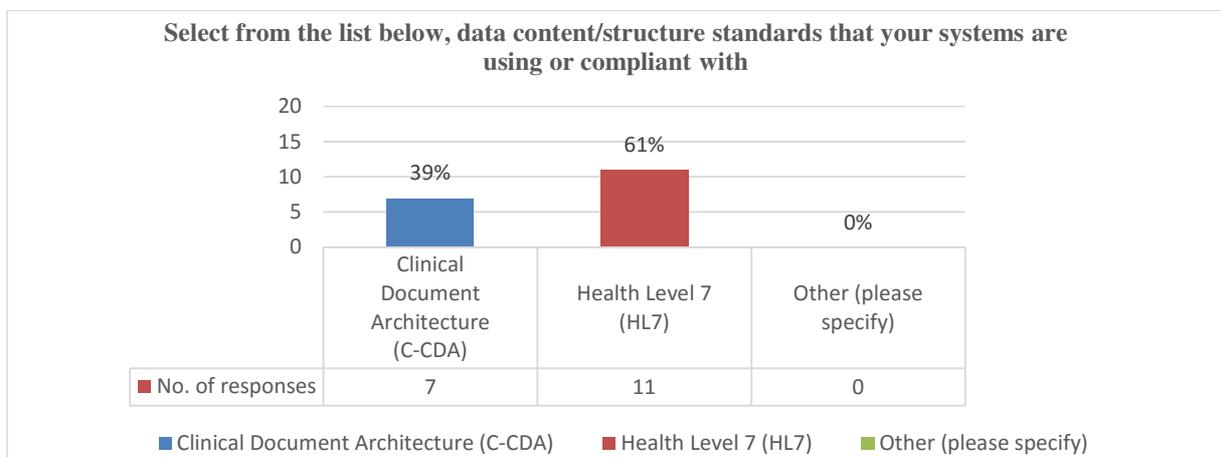
Chart 26 - Data content/structure standards

5.6.3 Structured vs unstructured date

Nine out of eighteen or fifty percent of respondents that are adopting EHRs indicate that they are storing electronic health records as structured data only. Therefore, health data will be easy to be collected and exchanged between systems, because it is pre-defined, standardized, computer-readable and typically quickly accessible from a database.

At the same time, the other 50% are storing electronic health data as mixed structured and unstructured data (See Chart 27).

Unstructured data is the information that typically requires human efforts to read, capture and interpret properly. It includes both handwritten information and machine-written on unstructured paper forms such as signed patient consent forms, audio voice dictations, scanned medical reports, email messages and attachments and diagnostic images. All these unstructured data relevant to the patient will require extra efforts to be collected, captured and recorded into an organization's EHRs
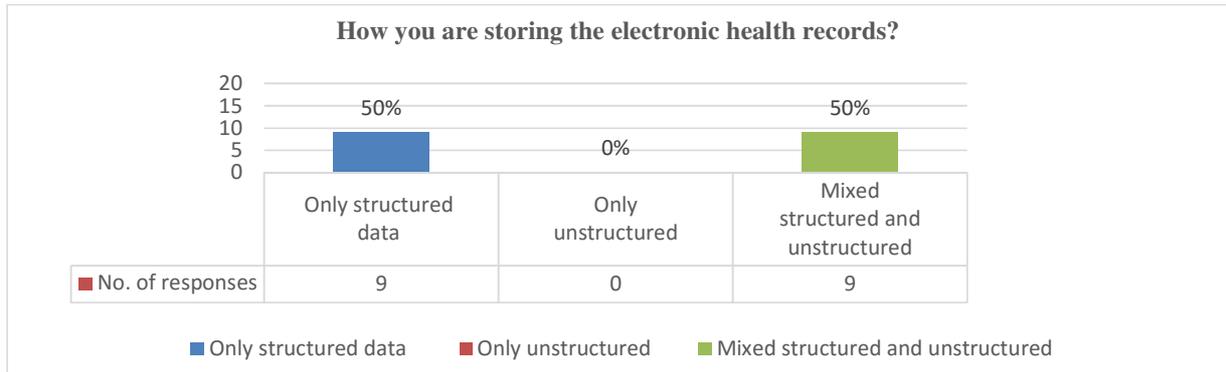
Chart 27 - EHRs data format

### 5.6.4 Broadband internet connection

Availability of broadband internet connection is crucial for health information exchange between the different entities involved in patient care. Fifteen out of eighteen or about 83% of respondents identified that they have broadband internet connection in all locations. In addition, eleven percent indicate that they do have in some location but the service is not available in some locations. At the same time, only one of the small private medical centers indicates that they cannot afford the service cost (See Chart 28).
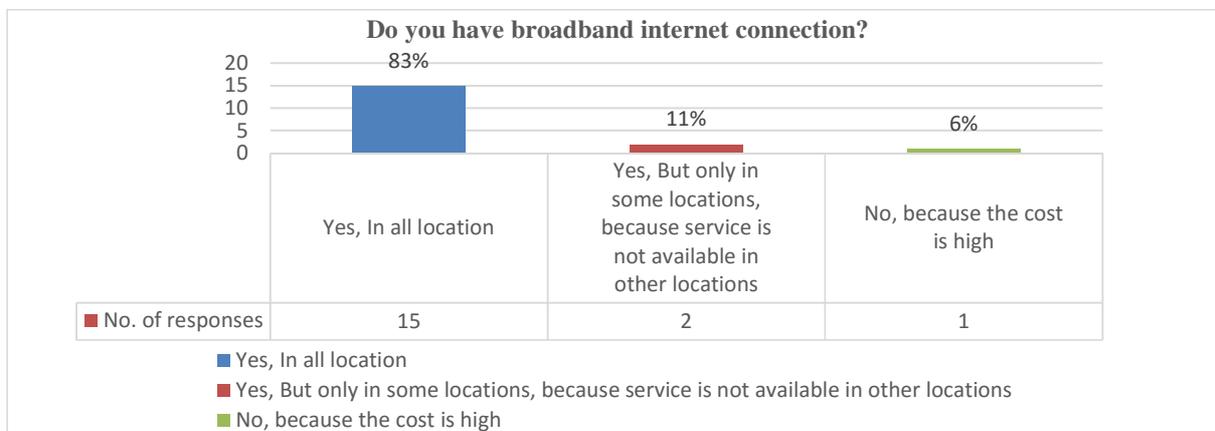
Chart 28 - Broadband internet connection

5.6.5 EHRs capability to communicate with other systems

Twelve out of eighteen or about sixty-seven percent of respondents indicate that their EHRs has the ability to communicate to other systems through web services or any other way and they are using this option. Additionally, twenty-two percent indicate that option is there but not in use. whilst, only eleven percent pointed to that their EHRs do not have this capability (See Chart 29).
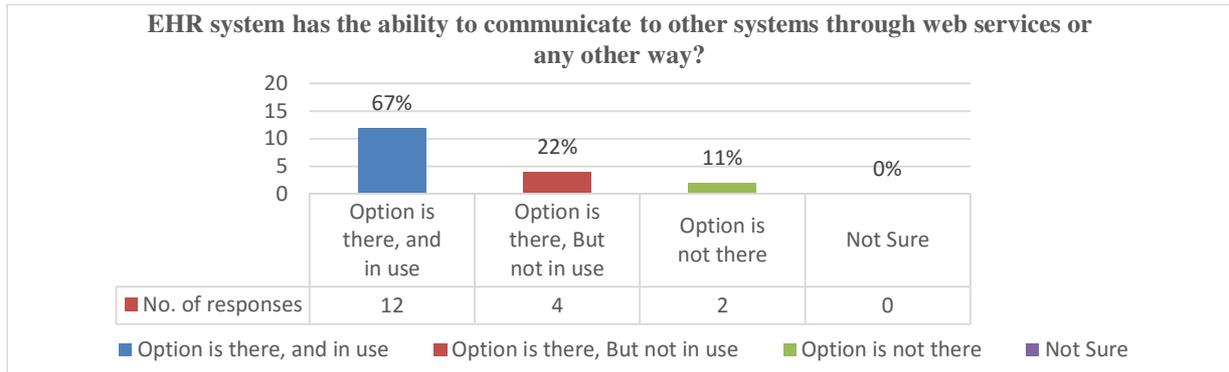
Chart 29 - EHR system has the ability to communicate to other systems

5.6.6 EHRs capability to exchange data electronically with personal health records

Thirty-three percent of respondents identified that their existing EHRs has the ability to exchange data electronically with mobile health applications, personal health records, wearable devices, and home health monitoring devices and they use this capabilities. In addition, 39% indicate that their EHRs have this capabilities but not in use. On the other hand , twenty-nine percent indicate that their systems do not have this capability or they unsure (See Chart 30).
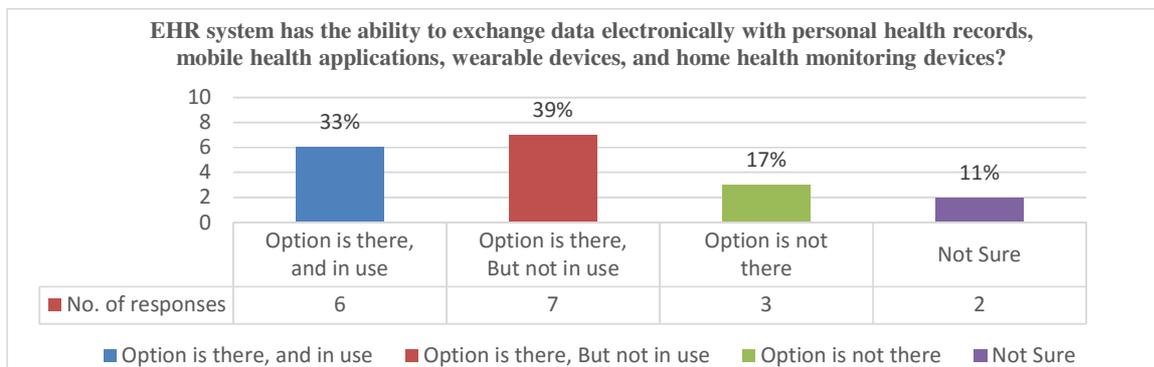
Chart 30 - Personal Health Record and EHRs Linkage

5.6.7 EHRs capability to submit e-claim and receive response electronically without any manual transaction

Ten out of eighteen or 56% of respondents identified that they their systems can communicate direct to e-claim portals to send and receive e-claim data without any manual transaction. In addition , all of these ten are private organizations, in other words 10 out of 12 or about 83% of private organizations indicate that their existing EHRs have the capability to communicate and exchange data with e-claims portal electronically. In Fact, all these organizations are distributed

over Abu Dhabi, Al Ain, and Dubai. However, all government organizations indicate that this capability is there but not in use (See Chart 31).
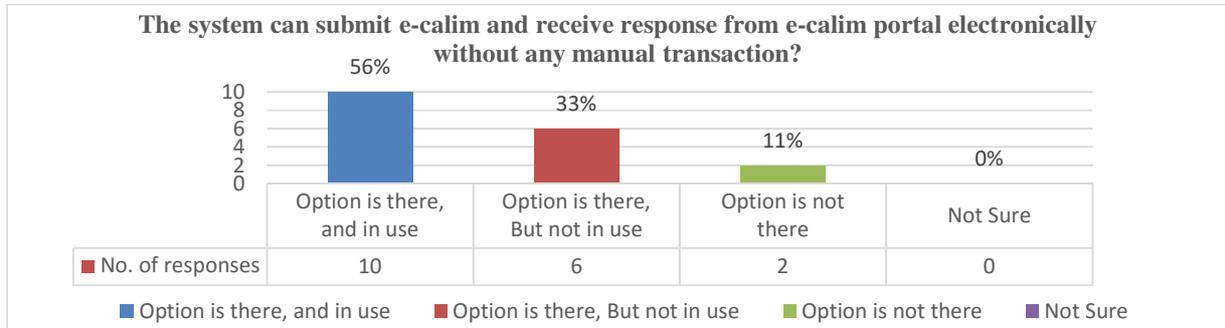
Chart 31 - Linkage between EHRs and e-claims portals

5.7 Health information privacy and security

5.7.1 Implementation of security and privacy protections

About eighty-nine percent of respondents indicated that they are adopting adequate privacy and security protections (i.e., HIPAA Privacy and Security Rules) for their patients' health records. Whilst, only 2 or 11% identified that they are not sure (See Chart 32)
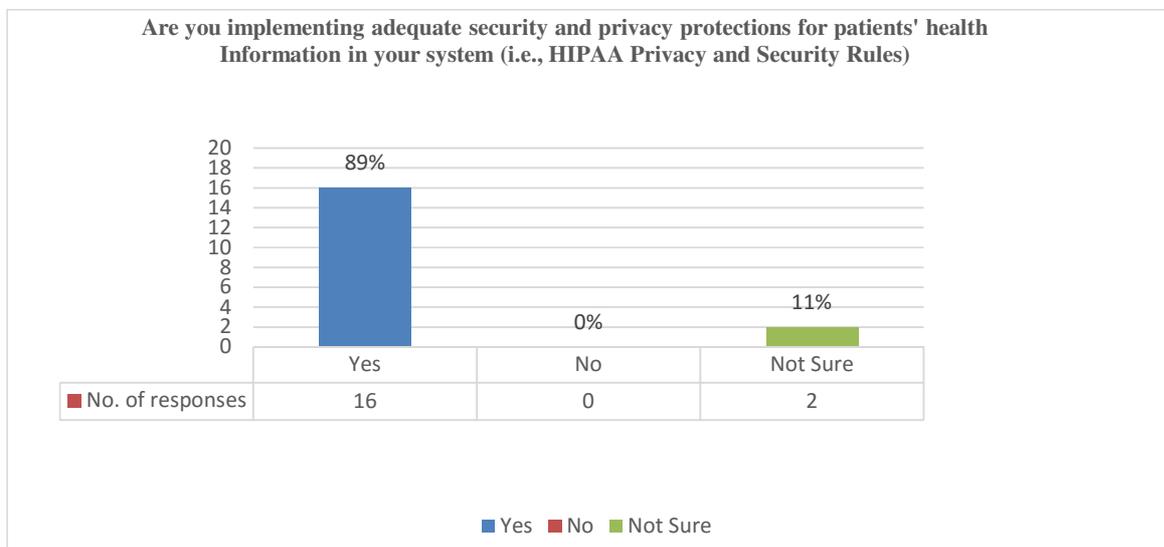
Chart 32 - implementation of privacy and security rules

5.7.2 Notifying patient about disclosure for personal health information

About Seventy-two percent (13) of respondents indicate that they are notifying their patient about any disclosure for their personal health information. At the same time, 22% point to that they are

not notifying their patients in such cases. Moreover, only 1 is not sure whether they are notifying the patients or no (See Chart 33).

Do you notify the patient about any disclosure for their personal health information?

	Yes	No	Not Sure
No. of responses	13	4	1

72% Yes, 22% No, 6% Not Sure

■ Yes ■ No ■ Not Sure
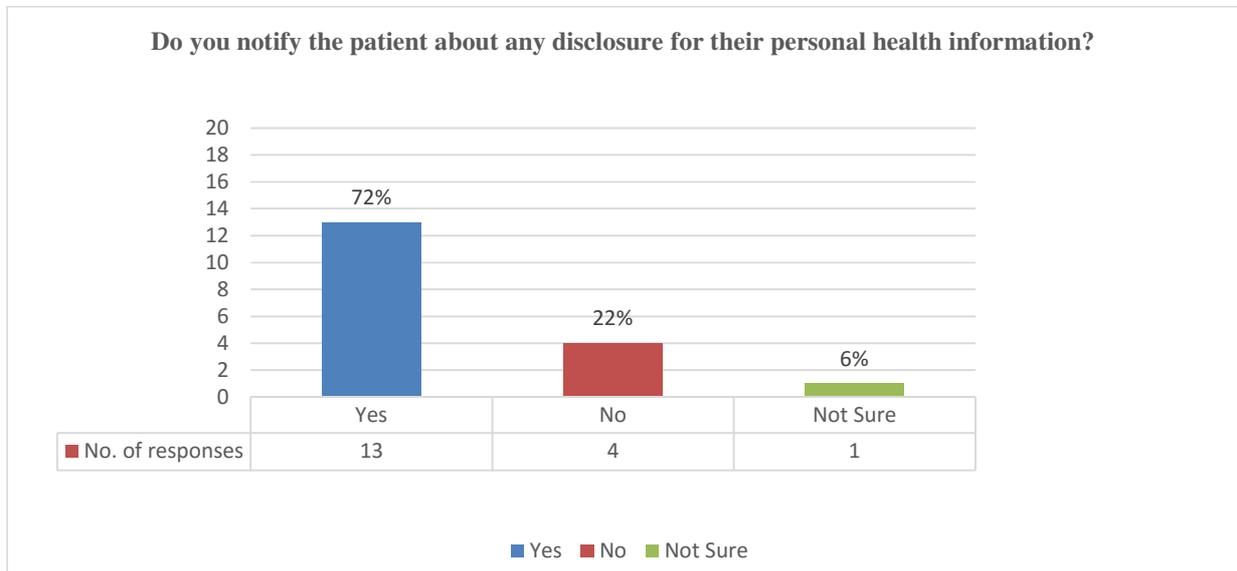
Chart 33 - Notifying patient about disclosure of personal health information

5.7.3 Inform patients about how their health information will be used and shared

Eleven out of eighteen or about sixty-one percent of respondents indicate that they are informing their patients about how their health data will be shared and used. Whilst, 39% of the respondents indicated that they are unsure or they are not informing their patient (See Chart 34).

Do you inform the patient about how their health information will be used and shared?

	Yes	No	Not Sure
No. of responses	11	4	3

61% Yes, 22% No, 17% Not Sure

■ Yes ■ No ■ Not Sure
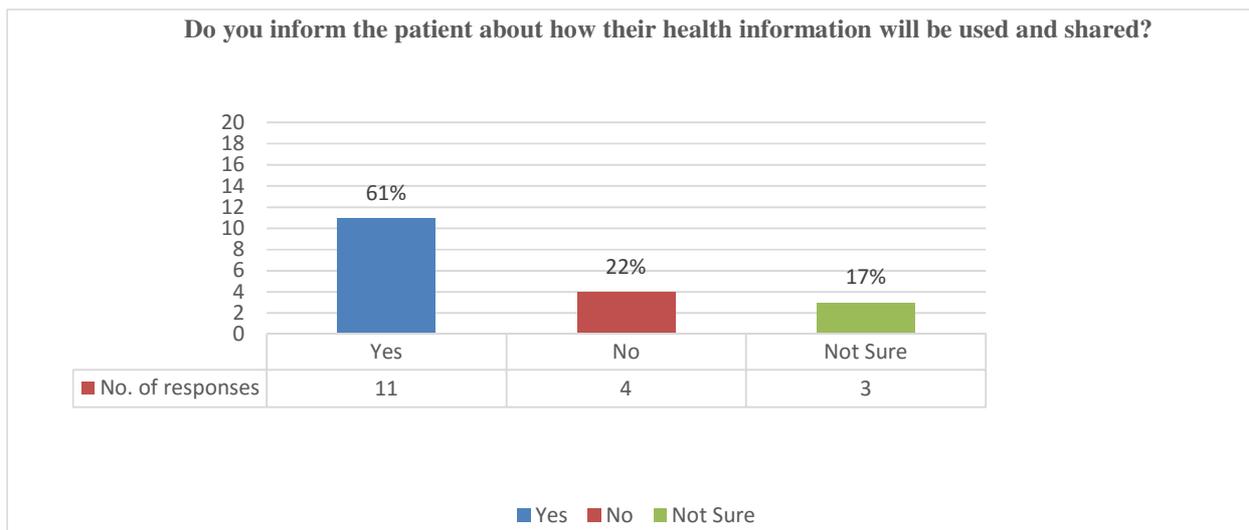
Chart 34 - Inform the patient about how their health information will be used and shared

5.7.4 Health information segmentation

Only eight out of the eighteen or about 44% of respondents indicate that health information in their EHRs can be segmented. Therefore, the patient has the option to select which part of their health information can be shared to protect the confidentiality of sensitive health information. On the other hand, about 33% indicate that this option is not there in their system. Moreover, 22% mentioned that they are not sure whether their EHRs has this capability (See Chart 35).
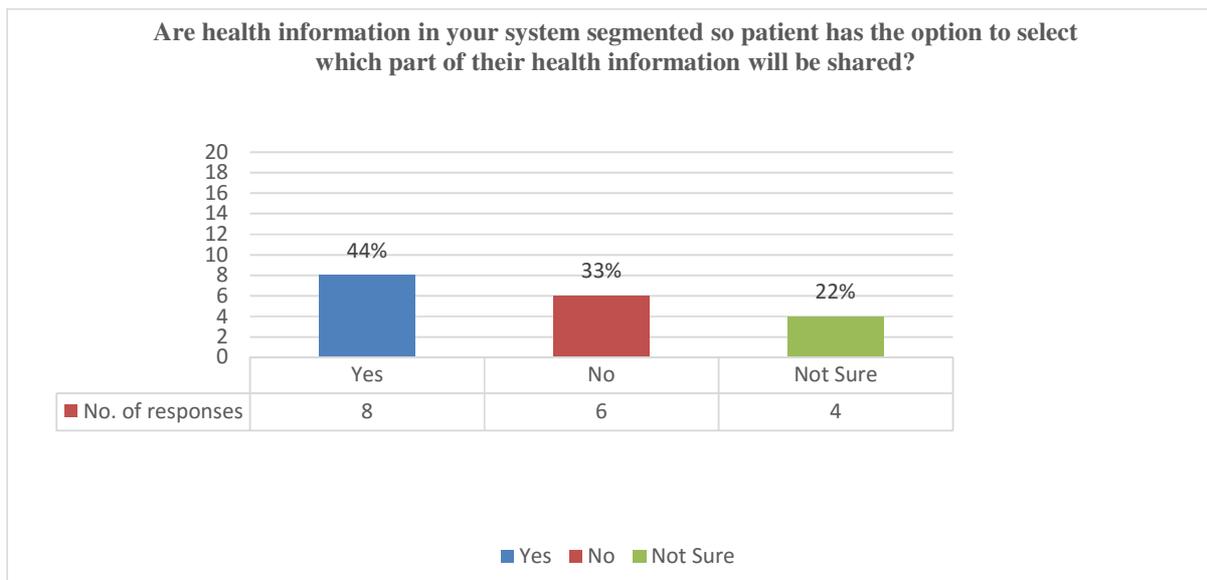

Chart 35 - Health information segmentation

Chapter 6: Discussion

In this chapter, the proposed conceptual model will be applied to the current status of healthcare system in UAE. The purpose is to evaluate the readiness of health organizations and health system in UAE for the transformation journey and information-driven healthcare.

As discussed in the previous chapters, any nation to be able to achieve that transformation there are three main stages. First, health organizations need to adopt Health IT and use it meaningfully. Second, health information should be shared and exchanged freely in a secure way and preserving patient privacy. Third, interoperability among all systems in the different health organizations nationwide. In fact, Health information exchange and interoperability can be done parallely or sequentially.

6.1 Readiness for transformation

6.1.1 Health IT Adoption

The Majority of healthcare providers in U.A.E from both private and government sectors are adopting electronic health record system. However, not all of them are recording all health information in electronic format. In Addition, a lot of these organizations still having mix of electronic and paper medical records. Moreover, not all these organizations recording all health data in structured format but they are having mix of structured and unstructured data.

Therefore, a lot of efforts will be required from healthcare providers in U.A.E to transfer all health paper records to electronic records. additionally, they should ensure that not only health records are recorded electronically but also should be recorded as structured data.

Most of healthcare organizations that are adopting EHRs indicate that they are currently implementing or planning to implement the core functions of electronic health record systems. However, not all of healthcare providers are implementing clinical decision support system. Therefore healthcare providers at the time of purchasing any EHRs, they should make sure that these systems have clinical decision support functionalities.

Healthcare providers from all sectors that are implementing EHRs indicate that the top most important reasons that encouraged them to adopt EHRs are: Improve organizational operations, capture data to improve reporting capabilities, and ability to communicate with other healthcare

providers to coordinate care. Additionally, about half of private organizations indicate that, improve billing and collections is one of the most reasons affects their decision to invest and implement EHRs. In sum, most of healthcare providers in U.A.E are aware of the importance of the adoption of Health IT. However, monetary incentives can play a major role to encourage the adoption of Health IT in the private sector.

Although a lot of healthcare providers can provide their patients with an electronic copy of their health information. At the same time, only few of them indicate that they are providing their patients with timely electronic access to their health information through patients' portals or any other way or providing patient-specific education resources. Therefore, awareness of importance of patient engagement in their healthcare are still low in UAE. Furthermore, more efforts are required to encourage patient engagement and provide patients and their families with the necessary tools and knowledge to make informed decisions and to be able to manage their health.

On the other hand, some healthcare providers don't not have any intention or plan to implement EHRs or any other health IT in the future. These organizations indicate that the top barriers that preventing them to adopt the different Health IT include cost of purchasing a system which consider the most important reason from their point of view. In Addition, lack of dedicated and trained staff to implement and maintain the system. Moreover, some of them pointed to concern regarding maintaining quality of care for their patients, and lack of the necessary knowledge about how to select the proper electronic health record system. Therefore the government should work to mitigate such barriers.

Adoption of other health IT such as telehealth are very low among healthcare providers in UAE, although such technologies can play very important role as a groundbreaking way of providing fast, high-quality and convenient healthcare services.

Telehealth can increase access to healthcare for remote patients in rural and other places that lack of appropriate care and improves health outcomes through the early diagnosis and treatment for remote patients. Additionally, Telehealth can reduces healthcare costs through home monitoring programs that can reduce the high-cost of hospital visits and reduce the high cost of patient transfers for emergency cases. Moreover, Telehealth can help in addressing shortages and mis-distribution of physicians and nursing staff among healthcare providers.

Therefore, government may prepare outreach programs for healthcare providers in UAE about the importance of the adoption of health IT and encourage and support healthcare organizations to adopt such technologies.

6.1.2 Health Information Exchange

Some healthcare providers in U.A.E that completed the survey indicate that they can exchange key clinical information electronically with other providers whether inside or outside their organizations. However, still big portion of them do not have this ability. Key clinical information include: medication list, medication allergy, discharge summary, problem lists, and diagnostic test results.

In addition, more efforts are required to enhance the submission of health data electronically to the different health public organizations such as immunization registries, syndromic surveillance, and reporting of laboratory results. The electronic submission of health information to public health organizations will help to improve population health at the national level. Moreover, will help public health decision makers to analyze, monitor and limit public health threats.

Many initiatives done by the different health authorities in UAE that aim to foster health information exchange among all entities that are involved in patient care (e.g., healthcare providers, insurance companies, pharmacies, government health organization). These initiatives include:

6.1.2.1 Health Authority Abu Dhabi (HAAD) initiatives

HAAD is the regulative body of the healthcare sector that defines the strategy for the health system in the emirate of Abu Dhabi. In addition, Among HAAD responsibilities is to ensure excellence in healthcare for the community by monitoring and analysis the health status of the population and the performance of the health system. Moreover, the Authority also aims to develop and implement projects and work plans necessary for promoting health care in Abu Dhabi, improving the methods of disease treatment and prevention (HAAD, 2015). HAAD initiatives include:

- **HAAD's e-claim system**

According to McMeans (2008), The new electronic health insurance claim (e-claims) system aims to reduce paperwork that are time consuming, speed up claim processing and payments, and increase transparency. Digitizing claim payments makes processing of insurance information

easier, facilitate the tracking of changes in health trends, and HAAD will be able to react more quickly to the different situations and makes more informed decisions.

Healthcare organizations in Abu Dhabi can exchange health information and claims electronically and report to HAAD through "Shafafiya" web services. Shafafiya portal describes HAAD data governance around health data, standard, and technical specifications.

- **E-Notifications System for Infectious Diseases**

HAAD launched in 2009 its new e-notification system for infectious diseases reporting as a part of the ongoing efforts to improve the healthcare systems. In addition, HAAD mandate all healthcare providers in Abu Dhabi to use the new system. The new electronic system is a replacement for the existing paper based system, and a direct communication and feedback tool among HAAD and physicians.

The new e-notification system aims to provide HAAD with real time notifications about infectious diseases. Therefore, improve HAAD response and readiness, and limit infectious diseases prevalence across the emirate of Abu Dhabi (WAM, 2009).

- **Pharmacy Benefit Management (PBM) and E-prescription**

HAAD makes it mandatory for all health insurers in Abu Dhabi to implement Pharmacy Benefit Management (PBM) system in 2012. The PBM initiative, requires all Abu Dhabi's pharmacies to seek pre-approval on the prescribed medication electronically from health insurers through "Shafafiya" web service.

In addition, The National Health Insurance Company (Daman) announced in 2012 its plans to introduce E-prescription services. E-prescriptions is an automated system that checks for harmful drug interactions and possible overdosing, accelerate insurance claims processing, and provide prescription history for Daman's members (Khaleej Times, 2012).

6.1.2.2   Dubai Health Authority (DHA) initiatives

In June 2007, His Highness Sheikh Mohammed bin Rashid Al Maktoum, Ruler of Dubai, Vice President and Prime Minister of the UAE issued Law 13 to create The Dubai Health Authority (DHA). DHA has main vision including the strategic oversight for the whole health sector in emirates of Dubai and boost private sector engagement.

The DHA's main aims include: provide an effective, accessible, integrated healthcare system, protecting public health, and improve the quality of life not only for nationals but also for residents and visitors within the Emirate of Dubai. Additionally, DHA provide healthcare services through its healthcare facilities that comprising hospitals (Dubai, Latifa, Hatta and Rashid), and specialty centers (i.e. the Dubai Diabetes Center) and DHA's primary health centers that are spread all over Dubai (DHA, 2015). DHA initiatives include:

- **eClaimLink**

DHA announced in 2012 that, all claim transactions between healthcare providers and payers in emirate of Dubai should be electronic (eClaims) starting 1st of January 2013. DHA established eClaimLink portal project that aims to make all parties involved in patient care speak a unified health language through the implementation of a unified communication structured. In addition, to provide a centralized tracking system for health data, and facilitate clinical and financial eClaim process among patients , healthcare providers, payers, and authorities. Therefore, enhance efficiency, quality of care, and reduce abuse, fraud and mistakes in the emirate of Dubai (eClaimLink, 2012).

- **e-Prescription (eRx) Initiative**

In 2013, DHA introduced the e-Prescription (eRx) initiative. eRx initiative is a computer-based electronic creation, transmission, and filling of a medication prescription that replace the existing paper-based prescriptions. e-Prescription became mandatory for all Providers\Clinician's, pharmacies, and payers in Dubai starting January 1st, 2014.

eRx allows healthcare providers\clinicians to electronically transmit a medication prescription to eRx Hub in the Dubai Health Post Office (DHPO), and receiving coverage feedback in real-time. Then the pharmacist will download the prescription electronically when the patient will visit the pharmacy to get coverage authorization before the medication will be dispensed to the patient. e-Prescription will help to reduce medical errors significantly and maximizes patient health and safety. Additionally, will help health insurers to manage medication expenses, reduce patient waiting time significantly, and reduce the time-consuming paperwork.

eClaimLink solution provides two ways that can be used to connect to the DHPO\eRx Hub, either through online portal or through direct integration with the DHPO\eRx Hub though web services. (eClaimLink, 2013).

- **Electronic Referral Transaction (eReferal)**

In 2014, DHA introduced eReferral initiative that aims to give more control over the insurance. eReferral is a computer-based patient referral system among specialist and General Clinicians that are working within the same facility or in different healthcare organizations. The eReferral system will enable insurance companies to track patient transfers among different physicians based on physicians' specialty or specialty group through DHPO\eReferralHub.

The Mandatory Insurance Law (11) in Dubai aims to increase the insured population in Dubai up to be three folds the current market size by the end of 2016. Therefore, DHA strive to introduce new smart electronic systems to make the transactions easier, gain visibility, and control the expenditures to achieve a cost effective healthcare Insurance sector (eClaimLink, 2014).

6.1.2.3   Ministry of Health (MoH) initiatives

- **Wareed**

Wareed launched by Ministry of Health (MoH) in October 2008. Wareed is MoH initiative to link and integrate electronic medical records in all MoH public hospitals and affiliated clinics across Dubai and the Northern Emirates. In addition, Wareed health information platform, aims to automate all healthcare processes across the various departments such as radiology, pharmacy, pathology, registration, and emergency.

Wareed, provide a unified medical record number for each patient across MoH facilities. The unified medical record number called Community Medical Record Number (CMRN). CMRN will help to eliminate duplication and reduces medication errors, registration times, length of hospital stay, and adverse drug reactions.

Wareed has linked 14 hospitals and 25 clinics across the country. However, implementation of Wareed faced some challenges because of the lack of fibre optic connections in some clinics' locations (Khaleej Times, 2014b).

In summary, the different health authorities in U.A.E are striving to enhance the existing health system. However, they are working individually and there is no one strategy to unify all the efforts toward one health system for all emirates.

6.1.3   Interoperability

Interoperability among the different health IT systems is the utmost goal for the transformation journey. Interoperability supports coordination of care among all entities that are involved in care process, facilitates informed decision-making, improves patients' engagement in their healthcare. Therefore, improve the overall population health, and reduce healthcare expenditure over the time.

To achieve Interoperability and to make the right data available to the right people and at the right time, all Health IT systems and products should be able to talk the same language. Thus, Interoperability can be achieved only by the implementation of unified standards, vocabulary and terminology, content and format, and secure network infrastructure.

Although the different health authorities in U.A.E are trying to unify the vocabulary, terminology, and standards. However, the different emirates are having different systems and not all emirates in U.A.E are implementing same standards and the same medical coding systems. As discussed in the analysis chapter ICD-10 CM (International Classification of Diseases - Clinical Modification) are in use in Dubai, Ajman and Fujairah but not in use in Abu Dhabi and Al-Ain. In addition, ICD-9 CM (International Classification of Diseases - Clinical Modification) is in use only in Abu Dhabi and Al-Ain. Whilst, CPT (Current Procedural Terminology) are in use in all U.A.E cities.

In addition, as discussed in analysis section few number of healthcare providers are adopting Clinical Document Architecture (C-CDA) standards, most of them are government organizations. Whilst, most of private healthcare providers indicate that their systems are compatible with HL7 messaging. Therefore, there is no unified content/structure standards are in use by all healthcare organizations in all emirates.

Moreover, although availability of broadband internet connection is crucial for health information exchange and interoperability, but broadband internet is not available in all areas of the U.A.E emirates. Therefore, more efforts should be done by the telecommunication companies and the government to provide the service to all location in the country. Additionally, the government can

support the small clinics and medical centers that can not afford the high cost of broadband internet service.

Furthermore, all health information should be recorded in structured format to support interoperability. Nevertheless, big portion of the health data are recorded as unstructured data in the different healthcare organizations in U.A.E. Therefore, more efforts will be required from all healthcare providers to transfer all unstructured data to structured format that can be exchanged easily between the different systems. For example, Natural Language Processing (NLP) tools can be used to extract structured data from the free text documents.

Although e-claim portals of Abu Dhabi health authority and Dubai health authority having the option to be integrated with the different systems in healthcare organizations though web services. Despite that, not all healthcare organizations are integrating their systems with portals to have direct communication without any human interaction.

Finally, not all the existing systems that are adopted by healthcare providers in UAE can communicate and exchange health information electronically with personal health records, mobile health applications, home health monitoring devices and wearable devices. Therefore, standards should be identified by health authorities and should be applied by health IT vendors.

6.1.4   The building blocks

6.1.4.1   Vision and Leadership

According to The Ministry of Cabinet Affairs (MOCA) (2010), UAE government strategy for the years 2011-2013 launched by His Highness Sheikh Mohammed Bin Rashid Al Maktoum. The strategy have seven priorities among them "World-Class Healthcare".

To achieve a world-class healthcare system, the strategy defined three main strategic directions include:

1. Ensuring universal access to healthcare services
   The government aims to ensure that all UAE nationals and residents have access to primary healthcare, and healthcare services should be available in all regions.
2. Providing world-class healthcare services
   By providing health care services with high quality that cope with the universal standards.
3. Reducing epidemic and health risks

The government aims to reduce the spread of diseases by promoting the healthy lifestyle. In addition, the government and seeks to increase the preparedness of public health organizations to deal with epidemics and health threats.

Policy makers in the different U.A.E emirates announced their visions for health care reform. In 2013, Dubai Health Authority (DHA) announced the vision of the Dubai Health Strategy 2013-2025. The strategy include 43 initiatives, and seeks to achieve four main aims; easy access to health services, quality, competitiveness and investment, and awareness and prevention (DHA, 2013).

Additionally, In 2014, Health Authority – Abu Dhabi (HAAD) announced Healthcare Sector strategic plan for the next 5 years for the Emirate of Abu Dhabi. The strategy include seven key areas or priorities and 58 initiatives to achieve these priorities. Among these priorities "E-Health" programme that seek to facilitate the exchange of health information between healthcare providers by creating a health information platform in Abu Dhabi. E-Health programme will help to achieve the other six priorities: healthcare quality improvement, continuum of care, ensuring value for Money, Preparedness for Emergency, Prevention of Disease, and Wellness (HAAD, 2014).

In summary, although the different health authorities in U.A.E are striving to achieve the national health strategy. However, they are working on emirates-level and there is no national unified Health IT strategy.

6.1.4.2   Supportive regulatory and cultural

U.A.E government announced the national health strategy, and also the different health authorities in the different emirates announced their strategies. In addition, UAE carried out many initiatives that would foster health information exchange to improve healthcare, and pave the way for healthcare reform in the country.

On the other hand, changing the culture for both patients and healthcare providers still need more care. In fact, there is lack of the outreach programs that increase the community awareness about the benefits that can be realized by accessing and using of health information. Moreover, the culture of healthcare providers in UAE, need to be changed as decision making should be based on evidence and knowledge that generated from health information rather than physicians' experience.

6.1.4.3   Standards & Health IT Certifications

In the different U.A.E emirates, there are different vocabulary and terminology (i.e., in Abu Dhabi healthcare providers are using ICD-9, while in Dubai there are using ICD-10. In addition, not all data recorded in EHRs in the different healthcare organizations are following the same Content/structure standards. Moreover, not all data recorded as structured data. Furthermore, there is no nationwide defined standards that should be followed by the different IT systems and products while capturing, recording, and exchanging health information.

Additionally, there is no Health IT certifications in UAE to ensure that all EHRs are having the necessary capabilities, functionalities, and security protections. EHRs' certification is necessary also to ensure that all health IT products and systems are following the same standards that support heath information exchange and interoperability.

6.1.4.4   Robust Technology Infrastructure

The different health authorities in the different UAE emirates have started in the last few years to build health information platforms at emirates-level. The existing health information exchange models in Abu Dhabi include; e-claim, E-Notifications System for Infectious Diseases, Pharmacy Benefit Management (PBM) and E-prescription. In Dubai these models include; eClaimLink, e-Prescription (eRx), and Electronic Referral Transaction (eReferal).

However, until now there is no nationwide robust technology infrastructure governed by clear standards to build a fully integrated health system that support health information exchange and interoperability on the national level.

Moreover, not all individuals and healthcare organizations in UAE are having broadband Internet access. Either because the service is not available in all locations or because of the high cost of this service. Therefore, this can be a barrier for health information exchange among healthcare providers and the patients.

6.1.4.5   Engagement

To achieve healthcare reform, it is very important to communicate the national aims and strategies with all stakeholders from government, healthcare providers, payers, and the public. This engagement will increase the awareness and provide the whole community with a better understanding for the national directions to improve healthcare through gathering, exchanging, and using health information.

Although the different health authorities in U.A.E are striving to achieve healthcare reform and committed to accomplish a continuous initiatives. Nevertheless, it seems that the main aims behind these initiatives are not clear enough for all. As explained in analysis section, fifty percent of healthcare providers that participated in the survey from private sector indicate that, the main reason behind their decision to implement EHRs is to improve billing and collections. Therefore, healthcare providers in UAE may not have enough awareness about the importance of health IT in improving quality, efficiency, safety, and health in general.

Furthermore, here is no national programs that can increase healthcare providers knowledge about the available health IT products and systems to get benefited from the adoption and the use of such systems. In addition, there is no programs that share evidence and best practices on the use of health IT to improve health.

6.1.4.6 Incentives

There is no direct incentive programs in UA.E that encourage healthcare providers to adopt and use EHRs and other health IT products and services. As discussed in analysis section, cost of purchasing and maintaining EHRs is the most important barrier that can prevent the adoption of such technology. Therefore, incentive programs can foster the adoption of health IT.

6.1.4.7 Workforce training and support

Availability of the highly skilled IT professionals, is crucial to adopt and maintain EHRs and other health technologies nationwide. Therefore, it is necessary to establish education programs specialized in health informatics in all universities and higher education institutes in the country. According to data the web portal of Commission for Academic Accreditation (CAA) (2015). In UAE, although there are 75 licensed higher education institutions that offer 858 of accredited education programs. However, the number of education programs specialized in health health informatics or health information management is very limited (See Table 10).

Institution	Level	Program / major	Concentration
Emirates college of technology	Bachelor	Bachelor of applied health sciences	Health information management
Mena college of management (on probation)	Bachelor	Bachelor in health informatics	
Canadian university of dubai	Bachelor	Bachelor of science in health information management	

Table 10 - Education programs in health information/ informatics, in UAE

Adopted from (CAA, 2015)

In addition, in U.A.E there is no national support centers that can support healthcare providers to select, adopt, upgrade, and use health IT. And to share information regarding best practices of the adoption of EHRs and other health IT.

6.1.4.8 Privacy And Security Protections

Although most of healthcare organizations in U.A.E are adopting Privacy and Security Rules. However, big portion of these are not informing their patients about how their health data will be used and shared, or notifying their patient about any exposure for their personal health information. Additionally, few of healthcare providers included in the study indicate that health information in their existing EHRs can be segmented. Health information segmentation is necessary to determine which segment can be shared and which cannot be shared to protect sensitive health information confidentiality.

Concerns related to health information privacy and security can be a barrier toward the adoption of health IT and health information exchange. Therefore, health information privacy and security should be guaranteed while:

- Storing these information in electronic health records or any other repositories.
- At the time of health information exchanges among patients, providers, payers, pharmacies and any other entities involved in the patient care.
- Exchange health information with public health organization or for secondary uses such as research purposes.

Protecting health information privacy and security are one of the core responsibilities of the government.

6.1.4.9 Research & innovation

In October 2014, His Highness Sheikh Mohammed bin Rashid Al Maktoum launched a National Innovation Strategy that aims to place U.A.E within seven years among the most innovative nations in the world. The Strategy focusing on seven sectors including renewable energy, education, transport, technology, health, space, and water (Khaleej Times, 2014a).

The first phase of the national innovation strategy will be completed within three years and includes 30 national initiatives . These initiatives include new legislation, incubators, innovation,

incentives for private sector, international research partnerships, investing in specialised skills, and an innovation campaign within government.

In healthcare sector, the strategy will encourage advanced technologies in healthcare services. Additionally, will work with strategic partners to foster medical research and motivate the growth of the pharmaceutical and biotechnology industries.

6.1.5   Mobile health (m-Health)

According to Bell (2014), As part of a wider m-Health programme across the UAE the Ministry of Health (MoH) has signed two-years agreement with telecoms operators etisalat and du. The agreement aims to deliver sustainable mobile health services and products related to health and wellness. In addition, this programme aims to particularly support patients with non-communicable diseases such as diabetes, respiratory and cardiovascular diseases.

m-Health programme cope with UAE's Vision 2021 that aims to deliver world-class healthcare for both nationals and expatriates. The Minister of Health, Abdul Rahman Al Owais said, "Mobile health technology is at the heart of our strategy to deliver medical services that tackle the growing burden of non-communicable diseases." (Bell, 2014). m-health programme will offer:

- Remote patient monitoring and diagnosis.
- Patient health education.
- Tele-health and medical video conferencing
- Track a patient's conditions such as obesity control, cancer, diabetes.

In 18th of May 2015, du launched the first wellness hub in UAE. The wellness hub is an online portal dedicated to help the public to live a healthier, and more active life. Wellness hub offer variety of services and products include; wellness devices, health checkup, gym memberships, family activities, health food, and much more. Jawad Shaikh (executive vice president of digital business, du) said, "Health and wellness are a matter of national focus - as a leading UAE company we are committed to supporting this objective."(Du, 2015).

6.1.6   Language Barriers

Language can be a barrier to achieve the aims of healthcare reform in many aspects. It can hinder the delivery of safe and high-quality healthcare for patients, and also it can be a barrier for patients engagement.

Accoring to Partida (2007), language can challenge and breakdowns the communication between physicians and patients. This not only happen when physicians and patients are speaking different languages, but also can happen when both patients and their doctors speak the same language. The reason behind that, vocabulary and terminologies in healthcare environment use different language than what the average person use in their daily lives.

Failure in communication among caregivers and their patients can hinder the delivery of safe and high-quality care to patients especially for those patients with limited english proficiency. Therefore, this can increase the medical errors and to adverse events.

According to Flores et al. (2002), language and culture issues can affect quality of care and health. Additionally, Failure to handle these issues in point of care may result in many adverse consequences. These consequences including medical errors, fewer prescriptions , using harmful remedies, informed consent difficulties, decreased patients' satisfaction, and increase cost of care.

Language and culture gap between clinicians and their patient are increasing with the innovation in healthcare. Therefore, it's necessary to improve patients health literacy that include speaking, listening, and conceptual knowledge. Thus, patients will be able to understand health instructions, forms, and interactions (Partida, 2007).

Accrding to Coulter and Parsons (2008), patient engagement can help to provide better health, reduce medical cost, and improve patients satisfaction. Moreover, patients can play an important role in managing their chronic disease, choosing appropriate treatments, and in protecting their health.

Health literacy is essential to achieve patient engagement. Patients that are not able to understand the process and the basic health information, will not be able to manage their health conditions or take right and informed medical decisions. Improving health literacy is crucial to reduce health disparities. Individuals with low health literacy have less use of preventive services, more exposed to medical and drug errors, higher rates of admission to hospitals, and more poor health status.

Health literacy encompasses the individual's ability to read, understand, evaluate and use health information to make suitable decisions about their health and healthcare. Health literacy have three main goals: provide necessary information and education, foster effective and appropriate use of healthcare resources and to decrease health disparities.

There are many ways to improve health literacy, promote patients engagement in medical decision, and educate patients to play an active role in the self-management of their chronic diseases. That include:

- Websites, patients portals, and other electronic information resources.
- Personalized Computer-based information systems and virtual support.
- Decision aids for patients, such as DVDs, or interactive tools.
- Written information that complement the clinical consultations.
- Training programs of communication skills for health professionals.
- Self-management education programs in chronic disease.

At the same time, language can be also a barrier to improve health literacy. Therefore, all health literacy programs, tools, and resources should be available in both English and the local language.

In U.A.E, healthcare organizations almost recording all health information in English language and big portion of doctors, nurses, and allied medical staff are non-arab. On the other hand, there are many people who don't speak english or their english proficiency is low to average, especially those need more care from the elderly people and women. Therefore, the government should give more care for this important issue that can affect the national aims that seeks to achieve health care reform and achieve better care and better health for individuals and population.

6.2 Recommendations

Based on the survey data analysis and the current status of Health IT implementation in UAE, and with the guidance of the proposed conceptual model. There are a lot of recommendation that can give some ideas for health sector decision makers in United Arab Emirates. In addition, there are some recommendation for both healthcare providers and EHRs Vendors.

6.2.1 Recommendations for Government

- All health authorities and other organizations involved in health decision making in U.A.E should cooperate and work together toward a unified national vision, goals and objectives. And all parties should collaborate and should be committed to achieve that objectives including the government, private and public sector, and the public.
- Standards should be unified nationwide (e.g., health vocabulary and terminologies, health data content/structure, and security standards).

- The government can establish certification authority for Health IT products to ensure that all systems are following the national standards. In addition, to certify that health IT products and systems has the ability to interoperate with different health data sources, and enable health information exchange among different systems.

- To achieve the interoperability and to have a fully integrated national health system, UAE should have a robust technology infrastructure. Additionally this infrastructure should be compatible with the national vision, aims, and should be directed by a clear standards for health information exchange and interoperability.

- The government shall build on the existing technology infrastructure established by the different health authorities. Therefore, the different health systems in the different emirates should be integrated in one big system nationwide instead of building a new system from scratch.

- The government may collaborate with all entities such as, healthcare providers, individuals, health insurance companies, technology developers, and any others entities to foster health information exchange that can improve healthcare.

- Broadband Internet access should be available for all healthcare organizations and individuals to be able to exchange health information electronically. Thus, the government should ensure that service is available for all and in all locations inside the country. To achieve that, the government can work with telecommunication companies to reduce service cost and make the service available all over the country. Moreover, broadband internet can be subsidized by the government.

- The government may establish outreach programs to change the culture of both healthcare providers and individuals. Outreach programs that aim provide the community with a better understanding of the national direction to improve healthcare. Additionally, to illustrate that health IT can improve efficiency, quality, and reduce the cost of healthcare.

- The government may establish incentives programs that can decrease the burdens of healthcare providers to buy, implement, and maintain EHRs. At the same time, these incentives can be combined with the condition of the meaningful use of such systems to make sure that the use of health IT will lead to improvements in efficiency and quality of care.

- The government may create nationwide support centers that will give a direct support to healthcare providers while selecting, implementing, upgrading, and using health IT. Moreover, to collect and share information regarding the best practices of the adoption of EHRs and other health IT systems.

- The government may support higher education institutions and universities to launch health informatics education programs and competency exams. This can help to ensure the availability of the highly skilled IT professionals. Consequently, this will facilitate the development, adoption and the support of EHRs and other health information technologies such as mobile health and telehealth technologies.

- The government should continuously review and update all policies, procedures, and regulations related to health information privacy and security. Moreover, the government should make sure that healthcare providers are applying adequate privacy and security protections during the collection, storing, using, and exchanging health information.

- The government should make periodic audit on healthcare organizations to ensure and expand the compliance with the HIPAA Privacy and Security Rules. Furthermore, any violation for of health information privacy and security should be investigated and penalties should be there, and make sure that the corrective actions has been taken.

- The government shall encourage all healthcare providers to adopt telehealth, to reduce health disparities between the whole population in all location inside UAE. Therefore, patient in rural location can obtain high quality clinical services like patients that living in U.A.E big cities. In addition, doctors in rural area can have second opinion and remote training from highly skilled doctors in U.A.E big cities. Consequently, reduce high cost of transferring patients in emergency cases and reduce high cost of hospital visits through home monitoring programs.

- The government may make it mandatory for all healthcare providers to submit health data electronically to public organizations, that will help these organizations them to analyze, monitor and mitigate threats to public health. Therefore, improve population health at the national level.

- The government may directly fund the researches or provide innovation prizes to private sector to find solution for the major challenges that are facing the healthcare through the advances in Health IT, Then to adopt these innovations nationwide.

- The government may review any regulations or requirements that may prevent the innovation in Health IT.

- The government may collaborate with health authorities and health care providers in the different emirates, to provide training and outreach programs to improve health literacy among the whole population.

- The government may promote research and innovation in medical interpretation and translation, to find innovative and electronic ways to translate health information into Arabic. Moreover, to present these information in more easier and understandable way.

- The government may work with the different health authority to translate the international coding sets into Arabic. Therefore, the country will follow the international standards, and in the same time will reduce the language barriers among caregivers and patients, and improve health literacy.

6.2.2 Recommendations for Healthcare providers

- Healthcare providers in UAE should make sure that, all patient health records should be recorded electronically, and all health data should be recorded as structured data in relational databases. Therefore, facilitate the retrieve, use and exchange of health information among all parties involved in healthcare.

- Healthcare providers while selecting new EHRs or upgrading the existing system, they should make sure that these systems are having clinical decision support capabilities. Thus, help doctors and their patients to make informed health decisions. Consequently, improve efficiency, avoid medical errors and adverse events, increase quality of care and enhanced health outcomes, reduce cost, and raise the satisfaction of patients and providers.

- Healthcare providers should make sure that their system having the capability to be integrated with other system through web services, HL7 or any other way.

- Healthcare providers should make sure that EHRs are integrated with all medical equipments that generate health data such as medical imaging, medical monitors, medical laboratory, and diagnostic medical equipments. Thus, all patients health date will be available in one place to support clinical decision making.

- Healthcare providers may encourage patient engagement and provide patient with timely access to their health information through patient portals. For example, they can provide a set of electronic services to their patients such as online appointment booking, view and

download laboratory results, radiology images and reports, view and download prescribed medication and dosages. Therefore, foster patient engagement and gain patient trust and raise satisfactions.

- Healthcare providers may adopt innovative health IT and telehealth technologies that provide a lot of benefits for them and their patients, including:
    - o Enable their doctors to get second opinion and a specialist support, to help them to provide better care for their patients and community.
    - o Extend their clinical reach to patients who can benefit from their medical staff' expertise.
    - o Save the consumed time of doctors while traveling between facilities to see patients. Therefore increase their productivity and improve their quality of life.
    - o Retain some patients those may be transferred to another healthcare facilities, Therefore, retaining the revenues associated with care of these patients.
    - o In some cases, earn on-call pay for providing tele-consults.
- Healthcare providers should adopt adequate privacy and security protections for their patients' health information. In addition, they should inform their patients about any disclosure for their health information.
- Quality metrics required by health authorities should be generated electronically from EHRs to save time and reduce errors.
- Healthcare providers may provide the necessary training for their doctors, allied staff, and nurses to improve their communication skills. Therefore, reduce culture and language gaps between caregivers and patients.
- Healthcare providers should implement innovative technologies to translate health information into Arabic and other languages. Moreover, They should make sure that their websites, patients' portals and patients education resources are available at least in both English and Arabic languages.

6.2.3 Recommendations for EHRs Vendors

- EHRs vendors should make sure that their systems can communicate with other systems electronically and compatible with interoperability standards.
- EHRs vendors can provide entry-level EHRs with lower cost that focus on coordination of care and health information exchange. Therefore, small medical centers/clinics can afford

to adopt such system. In addition, EHRs vendors should make sure that health data recorded in these system can be migrated easily to any other EHRs in the future.

- EHRs should cope with the latest advances in Health IT and information technology in general.

- EHRs vendors should make sure that their products are compatible with and follow the national vision, objectives, and standards.

- To assure health data privacy and security, EHRs should have the following capabilities:
    o Health information should be secured any encrypted.
    o EHRs should have adequate Access control rules to ensure that only authorized persons can access EHRs.
    o EHRs should have audit logs for specific actions.
    o After a certain time Idle user should be logged out automatically from EHRs.
    o After a certain number of unsuccessful login tries, user should be blocked automatically.

- Health information in EHRs should be segmented, so patient can choose which part/segment of their data can be shared to protect the confidentiality of sensitive health information.

- EHRs vendors should make sure that their products are supporting Arabic language and system can generate medical reports in both English and Arabic.

Chapter 7: Conclusion

7.1   Conclusion

This dissertation proposed a model and roadmap for healthcare transformation journey from the traditional healthcare system to the information-driven healthcare. The main aim of the information-driven healthcare is to deliver the right information to the right people and at the right time. Therefore, facilitate informed decision-making, coordination of care, allow patients and their families to be more engaged in managing their health conditions. Consequently, achieving great improvements in quality of care, efficiency, and population health and wellness. Moreover, reduce healthcare expenditure over the time. Health information technology can play crucial role to foster this transformation.

The proposed model was built based on extrapolation for the developed world experience in health care system reform. More specifically, based upon U.S experience since 2000 onward.

The proposed model and roadmap applied to the current status of health care system in the United Arab Emirates as one of the developing country. Survey was conducted and data gathered from 22 healthcare organizations that distributed geographically over all UAE emirates.

Readiness of the healthcare system in UAE for the transformation journey toward Information-driven healthcare were evaluated. The evaluation focused on three main areas that are: adoption of health information technology, health information exchange, and interoperability. In addition, the building blocks in the proposed model applied also to the current status in UAE.

In sum, the different health authorities in UAE are striving to achieve health system reform and have executed a lot of initiatives that foster the exchange of health information. Additionally, the majority of healthcare providers included in the study from both private and government sectors are already adopting EHRs. However, there is no clear strategies for health information exchange and interoperability on the national level, and all these entities are working individually or on emirates-level.

In addition, in UAE to build a unified and fully integrated national health system more efforts are required from government, healthcare providers, and health IT vendors. It is required to have a unified national health IT strategies and standards. Additionally, all related parties should collaborate toward the national aims, objectives and should follow the same standards.

The dissertation provided a lot of recommendations that highlight the actions required from government, healthcare organizations, and EHRs vendors to enhance the current situation and move toward the information-driven healthcare.

7.2 Research Limitations

Research topic is a very forked topic. Therefore, there was time constraints to cover the whole aspects during the research period. The research covered the whole aspects of healthcare system reform nationwide. However, the study did not expose to further details about the reform that should happen inside all healthcare organizations. Nor did the study investigate how healthcare organizations can build the infrastructure to support the national aims toward the healthcare system reform.

In Addition, there was some difficulties to encourage IT professionals and administration in healthcare organization to participate in the study. More specifically, the government sector because of the confidentiality.

Finally, The research focused the American healthcare reform experience and model only. Although, There are other successful models all over the world.

7.3 Future directions

One of the interesting future directions that can exposed is investigating the role of digital hospitals. In digital hospitals, technology convergence happen by integrating digital hospital applications with hospital infrastructure to streamline the processes, involving patients in their own care and finding new and improved ways to deliver healthcare. Therefore, digital hospitals can help and support healthcare transformation.

Another interesting direction is comparing the plans and reforms of multiple developed countries, instead of focusing solely on the United States. This can highlight differences and similarities between countries. Thus, expose valuable lessons.

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APPENDICE

Appendix A - Implementation schedule of PPACA

Issue	What legislation would do	Effective date
2010		
Business tax credits	Small businesses with no more than 25 employees and average annual wages of $40 000 would receive tax credits to help provide insurance to employees. The tax credit would be up to 35% of the employer's contribution if the employer pays 50% of the total premium cost.	2010 tax year, with the credit increasing up to 50% in 2014
Temporary reinsurance program	A $5 billion temporary reinsurance program would be created for employees to provide healthcare coverage for retirees over the age of 55 who are not eligible for Medicare.	90 days after enactment
Temporary high-risk insurance pool	A $5 billion temporary national high-risk insurance pool would be created to provide health coverage to individuals with pre-existing medical conditions who have been uninsured for at least 6 months.	90 days after enactment
Pre-existing conditions	Insurance companies would be barred from denying coverage to children who have pre-existing medical conditions.	6 months after enactment
Adult dependent children	Insurance companies would have to provide coverage for dependent children up to the age of 26.	6 months after enactment
Insurance coverage limits	Insurance plans would be prohibited from placing lifetime limits on how much they pay out to individual policyholders and from rescinding coverage except in cases of fraud.	6 months after enactment
Medicare drug rebates	Medicare patients who face a gap in prescription drug coverage would receive a 1-year, $250 rebate to help pay for medication.	Immediately
Tanning salon tax	A tax of 10% would be imposed on the cost of indoor tanning services.	Immediately
Preventive services	Health insurance plans would be required to cover preventive services such as immunization for children and cancer screenings for women.	6 months after enactment
2011		
Tax changes on healthcare savings accounts	The federal tax on individuals who spend money from heathcare savings accounts on ineligible medical expenses would double to 20%.	1 January 2011
Community health centers	Funding would increase by $11 billion for community health centers that provide medical care to patients who can not afford it.	1 October 2011
Medicare 'doughnut hole'	Drug companies would provide a 50% discount on brand-name prescription drugs for seniors who face a gap in drug coverage. More subsidies would be phased in through 2020, when the coverage gap would be closed.	1 January 2011
Primary care	Primary care doctors and general surgeons practicing in areas that lack primary care doctors would receive a 10% bonus payment under Medicare.	1 January 2011 through 2015
Long-term care	A voluntary long-term care program called CLASS* would be created. After at least 5 years of contributions, enrollees would be entitled to a $50-a-day cash benefit to pay for long-term care.	1 January 2011
New annual fee on drug-makers	A total annual fee of $2.5 billion would be imposed on pharmaceutical manufacturers.	1 January 2011
Insurance rebates	Health insurance companies would be required to provide rebates to enrollees if they spend <85% of their premium dollars on healthcare as opposed to administrative costs.	1 January 2011
2012—2013		
Annual fee on drug-makers	The annual fee on pharmaceutical manufacturers would increase to $3 billion each year through 2016.	1 January 2012
Contribution limits on healthcare savings accounts	The limit on how much individuals could contribute to flexible savings accounts that let people set aside money tax free for health costs would be set at $2500. Currently employers set the limit.	1 January 2013
Itemized deductions for unreimbursed medical expenses	The threshold for deducting such expenses would increase from 7.5% of adjusted gross income to 10%.	1 January 2013
Medicare taxes	The Medicare tax rate would increase by 0.9 percentage points—from 1.45% to 2.35%—on earnings over $200 000 for individuals and $250 000 for families. Also, for the first time, a 3.8% Medicare tax would be imposed on unearned income.	1 January 2013
2014		
Individual mandate	Most Americans would be required to buy health insurance or pay fines of $95 per individual up to $285 per family or 1% of taxable household income, whichever is greater.	1 January 2014
Employer requirements	Companies with ≥50 employees would pay a fine if any of their full-time workers qualified for federal healthcare subsidies.	1 January 2014
Medicaid expansion	The program for low-income Americans under the age of 65 would expand by increasing the income eligibility to 133% of federal poverty, or $29 327 for a family of four.	1 January 2014
Federal subsidies	Federal subsidies, which vary based on household income, would help offset the cost of buying insurance for Americans and legal residents who qualify.	1 January 2014
Annual fee on insurance companies	An annual fee totaling $8 billion would be imposed on heath insurance companies.	1 January 2014
Health insurance Exchanges	A state-based healthcare Exchange—a marketplace where uninsured individuals and small businesses could comparison shop for insurance policies—would be created.	1 January 2014
2015—2016		
Individual mandate	Penalties for not carrying insurance would increase to $325 for each family member up to $975 per family or 2% of taxable household income, whichever is greater.	1 January 2015
Annual fee on insurance companies	The annual fee on health insurance companies would increase to $11.3 billion.	1 January 2015
Individual mandate	Penalties for not carrying insurance would increase to $695 for each family member up to $2085 per family or 2.5% of taxable household income, whichever is greater.	1 January 2016 (adjusted for inflation after 2016)
2017—2018		
Annual fee on drug-makers	The annual fee on pharmaceutical manufacturers would increase to $3.5 billion in 2017 and $4.2 billion in 2018.	1 January 2017
Annual fee on insurance companies	The annual fee on health insurance companies would increase to $13.9 billion in 2017 and $14.3 billion in 2018.	1 January 2017
Excise tax on high-cost insurance plans	A 40% excise tax would be imposed on healthcare plans that cost more than $10 200 for individual coverage and $27 500 for family coverage.	1 January 2018

*Community Living Assistance Services and Support.
Source: Kaiser Family Foundation, White House, The Commonwealth Fund.

(Manchikanti and Hirsch, 2012)

Appendix B - CMS EHR Incentive Programs Milestone Timeline
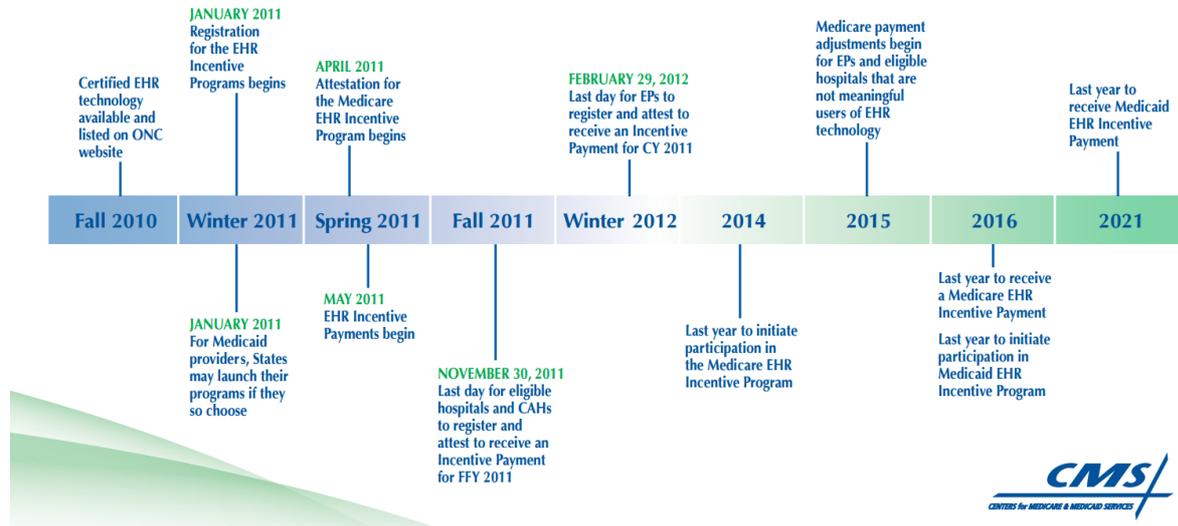
(CMS, 2010)

Appendix C - Stage 1 & Stage 2 core and menu objectives for eligible hospitals and CAHs

- **Stage 1**

Eligible Hospital and CAH Core Objectives		
(1)	Use CPOE for medication orders directly entered by any licensed healthcare professional who can enter orders into the medical record per State, local, and professional guidelines.	AVAILABLE
(2)	Implement drug-drug and drug-allergy interaction checks.	AVAILABLE
(3)	Maintain an up-to-date problem list of current and active diagnoses.	AVAILABLE
(4)	Maintain active medication list.	AVAILABLE
(5)	Maintain active medication allergy list.	AVAILABLE
(6)	Record all of the following demographics: (A) Preferred language (B) Gender (C) Race (D) Ethnicity (E) Date of birth (F) Date and preliminary cause of death in the event of mortality in the eligible hospital or CAH	AVAILABLE
(7)	Record and chart changes in the following vital signs: (A) Height (B) Weight (C) Blood pressure (D) Calculate and display body mass index (BMI) (E) Plot and display growth charts for children 2—20 years, including BMI	AVAILABLE
(8)	Record smoking for patients 13 years old or older.	AVAILABLE
(9)	Report hospital clinical quality measures to CMS. *(No longer core objective but still required)*	AVAILABLE
(10)	Implement one clinical decision support rule related to a high priority hospital condition along with the ability to track compliance with that rule.	AVAILABLE
(11)	Provide patients with an electronic copy of their health information (including diagnostic test results, problem list, medication lists, medication allergies, discharge summary, procedures) upon request.	AVAILABLE
(12)	Provide patients with an electronic copy of their discharge instructions at time of discharge, upon request.	AVAILABLE
(13)	Protect electronic health information created or maintained by the certified EHR technology through the implementation of appropriate technical capabilities.	AVAILABLE

Eligible Hospital and CAH Menu Set Objectives		
(1)	Implement drug formulary checks.	AVAILABLE
(2)	Record advance directives for patient 65 years old or older.	AVAILABLE
(3)	Incorporate clinical lab-test results into EHR as structured data.	AVAILABLE
(4)	Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach.	AVAILABLE
(5)	Use certified EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate.	AVAILABLE
(6)	The eligible hospital or CAH who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation.	AVAILABLE
(7)	The eligible hospital or CAH that transitions their patient to another setting of care or provider of care or refers their patient to another provider of care should provide summary care record for each transition of care or referral.	AVAILABLE
(8)	Capability to submit electronic data to immunization registries or immunization information systems and actual submission according to applicable law and practice.	AVAILABLE
(9)	Capability to submit electronic data on reportable lab results to public health agencies and actual submission according to applicable law and practice.	AVAILABLE
(10)	Capability to submit electronic syndromic surveillance data to public health agencies and actual submission according to applicable law and practice.	AVAILABLE

(CMS, 2014)

- **Stage 2**

Eligible Hospital Core Objectives	
(1)	Use computerized provider order entry (CPOE) for medication, laboratory, and radiology orders directly entered by any licensed healthcare professional who can enter orders into the medical record per state, local, and professional guidelines.
(2)	Record all of the following demographics: preferred language, sex, race, ethnicity, date of birth, date and preliminary cause of death in the event of mortality in the eligible hospital or CAH.
(3)	Record and chart changes in the following vital signs: height/length and weight (no age limit); blood pressure (ages 3 and over); calculate and display body mass index (BMI); and plot and display growth charts for patients 0-20 years, including BMI.
(4)	Record smoking status for patients 13 years old or older.
(5)	Use clinical decision support to improve performance on high-priority health conditions.
(6)	Provide patients the ability to view online, download, and transmit information about a hospital admission.
(7)	Protect electronic health information created or maintained by the Certified EHR Technology through the implementation of appropriate technical capabilities.
(8)	Incorporate clinical lab test results into Certified EHR Technology as structured data.
(9)	Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research, or outreach.
(10)	Use clinically relevant information from Certified EHR Technology to identify patient-specific education resources and provide those resources to the patient.
(11)	The eligible hospital or CAH who receives a patient from another setting of care or provider of care or believes an encounter is relevant should perform medication reconciliation.
(12)	The eligible hospital or CAH who transitions their patient to another setting of care or provider of care or refers their patient to another provider of care provides a summary care record for each transition of care or referral.
(13)	Capability to submit electronic data to immunization registries or immunization information systems except where prohibited, and in accordance with applicable law and practice.
(14)	Capability to submit electronic reportable laboratory results to public health agencies, where except where prohibited, and in accordance with applicable law and practice.
(15)	Capability to submit electronic syndromic surveillance data to public health agencies, except where prohibited, and in accordance with applicable law and practice.
(16)	Automatically track medications from order to administration using assistive technologies in conjunction with an electronic medication administration record (eMAR).
Eligible Hospital Menu Objectives	
(1)	Record whether a patient 65 years old or older has an advance directive.
(2)	Record electronic notes in patient records.
(3)	Imaging results consisting of the image itself and any explanation or other accompanying information are accessible through CEHRT.
(4)	Record patient family health history as structured data.
(5)	Generate and transmit permissible discharge prescriptions electronically (eRx).
(6)	Provide structured electronic lab results to ambulatory providers.

(CMS, 2012)

Appendix D - National Quality Strategy Priorities and Goals, With Illustrative Measures

Priority	Initial Goals, Opportunities for Success, and Illustrative Measures
#1 **Safer Care**	**Goal:** Eliminate preventable health care-acquired conditions **Opportunities for success:** • Eliminate hospital-acquired infections • Reduce the number of serious adverse medication events **Illustrative measures:** • Standardized infection ratio for central line-associated blood stream infection as reported by CDC's National Healthcare Safety Network • Incidence of serious adverse medication events
#2 **Effective Care Coordination**	**Goal:** Create a delivery system that is less fragmented and more coordinated, where handoffs are clear, and patients and clinicians have the information they need to optimize the patient-clinician partnership **Opportunities for success:** • Reduce preventable hospital admissions and readmissions • Prevent and manage chronic illness and disability • Ensure secure information exchange to facilitate efficient care delivery **Illustrative measures:** • All-cause readmissions within 30 days of discharge • Percentage of providers who provide a summary record of care for transitions and referrals
#3 **Person- and Family-Centered Care**	**Goal:** Build a system that has the capacity to capture and act on patient-reported information, including preferences, desired outcomes, and experiences with health care **Opportunities for success:** • Integrate patient feedback on preferences, functional outcomes, and experiences of care into all care settings and care delivery • Increase use of EHRs that capture the voice of the patient by integrating patient-generated data in EHRs • Routinely measure patient engagement and self-management, shared decision-making, and patient-reported outcomes **Illustrative measures:** • Percentage of patients asked for feedback
#4 **Prevention and Treatment of Leading Causes of Mortality**	**Goal:** Prevent and reduce the harm caused by cardiovascular disease **Opportunities for success:** • Increase blood pressure control in adults • Reduce high cholesterol levels in adults • Increase the use of aspirin to prevent cardiovascular disease • Decrease smoking among adults and adolescents **Illustrative measures:** • Percentage of patients ages 18 years and older with ischemic vascular disease whose most recent blood pressure during the measurement year is <140/90 mm Hg

	• Percentage of patients with ischemic vascular disease whose most recent low-density cholesterol is <100 • Percentage of patients with ischemic vascular disease who have documentation of use of aspirin or other antithrombotic during the 12-month measurement period
#5 **Supporting Better Health in Communities**	**Goal:** Support every U.S. community as it pursues its local health priorities **Opportunities for success:** • Increase the provision of clinical preventive services for children and adults • Increase the adoption of evidence-based interventions to improve health **Illustrative measures:** • Percentage of children and adults screened for depression and receiving a documented follow-up plan • Percentage of adults screened for risky alcohol use and if positive, received brief counseling • Percentage of children and adults who use the oral health care system each year • Proportion of U.S. population served by community water systems with optimally fluoridated water
#6 **Making Care More Affordable**	**Goal:** Identify and apply measures that can serve as effective indicators of progress in reducing costs **Opportunities for success:** • Build cost and resource use measurement into payment reforms • Establish common measures to assess the cost impacts of new programs and payment systems • Reduce amount of health care spending that goes to administrative burden • Make costs and quality more transparent to consumers **Illustrative measures:** • To be developed

(US Department of Health and Human Services, 2011)

Appendix E - Federal Health IT Strategic Plan 2011-2015, Goals, Objectives, and Strategies

Goal I: Achieve Adoption and Information Exchange through Meaningful Use of Health IT	
Objectives	**Strategies**
I.A. Accelerate adoption of electronic health records	I.A.1. Provide financial incentive payments for the adoption and meaningful use of certified EHR technology.
	I.A.2. Provide implementation support to health care providers to help them adopt, implement, and use certified EHR technology.
	I.A.3. Support the development of a trained workforce to implement and use health IT technologies.
	I.A.4. Encourage the inclusion of meaningful use in professional certification and medical education.
	I.A.5. Establish criteria and a process to certify EHR technology that can support meaningful use criteria.
	I.A.6. Communicate the value of EHRs and the benefits of achieving meaningful use.
	I.A.7. Align federal programs and services with the adoption and meaningful use of certified EHR technology.
	I.A.8. Work with private sector payers and provider groups to encourage providers to achieve meaningful use.
	I.A.9. Encourage and facilitate improved usability of EHR technology.
I.B. Facilitate information exchange to support meaningful use of electronic health records	I.B.1. Foster business models that create health information exchange.
	I.B.2. Monitor health information exchange options and fill the gaps for providers that do not have viable options.
	I.B.3. Ensure that health information exchange takes place across individual exchange models, and advance health systems and data interoperability.
I.C. Support health IT adoption and information exchange for public health and populations with unique needs.	I.C.1. Ensure public health agencies are able to receive and share information with providers using certified EHR technology.
	I.C.2. Track health disparities and promote health IT that reduces them.
	I.C.3. Support health IT adoption and information exchange in long-term/post-acute, behavioral health, and emergency care settings.

Goal II: Improve Care, Improve Population Health, and Reduce Health Care Costs through the Use of Health IT	
Objectives	**Strategies**
II.A. Support more sophisticated uses of EHRs and other health IT to improve health system performance	II.A.1. Identify and implement best practices that use EHRs and other health IT to improve care, efficiency, and population health.
	II.A.2. Create administrative efficiencies to reduce cost and burden for providers, payers, and government health programs.
II.B. Better manage care, efficiency, and population health through EHR-generated reporting measures	II.B.1. Identify specific measures that align with the National Quality Strategy.
	II.B.2. Establish standards, specifications, and certification criteria for collecting and reporting measures through certified EHR technology.
II.C. Demonstrate health IT-enabled reform of payment structures, clinical practices, and population health management	II.C.1. Fund and administer demonstration communities to show how the advanced use of health IT can achieve measurable improvements in care, efficiency, and population health.
	II.C.2. Align health IT initiatives and clinical and payment reform pilots and demonstrations.
II.D. Support new approaches to the use of health IT in research, public and population health, and national health security	II.D.1: Establish new approaches to and identify ways health IT can support national prevention, health promotion, public health, and national health security.
	II.D.2: Invest in health IT infrastructure to support the National Prevention and Health Promotion Strategy.
	II.D.3: Ensure a mechanism for information exchange in support of research and the translation of research findings back into clinical practice.

Goal III: Inspire Confidence and Trust in Health IT	
Objectives	**Strategies**
III.A. Protect confidentiality, integrity, and availability of health information	III.A.1. Promulgate appropriate and enforceable federal policies to protect the privacy and security of health information.
	III.A.2. Enforce existing federal privacy and security laws and maintain consistency with federal policy.
	III.A.3. Encourage the incorporation of privacy and security functionality into health IT.
	III.A.4. Assess technical solutions that could support more granular patient choice and data segmentation.
	III.A.5. Identify health IT system security vulnerabilities and develop strategic solutions.
	III.A.6. Identify health IT privacy and security requirements and best practices, and communicate them through health IT programs.
III.B. Inform individuals of their rights and increase transparency regarding the uses of protected health information	III.B.1. Inform individuals about their privacy and security rights and how their information may be used and shared.
	III.B.2. Increase transparency regarding the development of policies and standards related to uses and sharing of protected health information.
	III.B.3. Maintain strong breach notification requirements.
III.C. Improve safety and effectiveness of health IT	III.C.1. Provide implementation and best practice tools for the effective use of health IT.
	III.C.2. Evaluate safety concerns and update approach to health IT safety.
	III.C.3. Monitor patient safety issues related to health IT and address concerns.

Goal IV: Empower Individuals with Health IT to Improve their Health and the Health Care System	
Objectives	**Strategies**
IV.A. Engage individuals with health IT	IV.A.1. Listen to individuals and implement health IT policies and programs to meet their priorities.
	IV.A.2. Communicate with individuals openly and spread messages through existing communication networks and dialogues.
IV.B. Accelerate individual and caregiver access to their electronic health information in a format they can use and reuse	IV.B.1. Through Medicare and Medicaid EHR Incentive Programs, encourage providers to give patients access to their health information in an electronic format.
	IV.B.2. Through federal agencies that deliver or pay for health care, act as a model for sharing information with individuals and make available tools to do so.
	IV.B.3. Establish public policies that foster individual and caregiver access to their health information while protecting privacy and security.
IV.C. Integrate patient-generated health information and consumer health IT with clinical applications to support patient-centered care	IV.C.1. Support the development of standards and tools that make EHR technology capable of interacting with consumer health IT and build these requirements for the use of standards and tools into EHR certification.
	IV.C.2. Solicit and integrate patient-generated health information into EHRs and quality measurements.
	IV.C.3. Encourage the use of consumer health IT to move toward patient-centered care.

Goal V: Achieve Rapid Learning and Technological Advancement	
Objectives	**Strategies**
V.A. Lead the creation of a learning health system to support quality, research, and public and population health	V.A.1. Establish an initial group of learning health system participants.
	V.A.2. Develop standards, policies, and technologies to connect participants within the learning health system.
	V.A.3. Engage patients, providers, researchers, and institutions to exchange information through the learning health system.
	V.A.4. Grow the learning health system by adding more members and expanding policies and standards as needed.
V.B. Broaden the capacity of health IT through innovation and research	V.B.1. Liberate health data to enable health IT innovation.
	V.B.2. Make targeted investments in health IT research.
	V.B.3. Employ government programs and services as test beds for innovative health IT.
	V.B.4. Monitor and promote industry innovation.
	V.B.5. Provide clear direction to the health IT industry regarding government roles and policies for protecting individuals while not stifling innovation.

(ONC, 2011, pp.70–73)

Appendix F - Survey

Health Information Technologies (Health IT) Survey

Dear
You have been invited by Mohamed Fahmy, Student at The British University in Dubai (BUiD) to offer your valuable opinion in an important survey. The targeted populations are IT/HIS Team, and management those are working in healthcare organizations (Hospitals/ Clinics/ Medical centers) in U.A.E, from both private and public sectors. Your feedback will directly and immediately impact the success of my research regarding the health information technologies (Health IT) that are currently implemented in the United Arab Emirates, to evaluate the current status and to know to what extent healthcare system in UAE are ready to move from the isolated systems in the different healthcare organization to a fully integrated and interoperable systems that can share and exchange health information freely while securing health information privacy and security, to achieve healthcare reform and provide more affordable and better care for individuals and population.

In order to participate, you may either:

1. Click on this link

<div align="center">or</div>

2. Copy-paste the entire following link between quote marks (NOT including the quote marks) in a web browser
" http://www.sogosurvey.com/k/SsTPTPPsRsPsPsP "

Thank you for your participation.

Regards,

Mohamed Fahmy

Section 1: Participants /Organization Information

Required Information

Health Information Technologies (Health IT) Survey

Contact Information:

Your name:	
Contact No.:	
Email:	

Job level
- ○ CEOs, COOs, CFOs or VPs
- ○ Administrator/Director
- ○ CIO/IT Director
- ○ IT Manager
- ○ Other (Please specify)

Organization Name:

Characters Remaining: 100

Organization Type:
- ○ Hospital
- ○ Clinic
- ○ Other (Please specify)

In your hospital/ Clinic, do you have single or multi-specialty?
- ○ Single Specialty
- ○ Multi-Specialty

Sector:
- ○ Governmental
- ○ Private

in which of the UAE cities listed below, you have branches?
- ☐ Abu Dhabi
- ☐ Al Ain
- ☐ Ajman
- ☐ Dubai
- ☐ Fujairah
- ☐ Ras Al Khaimah
- ☐ Sharjah
- ☐ Umm Al Qaiwain

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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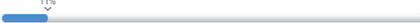
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Section 2: Health IT Adoption

الجامعة البريطانية في دبي
The British University in Dubai

⊗ **Required Information**

Health Information Technologies (Health IT) Survey

⊗ Do you provide services in a single or multiple Locations?

○ Only 1 Location

○ 2-5

○ 6-10

○ 11-20

○ over 20

⊗ Do you have onsite Information Technology Staff?

○ Yes

○ No

○ No, but have service contracts

⊗ Are you using Electronic Health Records (EHRs) in your hospital/clinic?

○ Yes, all electronic, at all sites, no paper records

○ Yes, all electronic at some sites, but all paper records or mix electronic/paper at other sites

○ No, all papers, at all sites

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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Section 3: Only for those not implementing EHRs (Online survey will move automatically to this page depending on user answer and it will be end of survey)

Health Information Technologies (Health IT) Survey

⊛ Required Information

Do you intend to use Electronic Health Records in your hospital /clinic?
- ○ Yes
- ○ No

When will you adopt and utilize EHRs?
- ○ less than a year
- ○ 1 – 2 years
- ○ 3 or more years
- ○ I don't know

Please select the top 5 items from the list below, according to what is preventing you from adopting and utilizing EHRs for your practice. [Please select at least 5 options.]
- ☐ I do not understand the benefits/value of EHRs
- ☐ Not comfortable using a computer
- ☐ Lack of internet access
- ☐ Concern regarding maintaining quality of care for my patients
- ☐ Too many choices of EHRs available in the market
- ☐ Too few choices of EHRs available in the market
- ☐ Don't Know how to select the proper system
- ☐ Cost of purchasing a system
- ☐ Annual maintenance cost
- ☐ Privacy and security
- ☐ lack of dedicated staff to implement and maintain the system
- ☐ Lack of trained staff to implement and maintain the system
- ☐ Lack of patient awareness
- ☐ I don't want to Implement EHRs
- ☐ Other (Please specify)

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

<< Back   Clear answers on page   Submit

100%

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End of survey

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Section 4: Only by those having EHRs

Section 5: EHRs functionalities to improving quality, safety, and efficiency and reducing health disparities

Required Information

Health Information Technologies (Health IT) Survey

Please Specify Which of the following functions are implemented in your EHRs or there is a plan to implement or there is no plan for implementation	Your response			
	Fully implemented in all units	Fully implemented in at least 1 unit	Began implementation or resources identified	No implementation and no specific plans
Computerized Provider Order Entry (CPOE) For prescription and Laboratory orders ✱	○	○	○	○
Implement drug-drug/drug-allergy interaction checks ✱	○	○	○	○
Generate and transmit e-prescriptions ✱	○	○	○	○
Implement drug formulary checks (Check electronically if prescribed drugs are in formulary or preferred drug list) ✱	○	○	○	○
Recording Patient demographics ✱	○	○	○	○
Report ambulatory/ hospital clinical quality measures electronically to any entity outside your organization ✱	○	○	○	○
Maintain an up-to-date problem list of current and active diagnoses ✱	○	○	○	○
Maintain active medication list ✱	○	○	○	○
Maintain an active medication allergy list ✱	○	○	○	○
Record and chart changes in vital signs ✱	○	○	○	○
Record smoking status for patients ages 13 or older ✱	○	○	○	○
Implement at least one clinical decision support rule related to specialty or a high priority hospital condition along with the ability to track compliance with that rule at the time of care ✱	○	○	○	○
Laboratory results are recorded as structured data ✱	○	○	○	○
Generate lists of patients by specific conditions to use for quality improvement, reduction of disparities, research or outreach ✱	○	○	○	○
Send reminders to patients for preventive/follow up care ✱	○	○	○	○

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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44%

Section 6: EHRs functionalities to engage patients and families in their care

❌ **Required Information**

Health Information Technologies (Health IT) Survey

Please specify whether the EHRs capabilities, are currently available in your system and are in use or not				
	Your response			
	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
❌ Provide patients with an electronic copy of their health information (including diagnostic test results, problem list, medication lists, medication allergies, discharge summary, procedures), upon request	○	○	○	○
❌ Provide patients with timely electronic access to their health information, through patients' portals or any other way	○	○	○	○
❌ Use EHR technology to identify patient-specific education resources and provide those resources to the patient if appropriate (I.e., depending on ICD9/ICD10 you can generate list of educational content and send these content to patient by emails)	○	○	○	○

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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56%

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Section 7: EHRs functionalities to improve care coordination, population and public health through health information exchange

⊗ **Required Information**

Health Information Technologies (Health IT) Survey

Please specify whether the EHRs capabilities, are currently available in your system and are in use or not				
	Your response			
	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
⊗ Capability to perform medication reconciliation, when receiving a patient from another setting of care or provider or believes an encounter is relevant, to ensure the medication information in the chart in your EHRs is accurate every time	○	○	○	○
⊗ Capability to exchange key clinical information electronically (e., discharge summary, procedures, problem list, medication list, medication allergies, diagnostic test results) with other providers/ Hospitals and patient-authorized entities outside your organization	○	○	○	○
⊗ Capability to exchange health information electronically with other hospitals/ clinics inside your organization	○	○	○	○
⊗ Capability to submit electronic data to immunization registries or Immunization Information Systems and actual submission in accordance with applicable law and practice	○	○	○	○
⊗ Capability to submit electronic Syndromic Surveillance Data to Public Health Agencies	○	○	○	○
Capability to submit electronic data on reportable laboratory results to public health agencies	○	○	○	○

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67%

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Section 8: Interoperability and standards

Health Information Technologies (Health IT) Survey

Please specify which of the medical code sets listed below are implemented in all or some of hospitals/clinics in your organization

Your response (Please select one or more city where this coding are implemented)									
	Abu Dhabi	Al Ain	Ajman	Dubai	Fujairah	Ras Al Khaimah	Sharjah	Umm Al Qaiwain	N/A
CPT (Current Procedural Terminology) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
HCPCS (Healthcare Common Procedure Coding System) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
Drugs (Greenrain Drug Codes) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
ICD-9 CM (International Classification of Diseases - Clinical Modification) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
ICD-10 CM (International Classification of Diseases - Clinical Modification) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
DRG (Diagnosis Related Groupings System) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
LONIC (Logical Observation Identifiers Names and Codes) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
CDT (Code on Dental Procedures and Nomenclature) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
DDC (Dubai Drug Code) ⊗	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐	☐

⊗ Select from the list below, data content/structure standards that your systems are using or compliant with

☐ Clinical Document Architecture (C-CDA)
☐ Health Level 7 (HL7)
☐ Other (Please specify)
[_____]

⊗ How you are storing the electronic health records?

○ Only structured data (i.e., in relational database)
○ Only unstructured (i.e., flat files)
○ Mixed structured and unstructured

⊗ Do you Have broadband internet connection?

○ Yes, In all location
○ Yes, But only in some locations, because service is not available in other locations
○ No, because the cost is high
○ No for other reason (Please specify)
[_____]

Please specify whether the capabilities listed below are currently available in your system and are in use or not

Your response				
	Option is there, and in use	Option is there, But not in use	Option is not there	Not Sure
EHR system has the ability to communicate to other systems through web services or any other way ⊗	○	○	○	○
EHR system has the ability to exchange data electronically with personal health records, mobile health applications, wearable devices, and home health monitoring devices? ⊗	○	○	○	○
The system can submit e-calim and receive response from e-calim portal electronically without any manual transaction ⊗	○	○	○	○

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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78%

Section 9: Health information privacy and security

Health Information Technologies (Health IT) Survey

Health information privacy and security			
	Your response		
	Yes	No	Not Sure
Are you implementing adequate security and privacy protections for patients' health Information in your system (i.e., HIPAA Privacy and Security Rules)	○	○	○
Do you notify the patient about any disclosure for their personal health information?	○	○	○
Do you inform the patient about how their health information will be used and shared?	○	○	○
Are health information in your system segmented so patient has the option to select which part of their health information will be shared?	○	○	○

Participation in this survey in completely voluntary and all responses will be kept strictly confidential and treated with full respect. No real names or identifications will be disclosed in the final report.

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89%

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End of survey

Thank you

Thank you for your participation. If you have additional questions about this survey, please email at 2013110115@student.buid.ac.ae.

To invite others to participate in this survey. please **Click Here**

You can see results by clicking here

Your response has been recorded.

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