A Cross-Sectional Study about a Health Information System (HIS) in the United Arab Emirates Federal Healthcare Organization (UAE FHO)

دراسة عرضية حول نظام المعلومات الصحية في مؤسسة الرعاية الصحية الاتحادية بدولة الإمارات العربية المتحدة

By

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Abbreviations List

UAE FHO: United Arab Emirates Federal Healthcare Organization

HIS: Health Information System

AJ: Ajman

FUJ: Al-Fujairah

DB: Dubai

RAK: Ras Al-Khaimah

SJ: Shrajah

UAQ: Um Al-Qwain

PMO: Project Management Office

IT: Information Technology

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Abstract

As healthcare organizations world-wide competing to provide the ultimate care as easy as possible to its customers, IT technologies have been embraced in delivering healthcare in various ways, such as: in diagnosing diseases, treatment and for research and planning purposes. Health information system (HIS) is part of IT technologies that most if not all healthcare organizations globally are moving toward implement it. Because of that a cross-sectional study was conducted about health information system (HIS) in the United Arab Emirates (UAE) Federal Health Organization.

The aims of this research were to identify the current status of the health information system (HIS) in the UAE Federal Health Organization (UAE FHO) and how health information system (HIS) can help in re-designing patients' care pathway as well as improving health outcomes. Another aim of this research was to identify the challenges faced in this system with possible solutions to overcome these challenges. Mainly, quantitative method was utilized to conduct the study.

The response rate in this study was high and the results were overall positive. The study met its aims and covered the targeted research questions related to HIS. Two hypotheses were tested related to patients' care pathway and health outcomes.

Keywords: the United Arab Emirates Federal healthcare Organization (UAE FHO), Health Information System (HIS), patients' care pathway, health care, health outcomes, HIS challenges and solutions.

الملخص

لأن منظمات الرعاية الصحية حول العالم تتنافس لتزويد العناية الفائقة إلى زبائنها بالسهولة المستطاعة، تكنولوجيا المعلومات أصبحت متضمنة في تسليم الرعاية الصحية بطرق المختلفة، مثل: في تشخيص الأمراض، المعالجات ولأهداف البحث والتخطيط . نظام المعلومات الصحية جزء من تكنولوجيا المعلومات ، حيث أن معظم إن لم يكن كلّ منظمات الرعاية الصحية عالمياً تتحرّك نحو تطبيقها. بسبب ذلك ، دراسة عرضية أجريت حول نظام المعلومات الصحية في مؤسسة الرعاية الصحية الإتحادية الإماراتية.

أهداف هذا البحث كانت لتعريف الوضع الحالي لنظام المعلومات الصحية في مؤسسة الرعاية الصحية الإتحادية الإماراتية وكيف لنظام المعلومات الصحية أن يساعد في إعادة تصميم سيرعناية المرضى ، بالإضافة إلى تحسين النتائج الصحية. الهدف الآخر لهذا البحث، تعريف التحديات التي واجهت في هذا النظام مع الحلول المحتملة للتغلّب على هذه التحديات. طريقة إجراء الدراسة كانت بشكل رئيسي كمياً.

نسبة الردّ في هذه الدراسة كانت عالية والنتائج كانت إيجابية بشكل عام. قابلت الدراسة أهدافها وغطّت أسئلة البحث المتعلقة بنظام المعلومات الصحية. فرضيتان تم اختبارهما متعلقتان بسيرعناية المرضى ونتائج الصحة.

كلمات دليلية: مؤسسة الرعاية الصحية الإتحادية الإماراتية، نظام المعلومات الصحية، سير عناية المرضى، رعاية صحية، نتائج الصحة، تحديات و حلول نظام المعلومات الصحية.

Chapter 1: Introduction

1.1 General Introduction

Healthcare organizations exist in uncertain time that requires from time to time immediate and right decisions to be taken and in order to achieve that, information must be adequate and available at all times for decision-makers, such as: healthcare providers, top management, patients…etc. So, this led healthcare organizations world-wide to develop systems that assist in taking the right decision at the right time and maintaining a high quality of care.

Also, these organizations are complex in its nature as it involves various departments and numbers of human resources that must work as teams and interchangeably to provide high quality of services to their customers. How to connect these various places and systems together under one platform in the healthcare field? The possible answer that many healthcare organizations are moving toward is health information system (HIS). Information Technology (IT) systems is one of the main solutions that most organizations are moving to implement. Years ago, medical care provided to customers required that healthcare providers to go through paper charts. This involved handwritten prescriptions, ordering tests, referrals...etc. There were potential risks of paper-charts, such as: misunderstanding medications instructions, unavailability of allergy alerts and no access to patients' history information, particularly if the patient went to a private clinic. However, all these can be avoided or at least minimized by implementing health information systems

Information is important for health care professionals to take decisions. For instance, the process of ordering medical tests depends on availability of reliable information, such as: history of medical conditions and vital signs. Unavailability of these essential information when are required; makes health information systems useless. Also, these systems must be well-integrated with existing processes and systems to prevent negative consequences, such as: double works.

With rapid developments in healthcare field, healthcare providers have to deal with more complex tasks and provide services to customers in a timely and comprehensive manner, which are becoming more challengeable. In order to achieve that, world-wide organizations are moving toward a significant solution that is becoming almost the concern of all organizations regardless of the services they provide. This solution is information technology (IT). Health information systems are being considered as a valuable strategy to replace traditional systems and processes that are based on papers.

Despite of many attempts to implement health information systems, failure rates are high due to various reasons, such as: inadequate trainings, eliminating users to involve in these projects and poor implementation strategies.

Advanced information technologies and its applications are playing significant roles in healthcare field these days. The advantages of it outweigh the disadvantages. For instance, these technologies and applications send reminders to healthcare providers and their customers (e.g. patients), allow to e-prescribe medications and refill, order and review different clinical tests as well as other tasks. However, IT investments are huge and expensive as well as risks and issues are yet elevating that keep affecting the successfulness of these projects, so proper evaluations and reliable studies are important to ensure effectiveness adoption and positive outcomes.

This paper starts with an introduction about the problems and objectives of the study as well as a brief introduction about the setting of interest which is the United Arab Emirates Federal Healthcare Organization (UAE FHO). Also, it introduces briefly the targeted project in this organization which is health information system (HIS) and states the rational for this study as well as an overview about the study stages, such as: identification, research, methodology, analysis, discussion and closure. Then, it presents 4 research questions for this study that are related to the current status of the implemented HIS, patients' care pathway, health outcomes, challenges and solutions in this system. After that, it demonstrates some of previous studies about health information systems. In addition, the study methodology and related aspects, such as: study design, targeted subjects, measurements and data collection method are illustrated.

Furthermore, analysis of the results obtained in this study are demonstrated for each facility involved as well as the hypotheses generated that are related to patients' care pathway and patients' health outcomes. Discussion section is followed by demonstrating the response rates, data validation and possible recommendations for the UAE FHO in particular and for organizations moving toward HIS, in general. Limitations of this study and possible future work are presented as well. The study ends with overall conclusion about the study and HIS.

1.2 Problems and Objectives

The study was targeted to cover the current status of health information system (HIS) in the UAE Federal Health Organization (UAE FHO). In addition, to cover how such system can assist in re-designing patients' care pathway and improve health outcomes for patients. Along with that, the challenges faced in this HIS were addressed, too. The information obtained from this study will be helpful for future implementation of HIS for other organizations as well as for taking remedies actions by the UAE FHO to improve the current HIS and provide high quality of services. Also, the study is valuable as the number of studies conducted regarding HIS in the Middle East is limited.

1.3 Setting of Interest

The UAE Federal Healthcare Organization (UAE FHO) is one of the critical organizations in the country that deals with different agencies, such as: Ministry of Interior, Ministry of Education, Federal Statistics Department...etc. In order to assure reliable shared information, technologies need to take place that facilitate centralized access to information. UAE FHO provides different types of services to its customers, such as: curative, preventive and rehabilitation.

The organization consists of a Minister, Undersecretary and four undersecretary assistants. Each assistant is responsible for a sector: support services, public health and licensing, health clinics and centers as well as hospitals. Under each sector, different departments are there. The headquarter is located in Dubai (MOH 2011a, MOH 2011b & MOH 2014).

Under the UAE FHO, there are 15 hospitals, 68 primary healthcare centers and 18 other facilities, such as: rehabilitation and diabetes centers. The number of manpower under the UAE FHO is more than 9000 staff distributed across the country. There are 6 medical districts in each Emirate (Dubai to Al-Fujairah) that manage these facilities (MOH 2013a & MOH 2013b).

1.4 The Implemented Health Information System (HIS) Background

Health information systems and technologies consist of tremendously various components and tools to convey, handle and manage health information that serves different type of consumers, such as: healthcare providers, patients and insurers (Blumenthal & Glaser 2007, p. 2527).

The country is facing growing population that requires more services to be provided. In order to facilitate providing services that reach this population, proper methods need to take place. HIS was one of the methods that the country is currently moving toward. The main reasons that led to implement this HIS were to create paperless environment as much as possible, reduces errors, attain centralized electronic patients records, improve processes and save time for healthcare professionals as well as customers. Also, to enhance care cooperation between healthcare professionals in urban and rural areas and reduce redundancy of exams (tests) orders, especially those with chronic diseases, for example, cardio-vascular diseases.

The covered health information system (HIS) is targeted to be implemented in 15 hospitals and 68 clinics and 18 other facilities under the UAE FHO. The system was designed based on Cerner Millennium Platform that serves various services, such as: nursing, surgery, pharmacy…etc. The project cost was about AED 350 millions. The software cost about AED 119,142,681. The project started in 2008 and was planned to be ended in 2011. However, the deadline was not meet.

Different parties are involved in this project, such as: Cerner Corporation to provide the software, iCapital as the vendor and Etisalat for network. The UAE FHO assigned a team to handle this project that consists of a project manager and members. At the beginning,

the project team was located in a separate office outside the organization, in Sharjah and later on, they were re-located in the UAE FHO, Dubai.

1.5 Rational for the Study

In order to meet the Smart Government Initiative that was launched by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, the UAE Federal Healthcare Organization is in the process of transforming its services to electronic formats and smartly that can be reached from multiple types of devices, such as: mobile applications. As a result, 80% of healthcare services were transformed electronically after implementing the HIS (Abdul Hamid 2013, p.19 & Al-Awadhi 2013).

This study will contribute positively to healthcare filed, specifically in health informatics as nowadays HIS is one of the main concerns for most healthcare organizations and parties, such as: companies, the public and decisions makers. So, there is a need to conduct comprehensive studies and researches in this field to serve those people. Although, many studies have been conducted, most of them were conducted in Europe and USA, but, this study will maximize the number of studies conducted in this field in the Middle East in general and in the UAE in specific. This study will also contribute to fill-in gaps in health informatics filed due to low number of studies in this field, particularly in the UAE and Gulf Region. This study covered most of the healthcare services provided; not only one area.

In addition, as mentioned above, this study will be helpful for the UAE FHO to take correction actions in order to improve the current HIS. Also, most of the previous studies focused on HIS users and administrative staff to evaluate it, but in this study hospitals' management staff and the HIS project team will be involved, too. The HIS in this study has just been implemented without being properly evaluated, so this study will assist to evaluate the system and provide proper analysis on the system's status for the management level in the UAE FHO.

This study will enable professionals and decision-makers in healthcare field to make better use and take proper decisions based on the information available in these systems,

in a timely manner. The analysis in this study will allow opening eyes on areas that need more attention while implementing such projects.

The below diagram (1) depicts the stages of conducting this study. Mainly, five stages were involved here: identification, research, methodology, analysis, discussion and closure. Each stage consisted of tasks.

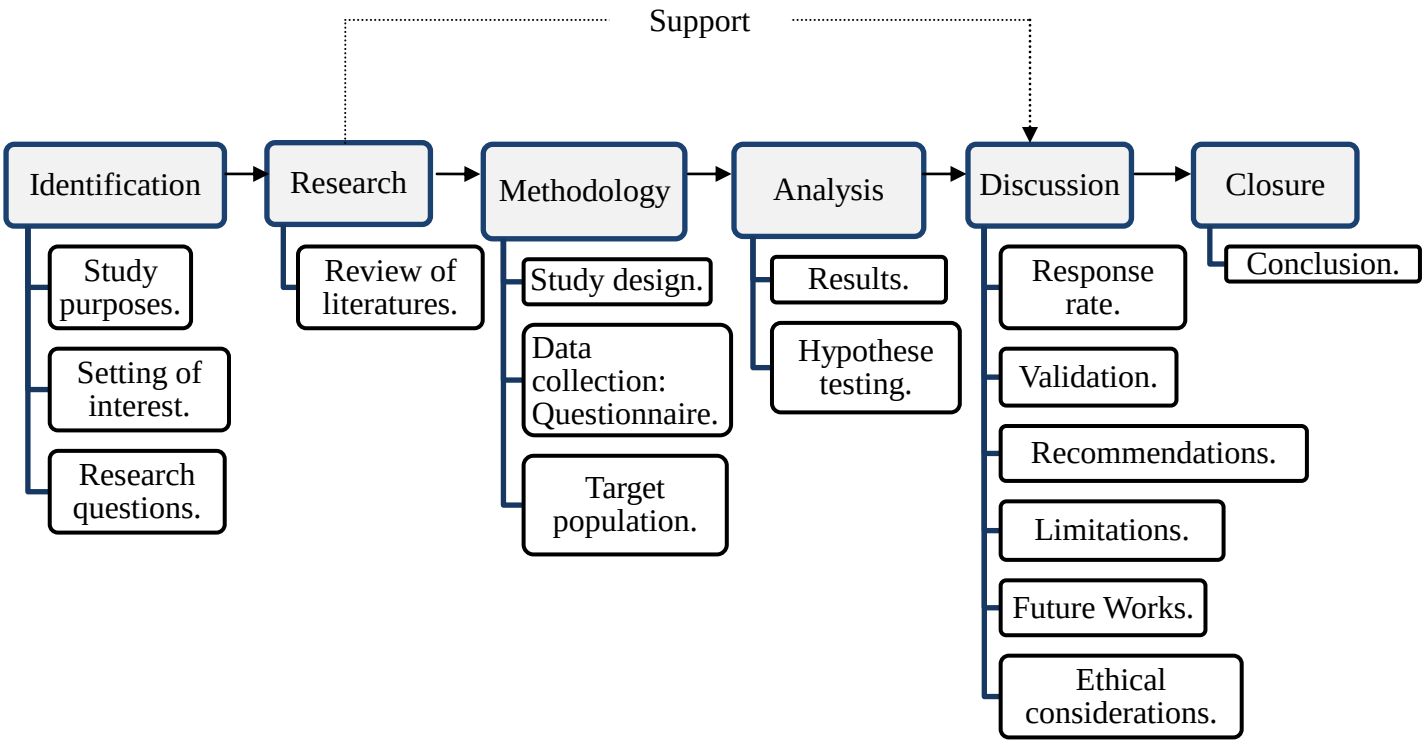

Figure 1: Outline of the study stages.

1.6 Research Questions

The aim of conducting this study is to cover the following areas:

1- What is the current status of the health information system (HIS) in the UAE Federal Health Organization (UAE FHO)?
2- How health information system (HIS) can help in re-designing patients' care pathway?
3- How health information system (HIS) can improve health outcomes for patients?
4- What are the challenges faced in this (HIS) and possible solutions to overcome these challenges?

Chapter 2: Review of Literatures

2.1 Perceptions of HIS Users

A study was conducted by Myers et al. (2012) about the perceptions of care teams in using health information systems to deal with HIV patients. The number of involved sites in this study was 5 located in the following States of USA: Louisiana, New Jersey, California, North Carolina and New York. Two approaches were utilized to collect the required data; interview and survey. Face-to-face and telephone interviews were conducted during the period of July 2008 and December 2010 to collect the required data. From these 5 sites, 60 users were interviewed. Each interview session lasted from 20 to 60 minutes. All sessions were audio-recorded and transcribed. Also, web-based survey was distributed to evaluate the perceptions of the users. Likert scale was used in designing the survey; ranging from 1=strongly disagree to 5= strongly agree. The response rate for the survey distributed in this study was 61%. The participants were from different occupational roles: 21 medical providers, 24 case managers and 17 non-clinical staff. Out of 102 survey invitations sent, 62 responses were received.

The results obtained from the interviews were variant from the actual use of these systems. Because of that, data were analyzed as well quantitatively. Stratified design based on occupational roles was followed. These roles were: medical providers, case managers and non-clinical staff which included administrative staff and billing.

In addition, the collected quantitative data varied by these roles. Medical providers were concerned about extra workload that these systems might bring. Also, they were less likely to use these systems if it could not be integrated with existed procedures and found to be less efficient. In contrast, some medical providers reported high accuracy and few errors when using these technologies. One of the medical providers stated that these technologies made it easier to focus and pay more attention on priority tasks. Overall, within these 5 sites, medical providers reported usefulness access to accurate data.

On the other hand, case managers reported that these technologies enabled them to easily access clinical information, check patients' clinical visits, medical care appointments and

other care tasks provided. Also, they can obtain the required information from the implemented systems instead of relying on patients to self-report. However, there were some skepticisms among this group about these systems. One of the case managers reported that sometimes traditional style of communication is more efficient than these systems to obtain patients' information due to these systems' updating ability in real-time. Overall, case managers reported positive perceptions about these systems as it allowed more access to information and provided extra time to provide care than to gather information.

Furthermore, non-clinical staff reported that these systems allowed administrators to directly access data and generate reports effectively. One of the staff stated that with using these systems more time were saved when consulting clinical staff about patients' information.

Despite that this study covered different occupational roles; patients' perceptions of these new technologies were not covered. Also, the study did not clearly illustrated how the implemented systems helped in reducing errors and improve quality. Additionally, there was not elucidating description of the implemented systems in these 5 sites.

2.2 Implementation Puzzles in Health Information Exchange Projects

Another study was conducted by Sicotte and Pare (2010) to investigate the success or failure of two large health information exchange projects in Canada. These two projects were considered as the largest initiatives at that time due to their political and strategic importance as well as big budget. The first project consisted of a pediatric network and cost almost CAN$ 11.0 million, while the second project consisted of a primary care network and cost almost CAN$ 14.8 million. Both projects shared similar goals and utilized same technologies. The two main goals were exchanging health information between network partners and adopting medical information systems by the targeted physicians.

Data were collected via face-to-face semi-structured interviews and following in-real time the implementation of these two projects in 2001. The interview sessions lasted 45-90 minutes and all sessions were tape-recorded and transcribed. The number of interviews for project one was 27 and for project two was 25. These two projects were analyzed and divided into 4 stages. For the first project, the stages were:

- Stage 1: setting the project's agenda. The main challenge identified during this stage was technical feasibility. The project team consisted of only 3 people on part-time basis and with no prior experience in large IT projects. Another challenge was political risks. The Department of Health there had a major concern about managing patients' consent to transfer data to the new project data warehouse, which acquired a new management system for patients consent.
- Stage 2: system design. Technical interfaces were required to transfer data to the new system data warehouse, which added more risks in terms of timeline and budget.
- Stage 3: testing and installation. Due to the new patients' consent management system that was decided to be built which also fell behind the schedule as well as reducing the number of interfaces and inability to transfer the required data to the new system data warehouse; all these compromised the usefulness of the project.
- Stage 4: experimenting with the new project. To achieve this, 39 volunteered physicians conducted this experiment. However, the results were dissatisfying as the new system was unable to refresh data automatically. The users needed to logout and login every-time to obtain refreshed data. Despite that the users requested to modify refresh option, the request was rejected to prevent another delay in completing the project. Eventually, the project team responded to the request, but this added 4 months delay.

Overall, only 25% of the targeted users in this project used the new system and the project failed in terms of meeting its goals, deadline and budget.

In contrast, the second project consisted of the following stages:

- Stage 1: project planning. The project team consisted of experienced and full-time members. Also, two general practitioners were recruited to handle users' relationships and to avoid technical risks. A contract was signed with a consulting firm to guide and advice strategically and operationally.
- Stage 2: ensuring realistic project vision. The involved general practitioners added more value as they helped more to understand physicians' constraints and type of information required. Also, views of all parties were considered instead of only considering the project team vision.
- Stage 3: system customization and testing. A selected physician at each clinic in this project acted as a project champion. The main responsibilities were to participate in experimental system testing, assist other users by acting as a super user and conducting thorough analysis related to clinical information as well as being part of the system configuration process.
- Stage 4: system experimentation. Although many risk mitigation measures took place, the project faced a technological threat that jeopardized the project successfulness. The threat was poor response time of the new system which affected patients' waiting time. To handle this threat, different solutions were tested; however, replacing the network server was the solution.

Overall, this project succeeded to meet its goal and was completed on time and within budget. After 11 months of implementing the new system, the majority of the targeted physicians were using the system regularly.

The study found that risks identified at the projects' early stages had also influenced those risks in the later stages. In addition, there was a direct relationship between implementation strategies quality and projects' outcomes. Furthermore, there were some similar situations that both projects faced, but responding strategies to it were different which affected the projects' outcomes. For instance, both projects faced with obtaining patients' consent challenge, however, the second project identify a solution which was improving the existed functionalities related to patients' consent management system instead of developing a new system as in the first project. This saved the second project from extra time and costs. The study demonstrated two large projects with different

outcomes and illustrated how implementation strategies had relationships with the projects' outcomes, but did not clearly discussed the technologies used in these two projects. Also, the study focused on physicians, but what about other users' perceptions and roles in these projects? On the other hand, the study collected data in real-time, by this, participants' responses are easily observed and evaluated compared to other data collection technique, such as: survey that may not present real perceptions and attitudes.

2.3 Information Technology Adoption in Emergency Departments

A study was conducted by Pallin et al. (2010) about adopting information technology in Massachusetts Emergency Departments (USA) and to determine whether the implementation of information systems in Massachusetts had improved and progressed in 2006 since early 2000s. A cross-sectional study was adapted in this research with distributing a survey across 74 federal EDs in Massachusetts. The response rate was 82%. Those who did not respond to the survey via e-mail, structured telephone interviews were conducted. STATA 10.0 software was used to analyze the collected data. Participation in the study was optional.

The results obtained in this study were as the following. Only 15% of Massachusetts EDs fully implemented electronic medications ordering and 41% reported fully electronic implementation for capturing patients' current visits. Furthermore, only 10% of these EDs fully implemented the electronic clinical decisions support tool. Overall, the study confirmed that there had been progress in the implementation of information technologies in Massachusetts EDs since the early of 2000s (Pallin 2010, pp. 241-242). The study also predicted that health information systems and applications, such as: medications' errors checking, electronic lab results and medications' ordering may play a role in improving health outcomes.

The study followed quantitative and qualitative measurements to assess the progress of implementing information technologies in Massachusetts as sometimes one approach might not be helpful to collect the required data. However, the study only covered Massachusetts EDs. Covering other departments, such as: outpatients clinics and allied health services will be more valuable to address the impact of health information

technologies on healthcare services and quality of care as the case in UAE FHO study. Finally, the EDs in the study were only those located in Massachusetts. It would be much reliable if other EDs from different States were involved too; as by this, it will be more accurate to generalize the study's outcomes outside Massachusetts.

2.4 Physicians' Perceptions about Health Information Technology

A study was conducted by Davis et al. (2009) about health information technology and physicians' perceptions. The study's aims were to evaluate the relationship between information system and quality of care from physicians' perspectives. Seven countries were involved in this study: Australia, Germany, Netherlands, Canada, United States (US), New Zealand and United Kingdom (UK).Cross-sectional study design was applied with 2006 random survey from these seven countries were collected. Various methodologies were used to collect the required data, such as: mails, fax and telephones. The response rates from these seven countries were variant. For instance, the number of participants from Australia was 1003, Canada 578, Germany 1006, Netherlands 931, New Zealand 503, UK1063 and US 1004. The response rate for US was 51%, while Canada and Netherlands had the response rate of 43% and the survey was sent via e-mail to these countries. On the other hand, New Zealand had the response rate of 32%, while Australia had 20%. For these countries, the survey was sent by e-mail and fax. For UK, the data were collected mainly by telephone, but also mail was used and the response rate w20%. However, for Germany, the data were collected by telephone only and that had the response rate of18%.

The study found that using health information technologies among primary care physicians allowed better monitoring of patients with chronic diseases as well as addressing safety issues. These led to attain primary care physicians' satisfactions. Also, different aspects were evaluated. For instance, accessing to patients' medical record remotely was rated low by those seven countries. The rating ranged between 12% and 36%. In addition, e-tests ordering and e-prescription were rated high in some countries, such as: Australia and New Zealand, while in other countries, such as: Canada and US, the rating was low.

Furthermore, receiving alerts about drugs and sending reminders whether to physicians or

patients were rated high in some countries, such as: Australia and low in other countries, such as: US. Regarding generating reports about patients' diagnosis, overdue tests and statistics; the response rate was high and acceptable for all these countries, except US and Canada who had low response rates in terms of using these technologies; between 13% and 37%. Overall, the study found that using IT is associated with physicians being well prepared to deal with these technologies, which leads to better quality of care and more adherences to guidelines. Finally, comparing UK to US, the first country had 90% of its physicians with electronic medical records and 83% stated high IT functionalities. On the other hand, US was behind all these countries involved in this study regarding adopting IT technologies and being committed to it along with Canada. One of the reasons that UK had this positive perception and high percentage was the government support to information technologies and putting standards in place, while US was slow to do such things.

Although the study attempted to investigate the relationships between physicians automated systems, quality of care and satisfaction, the applied study design did not allowed to create a causal relationships between these variables. There are other study designs that may allow drawing a relationship between variables that might be more suitable to this study, such as: cohort study as it allows studying the relationship between physicians and using automated systems and the outcomes of using these systems.

2.5 Health Information Systems Progress

A study was conducted by Haux (2006a) regarding past, present and future of health information systems (HIS) in Europe. The main aim of the study was to cover the following two aspects: lines of HIS development from past until today and the consequences for HIS in the future.

Regarding the first aspect, 7 lines were discussed:

1- Toward computer-based processing tools and how HIS while utilizing technologies might have advantages and disadvantages. For instance, one of the disadvantages of shifting toward computerized processing tools is complexity of these technologies, but it has a benefit in providing more functionality for utilizing patients’ data and for medical knowledge. Despite that computer-based

form is becoming dominance in healthcare field, paper-based form still exists for various reasons, such as: easiness of using it and for medico-legal purposes. This is causing double works for healthcare professionals in obtaining and using data.

2- Shifting from local to global information system architectures. Years ago, HIS focused on specific specialties, such as: laboratory and radiology. However, almost in the last 15 years, there has been major shifting toward implementing HIS to cover other areas, such as: electronic medical records.
3- Providing support to other parties, such as: patients, not only physicians as it was in the past.
4- Using data for other purposes beside patients' care, such as: research and planning as this change will also have impact on medical statistics and epidemiology.
5- Moving from technical to strategic information management priorities which is becoming part of many healthcare organizations' business plans. Before, technical problems of these systems were the main concerns.
6- Including other types of data rather than images and alphanumeric data, such as: molecular data (DNA).
7- Including new technologies to monitor patients' health status. For instance, micro sensors can be embedded in patients' clothes to monitor those with critical medical conditions.

Regarding the second aspect:

1- There is a need for institutional and international HIS strategies to maintain privacy and confidentiality. HIS, systems' users, using HIS data and types of data need to be considered in strategic information management.
2- There is a need to search and find new HIS architectures styles to prevent redundancy and downtimes.
3- There is a need for trainings and educational courses about health informatics for healthcare professionals.
4- Thorough and comprehensive research to answer unsolved questions related to systems' architectures, functionalities, communication tools and management is required due to these systems' complexities and challenges.

The study covered the progress of HIS from past to present and what might happen in the future. This is helpful for healthcare organizations that are planning to implement HIS. Although the study aimed to discuss the consequences for HIS in the future, but these listed consequences are more requirements or recommendations than to be consequences. Finally, the study discussed the past, present and future of HIS in the Europe region. It would be much reliable if there was a real-life HIS implemented in Europe covered in this study.

2.6 Progress and Challenges of IT Healthcare

On the other hand, a study was conducted by Adler-Milstein and Bates (2010) to evaluate the progress and challenges of IT healthcare in the United States of America. The study divided the progress and challenges based on: inpatient system and outpatients system. The challenges and benefits related to these two categories were divided as the following. For challenges, high expenses related to hospitals' systems. Hospitals must determine to what level they want to customize their systems, but this will cause additional costs and more changes. Although this might add extra time for the users during the first period of implementation, but at later time, they will be more efficient (Adler-Milstein & Bates 2010, p. 123).

Another challenge discussed was physicians' resistance, which was also discussed in Urda et al. (2013). In Cedars-Sinai, in Los Angeles, one of the physicians' systems for order entry was abandoned as a result of resistance to use; claiming that it added extra time to their work (Adler-Milstein & Bates 2010, p. 123).

Furthermore, lack of trained resources to provide support for the implemented systems. On the other hand, there were several recommendations discussed in this study. For instance, technical support from specialized trainers in the medical informatics field is required. Those people must be aware of technical and clinical aspects. Also, users should be rewarded for providing high quality of care. In addition, the number of vendors in the region is to be identified as per policies and regulations. This means that certification process to be carried out for those vendors and their systems to ensure that these systems work as required.

As noticed from this study, the location of it was not specified. It was mentioned that the

study took place in the United States of America, but did not specify the targeted hospitals and whether these hospitals are private or public as well as the targeted study sample. Also, the study relied more on previous studies conducted in this field with no clear indications of whether the outcomes obtained where based on these previous studies or the study itself.

2.7 Health Information Exchange to Improve HIV Patients' Care and Outcomes

A study was conducted by Messer et al. (2012) about the development of a health information exchange to improve HIV patients' care and outcomes in Rural North Carolina.

In order to improve patients' care and provide reliable healthcare services, the Regional Health Integration Project (RHIP) developed the Carolina HIV Information Cooperative Regional Health Information Organization (CHIC RHIO). The CHIC RHIO consists of one medical clinic and five AIDS Service Organizations (ASOs) that provide services to eight rural counties. CAREWare software was implemented to create an electronic network system between these facilities. To evaluate CHIC RHIO satisfaction on the electronic system, three qualitative and quantitative approaches were followed. First approach was to evaluate organizations' readiness to adopt the system. Organizational Readiness for Change (ORC) measurement was applied. This measurement covers the motivation for change, resources, organizational climate and staff attributes, such as: growth, influence and adaptability. The results indicated that CHIC RHIO was ready to adopt the new system.

Second approach was interviewing CHIC RHIO members. Open-ended questions were used about health information exchange. The results were largely positive. The participants reported that the system assisted them to easily access clinical data, such as: lab results and making referrals, which helped in improving case management outcomes. In addition, it helped to monitor patients' medical progress. On the other hand, the users had a few number of concerns. For example, one of the users had a concern related to confidentiality when accessing patients' electronic data, but this was not a major issue as

protocols and security measurements were setup and followed to maintain security and confidentiality.

Third approach was survey. The survey was used to assess the satisfaction level about the system. The response options to the questions ranged from scale (1) unsatisfied to (5) very satisfied, or (1) very negative to (5) very positive. The participants reported increased ease of data exchange and improved patients' care that led to retain clients.

However, there were some challenges in this project. For instance, interfacing CAREWare with existed electronic health records in the clinics was difficult, which caused double work and more data entry errors. In addition, the funding process needed to be amended due to implementing this system.

The study did not state whether patients' satisfaction level was measured or not. Although it measured users' satisfaction level regarding CAREWare software, patients are also an important party that should be considered while evaluating such a system. In contrast, the study covered rural counties, which many previous studies did not cover and pay attention to these sites. Furthermore, the study covered how IT facilitates providing healthcare services in rural areas and improving patients' care by reducing workloads on healthcare professionals, enhancing communication with other agencies and reducing the feeling of isolation.

2.8 Evaluation of Health Information Systems

According to J. Wyatt & S. Wyatt (2003), health information system (HIS) involves various aspects, such as: entering orders, reporting, decision support tools and patients medical records to serve different parties, such as: patients, professionals and the public.

In this study, when and what methods to evaluate health information systems as well as different challenges were identified related to HIS. For instance, health information systems cover multi-functional tasks and processes that may require complex changes in an organization and re-design of processes. Also, such a system has many impacts that need to be weighted carefully as it deals with human lives.

There are two evaluations methods in order to assess HIS; objective/quantitative methods that are used to gather data, such as: patients' waiting time and number of tests ordered. The second type is subjective/qualitative methods that are used to analyze and create rich descriptions of data, such as: interviews and meetings.

Although one of the study's aims was to discuss when to evaluate HIS, it did not clearly discuss that. The focus was on the evaluation methods. Also, the study did not vividly mention how evaluating HIS can be beneficial to healthcare organizations, decision makers, system's users and customers, such as: patients. Finally, the study would be much reliable if there were cases on how to apply the mentioned evolution methods for HIS.

2.9 Health Information System to Reduce Mortality Rate

A study was conducted by Graven et al. (2013) about Belize Health Information System (BHIS) to reduce mortality rates. The system was developed by including 8 diseases management algorithms, such as: maternal health, essential hypertension and serious adverse drug reactions. All these 8 domains were developed by various professional organizations, but were adjusted and approved according to Belize rules and regulations. For this study, data were collected by comparing BHIS data and the Belize Ministry of Health reports. Also, mortality data were obtained from the Epidemiology Unit at the Belize Ministry of Health. SAS was used to carry out the analysis of the obtained data. The results obtained from this study were that infants' mortality rates, mother to child HIV transmission and maternal mortality declined sharply after deploying BHIS. In addition, there were some areas that declined steadily after implementing BHIS, such as: mortality rates for children aged 1 to less than 5 years and hypertension. Mortality due to adverse drug reactions declined almost 90% when BHIS was deployed as the new system requires that two to three caregivers to override adverse drug warnings with justifying the reasons before a patient receives that drug again. Furthermore, expenditure increased in 2009, but started to decline for the following three years. Hospital stays due to hypertension decreased by over 60% which saved 1% of the budget during the period of 2006-2007 and 2010-2011.

However, there were some medical conditions that did not change consistently after

implementing BHIS, such as: diabetes and transport accidents as these conditions were not embedded in the BHIS algorithms. One of the reasons that BHIS succeeded was users' involvement in the project stages.

The study discussed how BHIS helped in decreasing mortality rates based on the 8 embedded algorithms, but what about these not embedded medical conditions, such as: diabetes? Also, the study did not discuss the users' perceptions as those people are the main factor to determine a new system's successfulness.

2.10 Aspects of Health Information Technologies

A study was conducted by Haux (2006b) regarding the aspects of health information technologies with possible consequences for the aim of medical informatics. Health information systems HIS deal with processing healthcare data, information and knowledge using various methodologies and technologies. One of the main aims of HIS is to provide a high quality of services to patients and healthcare professionals. The study presented the evolution of HIS and how it changed from 1960 to 2000s in different aspects of HIS. For instance, HIS architectures range from local to regional, national and global architectures. Also, the users of HIS have changed since 1960, from focusing only on healthcare professionals to focus as well on patients and customers. The functionalities of HIS changed from using data only for patients' care to quality management, planning and research purposes. The changes as well included types of data that are processed by HIS, from alpha-numeric to molecules data. Haux also described such changes in another study conducted by the same author Haux (2006a) about past, present and future of health information systems HIS.

HIS allows for global access to healthcare services and medical knowledge, minimizes errors and facilitates continuous quality management; however, the study revealed that there are some challenges in HIS. For instance, users' acceptance of such a complex system that consists of several applications. Also, healthcare professionals, such as: physicians may face workload with such a system as the documentation process might be too long. In addition, technical problems, such as: downtime of one application in HIS or more may negatively impact the workflow of the entire system if not handled well.

In this study, few points were noticed. Firstly, one of the study's aims was about medical informatics and the consequences of it. The study did not analyze this aim in depth. Also, it would be much valuable if the study analyzed a real HIS system while describing HIS aspects theoretically. Finally, the information in this study are nearly the same as what was published in another study conducted by the same author about past, present and future of HIS (Haux 2006a), so some information in this study were redundant.

2.11 Cerner Health Information System

The conference (Cerner 2013) demonstrated about the Children's Cancer Hospital in Egypt that was opened in 2007. The hospital implemented Cerner Health Information System. Since the implementation of this system, the adoption rate was high particularly by nurses, which led to the successfulness of the implemented system. The hospital has it owns IT Nurse Unit that consists of nurses with IT skills to conduct training, provide system orientation and assist in upgrading. Cerner System enhanced the workflow of nurses there from different aspects. For instance, the quality of nursing documentation increased after implementing the system as before that, the vital signs for patients were not always recorded, but after the implementation of Cerner System, the vital signs are entered in the system for all patients.

In terms of patients safety, the number of medications errors decreased as the nurses have to double check the medication order placed by doctors and use bar code to enter medications ordered in the system to avoid handwritten errors. The errors decreased by 80% since the implementation of the system. Also, the system includes allergy alerts, which helped in reducing the number of allergy reactions.

In terms of infection control, the implemented system helped in following-up tests results and analyses in a timely manner and how to handle infections for each patient; individually.

For nursing performance, the system helped to evaluate nursing documentations on daily, monthly and yearly basis. Also, allowed at anytime to evaluate nurses' practices as well as promote nursing educations by discovering errors through continuous assessments.

In terms of technology evaluation, before implementing the system, a white board and marker were used for the nurses to follow their patients, however, after implementing

Cerner, a plasma screen was utilized for triaging and day care.
Despite of all these enhancements, there were no indications of barriers faced during and after the implementation of the new system. Also, it was not mentioned how the system was evaluated whether quantitatively or qualitatively to address users' perceptions. The enhancements described were all related to nursing side, but it did not cover other healthcare providers, such as: physicians.

2.12 Health Information System to Improve HIV/AIDS Patients Health

A study was conducted by Virga et al. (2012) about health information system HIS as a tool to improve quality of care and health outcomes for patients with HIV/AIDS. The study was conducted in the City of Paterson, New Jersey. A second version of online electronic health information system known as e2 was implemented. Three HIV/AIDS clinics were involved in this study form year 2008 to 2012. To improve the quality of activities in the system, the developers worked closely with the users to determine the needs of the users.

Qualitative and quantitative measurements were applied in this study to evaluate e2. Interviewing the quality management team who was as well representatives of these three clinics along with the clinical staff and administrators was carried out to measure the quality improvements in the system. In addition, serial cross-section design was used to measure the health outcomes from e2 data as well as to measure quality improvement interventions. To analyze data, 263 records of HIV patients were pulled out.

To determine whether health outcomes had improved while using e2 system, two indicators were selected; the first indicator was CD4-T Cell counts, while the second indicator was Viral Load Suppression (VL) as those two indicators are commonly related to the health status of patients with HIV/AIDS. The study revealed the following results. First of all, e2 system users stated that the system improved their ability to provide health care for patients by saving time as information are available at their fingertips. Furthermore, the system facilitated monitoring tests results, screening and identifying missing clinical data. Also, it allowed the users to easily access to reports and being

updated about patients' health status and staffs' works. One of the significant options in e2 system was introduction of [alert] option. This option sends reminders to healthcare providers. For instance, the alert reminds the healthcare provider about medical visits within six months for a HIV/AIDS patient as well as ordering CD4-T Cell counts. This option helped to maintain a high quality of care provided to patients.

A few points were noticed in this study. Firstly, the study sample involved in the study was the system's users. It would be much beneficial if patients' satisfaction level were also measured regarding e2. Also, incorporating other healthcare centers specialized in other types of care not only for HIV/AIDS in the study as by this, it would help other parties to take proper decisions regarding implementing such systems. Although the study listed the improvements of applying e2 system, it did not clearly discuss the challenges and issues of it. One of this study's aims is almost the same as in the UAE FHO study in terms of improving health outcomes.

2.13 Process of Evaluating Health Information Systems

A study was conducted by Al-Yaseen et al. (2010) about health information systems evaluation processes in Jordan private hospitals. Two evaluation processes were covered: Prior Operational Use evaluation (POUe) that is used to predict the impact of a project as well as before a system becomes operational. The second process covered was Operational Use evaluation (OUe) that is used when the system is in operational use. Data were gathered from government websites, such as: Ministry of Health and administered questionnaires to these 60 targeted private hospitals. Out of 60 questionnaires sent, only 19 were completed with 31.6% response rate.

The results were as the following. In order to improve efficiency and effectiveness,73.7% of these hospitals adopted technologies, while only 26.3% adopted technologies to handle problems. The reasons for adopting POUe were various, such as: meeting requirements, system effectiveness and security, while for OUe, the reasons were as well various, such as: risks, tangible benefits and estimating systems' life. In addition, about two thirds (68.5%) of these private hospitals showed that they do not collect evidences to determine the successfulness of their information systems. which means that they can not benefit

from OUe's information to enhance their evaluation techniques and outcomes. Furthermore, based on the results obtained, decision makers tend to believe in OUe as a formality instead of an evaluation process.

This study focused on private hospitals without covering public hospitals. Also, it did not present the types of information systems implemented in these hospitals. The response rate was low 31.6%, which is not reliable to generalize the findings.

2.14 Clinical Information Technology

A study was conducted by McAlearney et al. (2007) to evaluate physicians' views in the United States of America (US) about clinical information technology (CIT) in reducing medical errors, benefits of CIT and issues.

Ten focus groups were held during the period of April 2002 and February 2005. The duration of these sessions was about 60 to 90 minutes and each session was recorded on tape and transcribed for data analysis purposes. The number of physicians was 71 from different specialties. Two themes were covered in this study, which were: appropriateness of CIT to reduce medical errors and impact of CIT on physicians' work. The results obtained regarding these two themes were as the following. For theme one, the physicians had their concerns about appropriateness of CIT to reduce medical errors and introducing new errors. Also, they criticized the capability of CIT hardware and software, such as: battery life of handled computers. Furthermore, about new errors, the physicians were skepticism about CIT in introducing new errors, such as: systems designs to understand entered orders. For instance, number 7 will be read by the system as 70, so the physician has to enter 07 in order for the system to understand it as 7.

On the other hand, physicians had concerns related to theme two in terms of time and workload. Many of them were concerned that new technology means more time to use and accept than manual processes. Also, technical support availability on timely manner was considered as a threat to physicians. Furthermore, physicians were skepticism that such systems add more responsibilities in entering data as before they were relying on others, such as: clerks and nurses, but this helps to define the roles and responsibilities of individuals.

The study suggested to distinct physicians who have positive pre-conceptions from

negative physicians as a strategy during the implementation of these technologies. The study focused on physicians only without taking into consideration other caregivers, such as: nurses. Although the study used focus group to collect data and is one of the least applied methodology compared to other methodologies, such as: interview and survey, this might affect the participants' perceptions as they might be influenced by each other and feel uncomfortable to share opinions and thoughts during the sessions. In contrast, the study covered users and non-users of CIT, which allowed evaluating different parties' perspectives about CIT regardless of their interactions with these technologies.

2.15 Oracle-based Medical Information System

A study was conducted by Elmetwaly (2011) about a proposed medical information system that had been developed years ago in Saudi Arabia. The study covered how to use available technologies and use Oracle databases in order to save medical information.

The study covered the benefits of Oracle databases, such as: easiness of delivering reports requested to different parties and supporting all professionals in the healthcare field. Also, covered the stages of developing medical information systems, such as: data collection, converting information to meet Oracle databases requirements and training users. Oracle-based system allows rectifying work flaws by activating tasks easier and faster. For example, extracting charts from existed information systems, generating reports that show work flaws and following-up individuals, such as: physicians and nurses.

Although the study aimed to cover a medical information system in Saudi Arabia as well as utilizing Oracle databases, it only focused on Oracle without a clear illustration on those existed systems. Also, it did not demonstrate the exact targeted organizations whether public or private or both types as well as did not clearly explained the flaws in the existed systems. As in the UAE FHO study, the targeted hospitals were identified with evaluating the current status of the implemented health information system.

2.16 Information Quality based on Nursing Information System

A study was conducted by Michel-Verkerke (2012) about information quality based on Nursing Information System (NIS) that is part of hospital information system in a Dutch teaching hospital at Netherlands. Paper questionnaire distributed across 195 nurses with 48% respondents (93 nurses), while 12 nurses were interviewed. The main aim of the study was to determine whether NIS met the requirements of information quality of the system's users and the aspects to determine that.

The study results were as the following. The majority agreed that the information in the system is accurate, but there are possibilities for further improvements. Despite that 70% agreed that there were not contradictions between oral and written information, a high number of the system users agreed that patients' data were entered in the wrong records. In addition, some of the information was considered necessary to be available. For example, patients' history, care plans, treatments, planned investigations, medications and actual nursing interventions. However, the respondents found it difficult to specify the type of information needed. A possible reason could be that information depends on patients and situations.

Furthermore, the respondents had some information quality requirements, such as: completeness, accessibility and correctness. Accessibility apparently improved due to easy retrieval of data in the NIS, but technical problems sometimes impacted negatively the accessibility in patients' rooms. Overall, information quality depends on the system's users and re-designing of the NIS is required in order to increase quality of the information.

The study utilized two research methods: quantitative and qualitative which helped to support the findings and provide reliable results. The developed questionnaire was paper-based, which is the same as in the UAE FHO study. Also, the study provided a brief introduction about the utilized system. However, the response rate was low (48%), below the half, which may affect the study's findings' reliability. Additionally, the study did not clearly cover the quality of the information inputs and the impact on the outputs. Due to the small number of interviews (12 nurses), frequencies were not demonstrated.

2.17 Barriers in Implementing Health Information Systems

A study was conducted by Khalifa (2013) about barriers in implementing health information systems and electronic medical records at the Saudi Arabian Hospitals. Data were collected via questionnaire distributed across two Saudi Hospitals; one private and one public. The number of participants was 158.

The results obtained were as following. Six categories of barriers were listed: human, professional, technical, organizational, financial and legal barriers. For these six types of barriers, solutions were also suggested. The following table illustrates examples of these barriers and possible solutions:

Barrier	Solution
Human: - Lack of experience and knowledge about these systems. - Negative attitudes towards these new systems. - Unavailability of health informatics professionals.	- Conduct formal training sessions. - Provide continuous medical education programs related to these new technologies. - On-site orientations for staff. - Develop undergraduate and post-graduate programs in this field.
Professional: - Lack of support. - More responsibilities. - Lack of motivation.	- Increase users' involvement in projects' phases. - Motivate users by providing them bonuses and rewards. - Educate users on how to understand their parts when using these systems to prevent workloads.
Technical: - No user manuals. - Interface design issues.	- Vendors to provide the required documentations.

- Old communication networks.	- These systems need to be designed in a simple way and less complicated for daily uses. - Upgrade networks and operating systems for better performance.
Organizational: - Old workflows. - No system prototype. - Insufficient training courses.	- Re-designing workflows. - Demonstrate existed live systems to the targeted hospitals that are not yet live with such projects. - Continuous trainings for best use of health information systems and electronic medical records.
Financial: - Lack of capital resources for these projects. - High maintenance costs. - High implementation and adoption resources consumption compared to the benefits.	- Allocate proper funding resources. - Allocate annual budgets for these projects' maintenance instead of being burden on hospitals' resources. - Proper planning of resources during different phases of such projects.
Legal: - Confidentiality issues. - Lack of policies and procedures that control these systems.	- Ensure users' commitment and signing confidentiality agreements. - Develop regulations on nation-wide level about these systems.

Table 1: Health information systems barriers and solutions.

(Adapted from Khalifa 2013, pp. 338-341).

Overall, human and financial were the two main barriers in the implementation of health information systems and electronic medical records. In addition, public hospitals had

more concerns and complains compared to private hospitals, particularly to those related to organizational and technical aspects, such as: no experiences to deal with these systems.

Although the study covered the barriers in implementing health information systems and electronic medical records, it did not clearly indicate the outcomes for each sector involved in this study: private and public in order to evaluate the outcomes of these sectors. Also, the study did not thoroughly explain the sample size and the design applied to conduct this research as well as data collection methodology.

2.18 Critical Issues in an Oncology Information System

A study was conducted by Urda et al. (2013) about critical issues in an Oncology Information System at one of Spain hospitals. To address these issues, two approaches were utilized. First approach was identifying the percentage of medical consultations and notes enabled in the oncology system during the first three months of implementing the system, then after one year, the same approach was carried out. The second approach was distributing a survey to evaluate physicians' perceptions about the system.

A pilot trail of the system was conducted by physicians to evaluate and adjust minor aspects of the system. Once the system was verified of its usability and integration with other workflows; official implementation was carried out.
The number of participants was 14 physicians and the results obtained from this study were that the system improved the access to patients' information and status. Although above 70% of the physicians indicated that the system added more workload to their daily job, only about 43% believed this view after one year of conducting the evaluation. Also, half of the users believed that the system improved the quality of care provided to patients; however, this was shared almost by all users one year later.
The study revealed some of the barriers that affected the implementation of such a system. For instance, users' resistance to change, particularly those who do not have computer skills (Urda et al. 2013, p. 404). Another barrier was training period. This is important for users to be familiar with new systems which require more time to learn and absorb new information (Urda et al. 2013, p. 404). However, with continuous using of the

implemented system, physicians can be more aware of the system's benefits.
Although the study used two different approaches to evaluate the implemented system in Spain, it covered only physicians' views without evaluating other healthcare providers' perspectives. Also, the study did not clearly explain how the implemented system improved patients care from different aspects, such as: tests orders and results, diagnoses and medications prescriptions.

2.19 Nurses Perceptions about Hospital Information Systems

A study was conducted by Oroviogoicoechea and Watson (2009) to evaluate nurses' perceptions in North Spain about using hospital information systems and how these systems impact clinical practices. Cross-sectional analysis design was applied with distributing a questionnaire across 227 nurses, however, 179 nurses participated with78.8% response rate. SPSS 13.0 was used to analyze the obtained data. Likert scale was applied in the designed questionnaire (1=strongly agree to 5=strongly disagree). The results obtained were as the following. The implemented system is easy to use. They were asked about returning to paper-based records; 79.8% of the nurses said "no".
The areas covered in this study were categorized into three areas: context (e.g. Users characteristics), mechanisms (e.g. IT support) and outcomes (e.g. impact on patients care). Users' characteristics had direct and indirect impact on the outcomes. Nurses with positive attitudes about the system, had better perceptions about the system's impact on their routine works. Overall, the results obtained about the perception of nurses were positive.
This study only covered nurses, which might be valuable for nursing practice, but other areas, such as: allied health services need to be covered as well.

2.20 Consumers Perceptions about Health Information Exchange

A study was conducted by Ancker et al. (2012) to evaluate consumers' perceptions about electronic Health Information Exchange (HIE) in New York. Random digital dial telephone survey that conducts annually by the Survey Research Institute at Cornell University in 2011 was utilized in this study as a data collection tool. The survey consisted of 77 questions. Pre-testing of the questions was done with 25 respondents that resulted in making changes on the wording for clarity purposes. The number of

respondents was 800 with 71% response rate.

Overall, results were that 68% of the respondents agreed that HIE improves quality of care and 90% agreed that in emergency situations, HIE allows to access data without consent. In terms of privacy and security, 68% of the respondents expressed their concerns.

Despite that the study covered 800 respondents in New York State, this does not allow generalizing the findings as New York was only covered and 800 compared to the total number of the targeted population and the country is very small. Also, telephone conversations may prevent evaluating respondents' attitudes and impressions as it does not directly allow observing their body language.

2.21 Health Informatics and Future Plans

A study was conducted by Zhang et al. (2007) to address the current status of China health informatics as well as future plans. Data were collected by utilizing various methods, such as: interviews and regulations documents in China. The results obtained in this study were as the following. About 35%-40% of hospitals have developed hospital information systems. The percentages of healthcare organizations that can transmit real-time data and reports were above 80% of medical organizations above the country/district level, all Chinese Centers for Disease Control and Prevention (CDC) above country/district level and 27% of town level hospitals. Despite that China has embraced some coding classifications, vocabularies and messages standards; there are some barriers in health informatics standardizations related to financial, cultural, technical, legal, ethical...etc.

The study utilized different data collections methodologies, such as: interviews and existed law documents in China instead of utilizing one methodology compared to some of previous studies. However, it did not clearly state the targeted healthcare organizations as China is one of the biggest countries. Also, there was not clear illustration of the study design and if there was any evaluation process of the current status of health informatics targeted in this study.

Chapter 3: Methodology

3.1 Study Design

Mixed study design between descriptive and analytical design was conducted. Descriptive study design aims to collect information about a situation or subject without looking to the reasons and causes. However, analytical study design is used when there are hypotheses or theories that to be tested and evaluated. It answers how and why a situation happened (NIHR 2010). As this study is composed of four research questions as mentioned above, two questions, the first and the last questions are descriptive type and the other two, the second and third questions are analytical type. The second and third research questions were tested as hypotheses. The reasons for choosing this design are due to its easiness to conduct, quicker than other types of study and easy to obtain prevalence of outcomes.

Statistical measurements were estimated in this research, such as: central tendency that includes the mean, median and percentages of how HIS improved and re-designed patients' care pathway and outcomes. In addition, p-value was calculated for the second and third research questions. Mainly, bar charts and pie graphs with tables were used to demonstrate the findings.

Because descriptive studies are usually used to generate hypotheses, analytical study design was also applied here to test two hypotheses:
1- Hypothesis One: HIS helped in re-designing patients' care pathway positively.
2- Hypothesis Two: HIS helped in improving patients' health outcomes.
So, mixed study designs of descriptive and analytical were applied.

3.2 Subjects for Study

This study was conducted to cover 6 hospitals and the project management office. As six Emirates in the country implemented this HIS, the main hospitals under UAE FHO in these six Emirates were selected. For example, in Ras Al-Khaimah, there are three hospitals under UAE FHO, but only the main hospital was included. This saved times to collect data and prevented complexity in analyzing data. The selected hospitals were only

those which implemented HIS. Other facilities that did not implement the system were excluded. The reasons for not implementing the system in these hospitals are due to site infrastructure issues, such as: electricity and demolishing one of the hospitals which will be re-built.

The targeted populations are healthcare providers, IT/HIS, the project management team and hospitals' management staff. The sample size was 25% of the total staff at each facility. The reasons for selecting these facilities and populations are that this HIS is a one of its kind in the region and just been implemented without being evaluated properly. Also, selecting random population from a public will consume more time. Furthermore, it would not be practical as one of the aims of this study is to cover HIS from users' perspectives who interact with the system.

Many sampling methods are available, such as: simple random sampling, cluster random sampling, stratified sampling…etc. In this study, cluster random sampling method was used for several reasons. First of all, as the study covered healthcare field, it would be much practical when grouping the sample population according to their common characteristics. For instance, here, there were different groups based on roles, then the participants were selected randomly, so, not necessary that all the groups contain the same number of participants, such as: healthcare providers (physicians and nurses) who are using the system were grouped together, while radiologists, lab staff and pharmacists were merged in one group. Also, IT/HIS, project management team and hospitals' management staff who use the system and make decisions based on the system' data for planning and quality management purposes. In addition, it is more organized compared to simple random sampling as the study's samples are grouped together that have the same characteristics or interests. Cluster and stratified sampling almost are the same except in cluster sampling is not necessary that all clusters are included, while in the stratified, all strata to be included in the sampling.

Despite that cluster random sampling method has higher standard error and is less precise, for this study it would be more appropriate for the reasons mentioned above (Bowling 2009, pp. 205-206). In any study there is a chance for selection bias and in order to avoid that or at least minimize it, the participants were reminded to complete the

survey. This was done via e-mail, telephone or face-to-face conversation in order to save time especially that some of these hospitals are located far geographically.

3.3 Measurements

In order to cover the research questions listed above, a survey was distributed among the participants. Interview was put as a contingency plan in case there are missing answers. The interview was planned to be either face-to-face or via telephone.

The survey mainly covered the research questions which are about how HIS helped in re-designing patients' care pathway and improving health outcomes. The questions were in form of closed-needed questions. The design of the questionnaire was mainly close-ended questions, but there was a space for open answers where the participants may write their comments or write other answers instead of selecting the options available.

3.4 Data Collection

Quantitative method (survey) was used in this study. Participants in the survey were to answer most of the questions by ticking answers (Refer to appendix A: HIS Survey Sample).

The participants to follow the instructions provided in the survey. This type of data collection method was used as it is much easier to conduct, less expensive and time consuming. One more thing is that by applying this method, interviewer bias can be reduced as the participants will not be interacting directly with a human being. However, there is no interaction with participants to observe their feelings regarding the topic under study. Also, the questions might not be clear enough to the participants. In addition, the answers might not be reliable as it is not possible to know if the participants are truthful with their inputs.

To achieve the goal of this study and collect data appropriately and within the scheduled timeframe, assistance from Information Technology (IT) Departments across the selected hospitals were obtained. Also, the HIS Project Management Team assisted in distributing the questionnaire. As the research covered 6 hospitals in different Emirates as well as the

project management office, the time spent to collect the required date was about 4 months.

The survey mainly covered the research questions which are about how HIS helped in re-designing patients' care pathway and improving health outcomes. The questions were in form of closed-needed questions and the answers were based on Likert Scale (range from strongly agree to not applicable) and the participants had the space to write their comments beside each question. The options were as following:

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- Not Applicable: this option was provided as may not all participants use the questioned service in the studied HIS. For instance, lab technicians do not prescribe medications for patients.

The data collection tool [survey] was designed in way that allows gathering as much as related information. Before answering the questions, the participants had to provide some demographical information, such as: name, gender, age, major, employee ID organization's name, contact number and e-mail address. The name was optional to provide in order to maintain confidentiality and avoid sensitivity. Gender was included in the survey to measure the distribution level of the system users based on the gender. Age range was included starting from 20s and ending in 60s. The maximum age range was 60-69 as the retirement age in the UAE Federal Organizations is in 60s. The targeted majors for this study were listed and an option titled as "other" was provided for those who are not within the listed majors and the participant has to specify the major. However, all of the participants were from the listed majors. Medical services also include allied health services, such as: medical records personnel. As different facilities were involved in this study, organization's name and employees ID were added in the survey to cluster the collected data based on the facility and other criteria. Contact number and e-mail address were to be provided in order to contact the participants in case of missed data. After

implementing the system, e-mail addresses were created for them under the UAE FHO domain, which means that all the participants have e-mails.

The survey lay out and format was as following (Refer to appendix A: HIS Survey Sample).

- First page was general information about the survey and confidentiality statement. Also, there was a box for participants who do not want to be part of this study and they have to tick the box and write their names or employee ID, so they will not be reached regarding this study.
- The following pages started with demographical questions and then the research questions. Each research question was sectioned separately. As there was four research questions in this study, the sections were titled according to the research questions as following:
    - Part One: The current status of the health information system. This part consisted of 8 questions and the participants to select from available options.
    - Part Two: The current health information system (HIS) can help in re-designing patients' care pathway. This part consisted of 12 questions and the participants to select from available options.
    - Part Three: The current health information system (HIS) can improve health outcomes for patients. This part consisted of 3 sub-divisions. First sub-division was titled as "Diagnosis and Medical Care" and it contained 9 questions. The second sub-division was titled as "Discern Alerts" and it contained 4 questions. The third sub-division was titled as "Other" and it contained 11 questions. The participants to select from available options
    - Part Four, this section was divided into two sub-sections: (a): The challenges faced in this (HIS) and the participants may select more than one option if needed and (b): Possible solutions to overcome the challenges in this (HIS) and the participants may select more than one answer if needed. In this part, the participants had the space to add other answers, not only selecting from the list available.

A space for further comments and recommendations was provided and at the end of the survey, contact details of the researcher were provided for clarifications and enquiries. One call received by a physician from Al-Fujairah Hospital about making this study obligatory as it will serve the healthcare filed in the UAE by improving the implemented HIS and enhance the quality of the system by adding more useful options and rectify issues. However, the reply to this recommendation was that the study is voluntary so number of participants would be higher and to open a door for expressing thoughts and opinions about the system without any fears and hesitations. Also, that the study is mainly a research paper about HIS in the UAE Federal Healthcare Organization.
At the end of the survey, a thank statement was given as well contact details regarding the survey.

The survey was designed in English despite that the targeted organization is the UAE FHO and Arabic is the official language. However, as the evaluated information system is in English, the survey was designed as well in English. Also, the system's users are Arabians and non-Arabians and they deal with a system that is only available in English.

Chapter 4: Analysis

4.1 Results

Although the HIS is implemented in most of the hospitals under UAE FHO, the selected one in this study are the main hospitals in each Emirates and that fully implemented the system. The target percentage of the study sample was 25% out of the total number of staff who use the system in each hospital.

In order to maintain confidentiality, the hospitals' names in this study are not real and each name was selected based on the emirates they are located in.

The below table (Table 2) illustrates the hospitals involved in the study with the total number of staff in each hospital and the total number of participants as well as the total number of staff who refused to participate. The accepted percentage of participants in this study was 25% of the total number of staff. Also, the Project Management Office (PMO) was involved in the study.

Facility	Total number of staff	Targeted number of participants (Total number of staff X 0.25)	Total participants	Total refused to participate
Ajman	350	350 X 0.25 = 87.5	100	15
Al-Fujairah	600	150	175	30
Dubai	500	125	125	13
Ras Al-Khaimah	300	75	75	15
Sharjah	500	125	125	9
Um Al- Qwain	300	75	75	8
PMO	12	3	9	3
Total	2,562	640.5 rounded to the nearest whole number = 641	684	93
Total number of staff who participated and rejected				777

Table 2: Hospitals involved in the study.

The results obtained in this study were grouped according to the facilities involved as well as providing overall comparison between these facilities. The results obtained from this questionnaire were merged as:

- Strongly agree and agree were merged together.
- Disagree and strongly disagree were merged as well.

4.1.1 Ajman Hospital

The results obtained from Ajman Hospital are as following. The total number of participants in this study from this hospital was 100, while 15 refused to participate due to different reasons, such as: they do not have enough time to complete the questionnaire. To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (2), most of the participants about 95 agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same for the ability of the system to provide the required information when needed, 90 agreed, while only 1 disagreed. For the system reliability, 93 participants agreed that the system is reliable with 5 disagreed and the easiness and flexibility of the system, more than half of the participants agreed about that with only 2 disagreed. In addition, above half of the participants agreed that the system was implemented successfully, while about quarter of them disagreed. Almost, the same applied for the system friendliness. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available in the system, only 51 participants agreed with 37 disagreed.

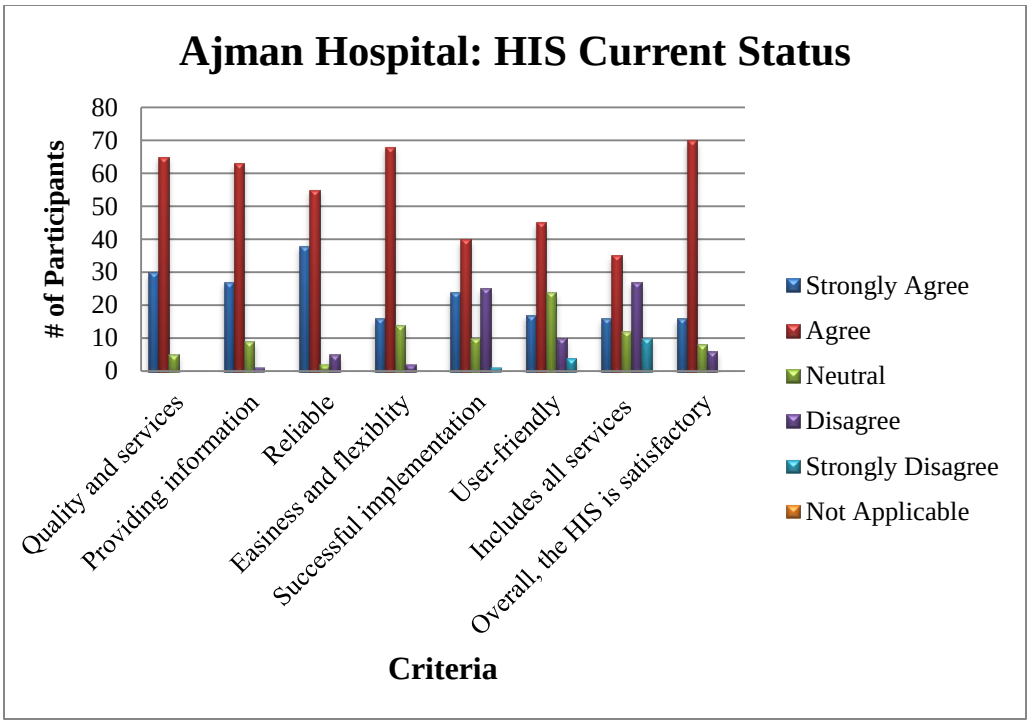

Figure 2: Ajman Hospital HIS current status.

The below figure (3) depicts the overall rating of the system. More than half of the participants, about 86% agreed that the system is satisfactory with 6% disagreement.

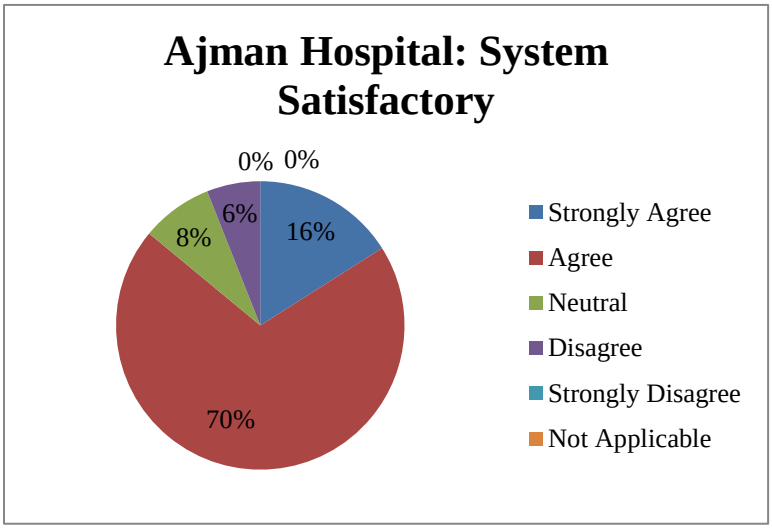

Figure 3: Ajman Hospital system satisfactory.

For re-designing patients care pathway, the below figure (4) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; once the patient enters the facility till leaving it with 5 disagreeing. For reviewing patients' progress notes, more than the half agreed about this and 9 disagreed. Almost the same is applied for documenting patients' care with only 7 disagreed. However, acquiring and analyzing laboratory, radiology and other results, the participants

agreed about this with a few disagreeing. About 81 participants agreed that the system simplified the processes with 10 disagreed. More than the half agreed that the system allows for taking decisions by communicating remotely with only 4 disagreed. Most of the participants agreed that the security and confidentiality are promoted in the system.

Furthermore, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

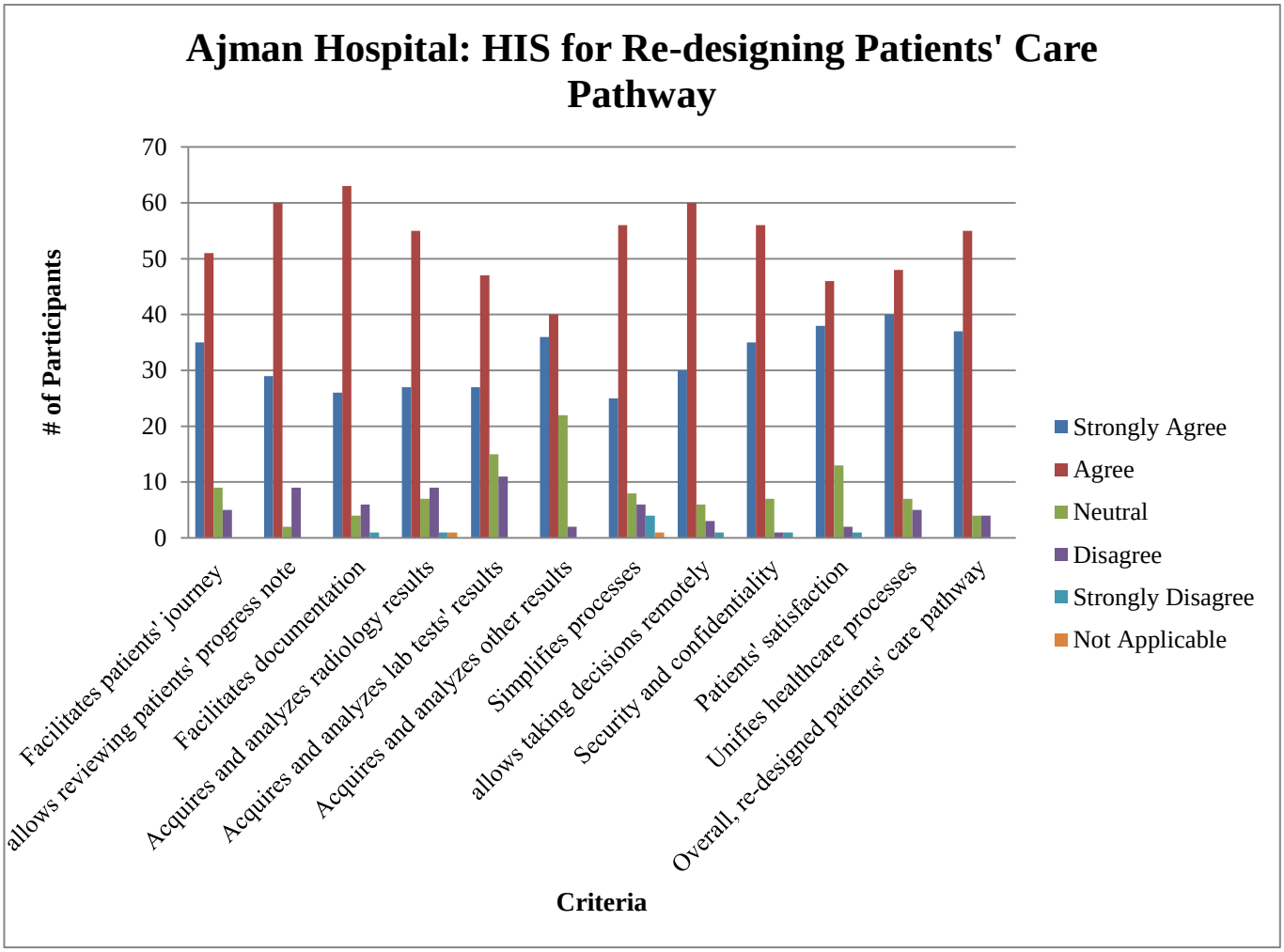

Figure 4: Ajman Hospital HIS for re-designing patients' care pathway.

The below figure (5) depicts the overall rating of the system. More than half of the participants agreed that the system helped in re-designing patient's care pathway with only 4% disagreement.

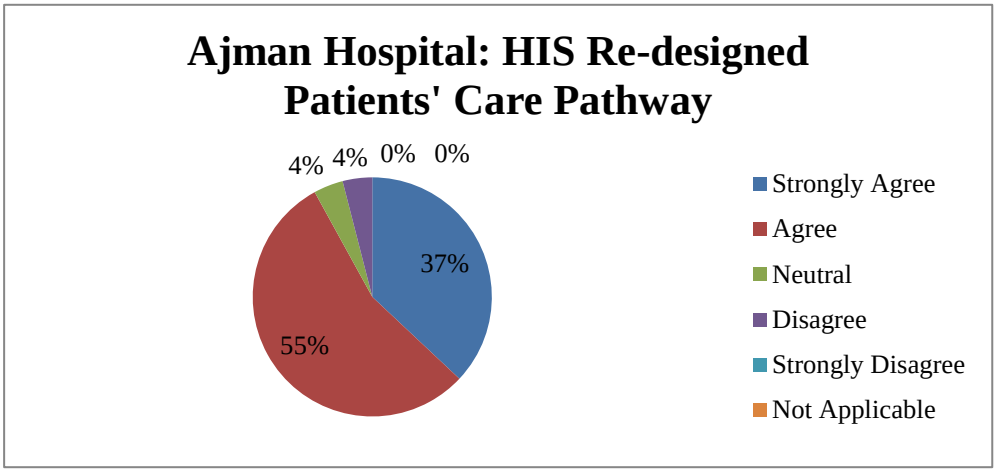

Figure 5: Ajman Hospital HIS helped in re-designing patients' care pathway.

The below figure (6) illustrates the results obtained from Ajman Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria. Regarding diagnosis and medical care, almost more than half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with a few disagreeing. Just about the same for having a comprehensive picture about a patient that helps in diagnosing problems sooner. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. In contrast, tracking patients' care progress and reliability of tests results for healthcare providers to take decisions about patients' conditions were almost average. Allow viewing drug formulary information and easy access to patients' assessments was selected by more than half of the participants. About quarter of the participants disagreed that the system has the option to send reminders to healthcare providers (e.g. surgeries appointments and nurses to give medications to inpatients).

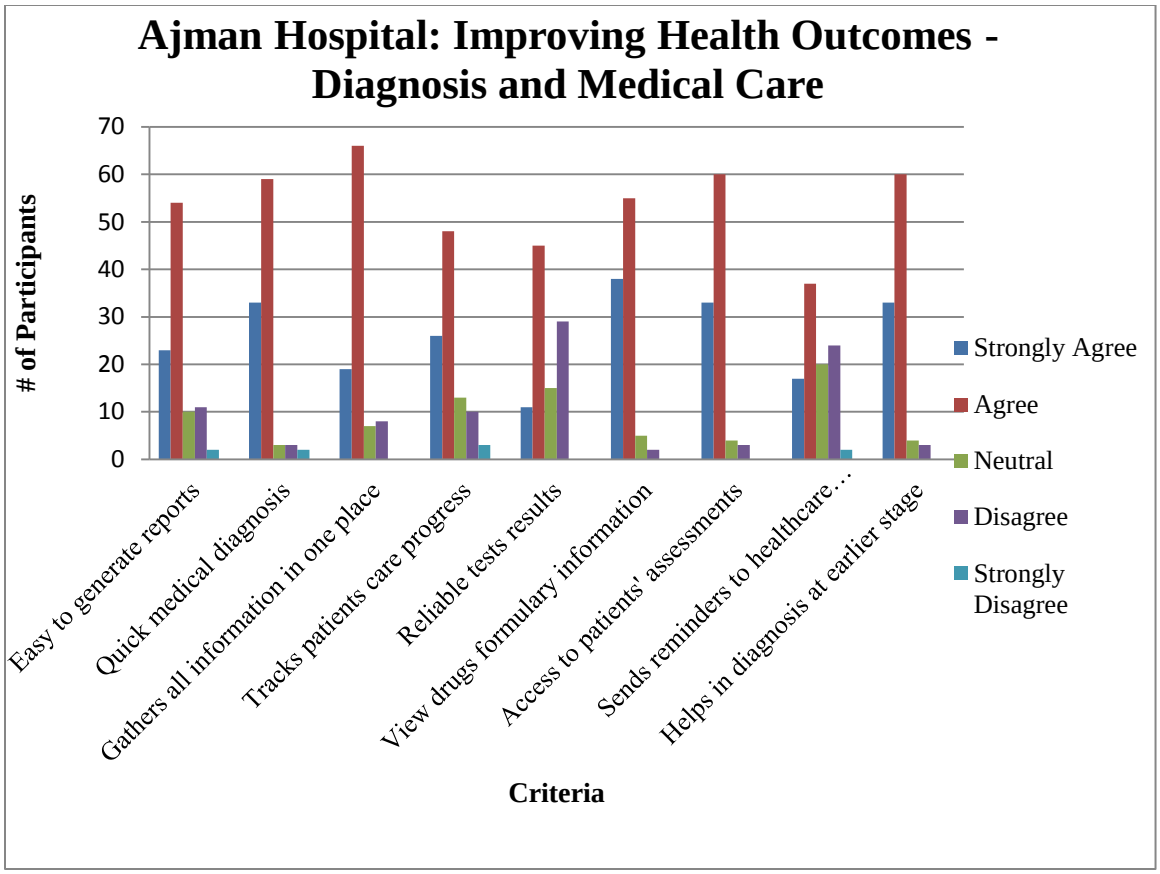

Figure 6: Ajman Hospital HIS for diagnosis and medical care.

However, the implementation of such systems helped in diagnosing medical conditions at earlier stage as depicted in figure (7). More than half of the participants agreed by 93% and only 3% disagreed.

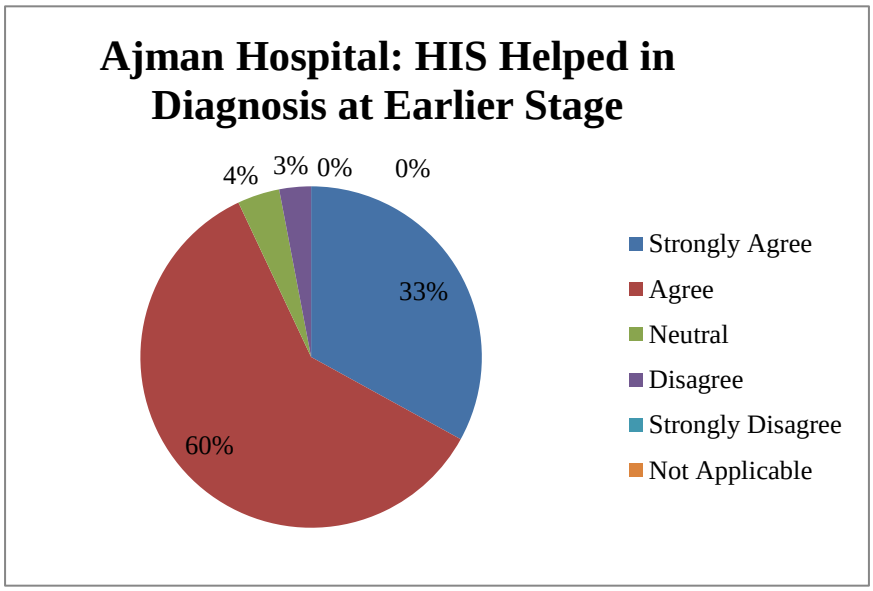

Figure 7: Ajman Hospital HIS helped in diagnosis at earlier stage.

The below figure (8) depicts how discern alerts helped in improving patients' health outcome in Ajman hospital while using the system. As noticed that most of the participants agreed and strongly agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only a very small number of participants disagreed.

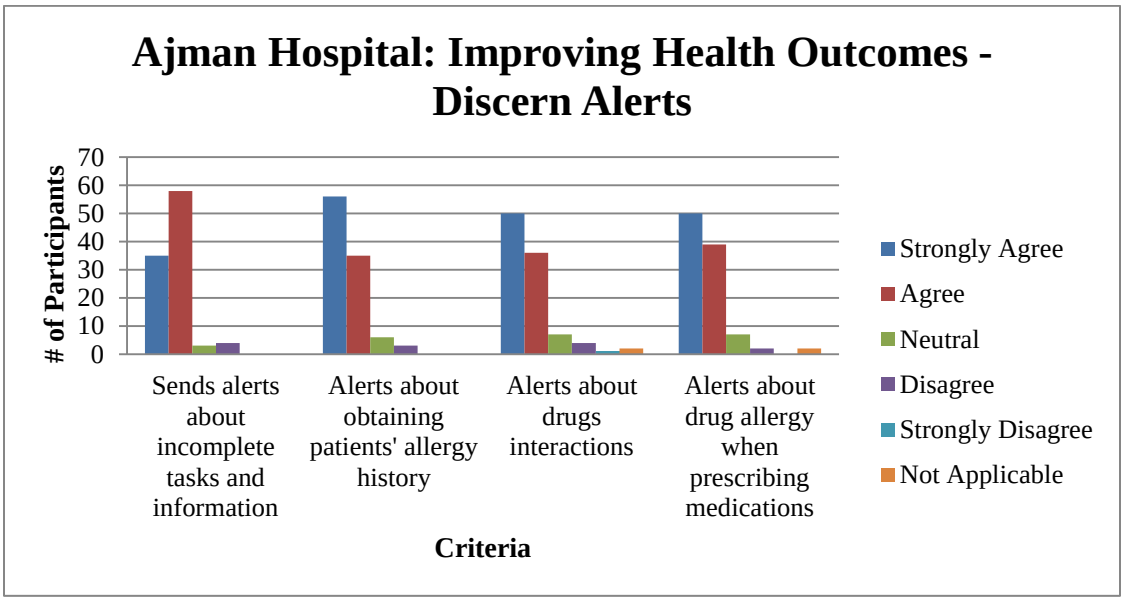

Figure 8: Ajman Hospital discern alerts.

The below figure (9) demonstrates how other areas in the implemented HIS improved patients' health outcomes for Ajman Hospital's patients. As noticed most the participants agreed and strongly agreed about the following: patients' registration and scheduling appointments processes take maximum 5 minutes per patient, but 5 participants selected this feature as not applicable. The reason could be that those people do not deal directly with scheduling appointments. However, more than the quarter disagreed that test results are transferred correctly from devices to the HIS and there is a need for double work to enter data from devices to the HIS. The same is almost applied with the successful integration of the system with other devices (e.g. lab machines). In contrast, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

On the other hand, there were a number of participants who disagreed that the system improves documentation process and coding system as well as patients waiting time is reduced and the ability of the system to send reminders to patients about their appointments.

Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. The participants mostly agreed about these two options in the system.

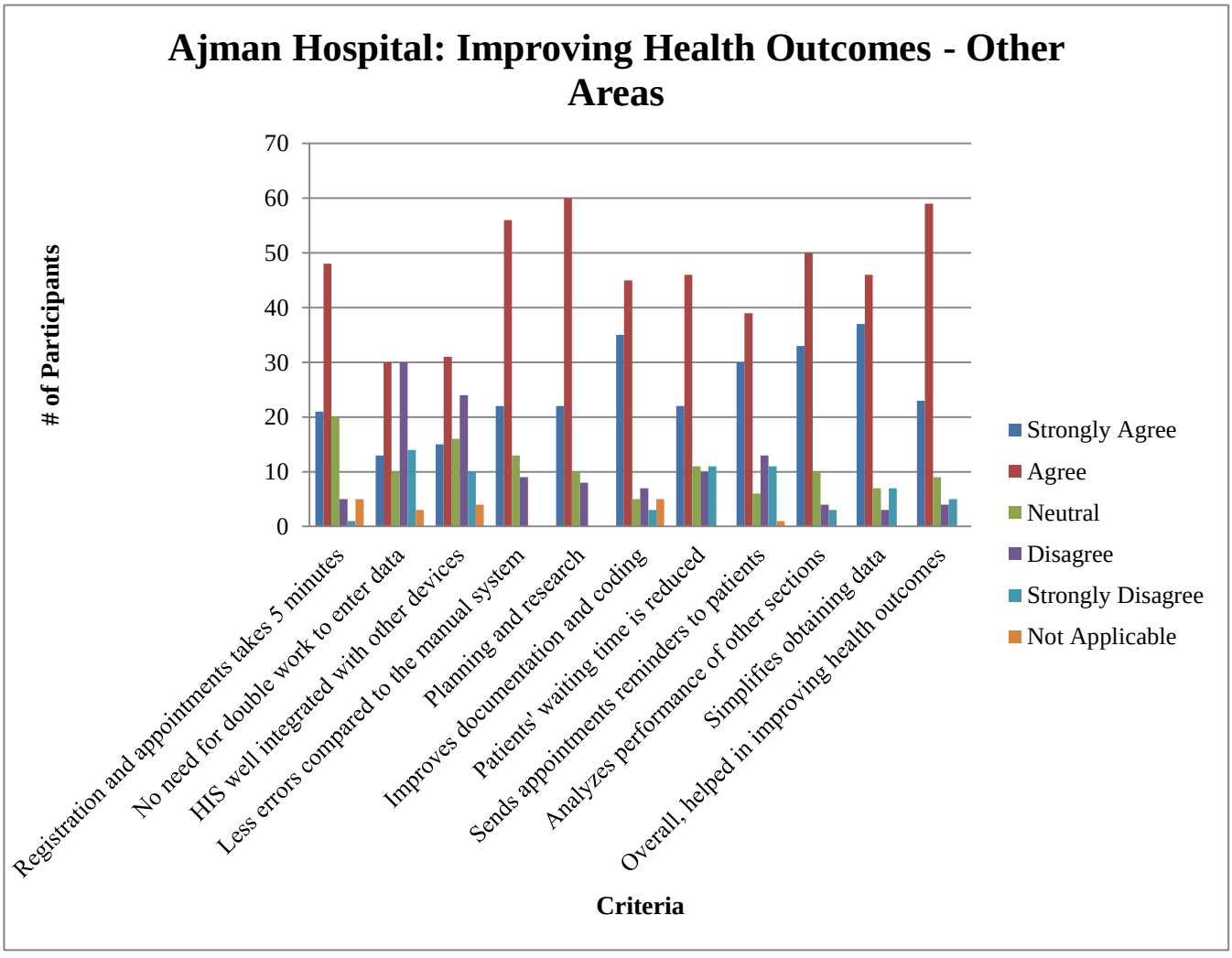

Figure 9: Ajman Hospital HIS for improving patients' health outcomes.

Overall, the system helped in improving patients' health outcomes as illustrated in the below figure (10). More than half of the participants agreed on that with small percentage of disagreement.

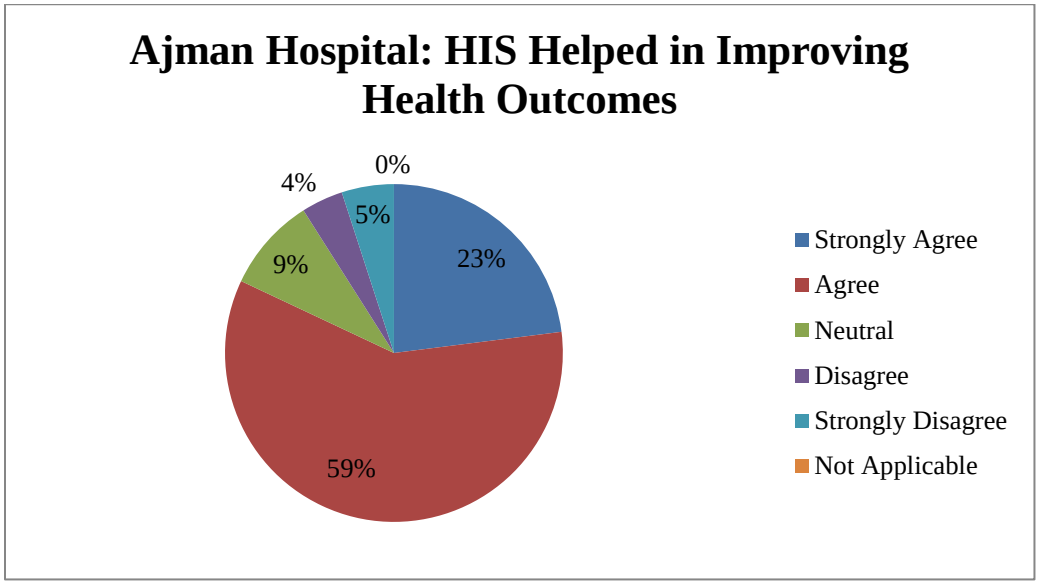

Figure 10: Ajman Hospital HIS helped in improving patients' health outcomes.

The below figure (11) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and support during the implementation of the system, then difficulty of the system layout and format (e.g. terminologies)and after that, the selected challenge was technical problems (e.g. unscheduled system downtime). The following was time consumption while using the system compared to the manual system (paper-based form). Only 5 participants selected user acceptance of the new system as a challenge. No participants provided other challenges.

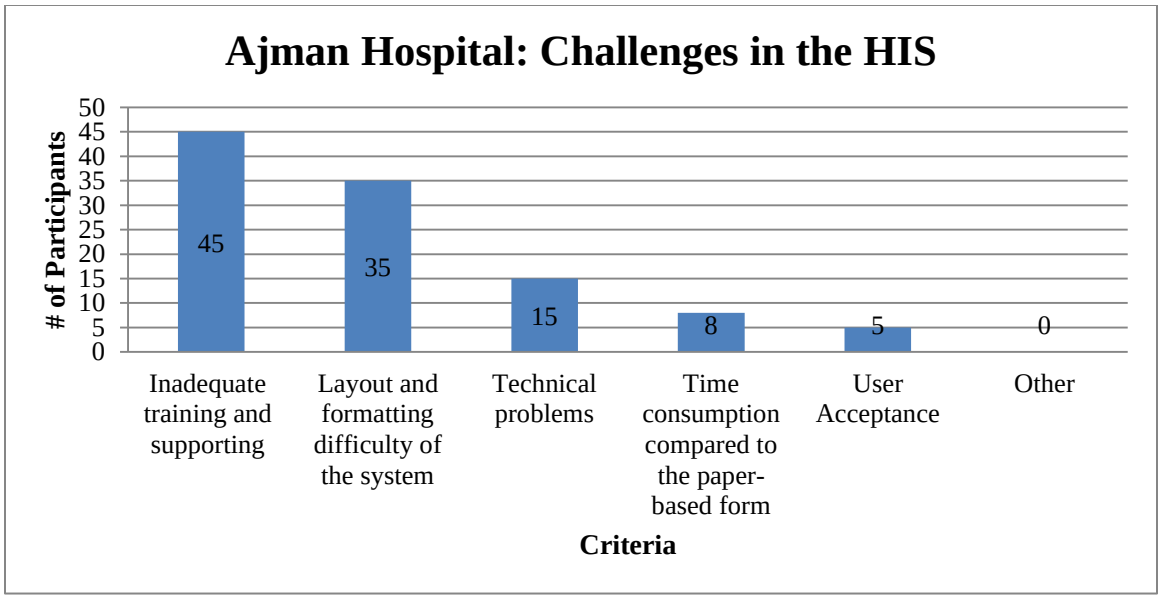

Figure 11: Ajman Hospital HIS challenges.

The below figure (12) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was providing more training courses, then extending support period and after that, the selected solution was simplifying the system and last solution was rewards and penalty strategy. No participants provided additional solution.

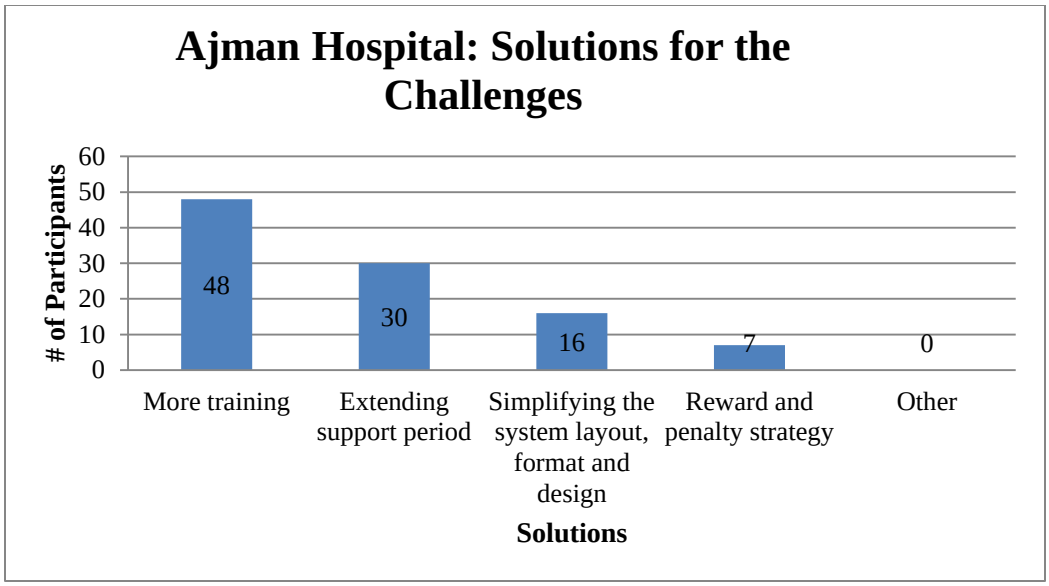

Figure 12: Ajman Hospital HIS solutions for challenges.

4.1.2 Al-Fujairah Hospital

The results obtained from Al-Fujairah Hospital are as following. The total number of participants in this study from this hospital was 175, while 30 refused to participate due to different reasons, such as: no enough time to complete the questionnaire and fear of sharing feedbacks and opinions.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (13) (Refer to appendix B: Al-Fujairah Hospital Figures), the majority of the participants agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same applied for the ability of the system to provide the required information when needed. However, there were a few of them who disagreed. For the system reliability, above the half agreed that the system is reliable with 45 were neutral and about the easiness and flexibility of the system, half of the participants agreed about that with nearly 61 participants had the opposite perspective. In addition, about 80 participants agreed that the system was implemented successfully, while about 62 disagreed with 33 were neutral. More than the half indicated that the system is friendly with only 29 out of 175 disagreed. The number of participants

who were neutral regarding the system friendliness was 33 which is higher than the number of disagreed participants. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available in the system was rated the lowest compared to other criteria here.

Figure (14) (Refer to appendix "B": Al-Fujairah Hospital Figures) depicts the overall rating of the system. More than half of the participants, about 65% agreed that the system is satisfactory with 16% dissatisfaction.

For re-designing patients care pathway, figure (15) (Refer to appendix B: Al-Fujairah Hospital Figures) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; the minute the patient enters the facility till leaving it with more than 30 disagreeing and 34 were neutral. For reviewing patients' progress notes, the majority agreed about this and a few disagreed. Almost the same is applied for documenting patients' care with a few disagreed. However, acquiring and analyzing laboratory, radiology and other results, the participants agreed about this with some disagreements. About 100 participants agreed that the system simplified the processes with 40 disagreements. About 86 agreed that the system allows for taking decisions by communicating remotely, while 37 were neutral and 47 disagreed. Most the participants agreed that the security and confidentiality are promoted in the system.

In contrast, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (16) (Refer to appendix B: Al-Fujairah Hospital Figures) depicts the overall rating of the system. More than half of the participants agreed that the system helped in re-designing patient's care pathway with only 6% disagreement.

Figure (17) (Refer to appendix B: Al-Fujairah Hospital Figures) illustrates the results obtained from Al-Fujairah Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria.

Regarding diagnosis and medical care, nearly half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with some disagreements. For having a comprehensive picture about a patient that helps in diagnosing problems sooner, more than 110 participants agreed with 26 disagreed. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. Also, tracking patients' care progress and reliability of tests results for healthcare providers to take decisions about patients' conditions were positive. Viewing drugs formulary information and easy access to patients' assessments was selected by more than half of the participants. About less than the half agreed that the system has the option to send reminders to healthcare providers (e.g. surgeries appointments and nurses to give medications to inpatients). However, the implementation of such system helped in diagnosing medical conditions at earlier stage as depicted in figure (18) (Refer to appendix B: Al-Fujairah Hospital Figures). More than half of the participants agreed by 69% and 13% disagreed.

Figure (19) (Refer to appendix B: Al-Fujairah Hospital Figures) depicts how discern alerts helped in improving patients' health outcome in Al-Fujairah Hospital while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only a very small number of participants disagreed. However, the noticeable is that the number of neutral responses is high compared to other hospitals rated this criteria, such as Ajman Hospital.

Figures (20) (Refer to appendix B: Al-Fujairah Hospital Figures) demonstrates other areas in the implemented HIS improved patients' health outcomes for Al-Fujairah Hospital's patients. The number of participants who agreed about patients' registration and scheduling appointments processes that take maximum 5 minutes per patient was about 83 with 42 disagreed. Nearly the same applies for no double work is required to enter data. There were a few numbers of participants who selected these two features as not applicable. The reason could be that those people do not directly deal with scheduling appointments or are not technicians. However, more than the quarter agreed that the

system is well integrated with other devices (e.g. lab machines). In contrast, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

On the other hand, there were a number of participants who disagreed that the system improves documentation process and coding system as well as patients waiting time is reduced and the ability of the system to send reminders to patients about their appointments.

Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. Most of the participants agreed about these two options in the system.

Overall, the system helped in improving patients' health outcomes as illustrated in figure (21) (Refer to appendix B: Al-Fujairah Hospital Figures). More than half of the participants agreed on that about 81% with only small percentage disagreed, about 9% and only 1% of the participants were not applicable to decide whether the system helped in improving health outcomes or not.

Figure (22) (Refer to appendix B: Al-Fujairah Hospital Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and support during the implementation of the system, then difficulty of the system layout and format (e.g. terminologies)and after that, the selected challenge was time consumption while using the system compared to the manual system (paper-based form). The following was technical problems (e.g. unscheduled system downtime). Last challenge selected was user acceptance of the new system as a challenge. No participants provided other challenges.

Figure (23) (Refer to appendix B: Al-Fujairah Hospital Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was extending support period, then

providing more training courses and after that, the selected solution was simplifying the system and last solution was rewards and penalty strategy. No participants provided additional solution.

4.1.3 Dubai Hospital

The results obtained from Dubai Hospital are as following. The total number of participants in this study from this hospital was 125, while 13 refused to participate due to different reasons, such as: fear to share feedbacks and opinions.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (24) (Refer to appendix C: Dubai Hospital Figures), the majority of the participants agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same applied for the ability of the system to provide the required information when needed with zero disagreeing. For the system reliability, above the half agreed that the system is reliable and about the easiness and flexibility of the system, more than half of the participants agreed about that with nearly 14 participants had the opposite response. In addition, about 90 participants agreed and that the system was implemented successfully, while about 16 disagreed and 19 were neutral. More than the half indicated that the system is friendly with 16 out of 125 disagreed. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available in the system, was agreed by 86 participants with 6 not applicable.

Figure (25) (Refer to appendix C: Dubai Hospital Figures) depicts the overall rating of the system. More than half of the participants, about 81% agreed that the system is satisfactory with only 4% dissatisfaction.

For re-designing patients care pathway, figure (26) (Refer to appendix C: Dubai Hospital Figures) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; the minute the patient enters the facility till leaving it with 8 disagreeing and 16 were neutral. For reviewing patients' progress notes, the majority agreed about this and a few disagreed. Almost the same is applied for documenting patients' care. However, acquiring and analyzing

laboratory, radiology and other results, the participants agreed about this, but the number of neutral participants was higher than disagreed participants. About 99 participants agreed that the system simplified the processes with 6 disagreements. Also, 96 agreed that the system allows for taking decisions by communicating remotely. Most the participants agreed that the security and confidentiality are promoted in the system.

In contrast, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (27) (Refer to appendix C: Dubai Hospital Figures) depicts the overall rating of the system. More than half of the participants 85% agreed that the system helped in re-designing patient's care pathway with 0% disagreement. As noticed, the percentage of neutral participants is 15%, which is higher than the percentage of disagreed participants.

Figure (28) (Refer to appendix C: Dubai Hospital Figures) illustrates the results obtained from Dubai Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria.

Regarding diagnosis and medical care, more than half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with some disagreements. For having a comprehensive picture about a patient that helps in diagnosing problems sooner, about 88 participants agreed with 6 disagreed. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. Also, tracking patients' care progress and reliability of tests results for healthcare providers to take decisions about patients' conditions were positive. Viewing drugs formulary information and easy access to patients' assessments were selected by more than half of the participants. The number of participants who agreed that the system has the option to send reminders to healthcare providers (e.g. surgeries appointments and nurses to give medications to inpatients) is 78 with 24 disagreeing.

However, the implementation of such system helped in diagnosing medical conditions at earlier stage as depicted in figure (29) (Refer to appendix C: Dubai Hospital Figures). More than half of the participants agreed by 82%, 0% disagreed with 15% neutral and 3% not applicable. The neutral and not applicable could be due to not willingness to declare thoughts.

Figure (30) (Refer to appendix C: Dubai Hospital Figures) depicts how discern alerts helped in improving patients' health outcome in Dubai Hospital while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only a small number of participants disagreed. However, the noticeable is that the number of neutral responses is high compared to the disagreed responses.

Figure (31) (Refer to appendix C: Dubai Hospital Figures) demonstrates how other areas in the implemented HIS improved patients' health outcomes for Dubai Hospital's patients. The number of participants who agreed about patients' registration and scheduling appointments processes that take maximum 5 minutes per patient was about 73 with 19 disagreed. Nearly the same applied for no double work is required to enter data. There were a few number of participants selected these two feature as not applicable. The reason could be that those people do not directly deal with scheduling appointments or are not technicians. However, more than the quarter agreed that the system is well integrated with other devices (e.g. lab machines). In addition, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

On the other hand, there were a number of participants who agreed that the system improves documentation process and coding system as well as patients waiting time is reduced and the system ability to send reminders to patients about their appointments.

Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such

as: diagnosis and planning. Most of the participants agreed about these two options in the system.

Overall, the system helped in improving patients' health outcomes as illustrated in figure (32) (Refer to appendix C: Dubai Hospital Figures). More than half of the participants agreed on that about 76% with only small percentage strongly disagreed, about 2% and the same percentage of the participants were not applicable to decide whether the system helped in improving health outcomes or not. The obvious is that the percentage of neutral participants was higher than those disagreed.

Figure (33) (Refer to appendix C: Dubai Hospital Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and supporting, then time consumption while using the system compared to the manual system (paper-based form) and after that, difficulty of the system layout and format (e.g. terminologies). The number of participants who selected user acceptance of the new system as a challenge is 20. The least selected challenge was Technical problems (e.g. unscheduled system downtime). No additional challenges were added.

Figure (34) (Refer to appendix C: Dubai Hospital Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was extending support period during the go-live period of the system. Then, providing more training courses and after that, the selected solution was simplifying the system and last solution was rewards and penalty strategy. This is the same order of selecting solutions made compared to Al-Fujairah Hospital. No participants provided additional solution.

4.1.4 Ras Al-Khaimah (RAK) Hospital

The results obtained from Ras Al-Khaimah (RAK) Hospital are as following. The total number of participants in this study from this hospital was 75, while 15 refused to participate due to different reasons, such as: time consumption.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (35) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures), most of the participants about 65 agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same for the ability of the system to provide the required information when needed, 64 agreed, while only 6 disagreed. For the system reliability, also 64 participants agreed that the system is reliable with 8 disagreed and the easiness and flexibility of the system, more than half of the participants agreed about that with only 7 disagreed. Nearly the same applied for successfulness of the system implementation while more than quarter of them agreed that the system is friendly. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available, was selected by most of the participants. Compared to other hospitals, this criterion was selected by the majority from RAK hospital.

Figure (36) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) depicts the overall rating of the system. More than half of the participants, about 87% agreed that the system is satisfactory with 8% dissatisfaction.

For re-designing patients care pathway, figure (37) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; once the patient enters the facility till leaving it with 4 disagreeing. For reviewing patients' progress notes, more than the half agreed about this and only 2 disagreed. Almost the same is applied for documenting patients' care with only 1 strongly disagreed. However, acquiring and analyzing laboratory, radiology and other results, the participants agreed about this with a few disagreeing. About 57 participants agreed that the system simplified the processes with 13 disagreed. More than the half agreed that the system allows for taking decisions by communicating remotely with only 4 disagreed. The participants agreed that the security and confidentiality are promoted in the system. In addition, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (38) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) depicts the overall rating of the system. More than half of the participants agreed that the system helped in re-designing patient's care pathway with only 7% dissatisfaction.

Figure (39) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) illustrates the results obtained from RAK Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria.

Regarding diagnosis and medical care, more than half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with 4 disagreeing. Just about the same for having a comprehensive picture about a patient that helps in diagnosing problems sooner. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. Almost the same applied for tracking patients' care progress and reliability of tests results for healthcare providers to take decisions about patients' conditions. Allow viewing drugs formulary information, easy access to patients' assessments and send reminders to healthcare providers were selected by more than half of the participants.

The implementation of such systems helped in diagnosing medical conditions at earlier stage as depicted in figure (40) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures). More than half of the participants agreed by 88% and only 4% disagreed.

Figure (41) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) depicts how discern alerts helped in improving patients' health outcome in RAK Hospital while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drugs allergy when prescribing medications. Only a very small number of participants disagreed with numbers of neutral responses.

Figure (42) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) demonstrates how other areas in the implemented HIS improved patients' health outcomes for RAK Hospital's patients. As noticed most the participants agreed about the

following: patients' registration and scheduling appointments processes take maximum 5 minutes per patient, but 5 participants selected this feature as not applicable. Also, more than the half agreed that test results are transferred correctly from devices to the HIS and there is no need for double work to enter data from devices to the HIS. Almost the same applied for the successful integration of the system with other devices (e.g. lab machines). In addition, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

Improving documentation process, coding system as well as reducing patients' waiting time and the system ability to send reminders to patients about their appointments were selected by more than half of the participants. Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. The participants mostly agreed about these two options in the system.

Overall, the system helped in improving patients' health outcomes as illustrated in figure (43) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures). More than half of the participants agreed on that with 11% disagreed.

Figure (44) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and support during the implementation of the system, then, technical problems (e.g. unscheduled system downtime) and after that, the selected challenge was difficulty of the system layout and format (e.g. terminologies).The following was time consumption while using the system compared to the manual system (paper-based form). Only 7 participants selected user acceptance of the new system as a challenge and 1participant added an extra challenge which is increasing in the number of patients compared to the number of staff.

Figure (45) (Refer to appendix D: Ras Al-Khaimah (RAK) Hospital Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The

participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was providing more training courses, then extending support period and after that, the selected solution was simplifying the system and last solution was rewards and penalty strategy. No participants provided additional solution. The same order of the solutions was also selected by Ajman Hospital.

4.1.5 Sharjah Hospital

The results obtained from Sharjah Hospital are as following. The total number of participants in this study from this hospital was 125, while 9 refused to participate due to different reasons, such as: not interested in being part of the study.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (46) (Refer to appendix E: Sharjah Hospital Figures), most of the participants about 100 agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same for the ability of the system to provide the required information when needed, 96 agreed, while 16 disagreed. For the system reliability, 97 participants agreed that the system is reliable with 11 disagreed and for the easiness and flexibility of the system, more than half of the participants agreed about that with 17 disagreed. More than half of the participants agreed that the system was implemented successfully and that the system is friendly. Furthermore, more than the half agreed that the system is comprehensive, which means that all services (e.g. laboratory and billing) are available with 13 disagreed and 6 indicated as not applicable as these participants might be medical records clerks so only know about their part of the system.

Figure (47) (Refer to appendix E: Sharjah Hospital Figures) depicts the overall rating of the system. More than half of the participants, about 76% agreed that the system is satisfactory with 8% dissatisfaction.

For re-designing patients care pathway, figure (48) (Refer to appendix E: Sharjah Hospital Figures) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; once the patient enters the facility till leaving it with 6 disagreeing. For reviewing patients' progress notes, more than the half agreed about this and 10 disagreed. Almost the same is applied for documenting patients' care with 10 disagreed. Also, acquiring and analyzing laboratory, radiology and other results, the participants agreed about this with a few disagreeing. About 93 participants agreed that the system simplified the processes with 1 strongly disagreed. More than the half agreed that the system allows for taking decisions by communicating remotely with only 6 strongly disagreed. The participants agreed that the security and confidentiality are promoted in the system.

In contrast, patients satisfaction from the HIS users perspectives was positive with 6 participants selected this criterion as not applicable. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (49) (Refer to appendix E: Sharjah Hospital Figures) depicts the overall rating of the system. More than half of the participants agreed that the system helped in re-designing patient's care pathway with 5% disagreeing and 2% not applicable.

Figure (50) (Refer to appendix E: Sharjah Hospital Figures) illustrates the results obtained from Sharjah Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria. Regarding diagnosis and medical care, more than half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with 4 disagreeing. Almost the same for having a comprehensive picture about a patient that helps in diagnosing problems sooner. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. Almost the same applied for tracking patients' care progress and reliability of tests results for healthcare providers to take decisions about patients' conditions. Viewing drugs formulary information, easy access

to patients' assessments and sending reminders to healthcare providers were selected by more than half of the participants.

However, about 86% agreed that the implementation of such systems helped in diagnosing medical conditions at earlier stage and 3% disagreed as depicted in figure (51) (Refer to appendix E: Sharjah Hospital Figures).

Figure (52) (Refer to appendix E: Sharjah Hospital Figures) depicts how discern alerts helped in improving patients' health outcome in Sharjah Hospital while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only a very small number of participants disagreed with numbers of neutral responses.

Figure (53) (Refer to appendix E: Sharjah Hospital Figures) demonstrates how other areas in the implemented HIS improved patients' health outcomes for Sharjah Hospital's patients. As noticed most the participants agreed about the following: patients' registration and scheduling appointments processes take maximum 5 minutes per patient, but 9 participants selected this feature as not applicable. Also, more than the half agreed that test results are transferred correctly from devices to the HIS and there is no need for double work to enter data from devices to the HIS. Almost the same applied for the successful integration of the system with other devices (e.g. lab machines). In addition, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

Improving documentation process, coding system as well as reducing patients' waiting time and the system ability to send reminders to patients about their appointments were selected by more than half of the participants. Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. The participants mostly agreed about these two options in the system.

Overall, the system helped in improving patients' health outcomes as illustrated in figure (54) (Refer to appendix E: Sharjah Hospital Figures). More than half of the participants agreed on that with 4% disagreed.

Figure (55) (Refer to appendix E: Sharjah Hospital Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and support during the implementation of the system, then difficulty of the system layout and format (e.g. terminologies) and after that, the selected challenge was technical problems (e.g. unscheduled system downtime). The following was time consumption while using the system compared to the manual system (paper-based form). The number of participants who selected user acceptance of the new system as a challenge is 16. No participants provided other challenges. The same order of challenges was selected by Ajman and UAQ Hospitals.

Figure (56) (Refer to appendix E: Sharjah Hospital Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was extending support period during the go-live of the system. Then providing more training courses and after that, the selected solution was rewards and penalty strategy and least selected solution was simplifying the system layout and format which includes using simple terminologies. No participants provided additional solution. The order of the selected solutions here is the same as for UAQ Hospital.

4.1.6 Um Al-Qwain (UAQ) Hospital

The results obtained from Um Al-Qwain (UAQ) Hospital are as following. The total number of participants in this study from this hospital was 75, while 8 refused to participate due to different reasons, such as: time consumption. In some ways, the results obtained from UAQ and RAK Hospitals have some commonality.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (57) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital

Figures), most of the participants about 63 agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). The same for the ability of the system to provide the required information when needed, 64 agreed, but only 6 disagreed. For the system reliability, 56 participants agreed that the system is reliable with 9 disagreed and the easiness and flexibility of the system, more than half of the participants agreed about that with only 5 disagreed. Nearly the same applied for successfulness of the system implementation while more than half of them agreed that the system is friendly. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available, was selected by most of the participants.

Figure (58) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) depicts the overall rating of the system. More than half of the participants, about 84% agreed that the system is satisfactory with 9% dissatisfaction.

For re-designing patients care pathway, figure (59) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) demonstrates the results. More than half of the participants agreed that the implemented HIS facilitates a patient's journey in the hospital; when the patient enters the facility till leaving it with 8 disagreeing. For reviewing patients' progress notes, more than the half agreed about this and only 3 disagreed. Nearly the same is applied for documenting patients' care with only 1 strongly disagreed. However, acquiring and analyzing laboratory, radiology and other results, the participants agreed about this with a few disagreeing. About 56 participants agreed that the system simplified the processes with 11 disagreed. More than the half agreed that the system allows for taking decisions by communicating remotely with only 3 disagreed. The participants agreed that the security and confidentiality are promoted in the system. In addition, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (60) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) depicts the overall rating of the system. More than half of the participants 89% agreed that the system helped in re-designing patient's care pathway with only 4% disagreeing.

Figure (61) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) illustrates the results obtained from UAQ Hospital about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria.

Regarding diagnosis and medical care, more than half of the participants agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with 7 disagreeing. Almost the same for having a comprehensive picture about a patient that helps in diagnosing problems sooner. In addition, more than the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions. Almost the same applied for tracking patients' care progress, while for reliable tests results so healthcare providers can take decisions about patients' conditions, the number of participants who agreed was 53 with 13 disagreeing. Allow viewing drugs formulary information, easy access to patients' assessments and send reminders to healthcare providers were selected by more than half of the participants.

The implementation of such systems helped in diagnosing medical conditions at earlier stage as depicted in figure (62) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures). More than half of the participants agreed by 82% and 10% disagreed.

Figure (63) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) depicts how discern alerts helped in improving patients' health outcome in UAQ Hospital while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only a very small number of participants disagreed with numbers of neutral responses.

Figure (64) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) demonstrates how other areas in the implemented HIS improved patients' health outcomes for UAQ Hospital's patients. As noticed, most the participants agreed about the following: patients' registration and scheduling appointments processes take maximum 5 minutes per patient, but 14 participants disagreed. Also, more than the half agreed that test results

are transferred correctly from devices to the HIS and there is no need for double work to enter data from devices to the HIS. Almost the same applied for the successful integration of the system with other devices (e.g. lab machines). In addition, more than the half agreed that the number of errors is decreased compared to the manual system and the system generates reports for planning and research.

Improving documentation process, coding system as well as reducing patients' waiting time and the system ability to send reminders to patients about their appointments were selected by more than half of the participants, but 7 participants indicated coding criterion as not applicable. This could be that those participants are not involves in coding task. Another area covered was the ability of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. The participants mostly agreed about these two options in the system.

Overall, the system helped in improving patients' health outcomes as illustrated in figure (65) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures). The percentage of participants who agreed that the system helped in improving health outcomes was 80% with 11% disagreed. The disagreeing percentage here is the same as for RAK Hospital.

Figure (66) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenges was inadequacy of training and support during the implementation of the system, then difficulty of the system layout and format (e.g. terminologies) and after that, the selected challenge was technical problems (e.g. unscheduled system downtime).The following was time consumption while using the system compared to the manual system (paper-based form). Only 9 participants selected user acceptance of the new system as a challenge. This is the same order of selecting challenges made compared to Ajman and Sharjah Hospitals. No additional challenges were added.

Figure (67) (Refer to appendix F: Um Al-Qwain (UAQ) Hospital Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was extending support period during the go-live of the system. The second solution was providing more training sessions and after that, the selected solution was reward and penalty strategy and least selected solution was simplifying the system layout, format and design which includes using simple terminologies. No additional solutions were added.

4.1.7 Project Management Office (PMO)

The results obtained from the Project Management Office (PMO) of the implemented HIS are as following. The total number of participants in this study from PMO was 9, while 3 were excluded as two of the individuals are recently joined the office and the third one is the author of the study, so to avoid any biases.

To evaluate the current status of the implemented Health Information System (HIS), as demonstrated in figure (68) (Refer to appendix G: HIS Project Management Office (PMO) Figures), all of the participants agreed that the system enhances the quality of the work and services provided to customers (e.g. patients). Almost the same applied for the ability of the system to provide the required information when needed. For the system reliability, above the half agreed that the system is reliable with 2 disagreed and the easiness and flexibility of the system, all of the participants agreed. In addition, for successfulness of the system implementation, 7 agreed, while 2 of the participants had neutral point of view. On the other hand, the system comprehensiveness, which means that all services (e.g. laboratory and billing) are available and was selected by most of the participants with 2 disagreeing.

Figure (69) (Refer to appendix G: HIS Project Management Office (PMO) Figures) depicts the overall rating of the system. All the participants agreed that the system is satisfactory.

For re-designing patients care pathway, figure (70) (Refer to appendix G: HIS Project Management Office (PMO) Figures) demonstrates the results. Almost all of the

participants agreed that the implemented HIS facilitates a patient's journey in the hospital; once the patient enters the facility till leaving it except 1 participant who had neutral perspective. For reviewing patients' progress notes, all of them agreed. Almost the same is applied for documenting patients' care with only 1 neutral perspective. However, acquiring and analyzing laboratory, radiology and other results, the participants agreed about this with a few disagreeing. About 5 participants agreed that the system simplified the processes with 1 disagreed. More than the half agreed that the system allows for taking decisions by communicating remotely. The participants agreed that the security and confidentiality are promoted in the system. In addition, patients satisfaction from the HIS users perspectives was positive. Also, the participants agreed that the system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.

Figure (71) (Refer to appendix G: HIS Project Management Office (PMO) Figures) depicts the overall rating of the system. All the participants agreed that the system helped in re-designing patient's care pathway.

Figure (72) (Refer to appendix G: HIS Project Management Office (PMO) Figures) illustrates the results obtained from PMO about improving patients' health outcomes while using the implemented HIS. This area was sub-divided into three areas: diagnosis and medical care, discern alerts and other areas that includes general criteria.

Regarding diagnosis and medical care, about half of the participants strongly agreed that the process of generating reports via the system is easy (e.g. statistics about a specific disease) with 4 disagreeing. While, for having a comprehensive picture about a patient that helps in diagnosing problems sooner, 5 agreed and 2 disagreed. In addition, about the half agreed that the system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions, but 2 disagreed. On the other hand, all of the participants agreed about the system ability to track patients' care progress. For reliability of tests results for healthcare providers to take decisions about patients' conditions, almost all of them agreed with 1 disagreeing. Allow viewing drugs formulary information and easy access to patients' assessments, the

participants agreed about that, while sending reminders to healthcare providers were selected by less than half of the participants and almost above the have disagreed.

The implementation of such systems helped in diagnosing medical conditions at earlier stage as depicted in figure (73) (Refer to appendix G: HIS Project Management Office (PMO) Figures). More than half of the participants agreed with a noticeable percentage of disagreeing. The PMO was the only facility had this percentage of disagreeing. The reason could be their perspective of the system from IT point of view, not like other facilities that see the system most likely from medical point of view.

Figure (74) (Refer to appendix G: HIS Project Management Office (PMO) Figures) depicts how discern alerts helped in improving patients' health outcome while using the system. As noticed that most of the participants agreed that the system sends alerts about incomplete tasks and information as well as to obtain patients' allergy history, drugs interaction and drug allergy when prescribing medications. Only 2 participants strongly disagreed about sending alerts for incomplete tasks and information with a few number of neutral responses.

Figure (75) (Refer to appendix G: HIS Project Management Office (PMO) Figures) demonstrates how other areas in the implemented HIS improved patients' health outcomes. As noticed, above the half, agreed that patients' registration and scheduling appointments processes take maximum 5 minutes per patient, but 4 participants disagreed. Also, more than the half agreed that test results are transferred correctly from devices to the HIS and there is no need for double work to enter data from devices to the HIS. Almost the same applied for the successful integration of the system with other devices (e.g. lab machines). In addition, all of them agreed that the number of errors is decreased compared to the manual system. However, about the ability of the system to generate reports for planning and research, less than the half strongly agreed with 3 disagreeing and 2 had neutral perspective.

Improving documentation process and coding system as well as reducing patients' waiting time and the system ability to send reminders to patients about their appointments were selected by more than half of the participants. Another area covered was the ability

of the system to analyze the performance of different sections at the facility and simply obtain required data for various reasons, such as: diagnosis and planning. The participants mostly agreed about these two options in the system. Overall, the system helped in improving patients' health outcomes as illustrated in figure (76) (Refer to appendix G: HIS Project Management Office (PMO) Figures). All the participants agreed on that.

Figure (77) (Refer to appendix G: HIS Project Management Office (PMO) Figures) depicts the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add other challenges that were not listed in the questionnaire. However, the most selected challenge was inadequacy of training and support during the implementation of the system, then, user acceptance and after that, technical problems (e.g. unscheduled system downtime). Nevertheless, none of the participants selected difficulty of the system layout and format (e.g. terminologies) and time consumption while using the system compared to the manual system (paper-based form) as challenges. Only 1 participant added an extra challenge which is language barrier as the system in only in English version and there are some users who are not good in English.

Figure (78) (Refer to appendix G: HIS Project Management Office (PMO) Figures) depicts the possible solutions to overcome the challenges faced in the implemented HIS. The participants had the option to select more than one answer and add solutions that were not listed in the questionnaire. However, the most selected solution was providing more training courses, then extending support period and after that, the selected solution was rewards and penalty strategy. Neither of the participants selected simplifying the system as a possible solution nor provided additional solution.

4.2 Evaluation of the Study Participants

To evaluate the HIS users from different angles; gender, age and major of the users based on the geographical distribution of the users were used as criteria. As seen from these three figures (79, 80 and 81), the number of females users is higher in all areas. However, this variation is only for the sample size involved in the study. As noticed that Dubai, Ras Al-Khaimah, Um Al-Qwain and the Project Management Office (PMO) has the remarkable variation in the number of males and females users. The variation is almost the double, except for the PMO; it was more than the double. For instance, the number of HIS males users involved in this study from Dubai Hospital was 40, while the number of HIS females users was 85.

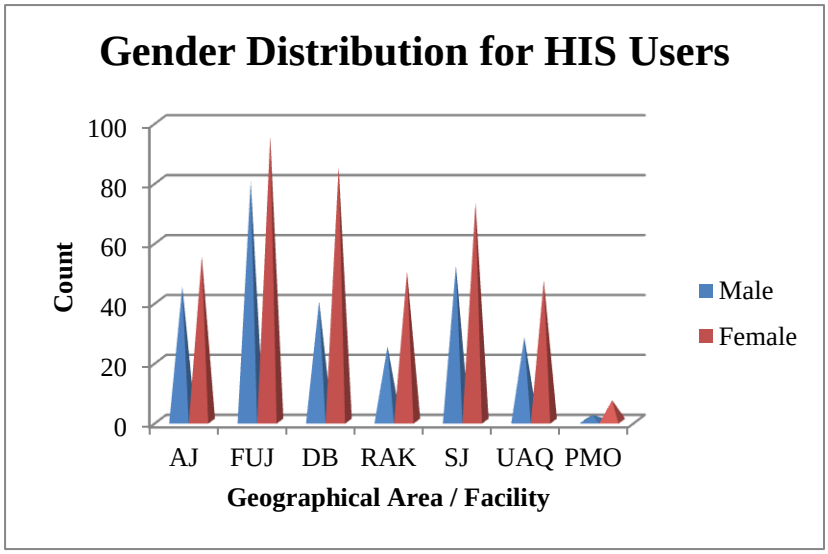

Figure 79: Gender distribution for HIS users.

On the other hand, the age distribution of the HIS users involved in this study was as the following. As noticed, most of the HIS users involved in this study were in their thirties, in another word, the most age range involved here was 30 to 39 except for the PMO; the majority of them fall in the age range of 20-29. While, the least age range of the

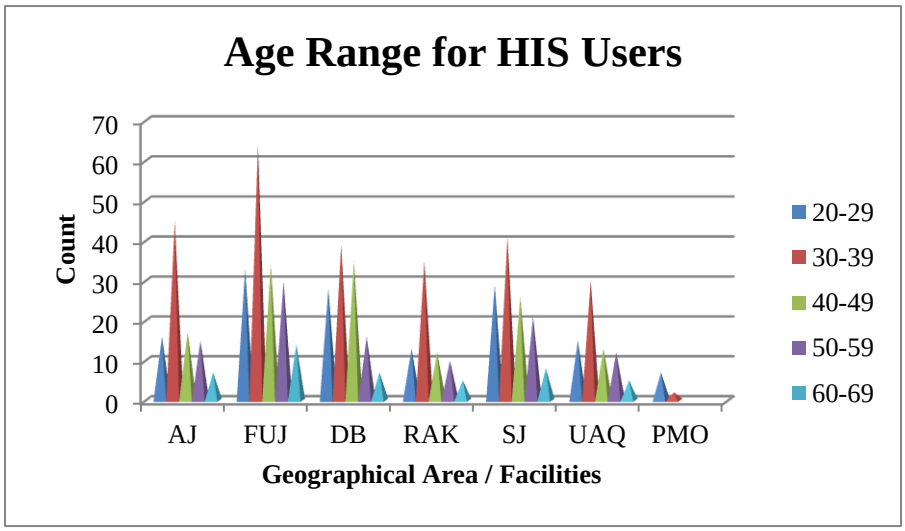

Figure 80: Age range for HIS users.

HIS users involved in this study was between 60 and 69. However, the users had to select the age range from the available options in the questionnaire distributed and the age range of sixties was the last option as the average age of retirement in the UAE public organizations falls in sixties. All of the facilities had users with different age ranges; in twenties, thirties, forties, fifties and sixties, except the PMO that only had the age range of twenties and thirties.

Another criteria was the HIS users' majors. Five majors/categories were provided for the participants to select that represent their specialties. As noticed, most of the participants were physicians and nurses about 482 participants despite of their busy schedules. The second major was medical services (e.g. radiologists, laboratory technicians, pharmacists…etc) about 124 participants.

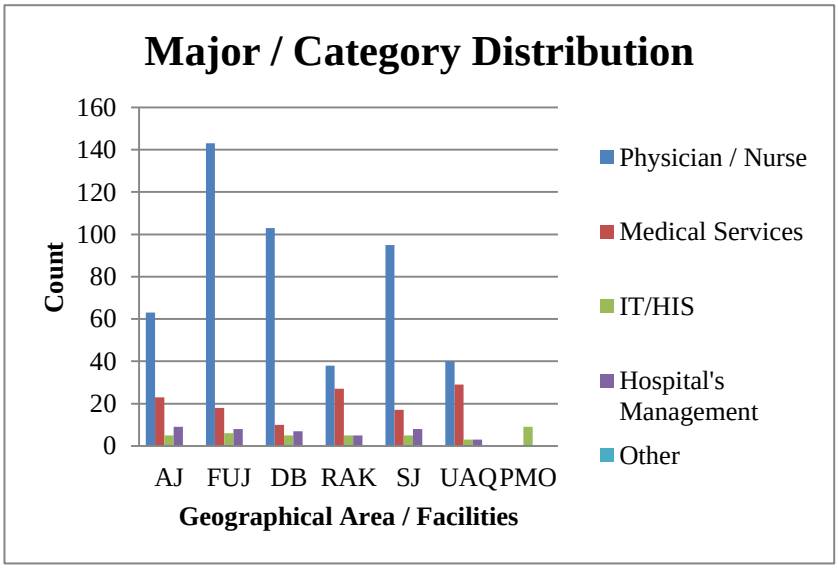

Figure 81: Majors of HIS users.

Information Technology (IT) personnel/ Health Information System (HIS) specialists and Hospitals' Management Staff were the involved in this study, but the number of participants was low compared to specificities (physicians, nurses…etc). The PMO staffs as shown in this figure (80) are only specialized in IT/HIS field. Also, there were no participants from other specialty not listed in the study.

The below figure (82) illustrates the participation level for all facilitates involved in this study. As obvious, the participation level is higher than the rejection level. The number inside each column indicates the number of participants and number of individuals who refused to participate. Those numbers were also represented in percentage for each facility. As stated above, the minimum requirement of participants in this study is 25% of

the total numbers of staffs for each facility that use the implemented HIS. Because of that, the number of participation is different for each facility. The reasons that there were participants who refused to be part of this study are various. For example, some of them were afraid to share thoughts about the implemented HIS despite of explaining that the study is for research purposes. Another reason was that there is no enough time to complete the questionnaire, although physicians and nurses were the most participated parties. Also, a few of them were not interested in this study. However, for the PMO staff, the three individuals who refused to be part of the study were actually excluded as one of them is the author of this study and the remaining two just recently joined the office and still not involved in the HIS tasks.

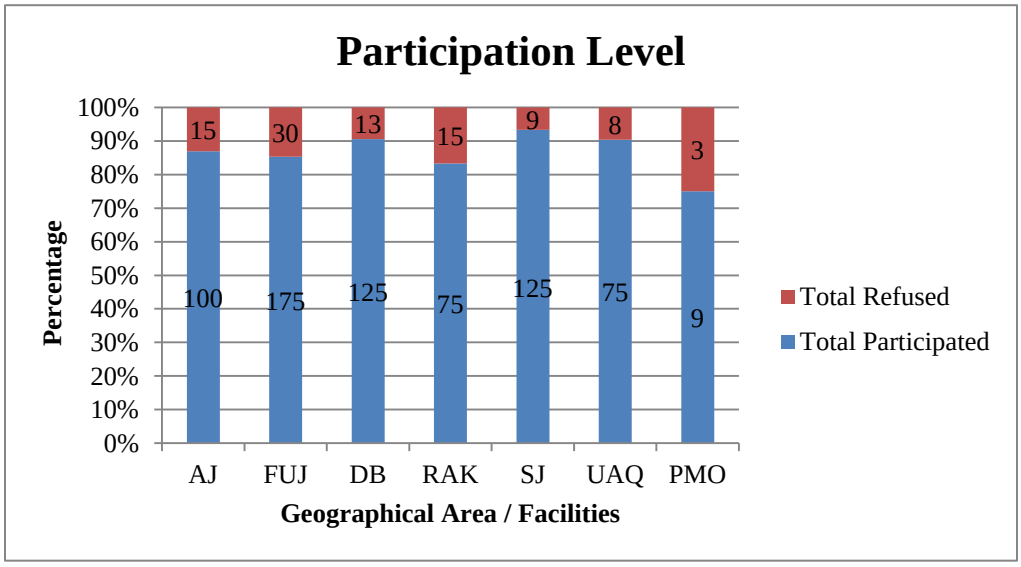

Figure 82: HIS users' participation level.

4.3 Hypotheses Testing

In order to analyze the collected data, Microsoft Office Excel was used. The below table (3) depicts the statistical analysis based on the mean and standard deviation (SD) for participation response per each facility. A mean can be defined as the average number of a dataset, while standard deviation is about how the values of a dataset are related to the mean. Small SD might mean that the values of a dataset are close to the mean, while large SD might mean that the values of the dataset are spread-out.

Since in this study, there were different numbers of population samples, the means and SDs for each population were calculated separately. As noticed from the table below that there is a variation between the mean and SD for each facility. Some of these facilities have small variation, such as: the PMO and UAQ Hospital, while other facilities have large variation, such as: Dubai and Sharjah Hospitals. The PMO has the smallest SD, but this could be due to the fact that the office has the lowest number of population compared to other facilities in this study. So, the data points/values are more centered toward the mean.

Facility	Mean	Standard Deviation (SD)
AJ	50.5	29.01
FUJ	88	50.66
DB	63	36.23
RAK	38	21.79
SJ	63	36.23
UAQ	38	21.79
PMO	5	2.74

Table 3: Response rate per facility.

In this study, two hypotheses were generated. The first hypothesis was how health information system helped in re-designing patients care pathway and the second hypothesis was how the implemented HIS helped in improving patients' health outcomes. To test and evaluate these two hypotheses, a questionnaire was administered across seven facilities. The results were rounded to two decimals places.

4.3.1 HIS for Re-designing Patients' Care Pathway

For each facility the responses to whether the implemented HIS helped in re-designing patients' care pathway or not were categorized as positive and negative response. As the participants had to select the response based on Likert Scale (Strongly Agree, Agree,

Neutral, Disagree, Strongly Disagree and Not Applicable), these scales were merged as the following:

- Strongly Agree and Agree = Positive Response
- Disagree and Strongly Disagree a = Negative Response
- Neutral and Not Applicable were excluded as they do not state a clear response

The below table (4) shows the total number of participants with positive and negative response for each facility:

HIS for re-designing patients' care pathway							
Two-sample assuming unequal variances							
Facility	Observations		Mean		Df	P(T<=t) two-tail	t Critical two-tail
	Positive	Negative	Positive	Negative			
AJ	92	4	46.5	2.5	93	2.55	1.99
FUJ	135	11	68	6	144	7.62	1.98
DB	107	0	54	0	106	5.20	1.98
RAK	61	5	31	3	63	1.53	2.00
SJ	106	7	53.5	4	110	1.83	1.98
UAQ	67	3	34	2	66	5.72	2.00
PMO	9	0	5	0	8	0.00059	2.31
Total *p*-value	2.71						

Table 4: HIS for re-designing patients' care pathway.

4.3.2 HIS for Improving Patients' Health Outcomes

For each facility the responses to whether the implemented HIS helped in improving patients' health outcomes or not were also categorized as positive and negative response. The below table (5) shows the total number of participants with positive and negative response for each facility:

HIS for improving patients' health outcomes							
Two-sample assuming unequal variances							
Facility	Observations		Mean		Df	P(T<=t) two-tail	t Critical two-tail
	Positive	Negative	Positive	Negative			
AJ	82	9	41.5	5	89	1.70	1.99
FUJ	142	15	71.5	8	155	2.14	1.98
DB	96	2	48.5	1.5	93	5.68	1.99
RAK	61	8	31	4.5	67	1.78	2.00
SJ	111	6	56	3.5	114	2.37	1.98
UAQ	60	8	30.5	4.5	66	3.60	2.00
PMO	9	0	5	0	8	0.00059	2.31
Total *p*-value	1.80						

Table 5: HIS for improving patients' health outcomes.

In this study, the probability value (*p*-value) = 0.05 was used to support the stated null hypotheses. Null hypothesis (H_0) is based on chance and when testing it, there is a chance to make wrong conclusion. There are two types of errors, which are:

Type 1 errors: this occurs when the null hypothesis is rejected although it is true. Also known as false positive. For this type of errors, the acceptable level is alpha (α=0.05 and 0.01). It means that type 1 errors can be accepted up to 5%.

Type 2 errors: this occurs when the null hypothesis is rejected although it is false. Also known as false negative. For this type of errors beta (β) is used as an acceptable level.

Here, to test the null hypotheses, *p*-value was used as: $p \leq \alpha$ (*p* smaller than or equals α), in that case, the null hypothesis is rejected (Real statistics using Excel n.d.).

Null hypothesis 1: the implemented HIS helped in re-designing patients' care pathway. Based on the results obtained, the null hypothesis is not rejected as the overall *p*-value

obtained = 2.71 is greater than 0.05. This means that there is no statistic significance at the level of 5%.

Null hypothesis 2: the implemented HIS helped in improving patients' health outcomes. Based on the results obtained, the null hypothesis is not rejected as the overall *p*-value obtained = 1.80 is greater than 0.05. This means that there is no statistic significance at the level of 5%.

What noticed is that the project management office (PMO) had low results. This could be due to the small population size of it compared to other facilities that were involved in this study. for this facility, the obtained *p*-values for both hypotheses 1 and 2 was the same 0.00059 which is smaller than 0.05 and the means are equal, in that case, the stated null hypotheses are rejected.

4.4 Overall

The below figure (83) depicts the overall satisfaction level about the implemented HIS in these 6 facilities under UAE FHO along with the HIS project management office. In general, most of the participants agreed that the system is satisfactory with number of disagreements. Al-Fujairah and Sharjah Hospitals had the highest agreement level compared to the remaining hospitals. The noticeable is that PMO had none disagreements about the satisfactory level of the system, while the 6 hospitals had some. This could be due to the fact that the hospitals are interacting daily with the system, while PMO team deal and handle the system from management aspects. Also, the number of neutral responses was higher compared to disagreed responses.

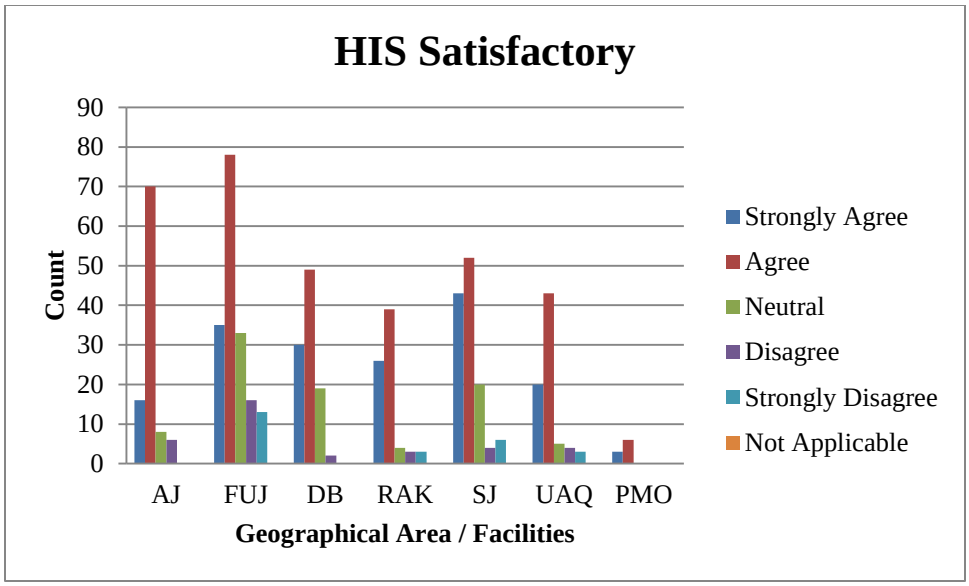

Figure 83: Overall satisfaction level.

The below figure (84) illustrates the overall response level about re-designing patients' care pathway while using the implemented HIS. In general, the agreement level was high in these facilities despite of being distributed across different geographical areas which means different types of patients and services provided. Al-Fujairah Hospital had the highest agreement response that the implemented HIS helped in re-designing patients' care pathway, while the disagreement level was also high in Al-Fujairah and Sharjah Hospitals. PMO had no disagreements about re-designing patients' care pathway. There were only 2 participants from Sharjah Hospital who selected "Not Applicable" option for this aspect. This could be due to uncertainty or unwillingness to share thoughts…etc. Also, the number of neutral responses was higher compared to disagreed responses.

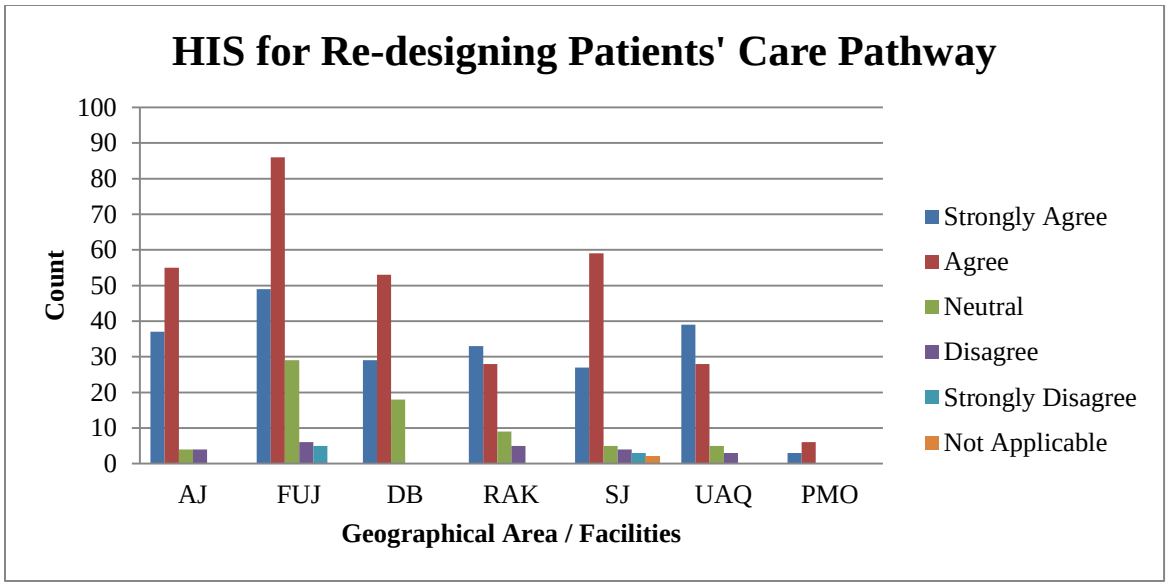

Figure 84: Overall response level about re-designing patients' care pathway.

The below figure (85) illustrates the overall response level about improving patients' health outcomes while using the implemented HIS. In general, the agreement level was high in these facilities despite of being distributed across different geographical areas which means different types of patients and services provided. Al-Fujairah Hospital had the highest agreement response that the implemented HIS helped in improving patient' health outcomes, while the disagreement level was high in Ajman and Al-Fujairah Hospitals. Ras Al-Khaimah and Um Al-Qwain Hospitals had the same number of disagreements. PMO had no disagreements about this aspect. There were only 4 participants from Al-Fujairah and Dubai Hospitals who selected "Not Applicable" option for this aspect. This could be due to uncertainty or unwillingness to share thoughts, fear of adding inputs…etc. Also, the number of neutral responses was almost higher compared to disagreed responses.

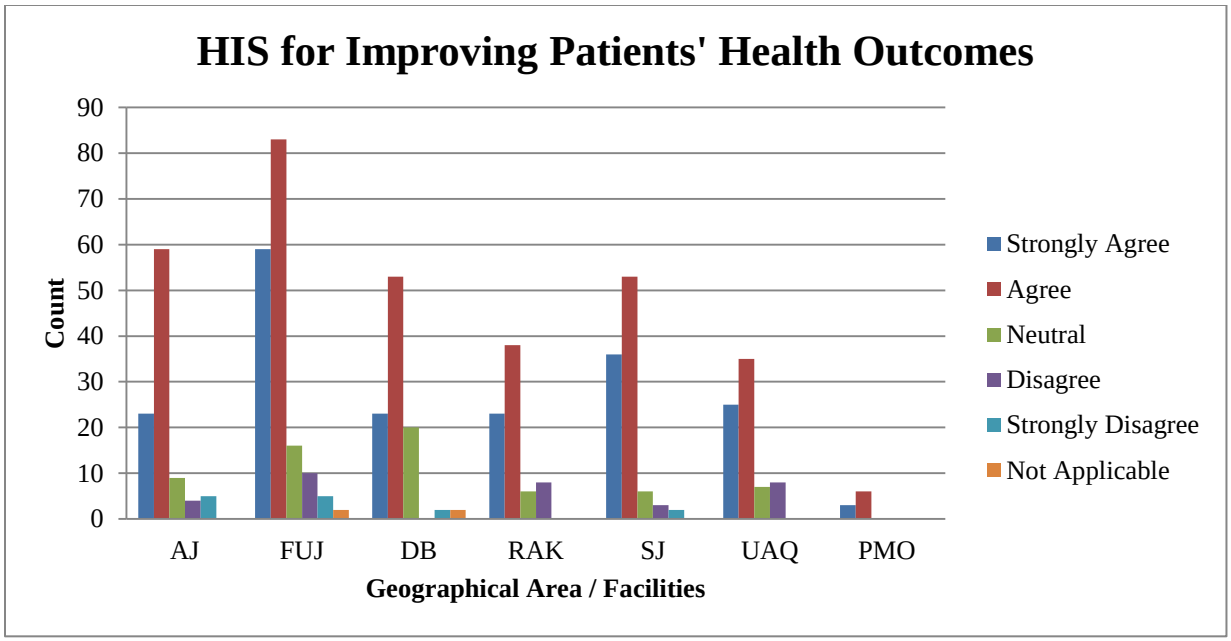

Figure 85: Overall response level about improving patients' health outcomes.

Health information systems can help physicians in achieving best practices by providing important information related to clinical protocols, such as: suggesting antibiotics. Also, such systems alert physicians of medications interactions and allergies as well as sharing medical information with authorized parties and other healthcare systems. Furthermore, these systems aid in identifying possible epidemics by listing uncommon symptoms during a specific period of time (Farley et al. 2013, p. 400). In contrast, as indicated by Farley et al. (2013) there are some shortcoming of such systems, such as: human errors due to lack of trainings and experiences in dealing with these technologies (Farley et al. 2013, p. 400). In addition, such systems minimize the interaction between healthcare providers and patients which may cause patients dissatisfaction. Also, in the Emergency Departments, it is difficult to use computers 24/7 as these departments are usually congested with critical cases that require urgent response not like other department, such as: outpatients clinics where physicians have their own offices. In Emergency Departments physicians may give orders verbally and later on they enter these orders in the patients' charts which sometimes are done by nurses who might misunderstand the handwriting and this could lead to issues affecting quality of care and patients safety (Farley et al. 2013, p. 401).

The below figure (86) depicts the challenges faced in this HIS. As noticed, the most selected challenge was inadequacy of training and support during the implementation of the system with 220 participants selected this challenge. The second selected challenge was difficulty of the system layout and format (e.g. terminologies) and the total number of participants was 157. However, the least selected challenge was user acceptance of the new system with only 84 participants selected it. Two other challenges that were not incorporated in this study were added by the participants, which were: increasing number of patients compared to the number of staff and language barrier as the system in only in English version and there are some users who are not good in English.

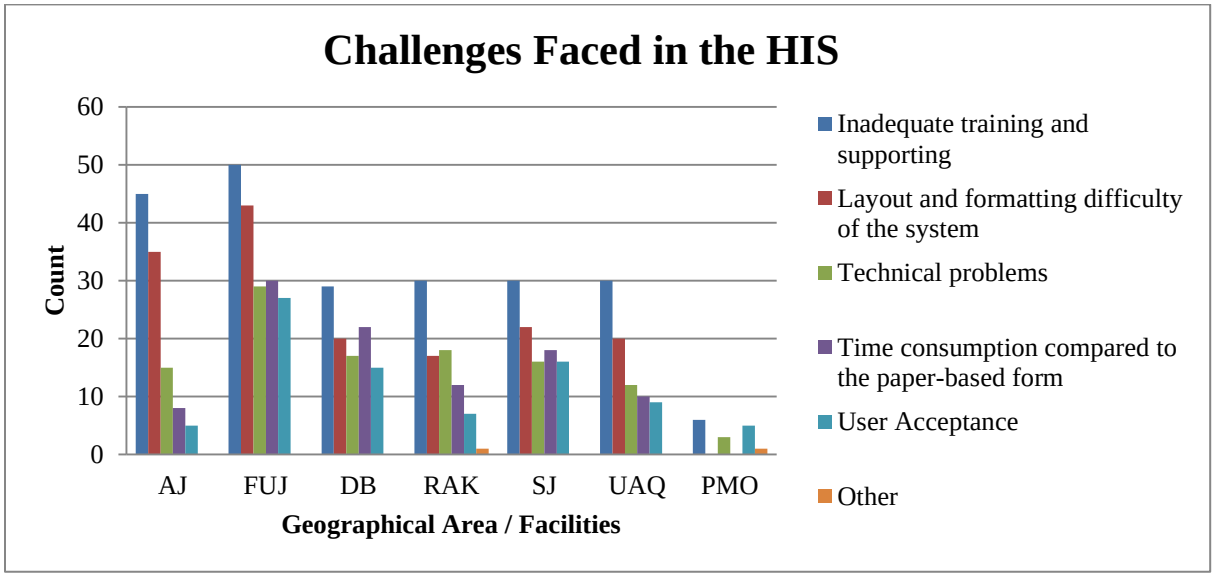

Figure 86: Overall challenges faced in the HIS.

The below figure (87) depicts the possible solutions to overcome the above listed challenges faced in this HIS. As noticed, the most selected solution was extending support period. From these targeted facilities, 239 participants selected this solution as a strategy to overcome the challenges. The second selected solution was providing additional trainings and total number of participants was 232. However, the least selected solution was rewards and penalties strategy for the system's users with only 91respondets selected it. No other solutions were added by the participants.

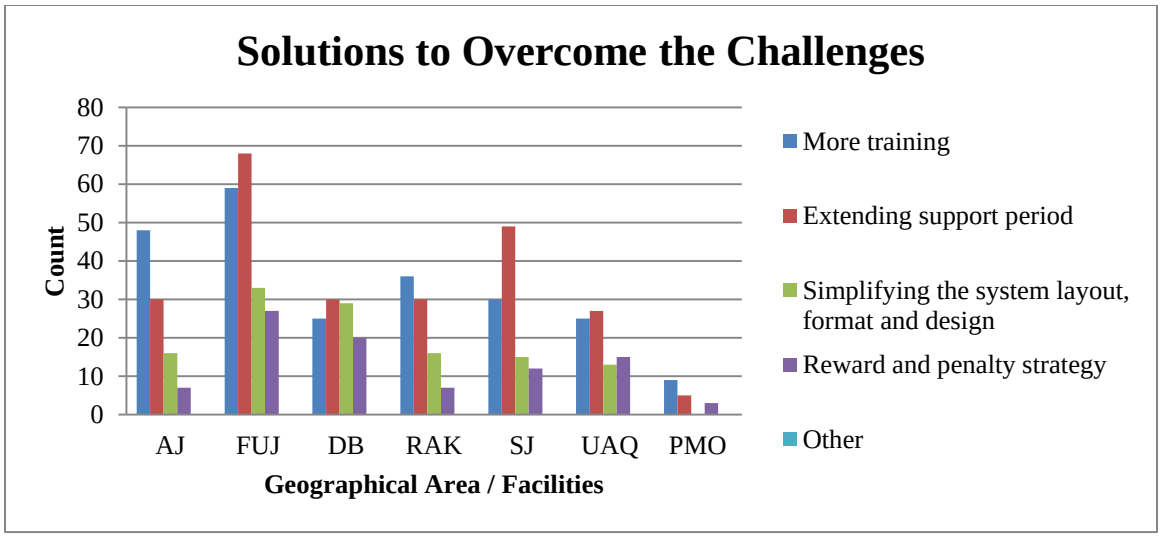

Figure 87: Overall possible solutions to overcome the challenges faced in the HIS.

4.5 Actual Data

The below data (Table 6) are the actual data retrieved from the implemented HIS database for the period of September 2013 related to these 6 hospitals that illustrate the performance of the system's users based on the following criteria:

Criteria / Hospital	Ajman	Al-Fujairah	Dubai	Ras Al-Khaimah	Sharjah	Um Al-Qwain	Total
Login transactions.	51,936	56,898	29,985	19,961	69,539	30,836	259,155
Patients' assessments signed.	92,747	69,777	17,388	28,245	45,571	19,157	272,885
Total medications administered.	37,313	31,905	21,557	55,707	78,178	18,588	243,248
Orders approved.	19,323	15,883	30,259	17,528	18,733	12,658	114,384
All laboratory orders.	40,903	38,940	24,535	23,941	110,264	18,413	256,996

Clinical notes documented.	27,465	19,785	14,325	11,762	17,386	20,080	110,803
All pharmacy orders.	124,802	67,538	54,011	76,927	180,611	54,793	558,682
Results viewed.	7,940	33,916	28,104	31,380	33,159	16,897	151,396
Total discern alerts fired.	10,620	15,442	6,643	19,608	25,872	24,428	102,613
Total discern alerts overridden.	0	0	0	0	0	3	3
Diagnosis created.	4,767	6,752	3,928	1,380	4,276	3,540	24,643
Allergies documented.	2,730	1,925	2,711	585	3,271	1,089	12,311

Table 6: Performance of the system's users.

(Adapted from Cerner 2010).

As noticed, there were not any discern alerts overridden for all these hospitals during this month, except for Um Al-Qwain that had 3 overridden alerts. Also, Ras Al-Khaimah Hospital had the lowest number of allergies documented during this period compared to remaining hospitals that had more than 1,000 documented allergies. Sharjah Hospital had the highest number of laboratory and pharmacy orders, but the total number of approved orders was low = 18,733 compared to the number of laboratory and pharmacy orders. There are some discrepancies in the data above. For instance, in some areas for the large hospitals, the numbers are low compared to the small hospitals. For example, the total number of discern alerts fired for Um Al-Qwain Hospital was 24,428, while for Al-Fujairah Hospital, it was 15,442 despite that Al-Fujairah Hospital has more patients attending than Um Al-Qwain Hospital. In addition, total medications administered in Ras

Al-Khaimah Hospital were 55,707, while for Al-Fujairah and Dubai Hospitals were 31,905 and 21,557, respectively. This could mean different things, such as: number of acute and chronic medical conditions, easiness of prescribing medications…etc. These actual data are important for the UAE FHO to evaluate their facilities performances, needs and quality of care.

Chapter 5: Discussion

5.1 Pre-Testing

To design an ideal survey is almost impossible, but designing effective survey is possible and to evaluate the effectiveness of a survey, pre-testing is an essential step before the actual use of the developed survey (CSU n.d). Pilot study is another term for pre-testing, which can be defined as a preliminary test designed and used to measure the effectiveness of the survey planned to use in full-scale study. One of the main aims of pre-testing is to ensure that the designed survey and the actual study are related and harmonious to attain the targeted information. Also, pre-testing helps researchers to evaluate the survey from different perspectives, such as: survey's layout and format, terminology, questions' order, there is a need to add/remove questions, the instructions in the survey are understandable…etc (CSU n.d.; FAO n.d. & Rigney & Associates n.d.).

In order to cover the research questions listed above, a survey was prepared and distributed among the participants, but before that, the developed survey was tested among 30 people from different backgrounds, such as: IT, Health Information System Specialists and Healthcare Providers. Although the sample size for pre-testing is small compared to the study sample size, but the participants are from the same backgrounds and within the same organization.

In this study, the participants in the pre-testing were informed about this step so they will provide their feedback freely and will a give a chance for discussion, although there is another type of pre-testing where participants are not aware of pre-testing step and are involved blindly. For pre-testing, the designed survey was sent to the participants via e-mail and out of 50, only 30 responded and provided their comments which were about the survey format, terminologies and adding space to write comments beside each question. Examples of their feedbacks are as following:

- Overall, the survey is understandable, but it would be much better if the numbers of questions are reduced. However, this could not be done as the

research questions require to cover these areas in order to obtain the aimed results.

- Another participant responded that to provide the survey in two versions, Arabic and English as for the distributed survey was only in English, but this did not take place as the research topic is about health information system in the UAE and the evaluated system is in English version, so the users of the system are familiar with basics English Language.
- Another feedback was that the instructions and questions in the survey are clear and understandable as well the questions were divided in sections.
- Also, the terminologies are easy to understand.

The participants' responds were taking into consideration and there was a channel for discussing with them via e-mail and phone. Some of the suggestions were added to the survey, such as: adding space to write comments beside each question.

5.2 Response Rate

The sample size in the study represents the study population due to its validity. By this, it is possible to say that 95% of the opinion and thoughts shared in the distributed survey and received are the same as for those who did not respond to the survey ("How statistically valid are your survey results" n.d.). In this study, the targeted population consisted of almost 2,562 staff, the minimum requirement of response was 25% and the number of participants was 684. For instance, Ajman Hospital consists of 350 staff, the minimum requirement for this study is 25%, so the result would be (350 X 25% = 87.5). However, the number of participants was more than this; about 100. According to table (7) (Refer to appendix H: Results Validity), for this study, the target sample should be around 332 and 334. However, the number of participants was 684, which is more than 330s. Also, the response rates for these 7 facilities were higher than rejection rates as illustrated in the figure (88) below. The response rate in this study was 86%, while the rejection rate was 14%. These two rates represent the response from the 7 facilities targeted in this study. To obtain high participation rates, there are some factors that need to be considered:

- Data collection methodology: for instance, in this study, the distributed survey consisted of direct and clear questions and the participants have to select from the available options along with a space to add their comments (optional) instead of writing sentences which takes time. Also, the layout and format of the survey to be friendly not complicated.
- Time and location: the time and location to gather the required data is essential. In this study, the designed survey was administered to each facility at their location. Participants were visited at their work locations. In addition, during the working hours, the survey was distributed in order to ensure the completion of the survey and prevent as much as possible of missing surveys.
- Study objectives: stating clear objectives and aims of the study is important as participants will not be interested in being part of a study if it is not clear. In this study, the aim was indicated and explained in the distributed survey's cover page as well as verbally.

On the other hand, low response rates result due to several reasons, such as: unclear purposes of the study, long data collection methodology, unclear instructions and selecting the wrong time to gather the required data, for example, during holidays, but this factor depends on the study's type.

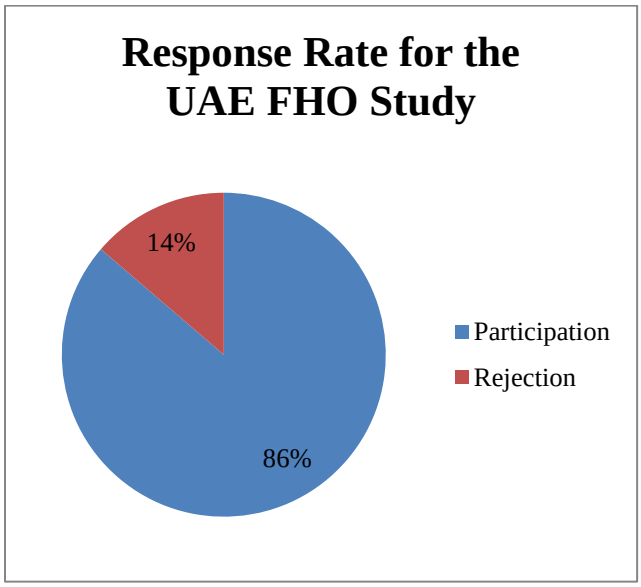

Figure 88: Response rate.

5.3 General Discussion

The study aimed to cover several questions, which were about the current status of the implemented HIS, how such a system may help in re-designing patients care pathway and improving health outcomes as well as the challenges faced during the implementation of the system and how to overcome these challenges.

Because descriptive studies are usually used to generate hypotheses, analytical study design was also applied here to test two hypotheses:

1- Hypothesis One: HIS helped in re-designing patients' care pathway positively.

2- Hypothesis Two: HIS helped in improving patients' health outcomes.

So, mixed study designs of descriptive and analytical were applied.

The answers to these questions were discussed in the "Analysis Section" above.

However, in terms of the current status of the implemented HIS, the followings were covered:

- Quality of work and services.
- Providing required information.
- System reliability.
- System easiness and flexibility.
- Successfulness implementation of the system.
- System friendliness.
- System comprehensiveness.
- Overall, system satisfaction.

In terms of re-designing patients' care pathway, the followings were covered:

- Patients' journey in the hospital.
- Patients' progress notes.
- Patients' care documentation
- Radiology, laboratory and other tests' results.
- Simplifying supporting processes.
- Remote decisions making.
- Security and confidentiality

- Patients' satisfaction.
- Unifying healthcare processes across hospitals.
- Overall, re-designing patients' care pathway.

The implemented HIS helped in re-designing patients' care pathway positively by facilitating patients journey in the hospitals and related care activities in terms of care documentation, viewing and analyzing tests' results, taking decisions remotely, unifying healthcare processes across all hospitals under the UAE FHO and promoting patients' satisfaction as well as maintaining confidentiality and security of the implemented system by designing the system in a way that is protected based on password-driven style.
In terms of improving patients' health outcomes, this part was divided into three sub-categories as the following:

1- Diagnosis and Medical Care:
   - Process of generating reports.
   - Comprehensive picture of a patient.
   - Information is gathered in one place for therapeutic decisions.
   - Patients' care progress.
   - Reliable tests results.
   - Drugs formulary information.
   - Patients' assessments.
   - Sending reminders to healthcare providers.
   - Diagnosing medical conditions at early stages.
2- Discern Alerts:
   - Alerts about incomplete tasks and information.
   - Alerts of patients' allergy history.
   - Drugs interactions.
   - Drugs allergy when prescribing medications.
3- Other:
   - Patients' registration or scheduling appointments processes duration.
   - Correct transferring of tests' results.
   - System integration.

- Decreased number of errors compared to the manual system.
- Generating reports.
- Documentation process and coding system.
- Patients' waiting time.
- Reminder for patients.
- Departments' performance analysis.
- Obtaining required data.
- Overall, improving health outcomes.

The implemented HIS helped in improving patients' health outcomes positively by facilitating the process of generating reports for various reasons, such as: statistics, research and planning as well as evaluating the performance of other departments in hospitals and managing resources as the system helps in measuring the number of patients in each facility, prescriptions issued and tests ordered. Also, after implementing the system, patients' information are gathered in one place and healthcare users can access to these clinical information from anywhere based on their access privileges. This helps in viewing patients' care progress, history, assessments, results and medications. Furthermore, after implementing this system, patients' waiting time has been reduced that is considered as a factor to obtain patients' satisfaction. Patients health outcomes have been improved as the implemented system has the functionality of sending discern alerts to the users regarding incomplete tasks, information, allergy alerts, drugs interactions and allergies when prescribing medications. Furthermore, the implemented systems is well integrated with other devices that aids in providing correct results analysis and transfer these results to the HIS.

In terms of challenges and solutions, the followings aspects were covered:

- Training and support.
- System layout and format (e.g. terminologies).
- Technical problems (e.g. unscheduled system downtime).
- Time consumption compared to the manual system (paper-based form).
- User acceptance of the new system.
- Rewards and penalties strategy.

- Other challenges and solutions to be specified by the participant.

In many of previous studies, the above challenges and solutions were the most discussed along with other challenges and solutions. Because of that, in this study those challenges and solutions were listed. However, the participants had the option to add other unlisted challenges and solutions which only counted participants did, such as: language barrier.

For each facility in this study, the obtained results were analyzed separately and overall findings based on the research questions were demonstrated. Cluster random sampling technique was utilized as it is more practical when the study population is scattered, which is the same as in this study. Also, it is useful when the study sample will be selected randomly from different classes, such as: healthcare providers, hospitals' management staff and IT/HIS specialists as well as the project management team of the current HIS project in the UAE Federal Healthcare Organization (UAE FHO).

A previous study was conducted by Al Rae (n.d.) regarding centralized health records system in the UAE. The aims of the study were to address the status of electronic health record (EHR) in the country and the challenges in developing such system as well as covering the methods to manage EHR project in order to control change.

The author mainly applied qualitative methods, such as: interview and structured case-study. Data were collected by interviewing different people with different specialties, such as healthcare providers, hospital director and information technology specialists.

The study revealed about the challenges in EHR system. For example, users resistance to use the system. Also, lack of interaction between healthcare providers who use the system and patients as the users spend more time in front of machines than communicating with patients. Furthermore, technical challenges, such as: more efforts and time were required to create such system, security issues and data integration to database servers. Some of the proposed solutions by the interviewees were: enriching technical training for EHR users, arrange social meetings with users to share experiences and provide educational sessions to the users about the advantages of the EHR.

In order to adopt EHR, change management concept and actions was addressed in this study. For instance, apply leadership concept properly by improving the relationships in the organization and increasing employees' satisfaction rate.

In this study, the author applied qualitative methods, such as: interview to cover the research questions, which were related to the electronic health record (EHR) mainly in Abu Dhabi and one private hospital in Dubai. However, in the UAE FHO study different research questions related to the implementation of health information system (HIS) in six emirates were covered, from Dubai to Al-Fujairah, excluding Abu Dhabi as it is not included in the project scope of the HIS. The research paper covered the following points: the current status of HIS in the UAE Federal Healthcare Organization (UAE FHO). Also, how HIS helped in re-designing patients' care pathway and improving health outcomes as well as the challenges faced while implementing this HIS and how to overcome these challenges. In contrast, Al Rae covered the following points in his study: the current status of electronic health records in the UAE, the challenges of developing such system and how EHR can be managed to control change. Furthermore, the data collection method was mainly quantitative method, which was survey.

Some of previous studies, such as: Myers et al. (2012) and Davis et al. (2009) were in somehow similar to the UAE FHO study in terms of several sites involved. However, data collection methods were different as in Myers et al. (2012) survey and interview were utilized, while in the UAE FHO study, only survey was utilized. Another difference was the mode of administering the survey. In the UAE FHO study, the survey was administered by hand during working hours to ensure as much as possible high responding rate. Web-based survey as what in Myers et al. (2012) was not design for the UAE FHO study as the participants have limited access to Internet in the facilities and not all of them will be able to open the survey online. Yet, Likert scale was used in most previous studies, such as: Myers et al. (2012) and Oroviogoicoechea and Watson (2009) as well in this UAE FHO study. Likert scale based on (1=strongly agree to 5=strongly disagree) was applied in Oroviogoicoechea and Watson study (2009). In the UAE FHO study Likert scale was also applied, from strongly agree to strongly disagree, but two additional options were added: Not Applicable and Comments. The last option was added

for the participants if they want to elaborate more than just selecting options.
In the UAE FHO study participants were categorized based on their occupational roles and geographical distributions. These roles were: healthcare provider (Physician or Nurse), medical services (e.g. Allied Health Personnel, Pharmacy, Laboratory and Radiology Specialist or Technician), IT / health information system (HIS) specialist, hospital's management staff, which were more specific than in Myers et al. (2012) study: medical providers, case managers and non-clinical staff).

The response rate for the survey distributed in this study was 86%, while for Myers et al. (2012) was 61%. In Davis et al. (2009): The response rates from the seven countries were variant. For instance, the response rate for US was 51%, while Canada and Netherlands had the response rate of 43% and the survey was sent via e-mail to these countries. On the other hand, New Zealand had the response rate of 32%, while Australia had 20%. For these countries, the survey was sent by e-mail and fax. For UK, the data were collected mainly by telephone, but also mail was used and the response rate was 20%. However, for Germany, the data were collected by telephone only and that had the response rate of 18%. In UAE FHO 7 facilities located at different areas were involved and the response rate was also variant as the following: Ajman 87%, Al-Fujairah 85%, Dubai 91%, Ras Al-Khaimah 83%, Sharjah 93%, Um Al-Qwain 90% and the HIS Project Management Office 75%). The high response rates in the UAE FHO study could be due to the fact that all these sites are located in one country, which means more and easy control on the subjects.

Regarding the implemented system, in the Myers et al. (2012), medical providers had their own concerns about these systems, which contradict the findings in the UAE FHO study that healthcare providers were the most satisfied users of the implemented system.

In terms of patients' safety, the number of medications errors decreased as indicated in the conference Cerner (2013), the nurses at the Children's Cancer Hospital in Egypt have to double check the medication order placed by doctors and use bar code to enter medications ordered in the system to avoid handwritten errors. The errors decreased by 80% since the implementation of the system. Also, the system includes allergy alerts, which helped in reducing the number of allergy reactions. This was agreed by the

majority of the participants in this study that the system sends alerts to healthcare providers about allergy, drugs interactions, incomplete tasks…etc as well as the number of errors decreased compared to the manual system.). For nursing performance, the system implemented in the Children's Cancer Hospital in Egypt helped to evaluate nursing documentations on daily, monthly and yearly basis. Also, allowed at anytime to evaluate nurses' practices as well as promote nursing educations by discovering errors through continuous assessments. Most of the participants in this study agreed that the implemented system allowed evaluating the performance of other sections at a specific facility.

Regarding the easiness of the implemented system, the majority of the nurses as well as other healthcare specialists in the UAE FHO agreed that the implemented HIS is easy to use and friendly which is what was indicated by the nurses in Oroviogoicoechea and Watson study (2009).

In addition, many previous studies covered the possible challenges and solutions for these systems. In Khalifa (2013): lack of motivation was one of the professional barriers discussed. To overcome this barrier in the UAE FHO study reward and penalty strategy was suggested for the new system users. However, a few number of the participants selected this solution as a strategy to overcome challenges in the HIS. In addition, McAlearney et al. (2007) suggested to distinct physicians who have positive pre-conceptions from negative physicians as a strategy during the implementation of these technologies. This supports the suggested solution of applying rewards and penalty strategy, however, it was selected by a few number of participants, although this strategy might be useful to overcome challenges in health information systems.

Another technical barrier was discussed in Khalifa (2013) related to interface design issues which is almost the same as difficulty of the system layout and format (e.g. terminologies) that was listed as a challenge in the UAE FHO study. This was selected as the second challenge in the implemented HIS; about 157 participants selected this challenge. However, simplifying the implemented system was selected as a third strategy and about 122 participants agreed on that.

Sicotte and Pare (2010) discussed [super users] concept. In UAE FHO, super user concept was considered. Although names of users from different specialties and hospitals who want to be part of this strategy were collected, till this time, the strategy is not applied despite of its many advantages, such as: provide continuous trainings for users instead of waiting for the vendor to provide training plan and costs of trainings will be reduced.

One of the reasons that BHIS succeeded was users' involvement in the project stages (Graven et al. 2013). Although users' involvement was done in the UAE FHO, still users acquiring for modifications despite that the system is almost deployed in all hospitals under UAEFHO, except for 3 hospitals.
Another challenge discussed by Adler-Milstein and Bates (2010), p. 123 was lack of trained resources to provide support for the implemented systems. In the UAE FHO study, inadequacy of training and support during the implementation of the system was selected as a main challenge, by 220 participants. The same barrier was discussed by Urda et al. (2013) related to training period. This is important for users to be familiar with new systems which require more time to learn and absorb new information. In the UAE FHO study, providing more training courses was selected as a second solution for the challenges faced in the implemented HIS. The number of participants who selected this solution was 232.

5.4 Data Validation

Despite that the sample size met the requirements set in this study as described above, the data can not be said 100% accurate due to several reasons, such as: study design that was only survey which prevents observing the real behavior and thoughts of the participants and time consumption to analyze large set of data.

Since this study is quantitative research, the validity of it can be assessed internally and externally. Internal validation is assessed based on the study structure and how it is done. Here, the stated theories were measured statistically and tested according to the null hypothesis in terms of rejecting or accepting it. Also, the external validation is done based on results generalization and this can be done in this study for several reasons. For

instance, the study covered several facilities under UAE FHO, not only one facility as well as the participants were selected from different specialties; clinical and non-clinical staff. Also, the study covered most of the healthcare services provided in the UAE as well as 6 out of 7 emirates were involved along with the HIS Project Management Office, except for Abu Dhabi. The participants in the study were from different geographical areas and backgrounds.
In addition, the results were analyzed statistically, such as: p-value and confidence interval. Another reason is that participation in the study was voluntary and individual in the targeted population had the chance to participate.

Furthermore, despite that there were some rejections to participate in this study, all data were completed as the survey was designed by indicating that all questions must be answered unless stated optional. All surveys were checked for completion.

The below table (8) depicts the statistical analysis of the study participants based on age factor. The total number of participants from these 7 facilities was 684 from different age groups; starting from age group of 20-29 to 60-69. The average age distribution (mean) in this study was 39.5, which is slightly close to the median 34.5. The standard deviation was 11.71. The confidence interval (CI) of 95% was $\pm$0.88. So, the 95% CI around the mean equaled between 38.62 and 40.38.This means that the study participants' age lies between 38.62 and 40.38. In another word, if the same number of this study sample were taken from the same population, the expected age range would be someplace between 38.62 and 40.38.

Analysis (Age)	
Mean	39.5
Standard Error	0.447848777
Median	34.5
Mode	34.5
Standard Deviation	11.71276537
Sample Variance	137.1888726
Kurtosis	-0.610373565

Skewness	0.529116441
Range	40
Minimum	24.5
Maximum	64.5
Sum	27018
Count	684
Largest(1)	64.5
Smallest(1)	24.5
Confidence Level (95.0%)	0.879325687

Table 8: Statistical analysis of the study participants based on age factor.

The below table (9) illustrates the mean for grouped data (age factor).

Age Range	Midpoint	Frequency	Frequency X Midpoint
20-29	24.5	141	3,454.5
30-39	34.5	256	8,832
40-49	44.5	137	6,096.5
50-59	54.5	104	5,668
60-69	64.5	46	2,967
Total		684	27,018

Table 9: Mean for grouped data (age factor).

Mean from grouped data = Total of all frequencies X Interval Midpoints / Total frequencies

= 27,018 / 684

= 39.5

Average mean age of 685 individuals in this study = 39.5, rounded to the nearest whole number, which will be 40 (Koch 2000).

5.5 Recommendations

The following recommendations may aid in attaining potential benefits from the implemented health information system (HIS) as well as in dealing with health information system projects in order to have successful implementation and high adoption rate:

- The UAE FHO should have a clear and comprehensive policy and regulations related to health informatics that identify roles and responsibilities of parties, state the aims of these HIS projects, terms and conditions, security measurements…etc.
- Users need to be involved in all stages of these projects and advance trainings to be provided that are not related only to using these systems, but as well some technical aspects, such as: data cleaning in order to minimize external supports.
- Provide continuous training courses and to be accredited.
- In order to avoid or minimize employees turnover consequences, proper and comprehensive manuals and continuous trainings to be provided, particularly that these technologies are upgraded from time to time.
- Demonstrate success stories of implemented health information systems to potential users.
- Make adjustments to the implemented systems, but with caution in order to not cause overwhelming costs and workloads.

- The implemented system was purchased from USA, which means the design of it is based on America's healthcare style. This caused a lot of issues in customizing the system to fit UAE healthcare style. If the system was self-developed, which means that IT professionals from the UAE FHO with healthcare providers were involved in developing the system would help more to reduce the number of issues faced in the system as those people are more aware of the workflows. Also, number of customizations will be less, which means less time, efforts and costs for modifications.
- As part of HIS improvements, “patient portal” would be a positive tool for patients to access their own electronic health records which is useful for

communication, completing tasks, viewing their medical conditions…etc rather than visiting healthcare facilitates when it is not critical that save time, resources and efforts for both healthcare professionals and patients themselves.

5.6 Study Limitations

The study is quite large as it covered 7 facilities distributed across the country which requires a long period of time to conduct and cover more aspects; particularly that it is aimed to cover several facilities that consist of many parties. Due to the limited time-frame, only four aspects were covered: current status of HIS, how HIS helped in re-designing patients care pathway, how HIS helped in improving health outcomes, challenges and solutions.

In this study, patients' perception about health information systems was not covered. The study only covered the users of the implemented health information system and excluded those who are not yet live with the system. Including both users and non-users will help to evaluate different types of individuals. Also, only one data collection method was utilized.

5.7 Future Works

Further researches to cover the following areas are required. First of all, conducting a comparison study between hospitals that are live with health information systems and those are not yet live in order to evaluate the perceptions of staff and patients. In addition, covering both HIS users and non-users to evaluate these systems from various angels needs to be considered.

Furthermore, there is a need to determine which type of diseases; chronic or acute are more probable to mange and reduce its impacts when using health information systems as well as how HIS helps in reducing healthcare costs, making decisions and reduce redundancy when ordering clinical tests and medications.

Further research is needed to cover how health information systems may impact morbidity and mortality in the region and world-wide. Also, how these systems may help in resources management as most of the previous studies in this field focused on users'

perceptions, benefits and challenges, so resources management based on health information systems is a new concept that need to be covered as well.

Using other data collection methodologies, such as: focus group to study HISs and monitor participants' behaviors and body languages instead of utilizing the common methodologies, such as: interview and questionnaire.

5.8 Ethical Considerations

The study was conducted with no disclosure of real names of organizations, participants and identifications. The participants' responses were treated with respect and confidentiality. Appropriate questions were asked to avoid participants' resistance to answer the questions and pre-testing step was accomplished to ensure that the questions are appropriate and not offensive. Consent from the UAE Federal Healthcare Organization (UAE FHO): HIS Project Management Office was obtained to conduct this study. Participation in this study was optional and no one was forced to complete the survey. Also, to ensure confidentiality; participants' names were optional to provide. Supervision during the survey distribution was done by the author herself with assistance of IT Departments in the targeted facilities, so the participants may ask questions for clarifications and to make sure that no participant was forced to complete the survey.

Furthermore, a letter of "To whom it may concern" was obtained from the British University in Dubai (BUID) for the targeted organization to grant the permission for collecting the required data. Discussion of the study nature with the concerned parties in the targeted organization took place to grant the permission of carrying out the study.

Chapter 6: Conclusion

In conclusion, this study covered one of the significant IT projects in the Middle East that serves healthcare field. The project is a health information system (HIS). Data were gathered from 7 facilities distributed geographically under the UAE FHO and the number of the study subjects who participated was 684. Current status of the implemented information system was evaluated. Also, two hypotheses were tested in this study related to patients care pathway and health outcomes as well as evaluating possible challenges and solutions to overcome these challenges. Different statistical analyses were used, such as: p-value and confidence interval. Overall results obtained were positive and satisfactory.

Health information systems can be considered as possible improvement approaches that assist health care providers, clinicians and non-clinical staff to provide better services in order to add more values to healthcare field in terms of productivity, security, management…etc. However, these projects are still considered challenging and difficult to predict its outcomes as threats may suddenly appear that jeopardize projects' successfulness. No matter where, the aims of health information systems remain the same. The aims could be different terminologically, but share the same meanings, such as: easy access to patients' clinical information. These new technologies hold the promise to effectively handle unexpected situations.

Organizations, decision makers and healthcare providers depending on health information systems to improve the quality of services provided to customers by utilizing various information technologies, but they must be aware of these technologies' limitations as it might limit the usage and benefits of the implemented systems.

Developing and implementing health information systems requires prior analysis of various aspects, such as: the target organization, clinical activities, potential users, IT infrastructure and workflows. Collaboration between concerned parties is crucial to the success of the implemented system.

Hopefully, the findings of this study will help healthcare settings to manage and handle such projects appropriately and pay attention to essential areas.

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Appendices

Appendix (A): HIS Survey Sample

United Arab Emirates

Health Information System (HIS) Survey

(All information will be kept strictly confidential)

I would be very grateful if you would complete this questionnaire, which should only take about 15 minutes, and is concerned with studying the current implemented health information system (HIS) in the United Arab Emirates Federal Healthcare Organization (UAE FHO) and how this system helped in redesigning patients' care and improving health outcomes with the challenges faced in this HIS. Your feedback is essential to us and to the success of this study.

Please read through the covering letter before answering the questions in this survey. 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.

If you do not want to participate in this study, then please indicate that by ticking the box to ensure that you will not be approached again regarding this study. ☐

Instructions: Put (✓) in the following boxes and write your answer when it is required. All questions to be answered unless it is stated "Optional".

- Name (*Optional*):……...
- Gender: ☐ Male ☐ Female
- Age:
  - ☐ 20-29
  - ☐ 30-39
  - ☐ 40-49
  - ☐ 50-59
  - ☐ 60-69
- Major / Category:
  - ☐ Healthcare Provider (Physician or Nurse).
  - ☐ Medical Services (e.g. Allied Health Personnel, Pharmacy, Laboratory and Radiology Specialist or Technician).
  - ☐ IT / Health Information System (HIS) Specialist.
  - ☐ Hospital's Management Staff.
  - ☐ Other (Please Specify):……..……
- Employee ID:……..
- Organization's Name:…….
- Contact Number:…….
- E-mail Address:……..……..

Part One: The current status of the health information system (HIS):							
Criteria	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Not Applicable**	**Comments (*Optional*)**

1- The implemented HIS enhances the quality of the work and services provided to customers (e.g. patients).							
2- The system provides the required information when needed.							
3- The system is reliable.							
4- The system is easy to use and flexible.							
5- The implementation of the system was successful.							
6- The system is user-friendly.							
7- The system includes almost all the services provided to patients within the facility (e.g. laboratory, radiology, surgery and billing).							
8- Overall, the system is satisfactory.							

Part Two: The current health information system (HIS) can help in re-designing patients' care pathway:							
Criteria	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Not Applicable**	**Comments (*Optional*)**
1- This HIS facilitates a patient's journey in the hospital; since the patient enters the facility till							

leaving it.							
2- Allows reviewing patients' progress notes.							
3- Facilitates documenting patients' care.							
4- Acquires and analyzes radiology results.							
5- Acquires and analyzes lab tests' results.							
6- Acquires and analyzes other results.							
7- This HIS helps in simplifying supporting processes, such as billing.							
8- Allows taking decisions by communicating with specialists remotely.							
9- Promoting security and confidentiality.							
10- Promoting patients' satisfaction.							
11- The system facilitates unifying healthcare processes across all hospitals under the UAE Federal Healthcare Organization.							
12- Overall, the system helped in redesigning patients' care pathway.							

Part Three: The current health information system (HIS) can improve health outcomes for patients:							
Criteria	**Scale**						
<u>Diagnosis and Medical Care</u>:	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Not Applicable**	**Comments (*Optional*)**
1- The process of generating reports via the system is easy (e.g. statistics about a specific disease).							
2- The system allows having a comprehensive picture about a patient that helps in diagnosing problems sooner.							
3- The system allows gathering all information related to a patient in one place (e.g. lab results and radiology reports) that helps in making therapeutic decisions.							
4- This HIS helps to track patients' care progress.							
5- The tests results are reliable for healthcare providers to take decisions about patients' conditions.							
6- The system allows viewing drug formulary information.							
7- This HIS allows to access and							

view patients' assessments easily and quickly.							
8- The system has the option to send reminders to healthcare providers (e.g. surgeries appointments and nurses to give medications to inpatients).							
9- The implementation of such systems helped in diagnosing medical conditions at earlier stage.							
<u>Discern Alerts</u>:	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Not Applicable**	**Comments (*Optional*)**
1- The system sends alerts about incomplete tasks and information.							
2- Receiving patients' allergy history alerts.							
3- Receive drugs interactions alerts when prescribing medications.							
4- Receiving drugs allergy alerts when prescribing medications.							
<u>Other</u>:	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**	**Not Applicable**	**Comments (*Optional*)**
1- Patients' registration or scheduling appointment processes take maximum							

5 minutes per patient.							
2- Tests' results are transferred correctly from devices to the HIS. This means that there is no need for double work to enter data from devices to the HIS.							
3- The system is integrated successfully with other devices (e.g. lab machines).							
4- The number of errors is decreased compared to the manual system.							
5- The system generates reports for planning and research.							
6- The system improves documentation process and coding system.							
7- The system reduces the waiting time for patients.							
8- The system has the option to send reminders to patients about their appointments.							
9- Ability to analyze the performance of different sections at the facility.							
10- Simply obtaining required data for various reasons, such as: diagnosis and planning.							
11- Overall, the system helped in improving patients' health outcomes.							

Part Four (a): The challenges faced in this (HIS) (*You may select more than one answer if needed*)**:**
☐ Inadequacy of training and support during the implementation of the system.
☐ Difficulty of the system layout and format (e.g. terminologies).
☐ Technical problems (e.g. unscheduled system downtime).
☐ Time consumption while using the system compared to the manual system (paper-based form).
☐ User acceptance of the new system.
☐ Other (*Please Specify*):……..
Part Four (b): Possible solutions to overcome the challenges in this (HIS) (*You may select more than one answer if needed***):**
☐ Additional training to be provided.
☐ Extending support period.
☐ Simplifying the system layout, format and design which include using simple terminologies.
☐ Rewards and penalties strategy for the system's users.
☐ Other (*Please Specify*):……
Further comments and recommendations (*Optional***):**

End of the survey

Thank you for your time and cooperation.

For any enquires regarding this questionnaire, please contact: Shaikha Abdool, E-mail: shaikha.abdool@hotmail.com, Contact #: 050-3071177

Appendix (B): Al-Fujairah Hospital Figures

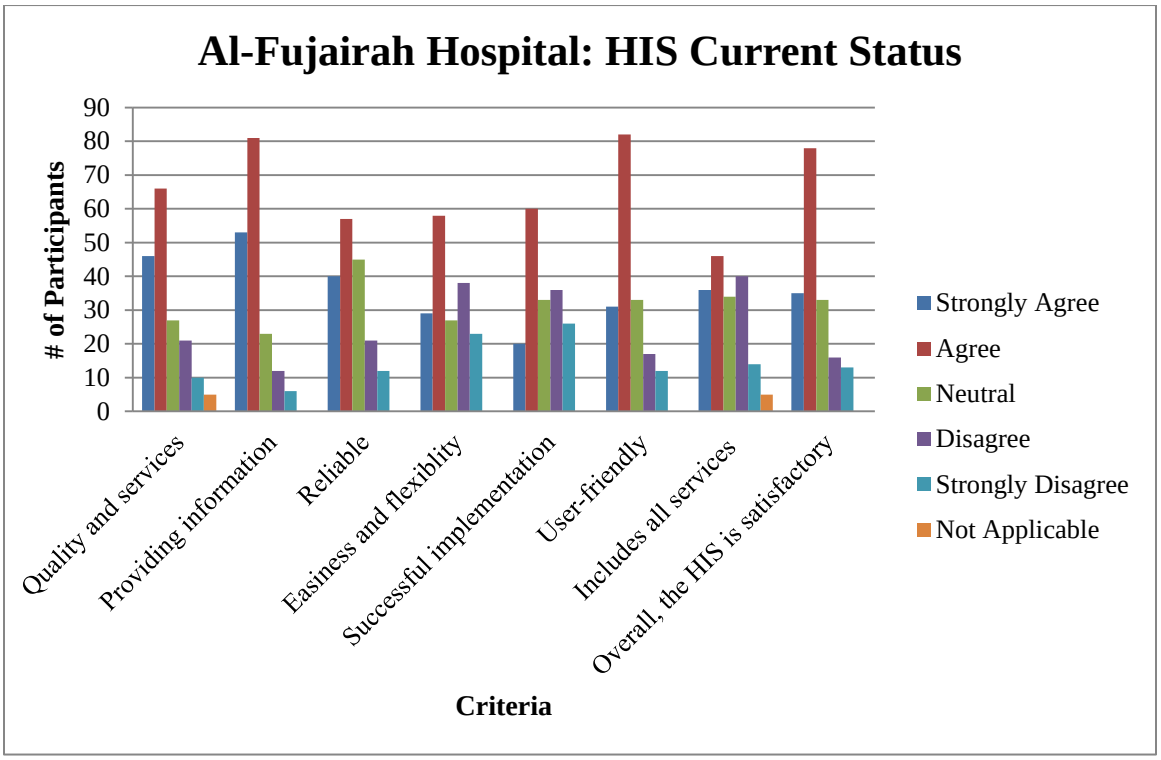

Figure 13: Al-Fujairah Hospital HIS current status.

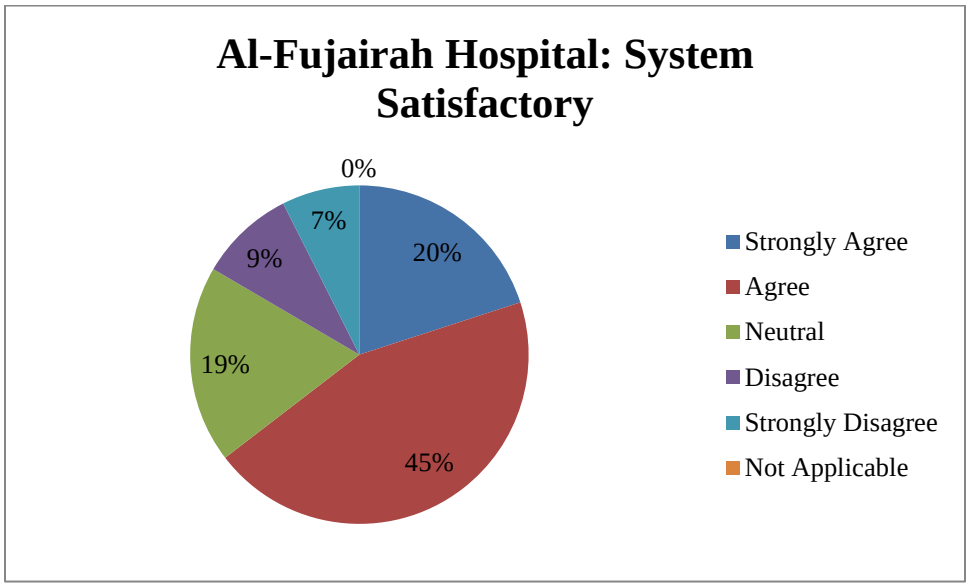

Figure 14: Al-Fujairah Hospital system satisfactory.

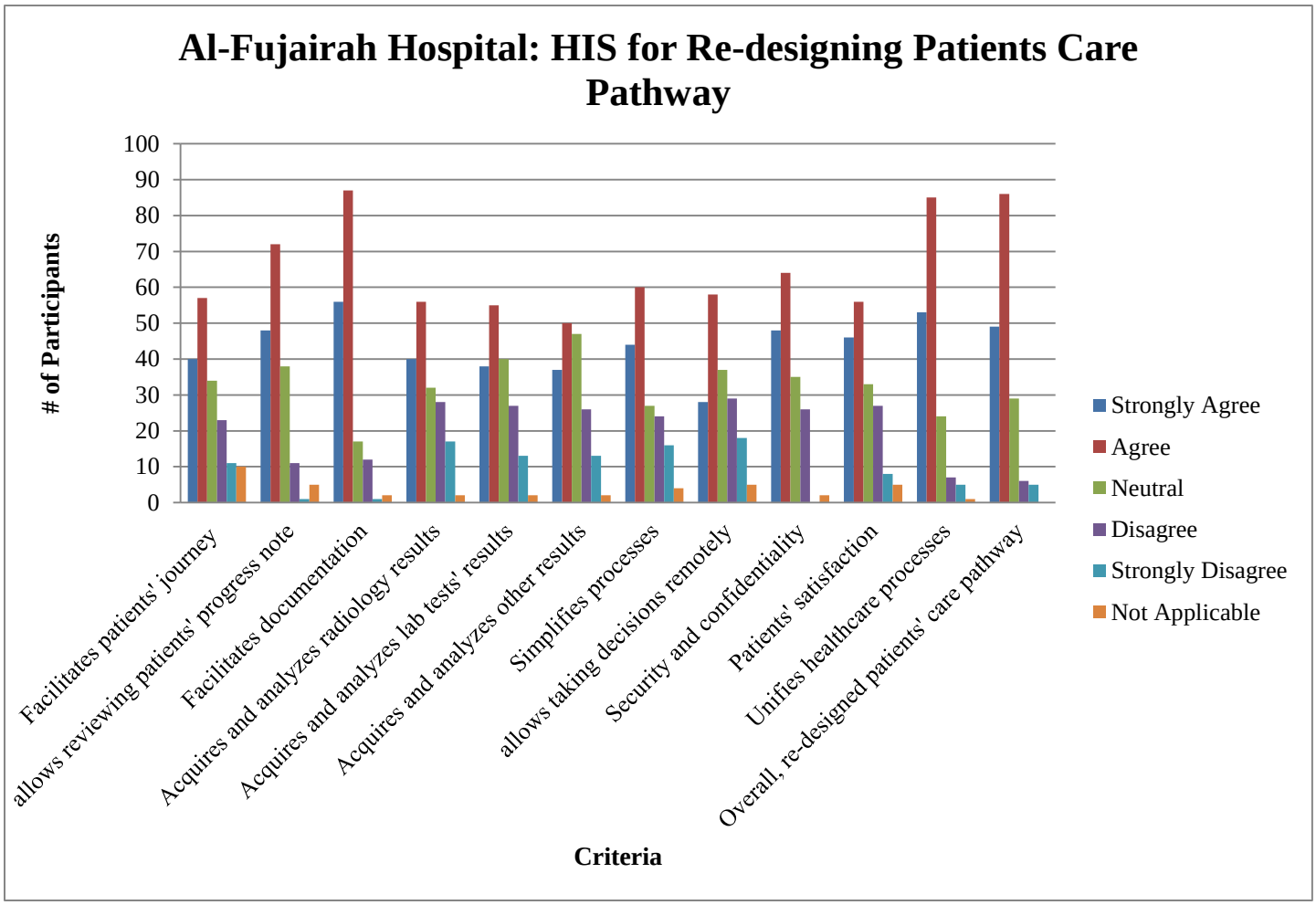

Figure 15: Al-Fujairah Hospital HIS for re-designing patients' care pathway.

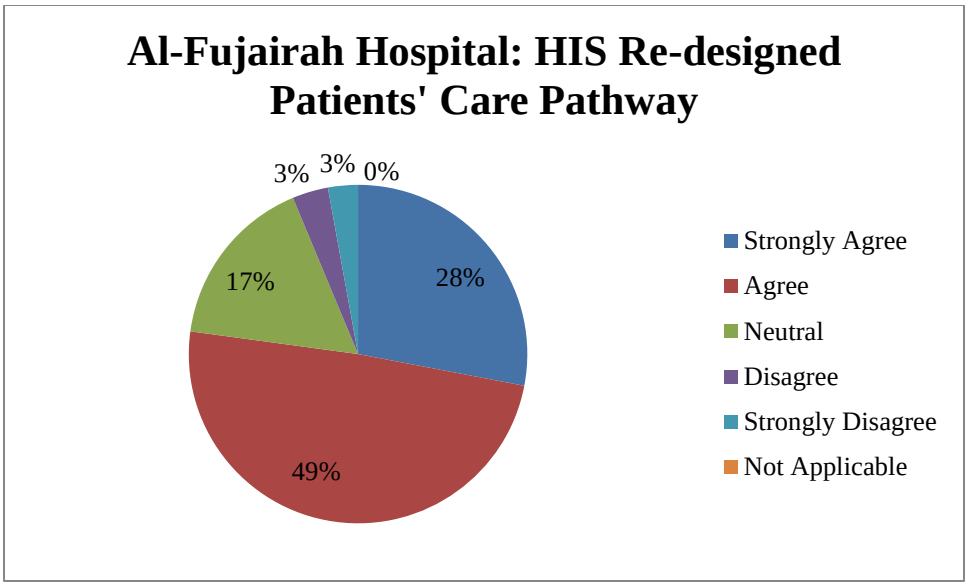

Figure 16: Al-Fujairah Hospital HIS helped in re-designing patients' care pathway.

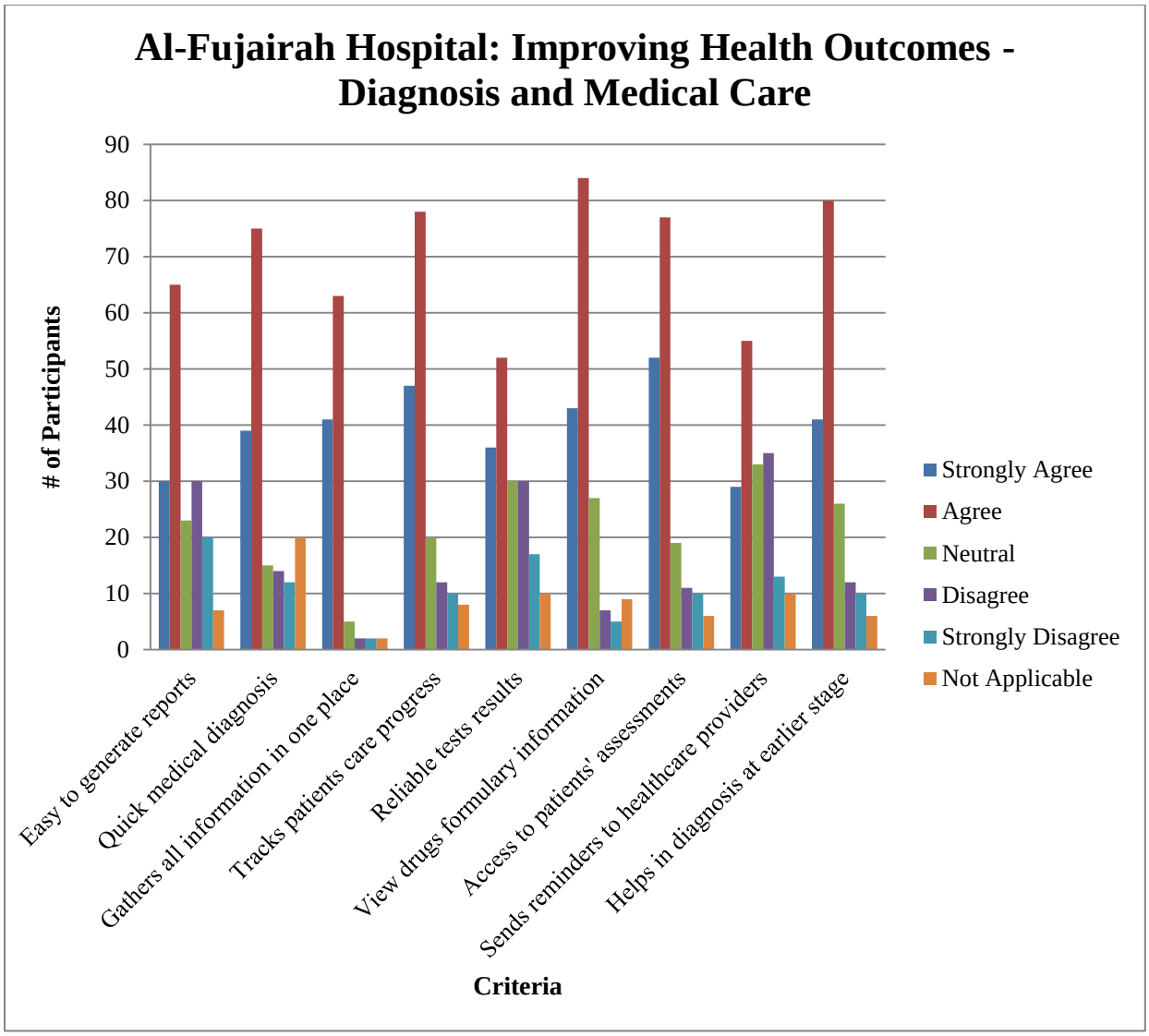

Figure 17: Al-Fujairah Hospital HIS for diagnosis and medical care.

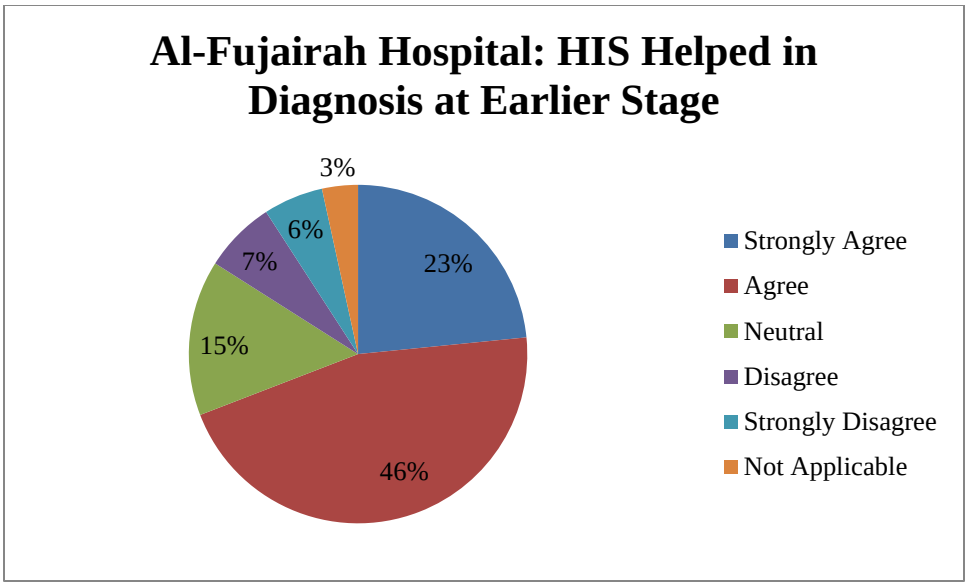

Figure 18: Al-Fujairah Hospital HIS for diagnosis and medical care at earlier stage.

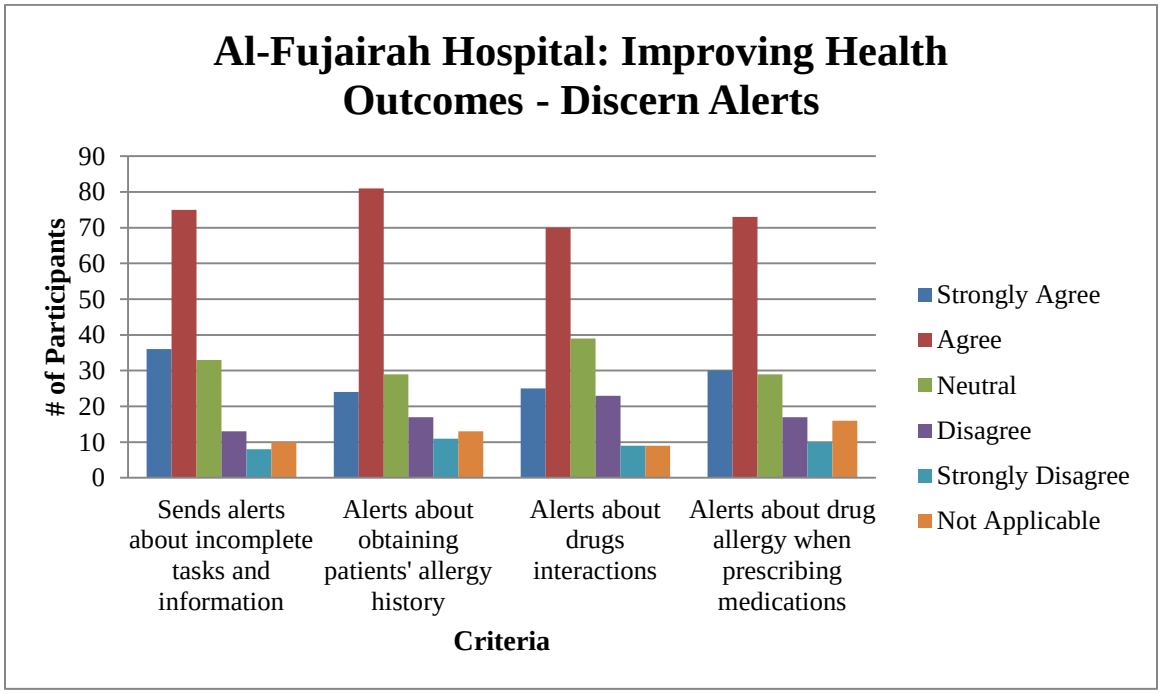

Figure 19: Al-Fujairah Hospital discern alerts.

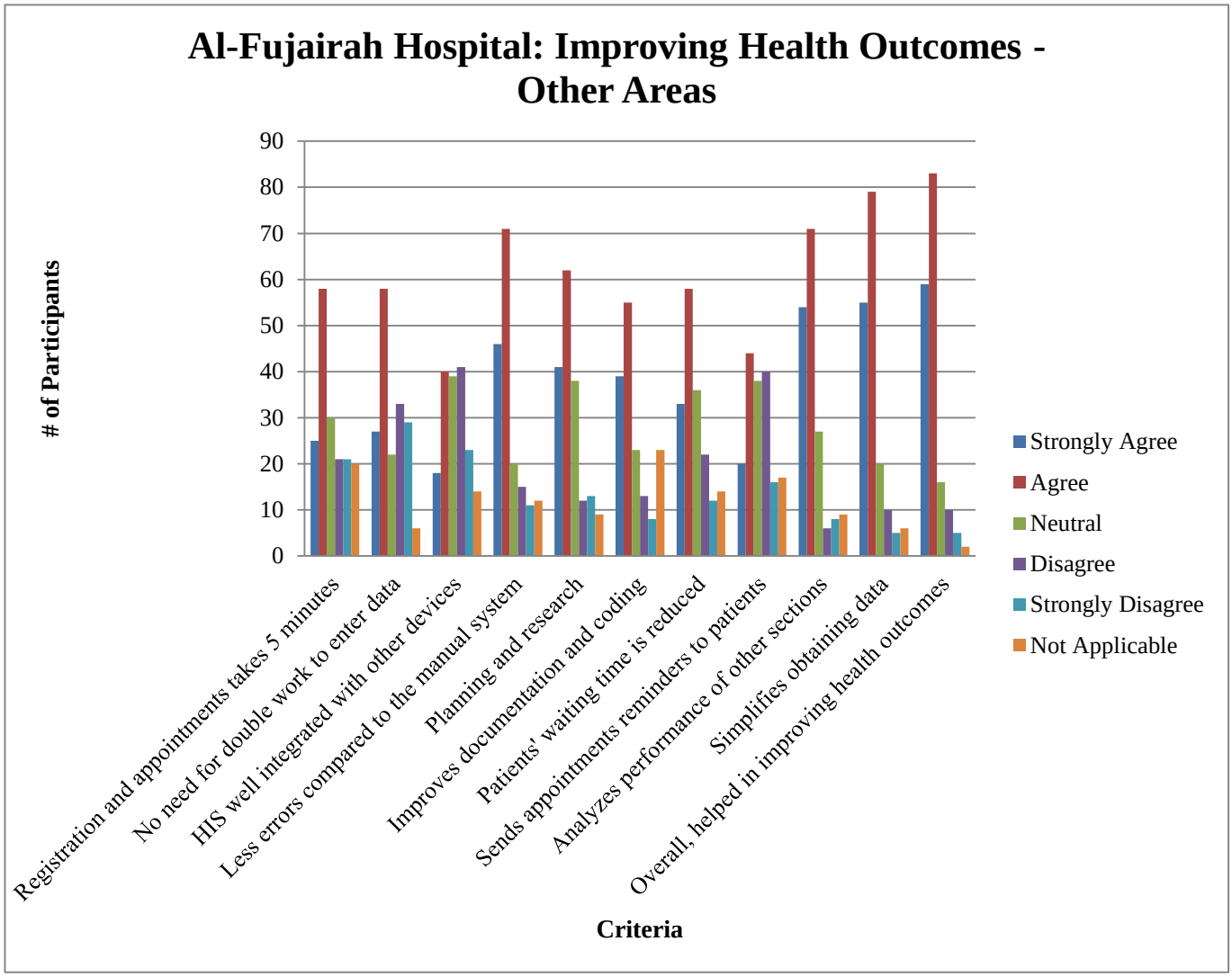

Figure 20: Al-Fujairah Hospital HIS for improving patients' health outcomes.

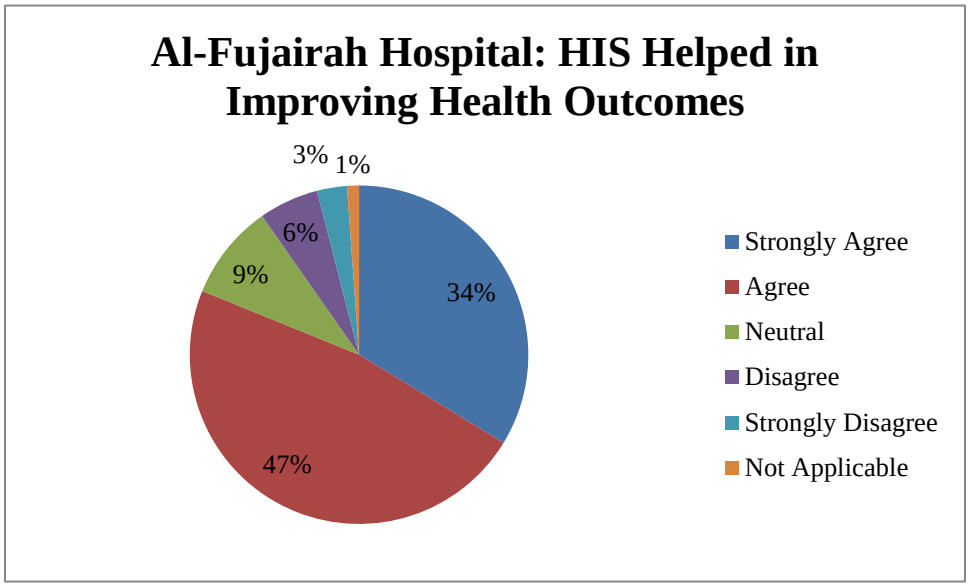

Figure 21: Al-Fujairah Hospital HIS helped in improving patients' health outcomes.

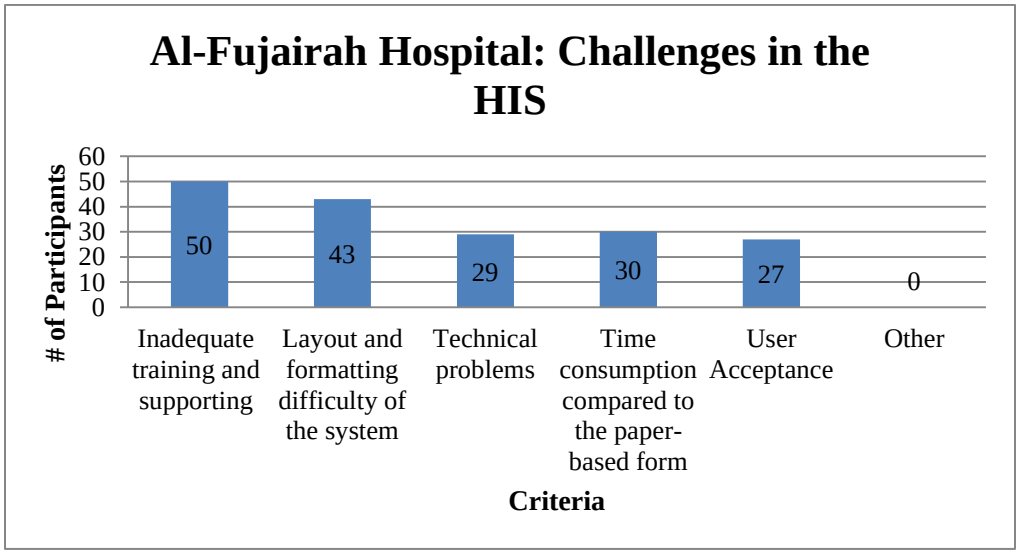

Figure 22: Al-Fujairah Hospital HIS challenges.

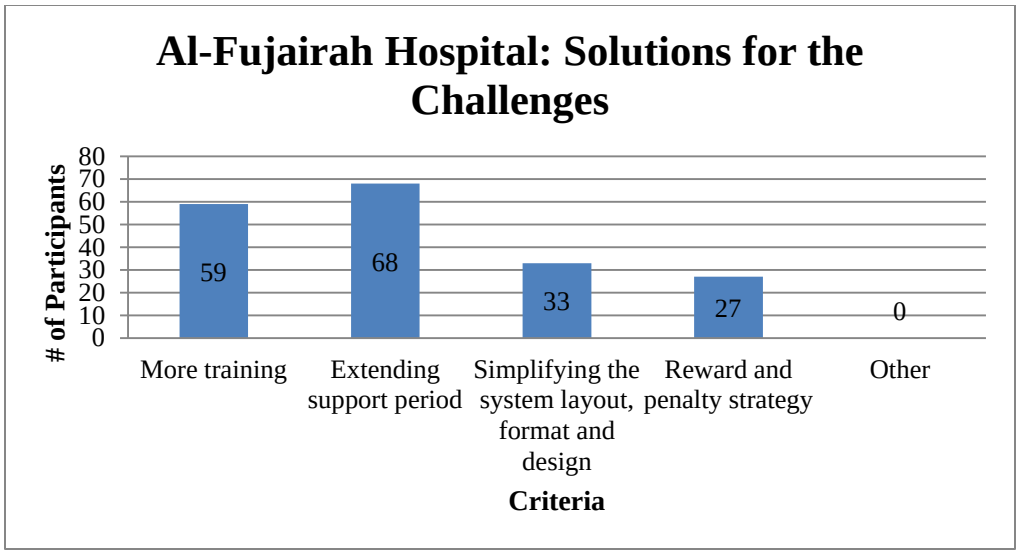

Figure 23: Al-Fujairah Hospital HIS solutions for challenges.

Appendix (C): Dubai Hospital Figures

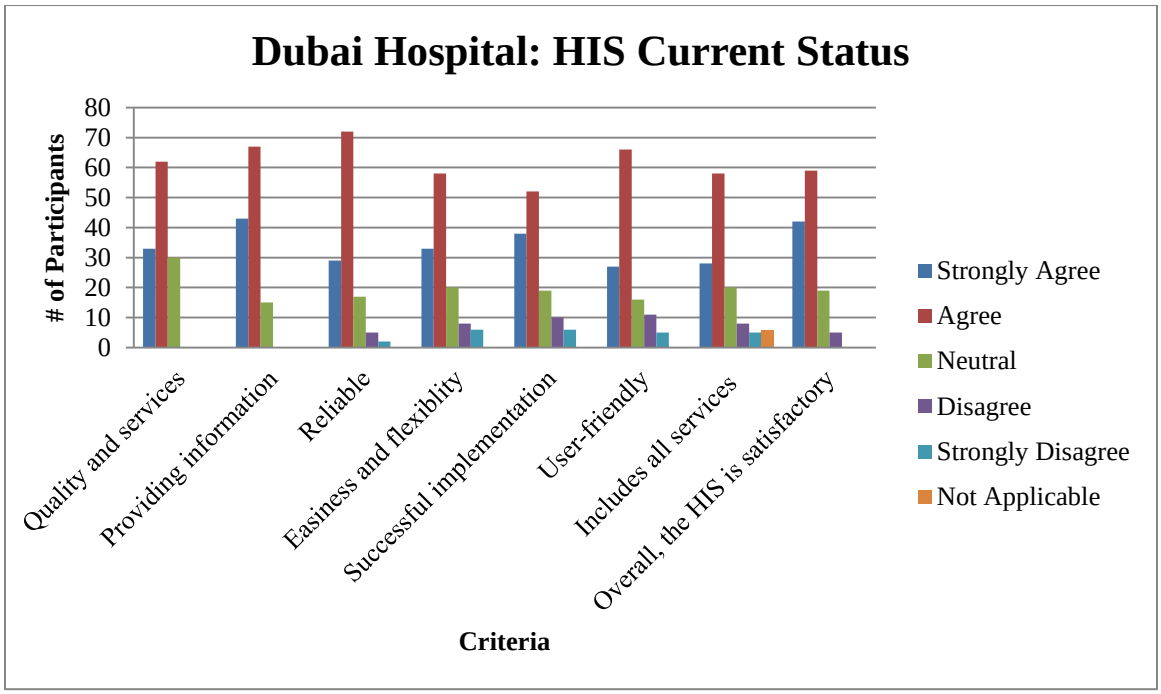

Figure 24: Dubai Hospital HIS current status.

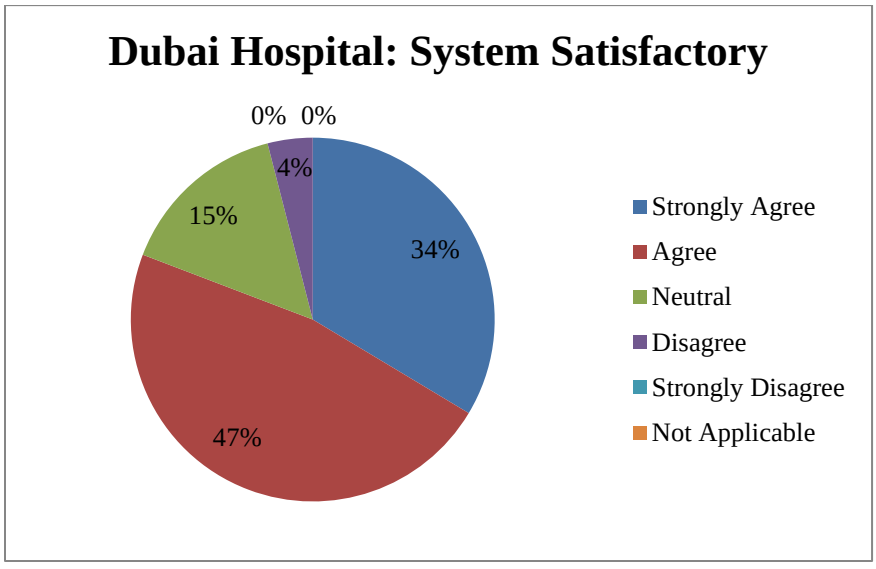

Figure 25: Dubai Hospital system satisfactory.

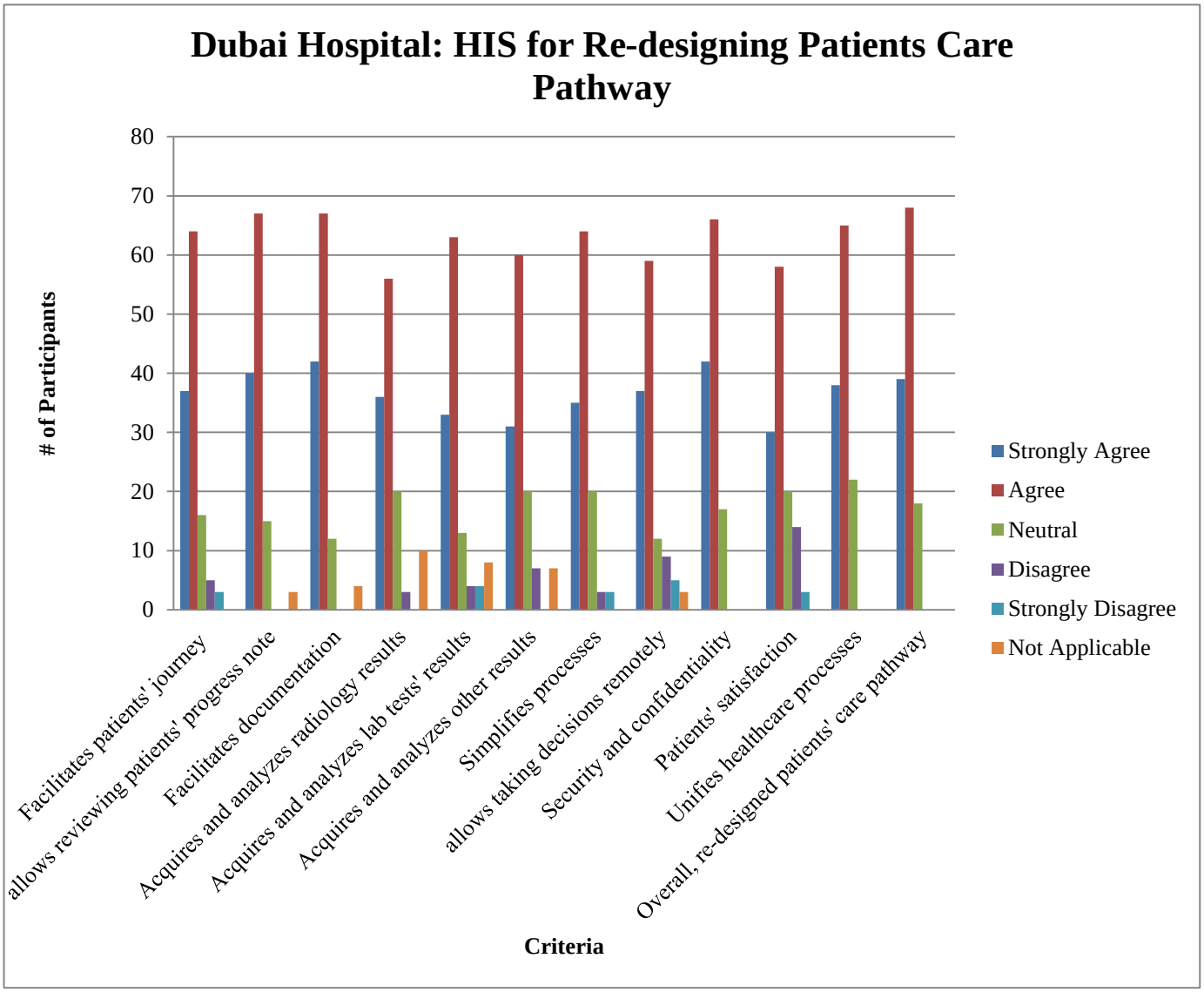

Figure 26: Dubai Hospital HIS for re-designing patients' care pathway.

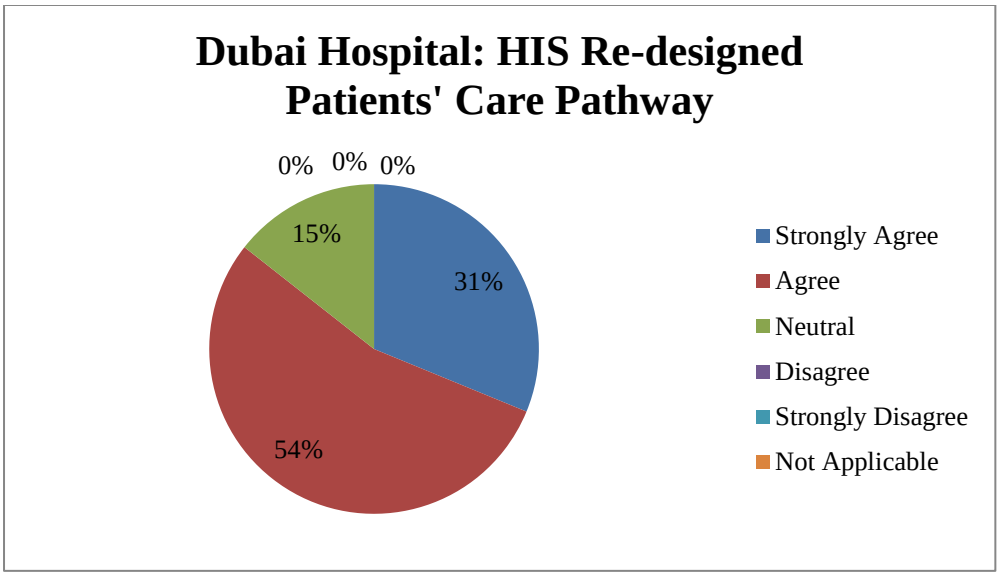

Figure 27: Dubai Hospital HIS helped in re-designing patients' care pathway.

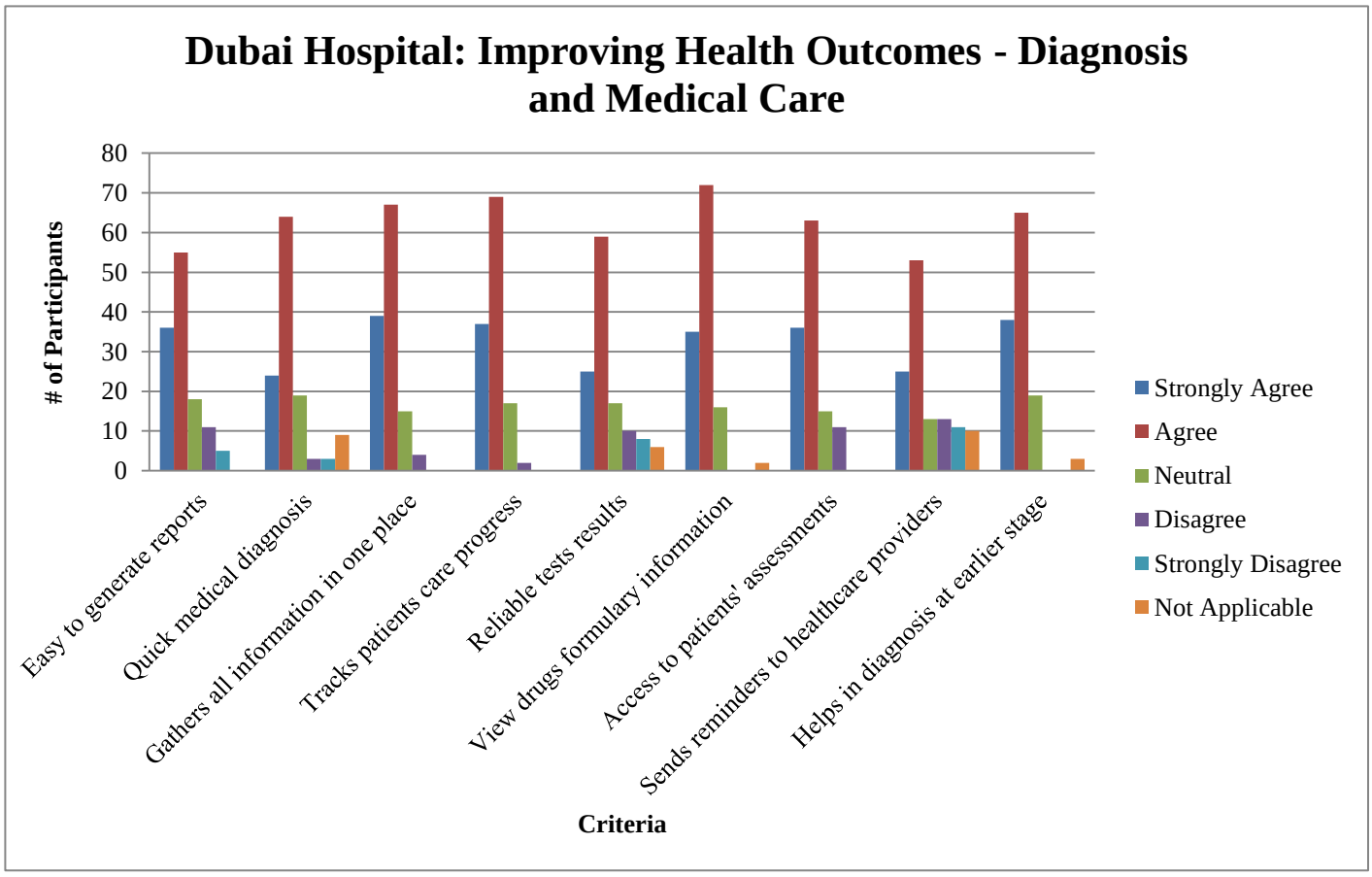

Figure 28: Dubai Hospital HIS for diagnosis and medical care.

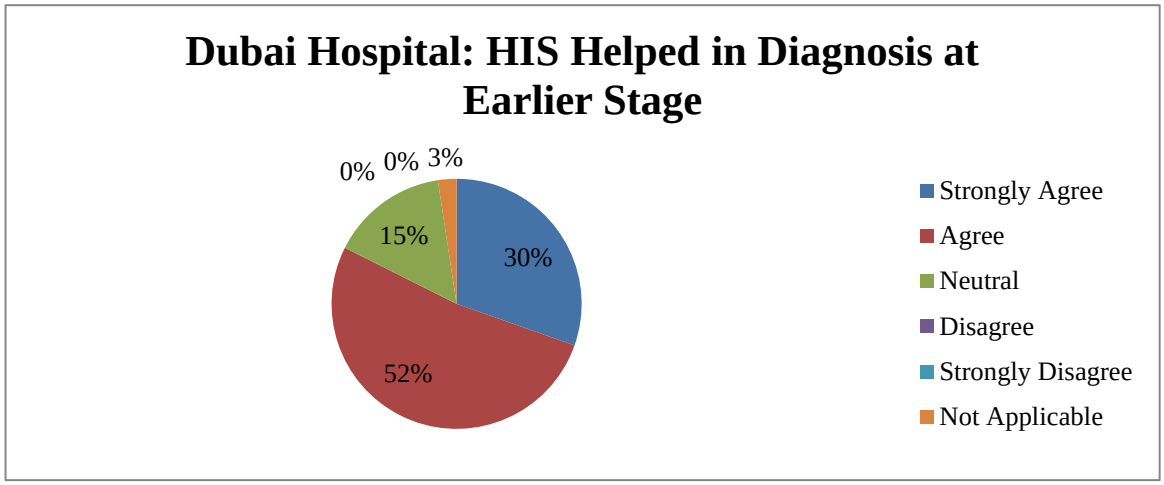

Figure 29: Dubai Hospital HIS for diagnosis and medical care at earlier stage.

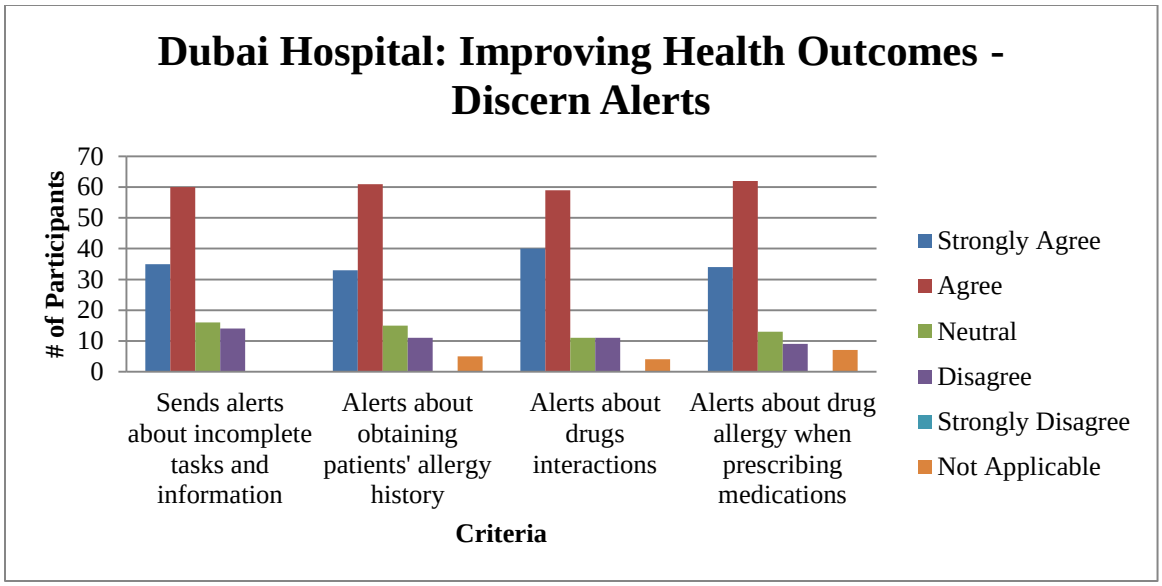

Figure 30: Dubai Hospital discern alerts.

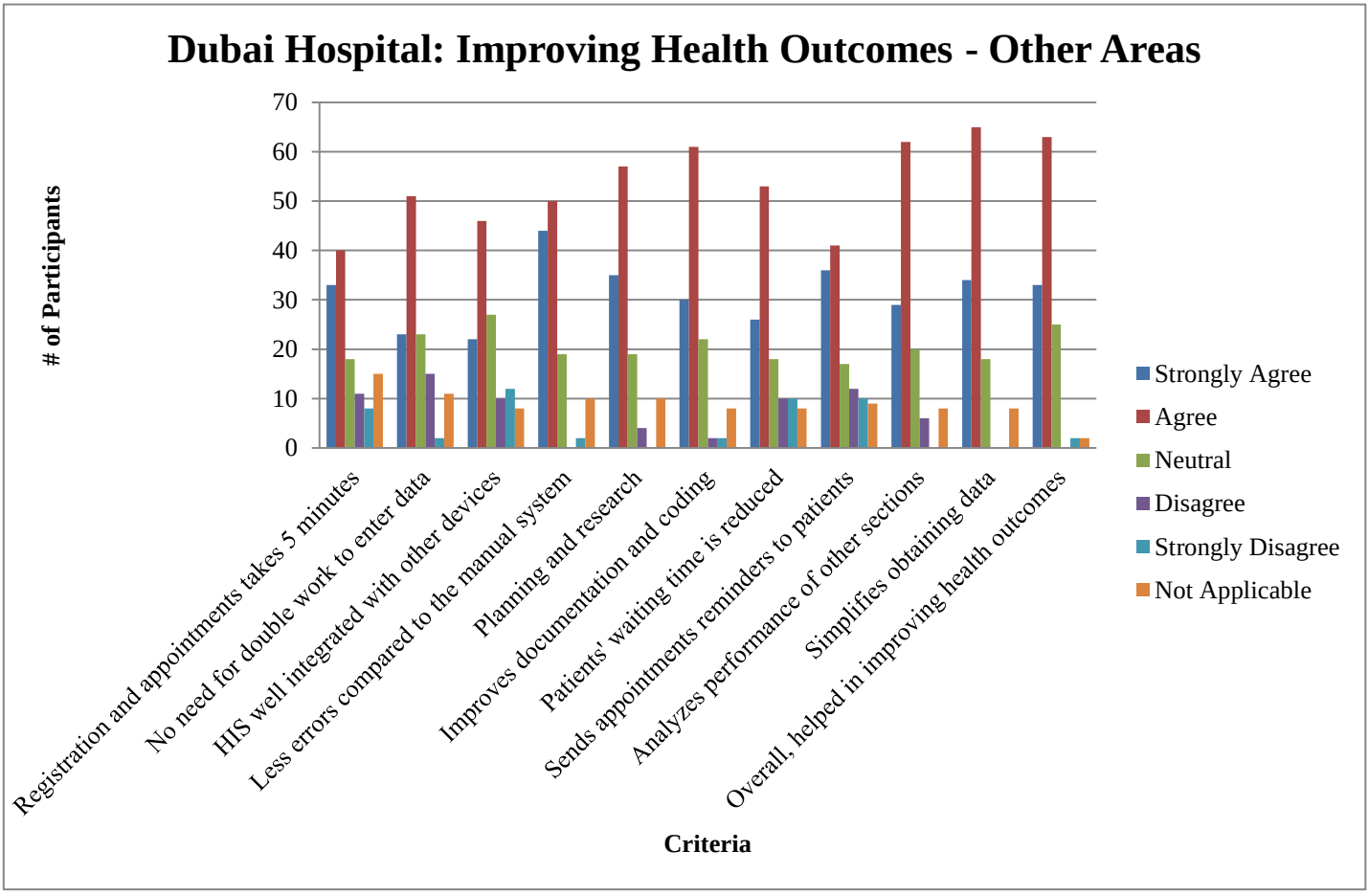

Figure 31: Dubai Hospital HIS for improving patients' health outcomes.

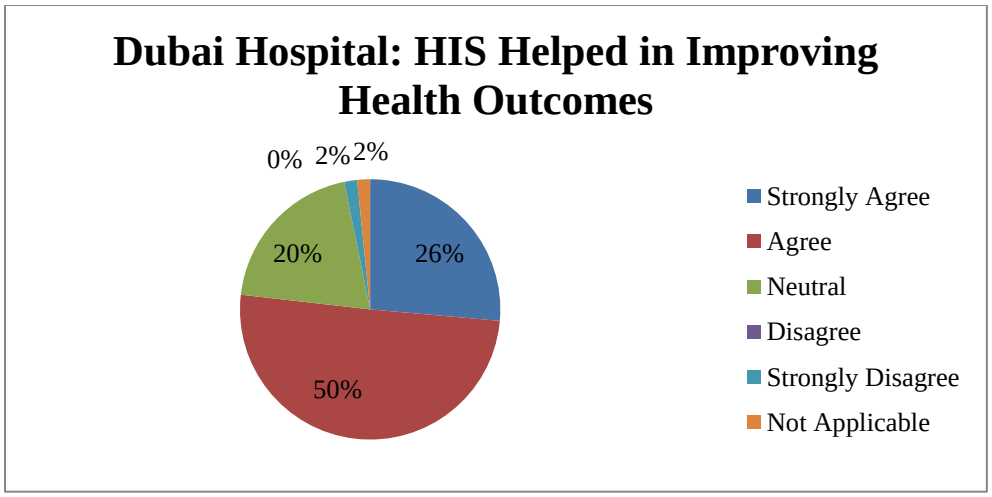

Figure 32: Dubai Hospital HIS helped in improving patients' health outcomes.

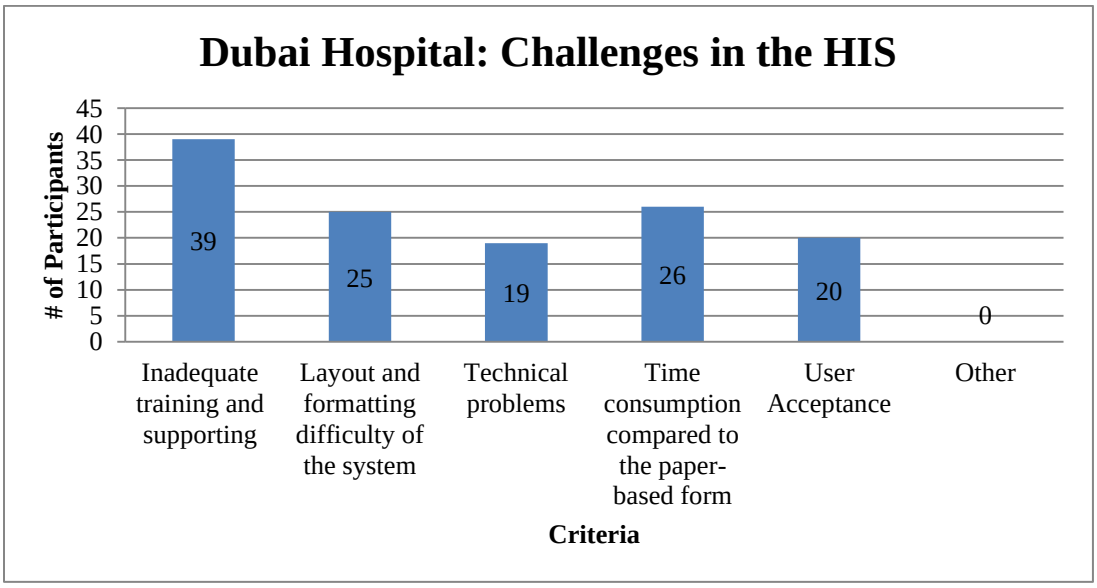

Figure 33: Dubai Hospital HIS challenges.

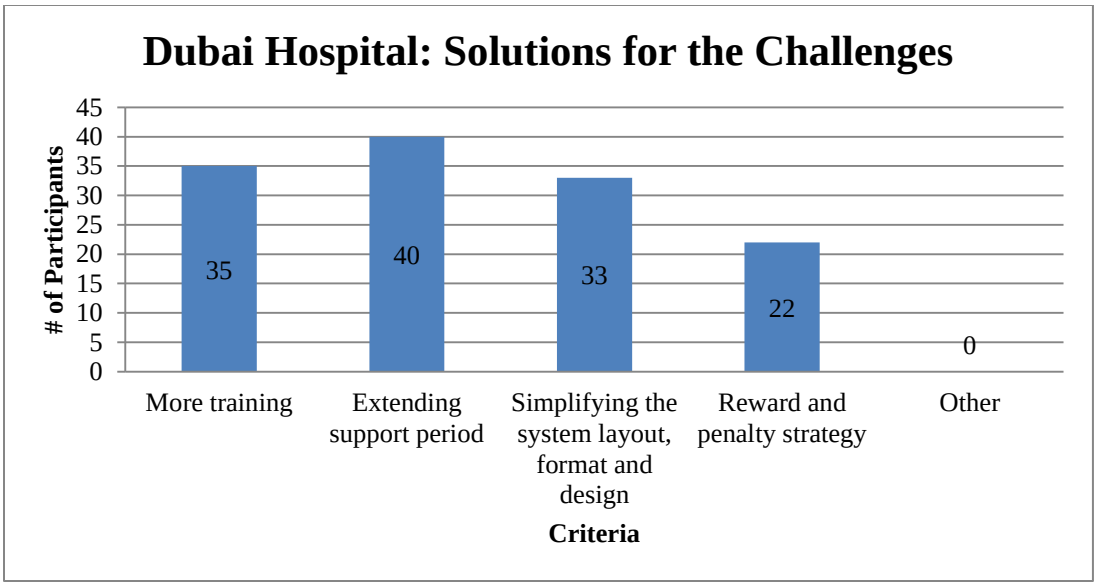

Figure 34: Dubai Hospital HIS solutions for challenges.

Appendix (D): Ras Al-Khaimah (RAK) Hospital Figures

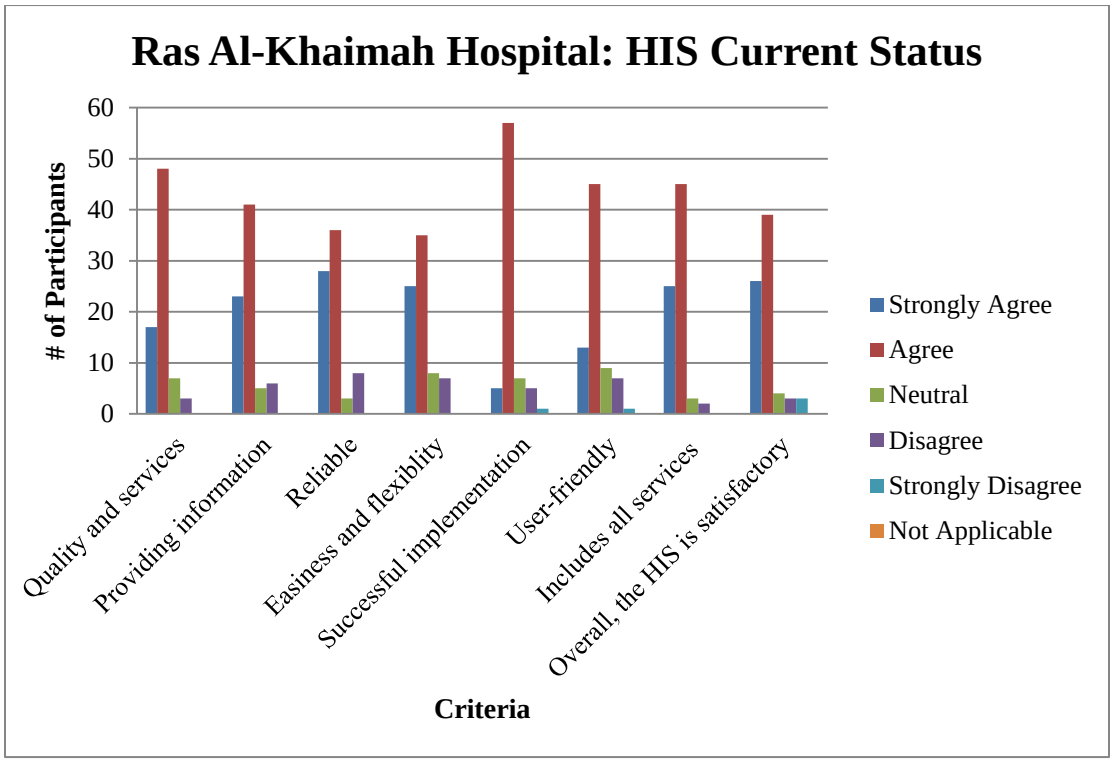

Figure 35: RAK Hospital HIS current status.

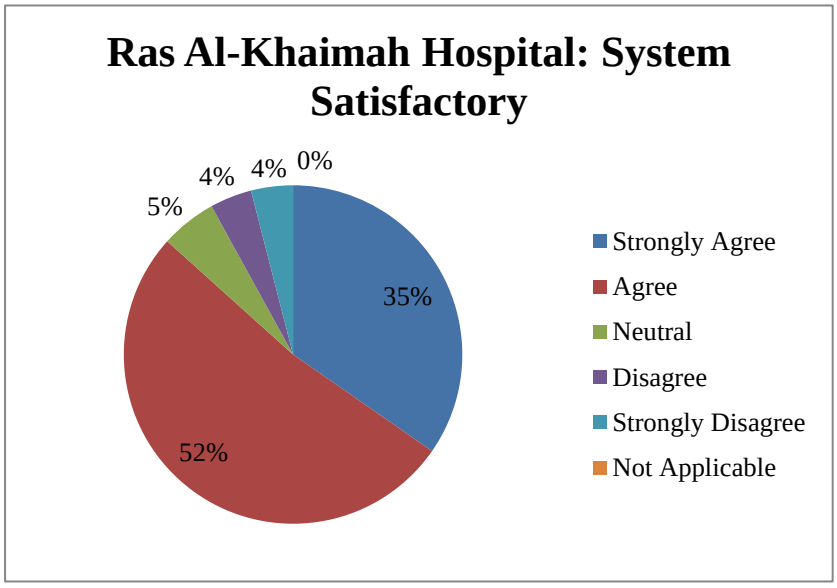

Figure 36: RAK Hospital system satisfactory.

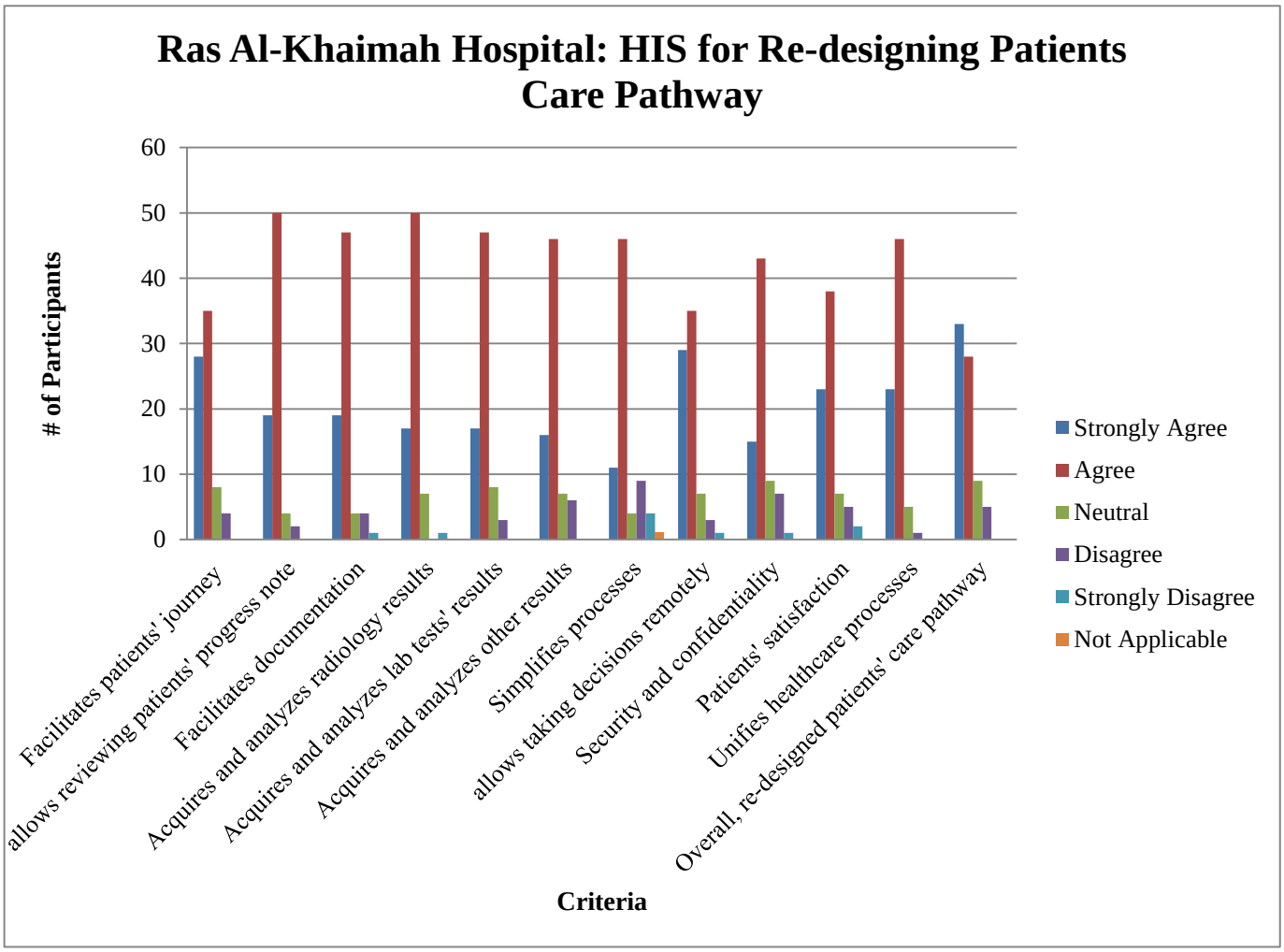

Figure 37: RAK Hospital HIS for re-designing patients' care pathway.

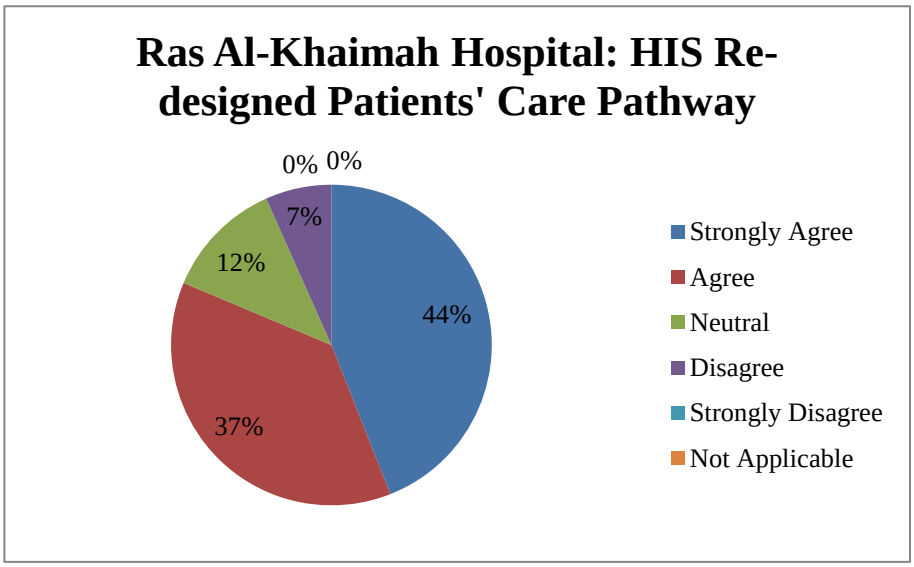

Figure 38: RAK Hospital HIS helped in re-designing patients' care pathway.

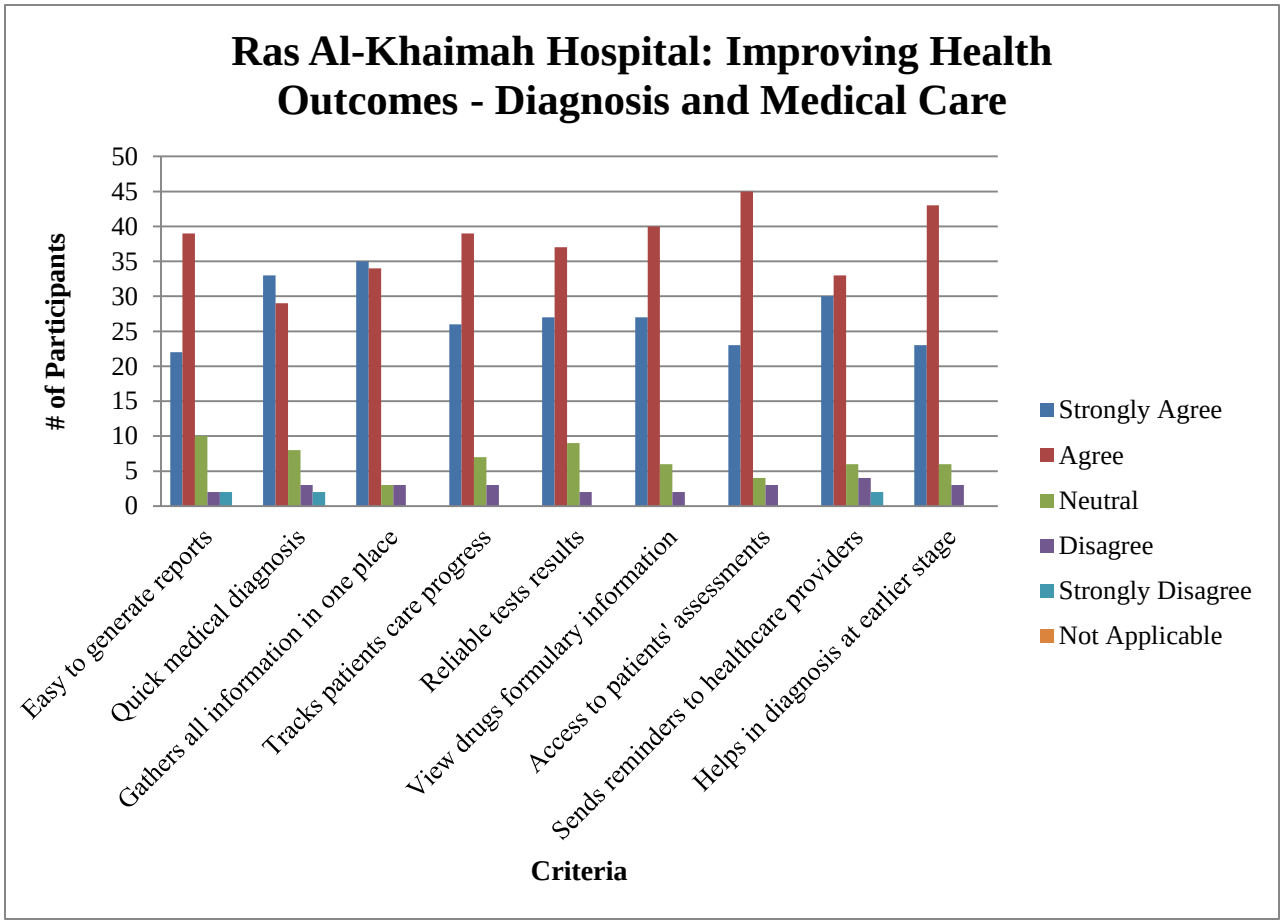

Figure 39: RAK Hospital HIS for diagnosis and medical care.

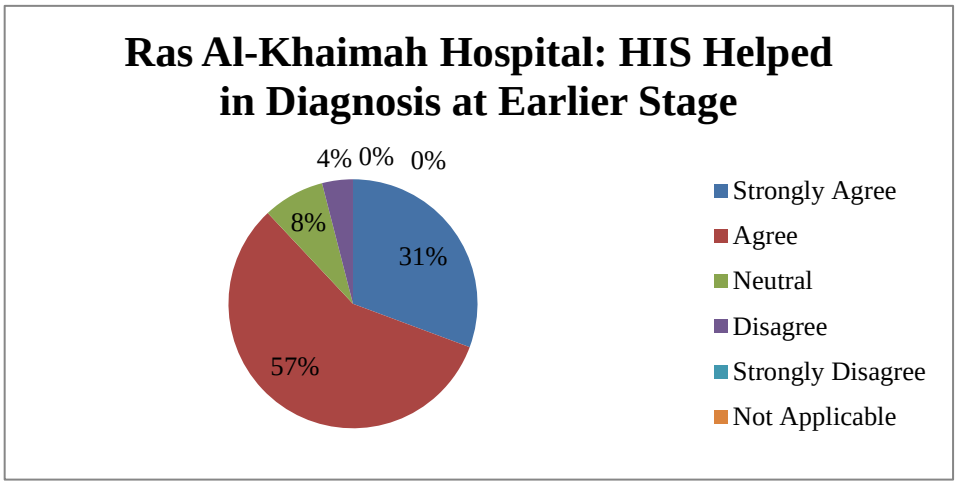

Figure 40: RAK Hospital HIS for diagnosis and medical care at earlier stage.

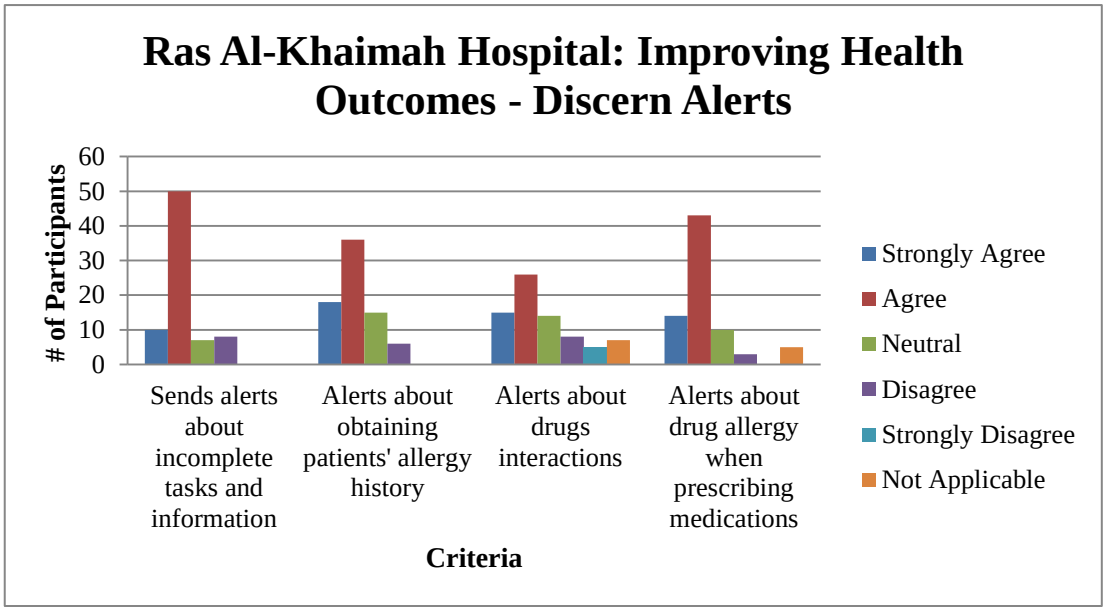

Figure 41: RAK Hospital discern alerts.

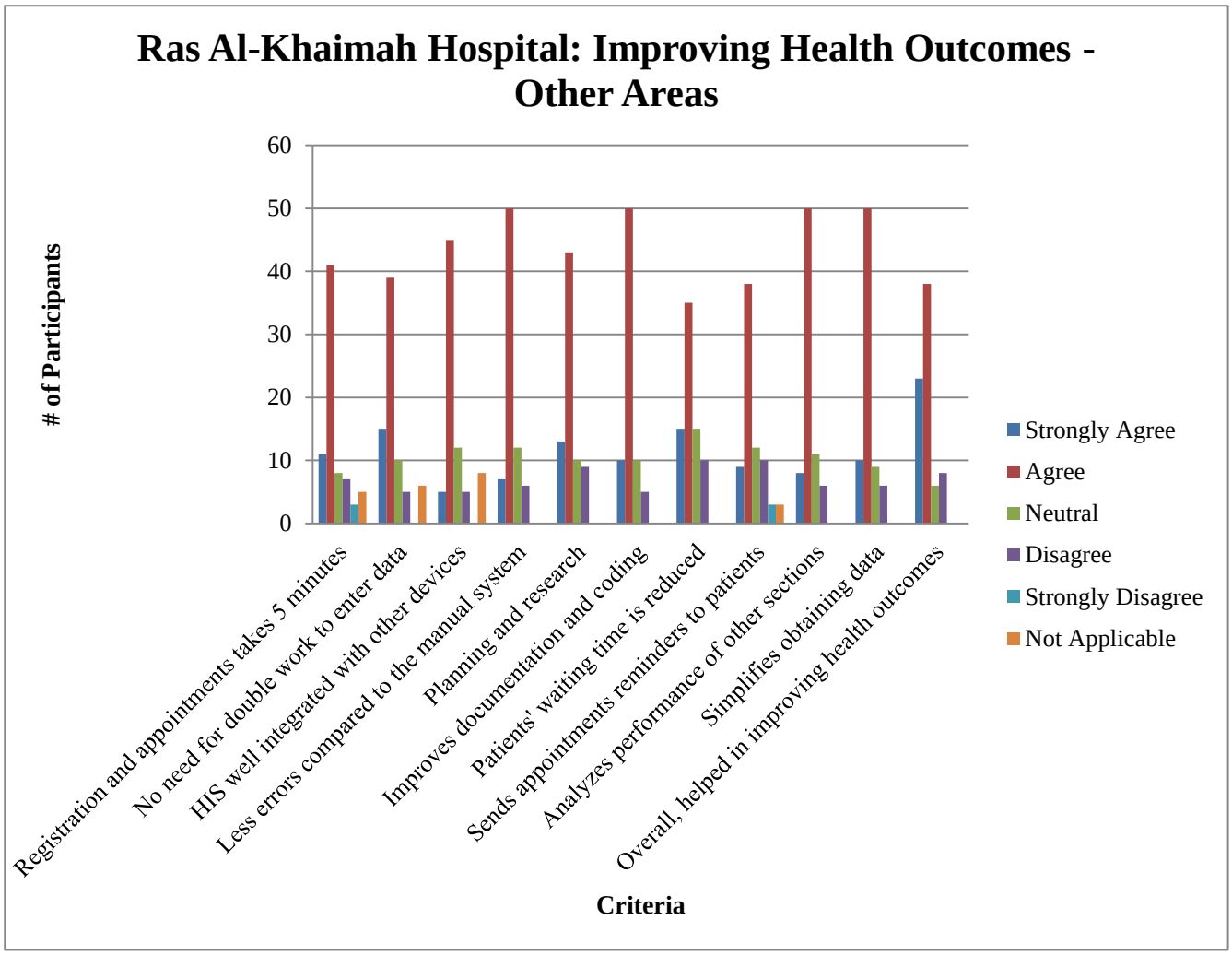

Figure 42: RAK Hospital HIS for improving patients' health outcomes.

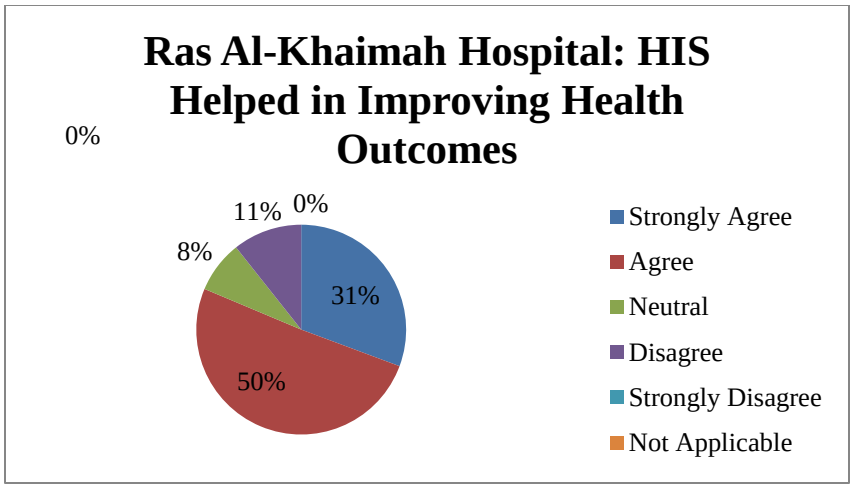

Figure 43: RAK Hospital HIS helped in improving patients' health outcomes.

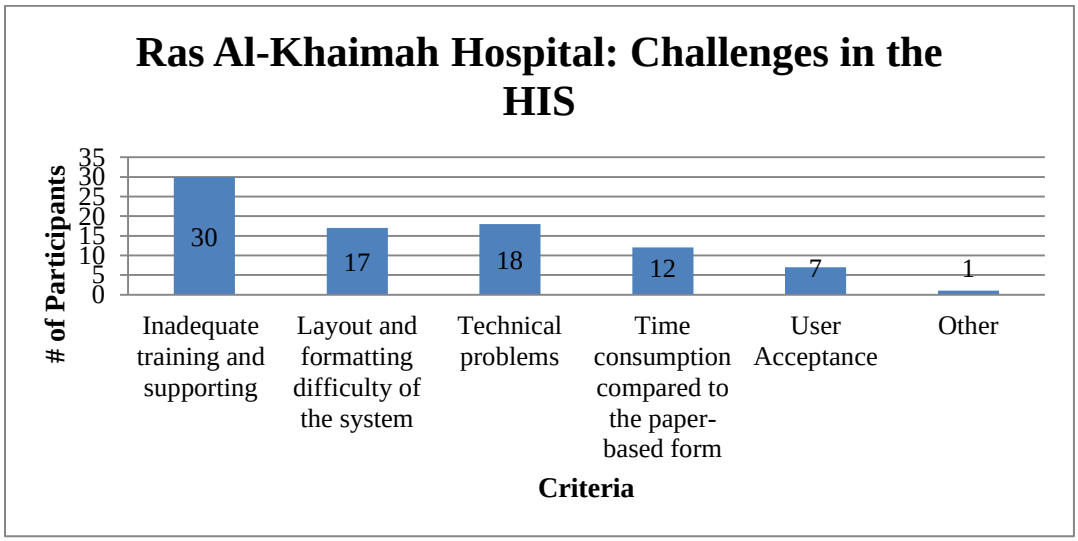

Figure 44: RAK Hospital HIS challenges.

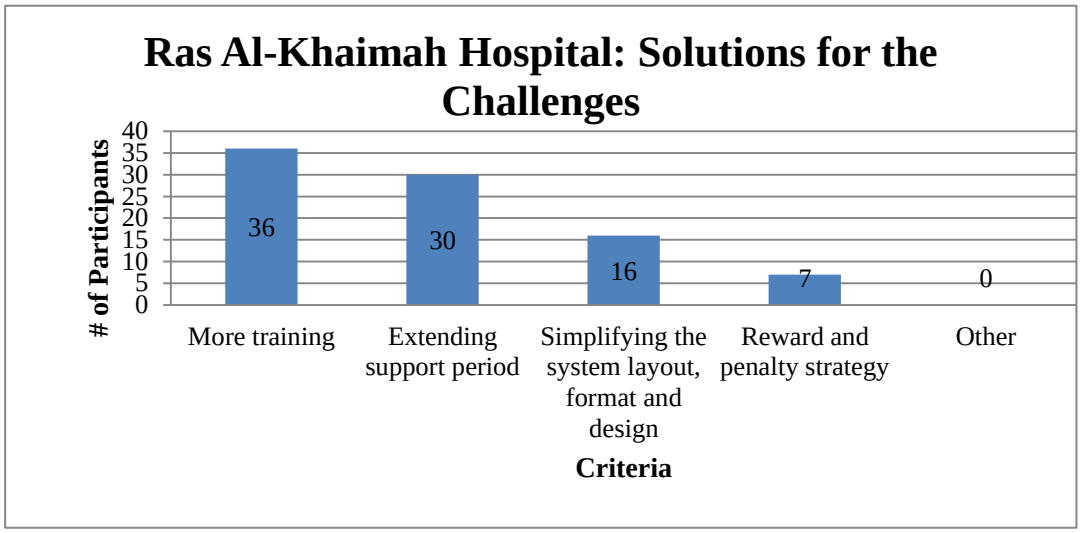

Figure 45: RAK Hospital HIS solutions for challenges.

Appendix (E): Sharjah Hospital Figures

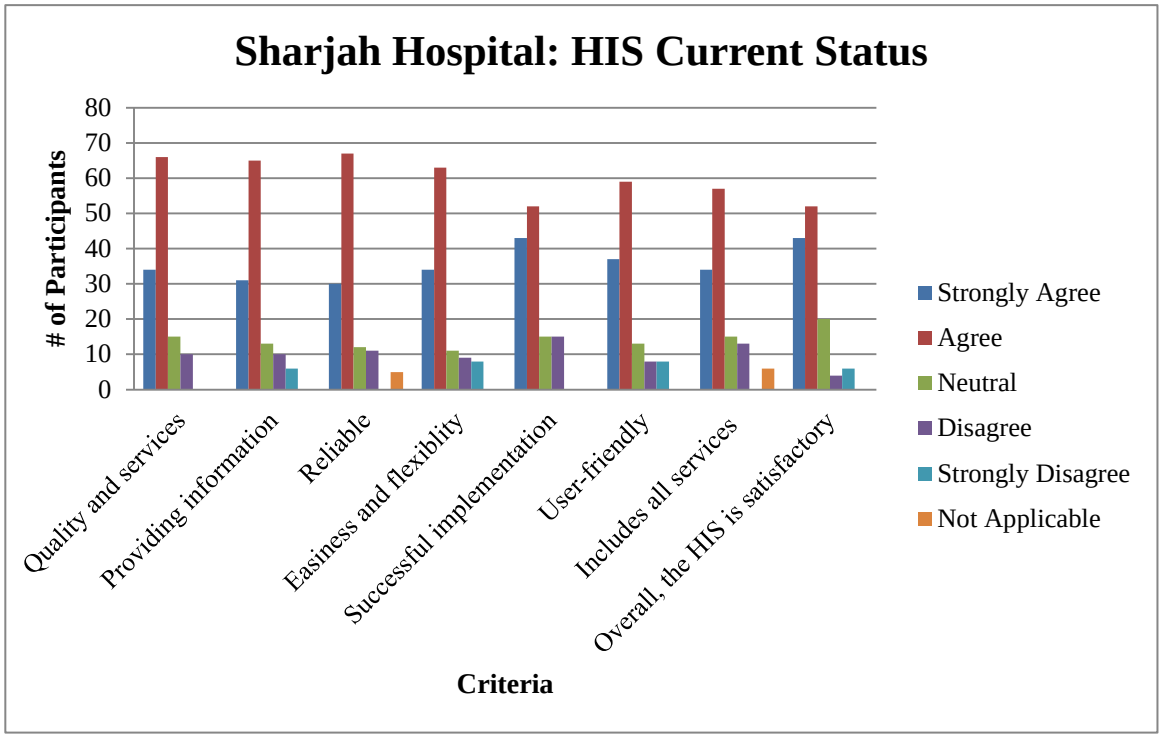

Figure 46: Sharjah Hospital HIS current status.

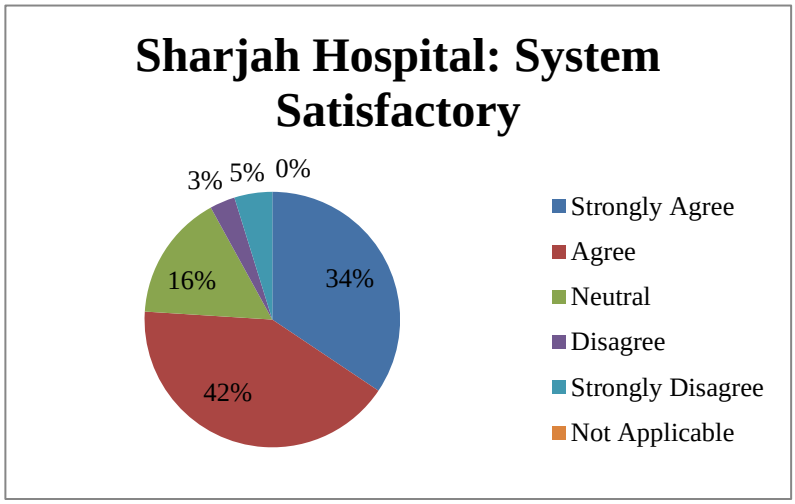

Figure 47: Sharjah Hospital system satisfactory.

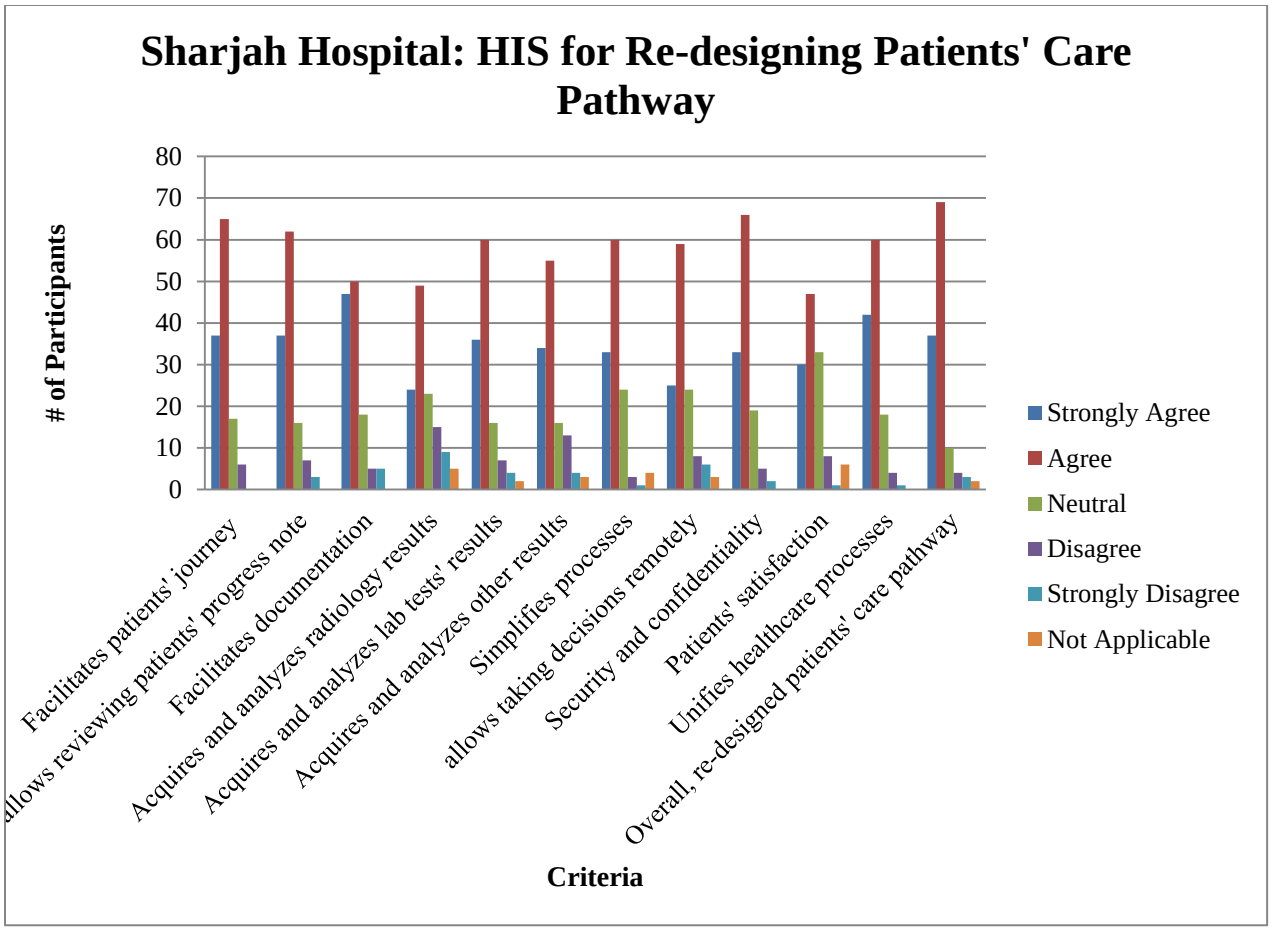

Figure 48: Sharjah Hospital HIS for re-designing patients' care pathway.

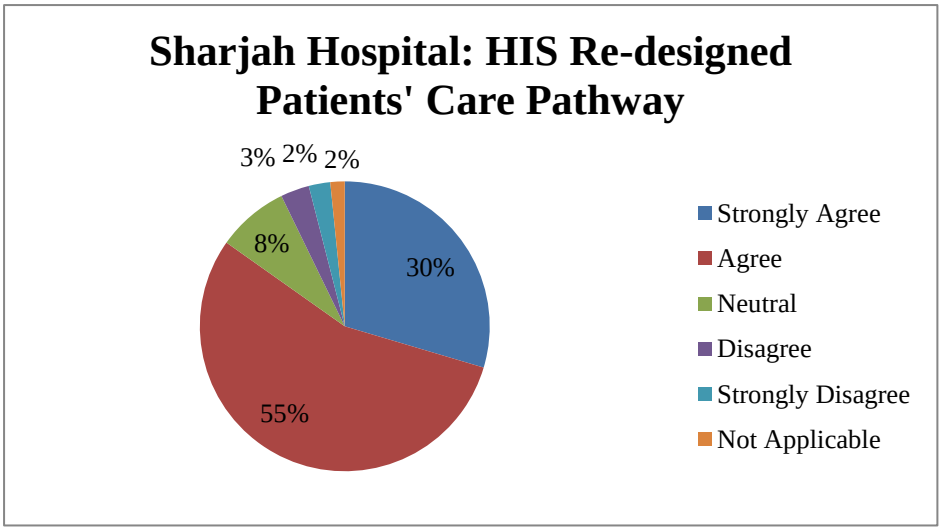

Figure 49: Sharjah Hospital HIS helped in re-designing patients' care pathway.

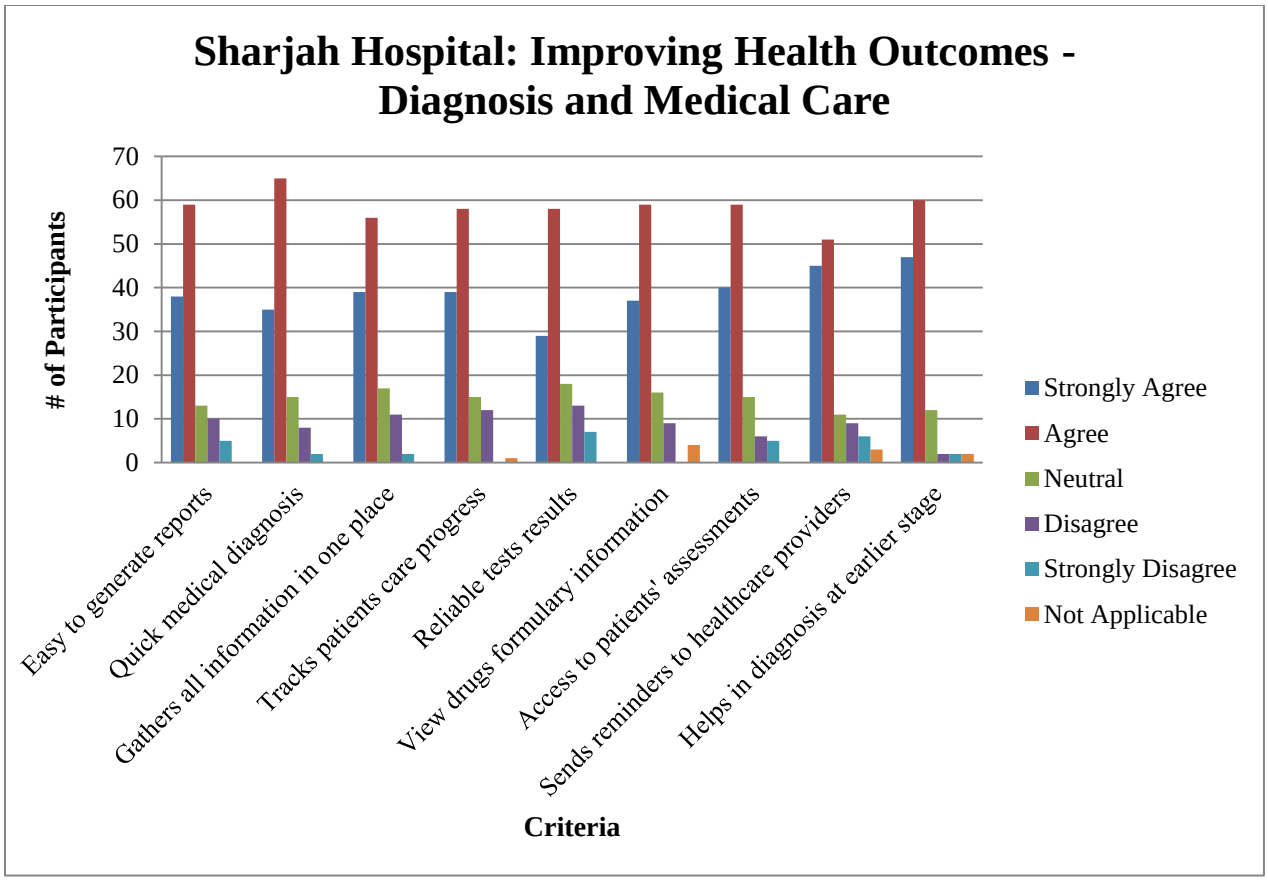

Figure 50: Sharjah Hospital HIS for diagnosis and medical care.

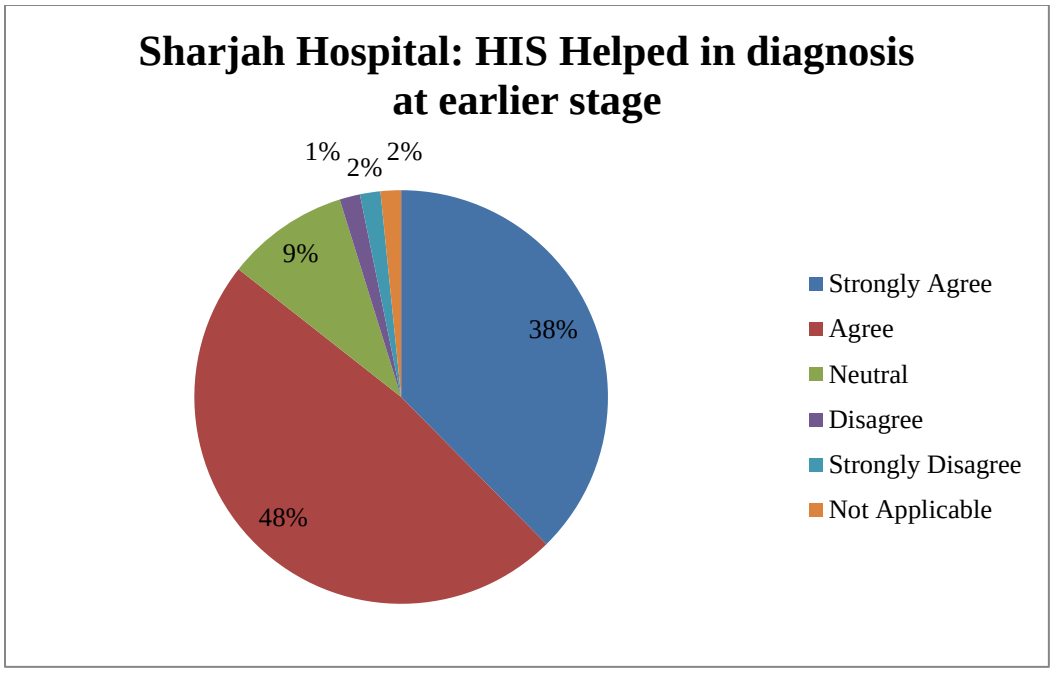

Figure 51: Sharjah Hospital HIS helped in diagnosis at earlier stage.

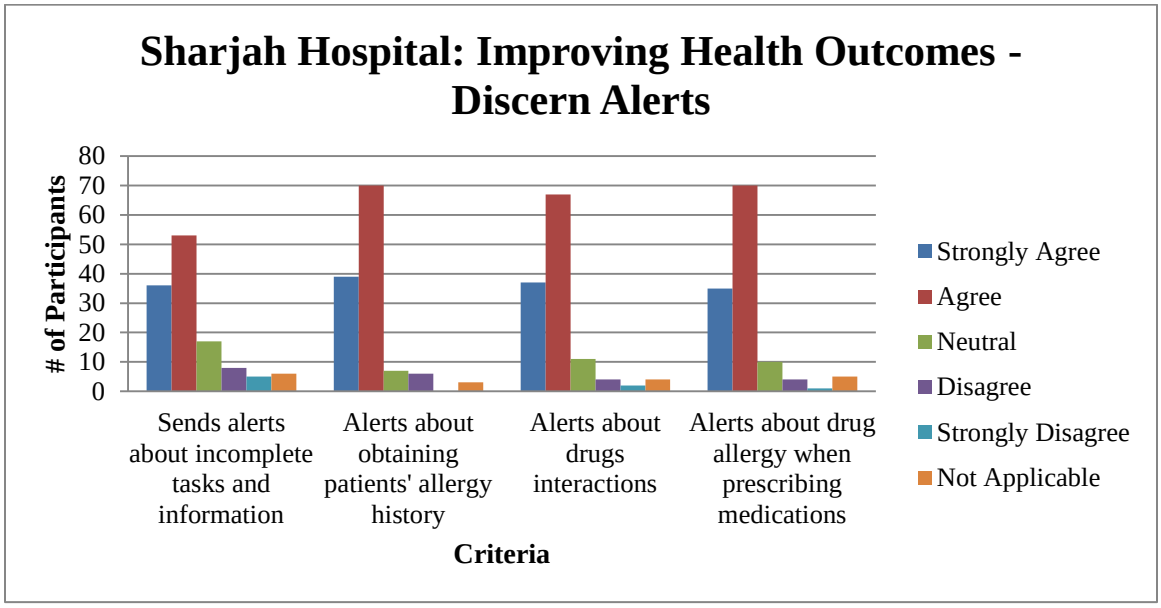

Figure 52: Sharjah Hospital discern alerts.

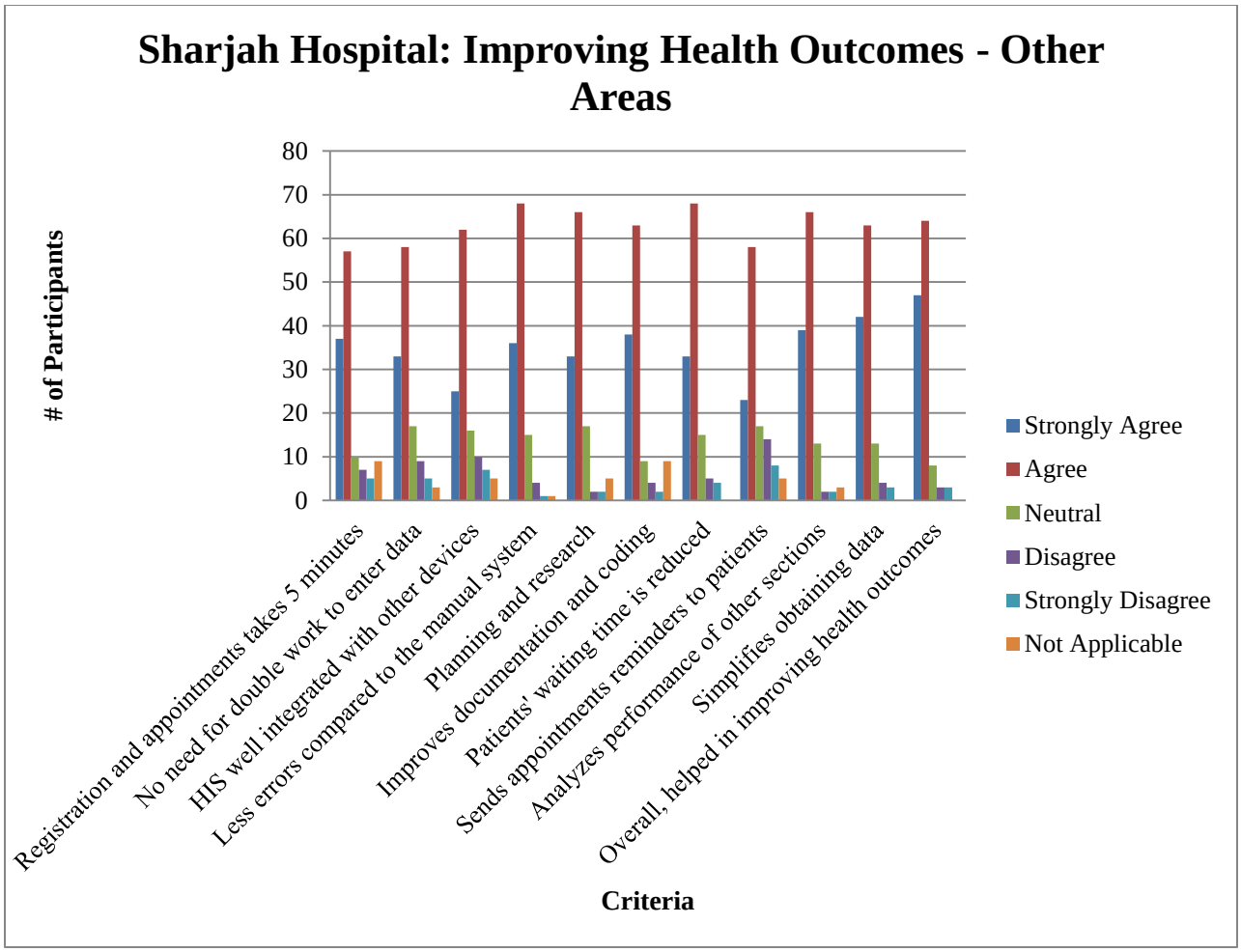

Figure 53: Sharjah Hospital HIS for improving patients' health outcomes.

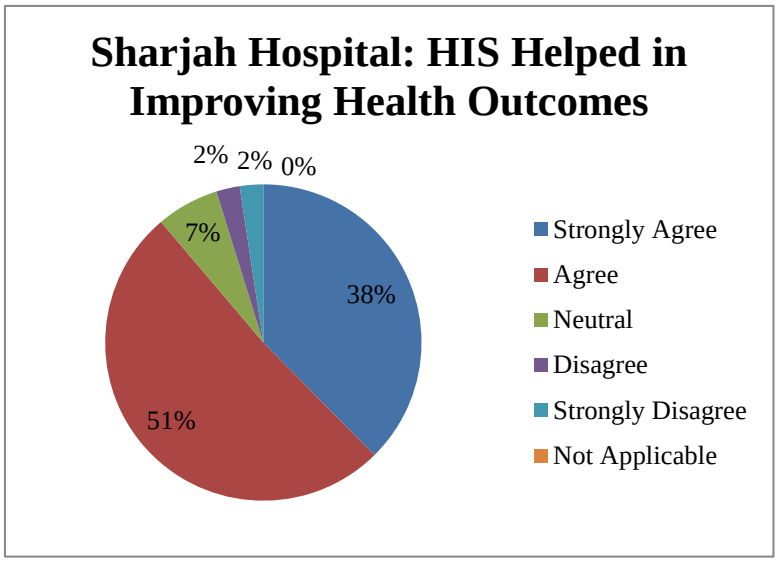

Figure 54: Sharjah Hospital HIS helped in improving patients' health outcomes.

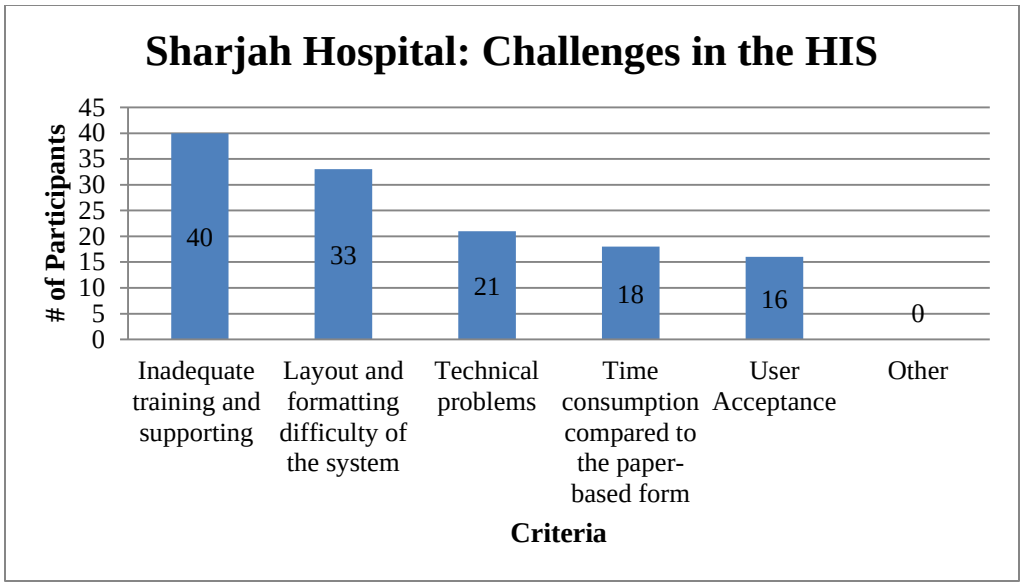

Figure 55: Sharjah Hospital HIS challenges.

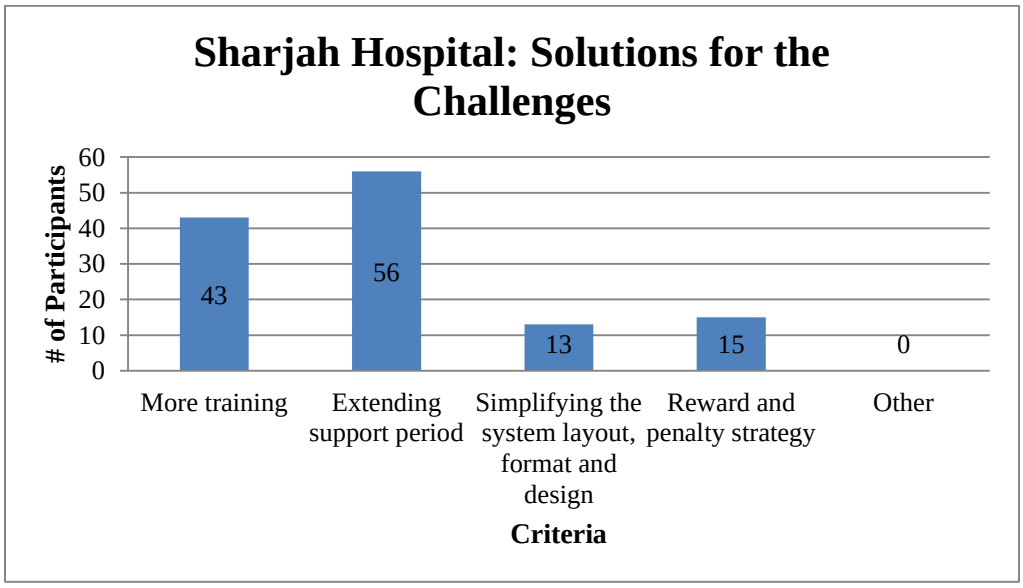

Figure 56: Sharjah Hospital HIS solutions for challenges.

Appendix (F): Um Al-Qwain (UAQ) Hospital Figures

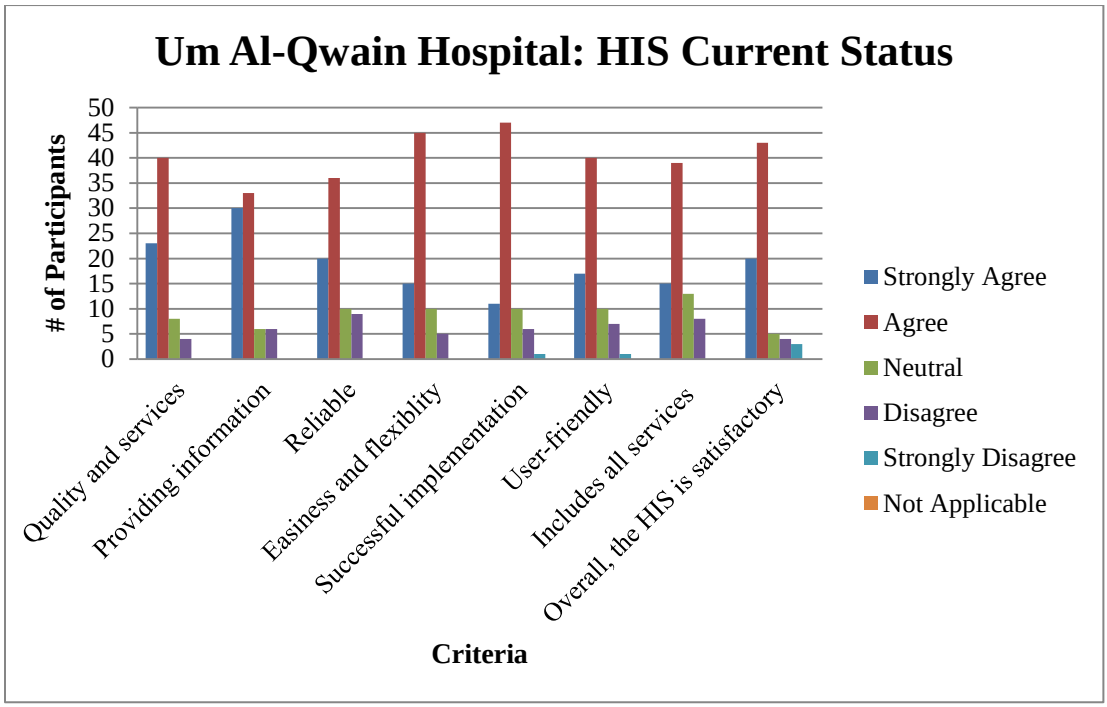

Figure 57: UAQ Hospital HIS current status.

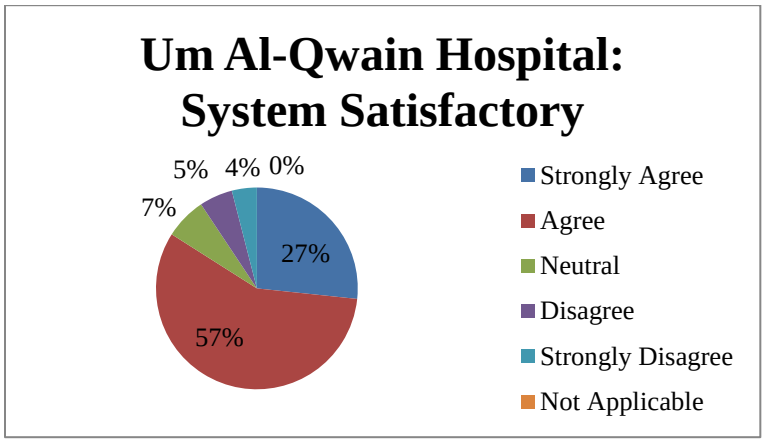

Figure 58: UAQ Hospital system satisfactory.

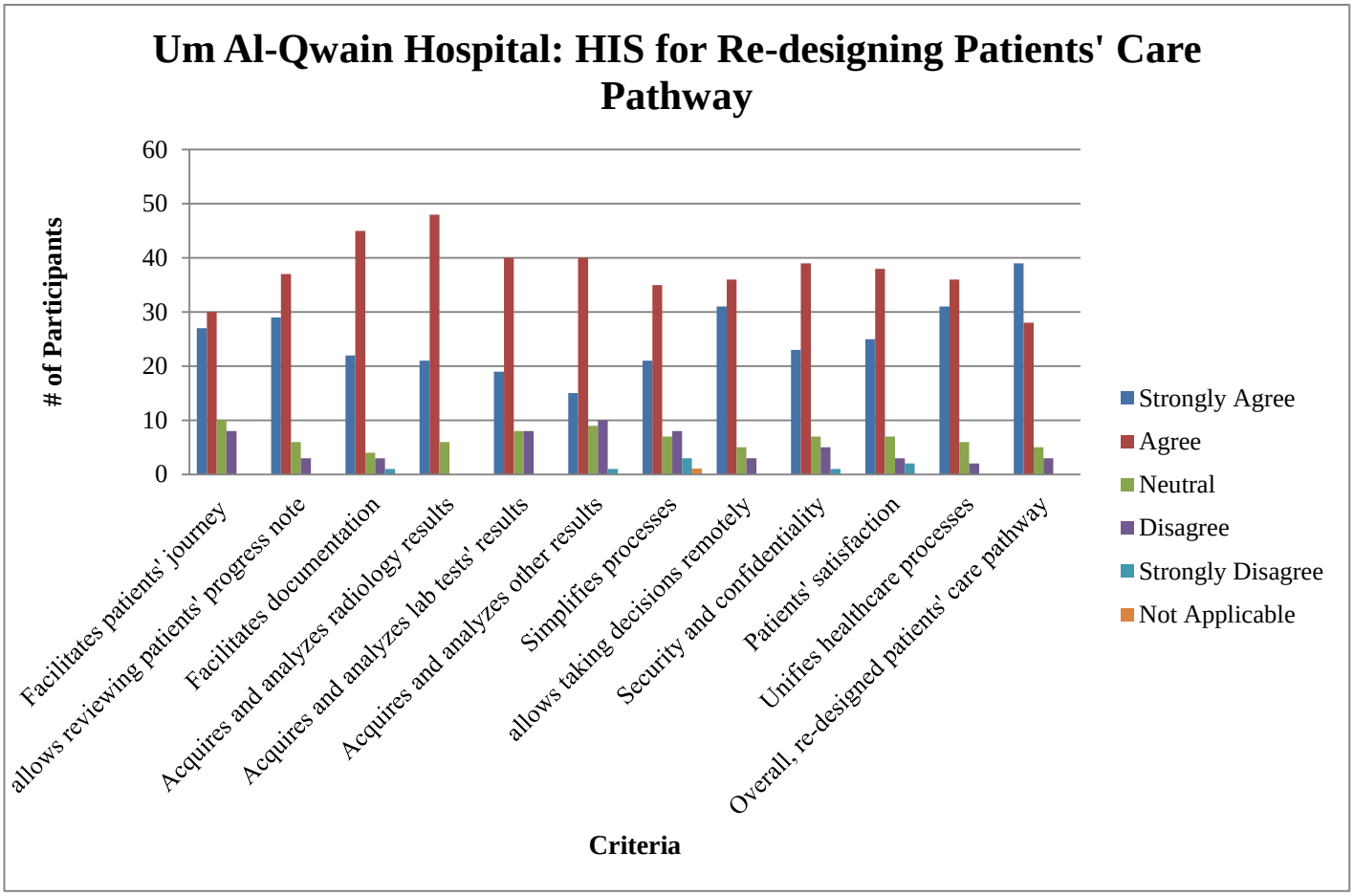

Figure 59: UAQ Hospital HIS for re-designing patients' care pathway.

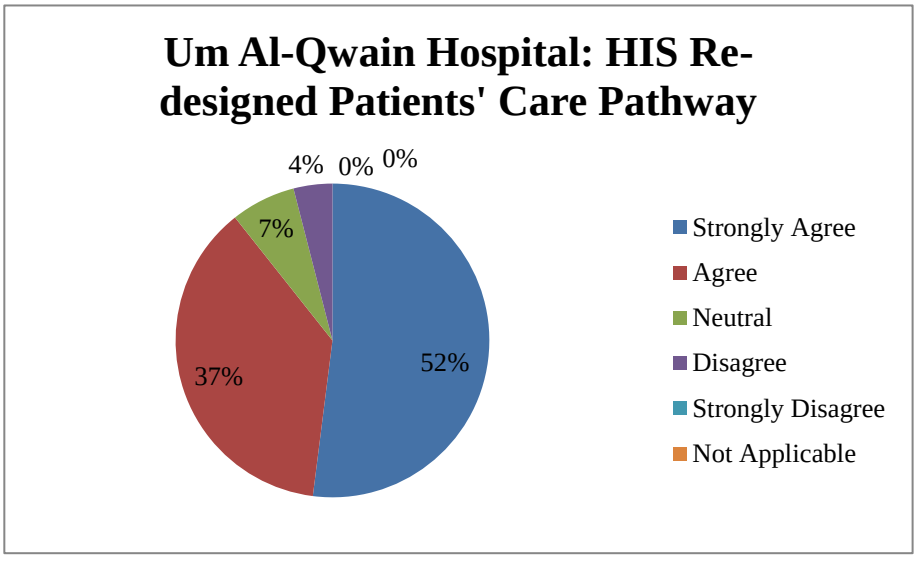

Figure 60: UAQ Hospital HIS in re-designing patients' care pathway.

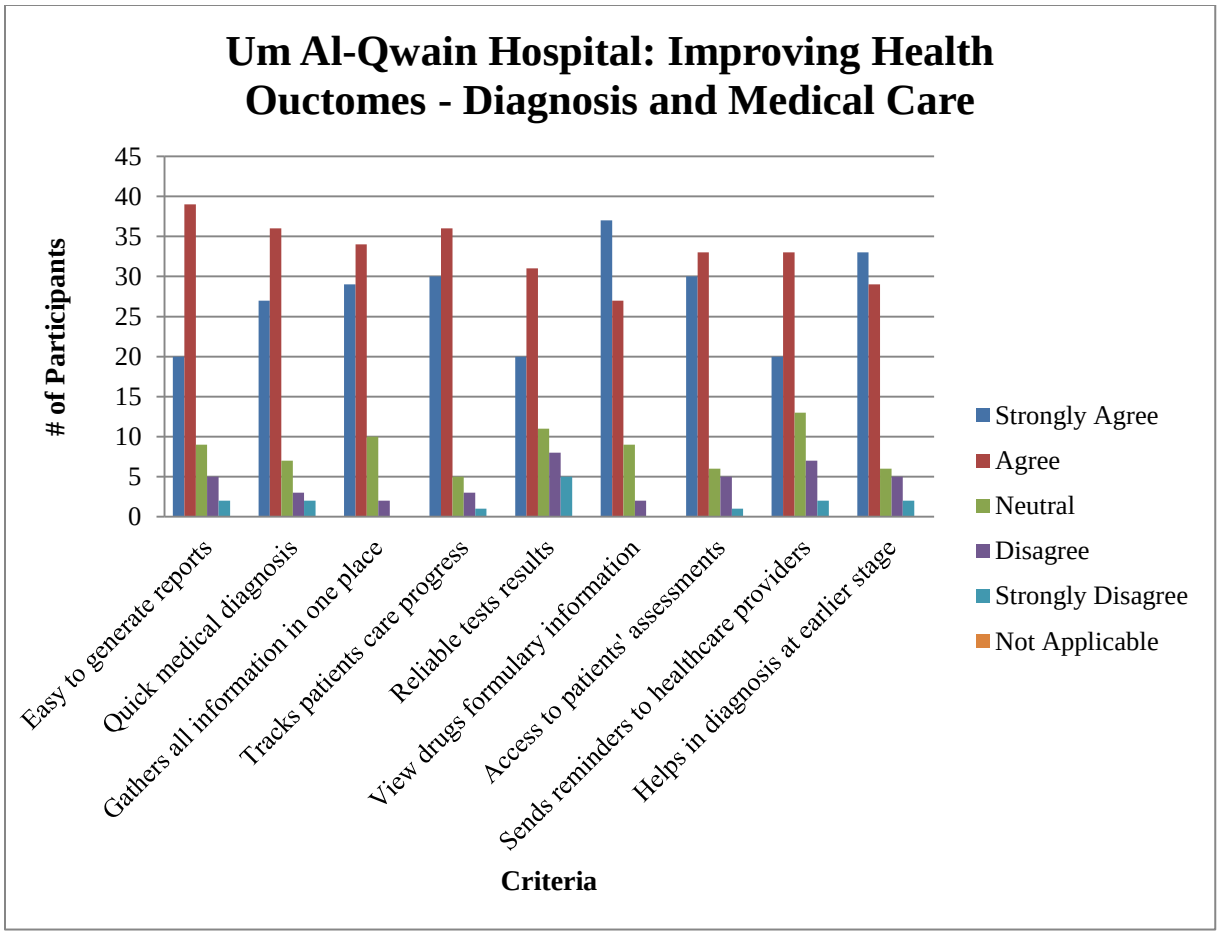

Figure 61: UAQ Hospital HIS for diagnosis and medical care.

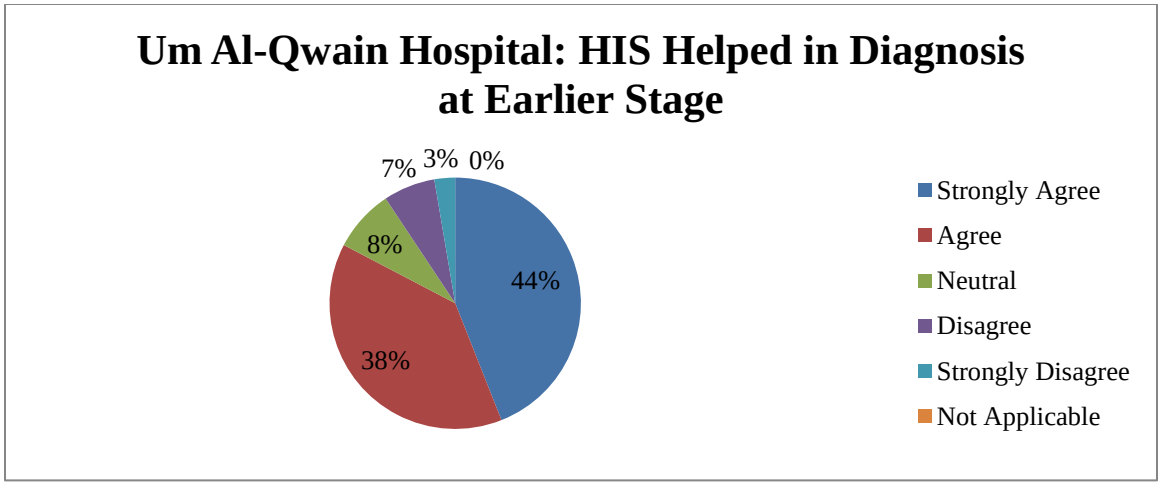

Figure 62: UAQ Hospital HIS for diagnosis and medical care at earlier stage.

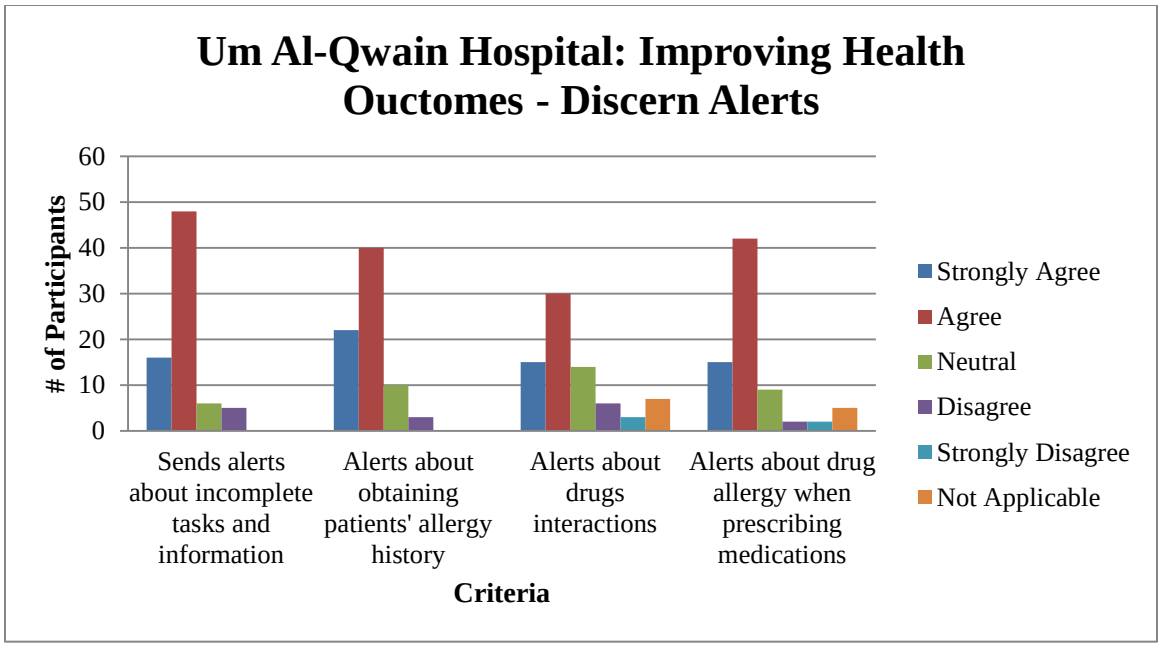

Figure 63: UAQ Hospital discern alerts.

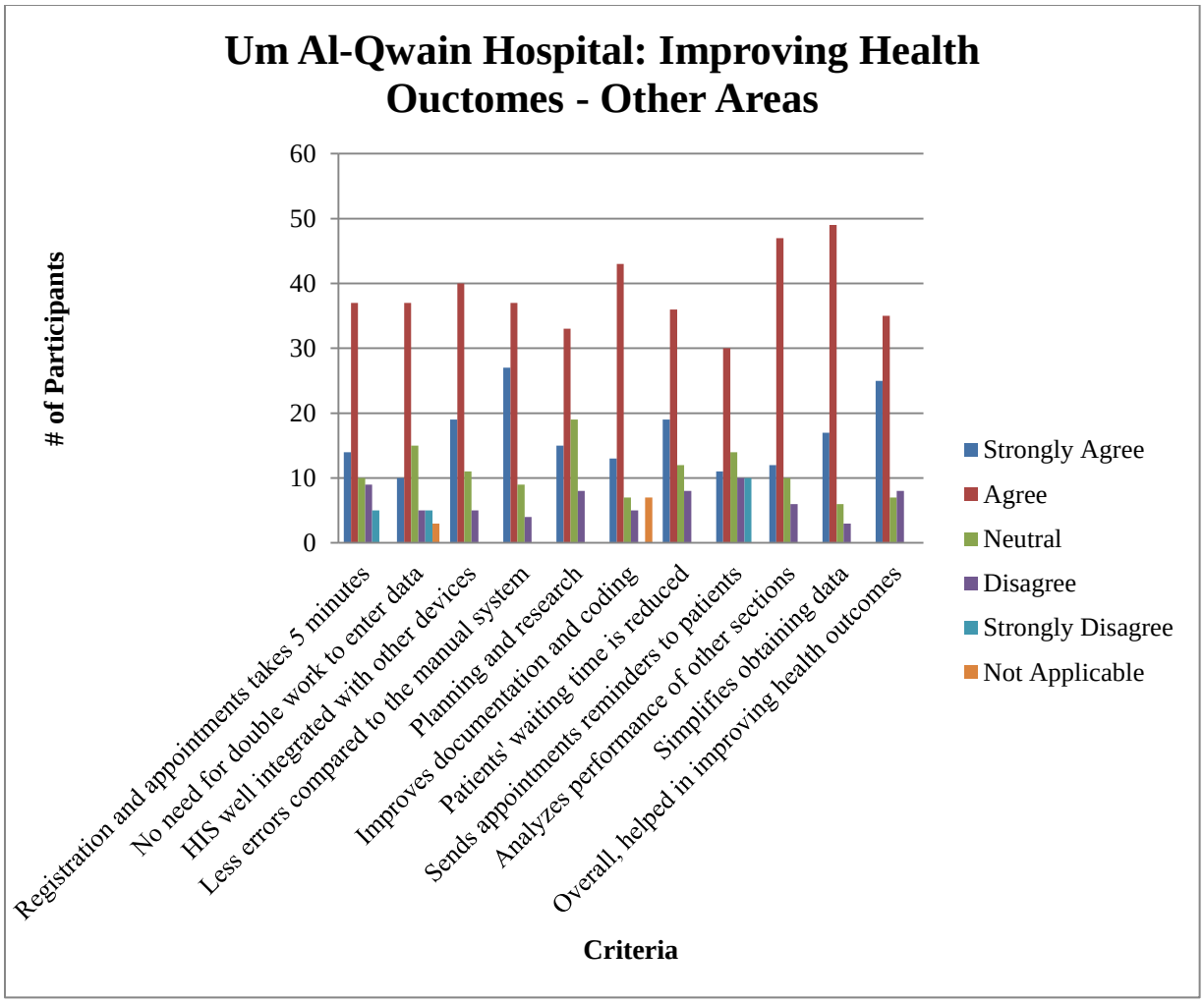

Figure 64: UAQ Hospital HIS for improving patients' health outcomes.

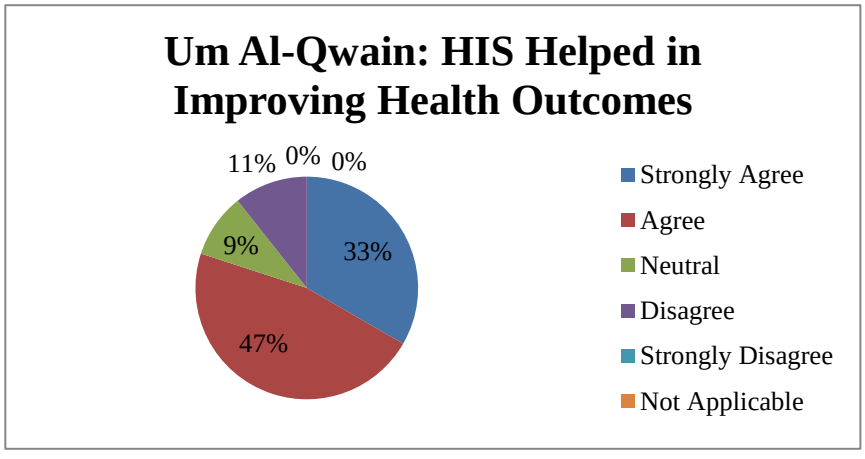

Figure 65: UAQ Hospital HIS helped in improving patients' health outcomes.

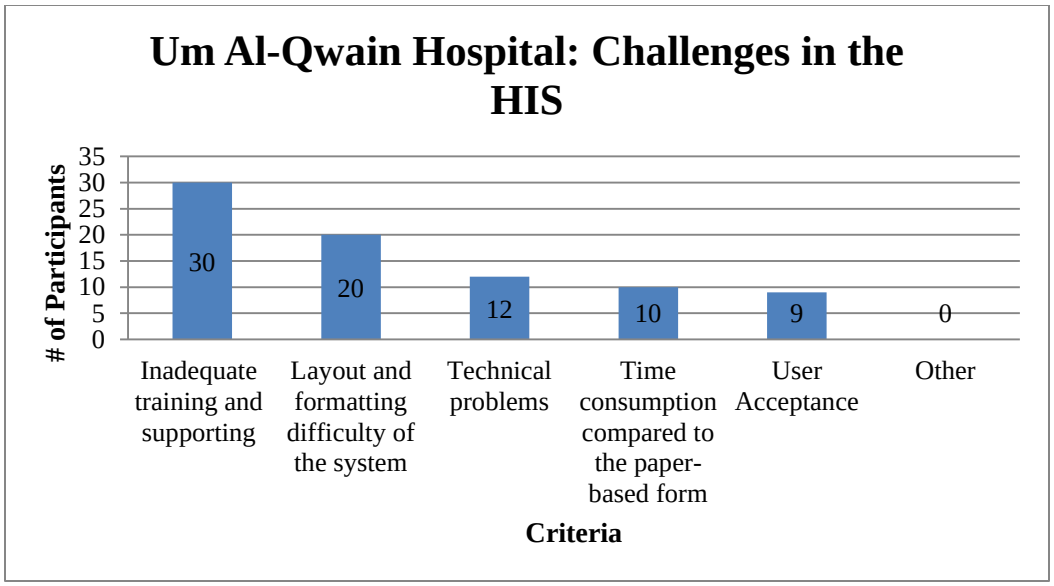

Figure 66: UAQ Hospital HIS challenges.

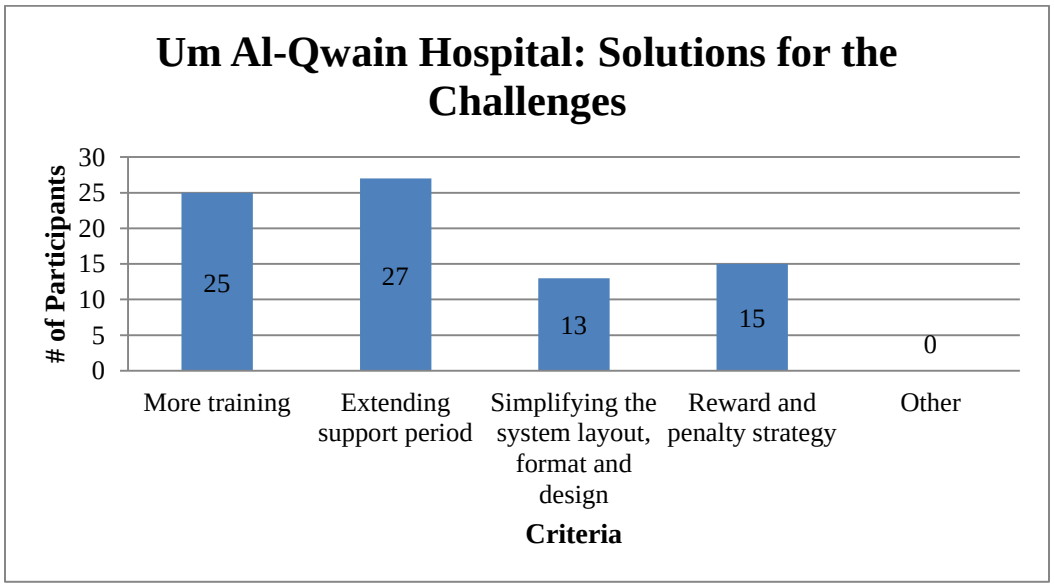

Figure 67: UAQ Hospital HIS solutions for challenges.

Appendix (G): HIS Project Management Office (PMO) Figures

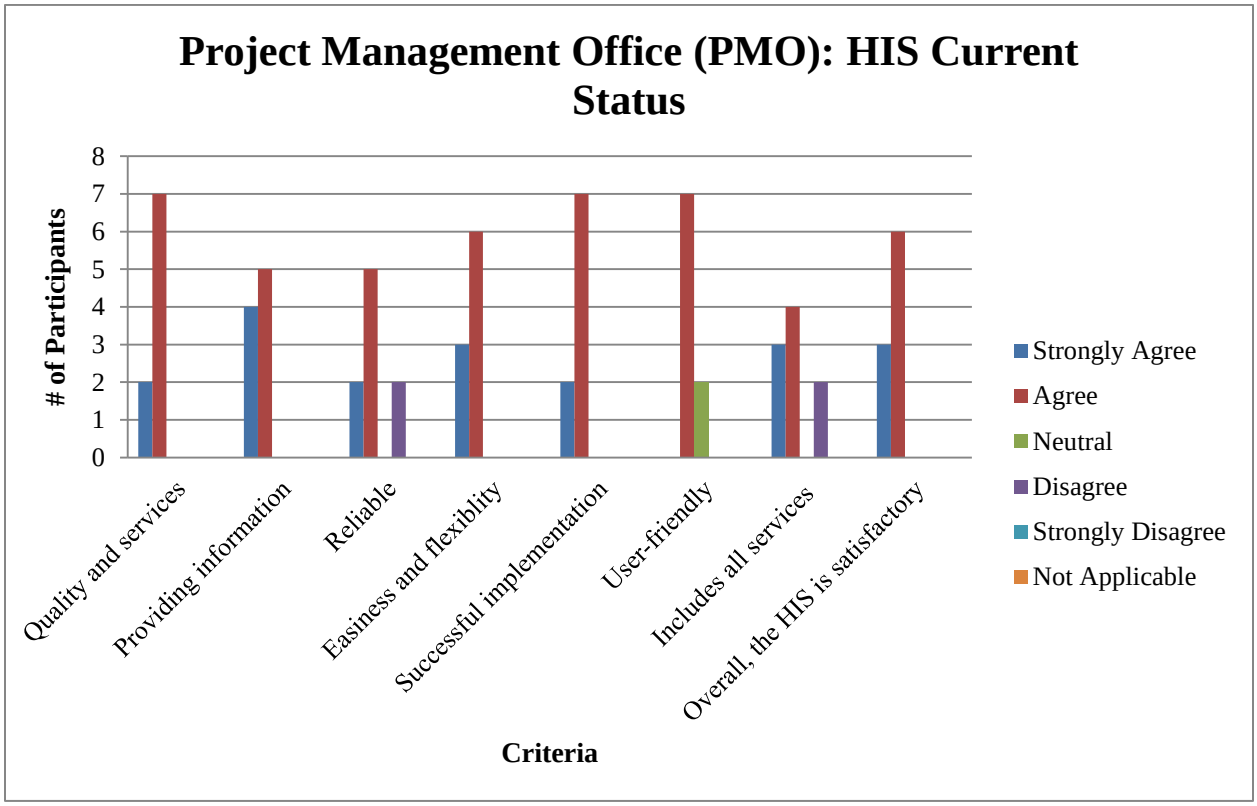

Figure 68: PMO HIS current status.

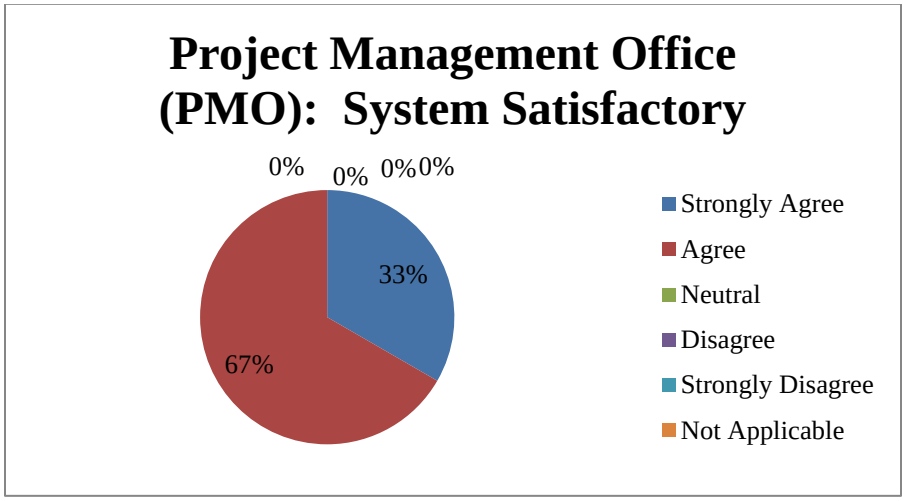

Figure 69: PMO HIS satisfactory.

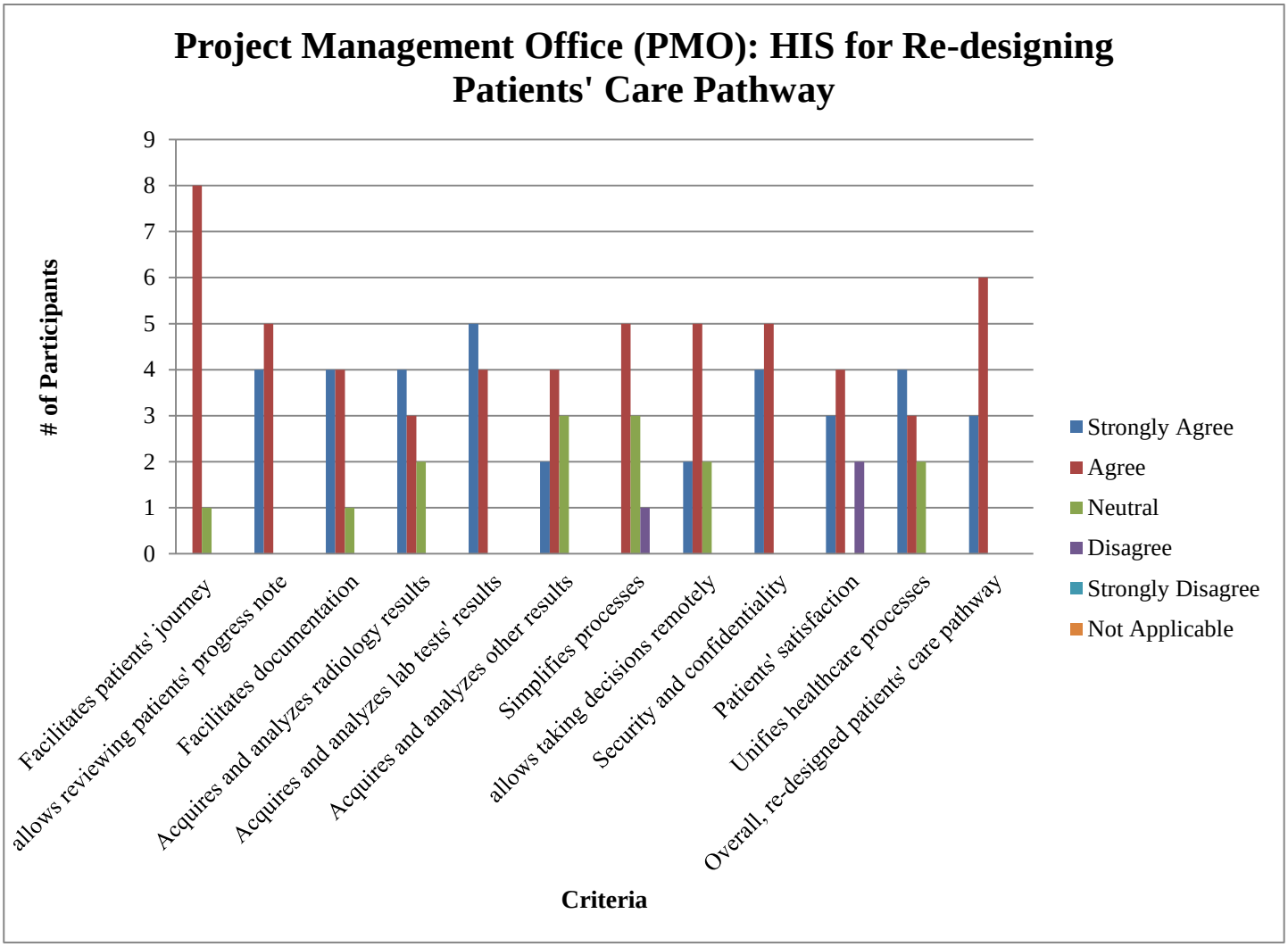

Figure 70: PMO HIS for re-designing patients' care pathway.

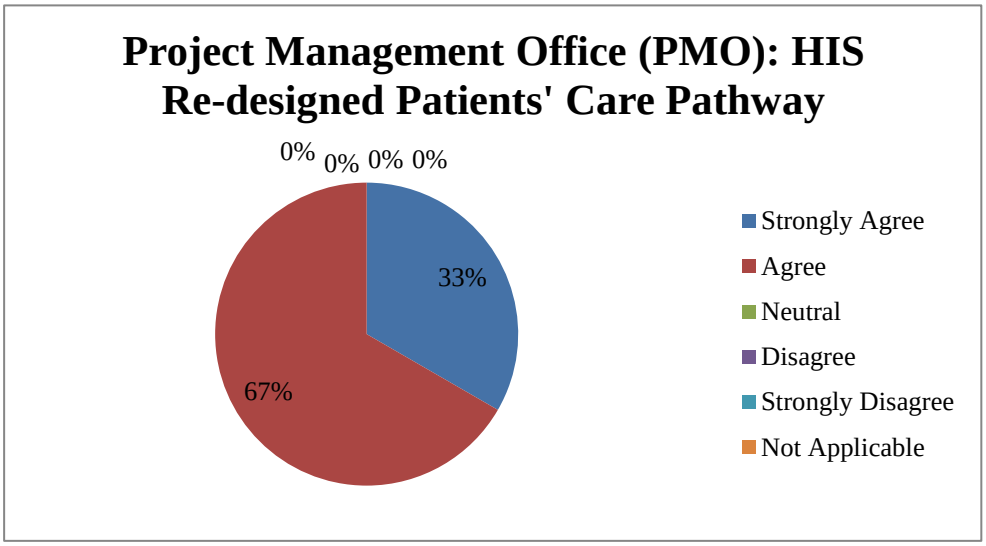

Figure 71: PMO HIS helped in re-designing patients' care pathway.

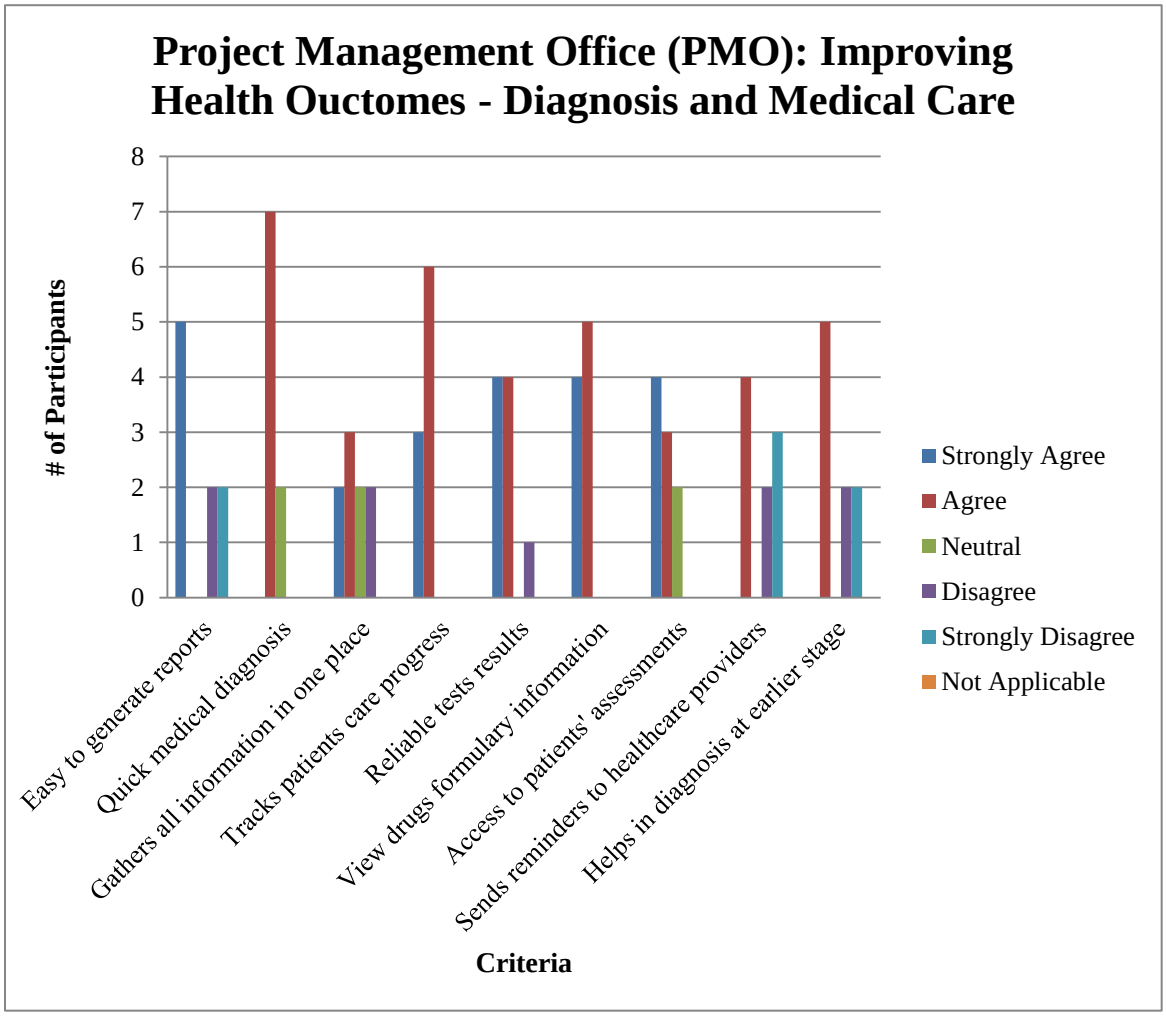

Figure 72: PMO HIS for diagnosis and medical care.

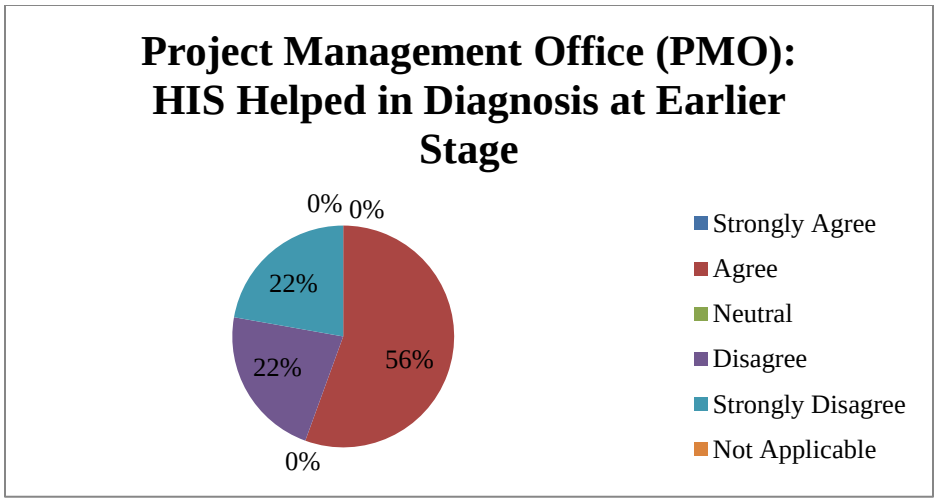

Figure 73: PMO HIS for diagnosis and medical care at earlier stage.

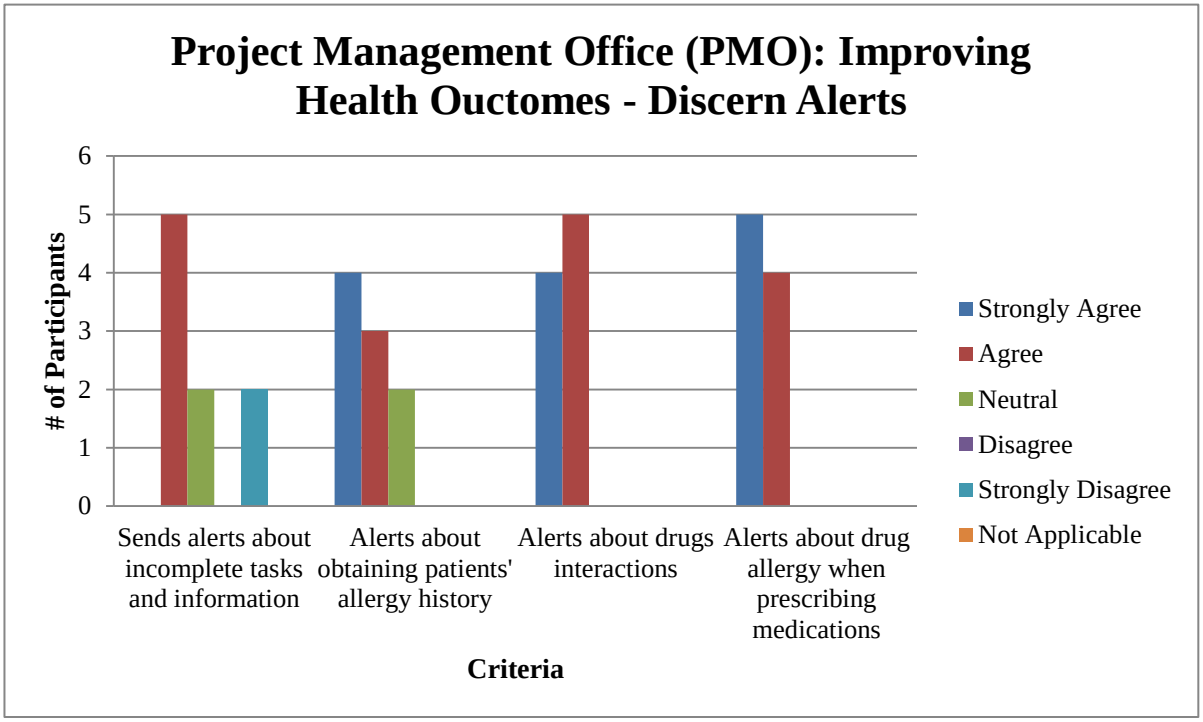

Figure 74: PMO HIS discern alerts.

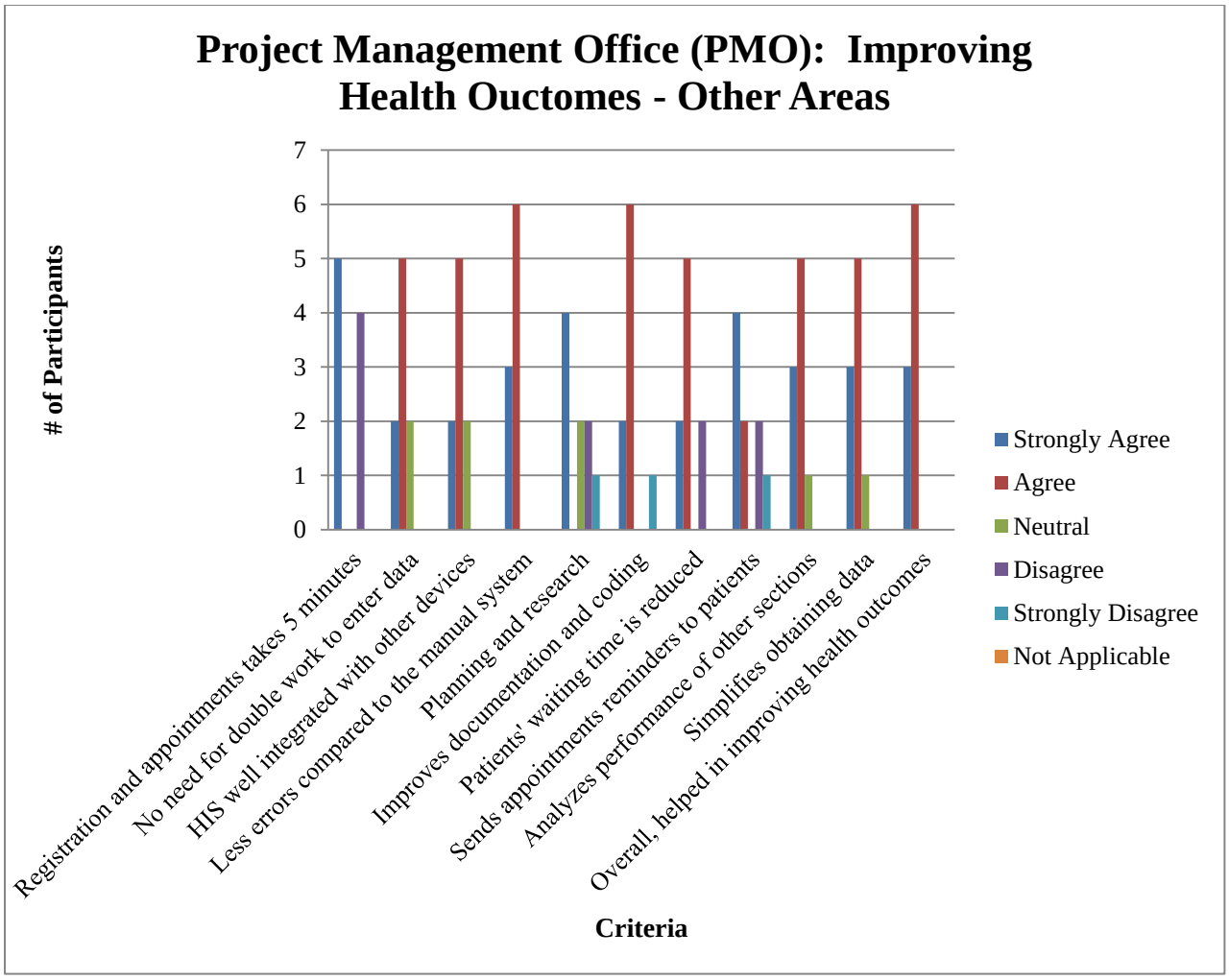

Figure 75: PMO HIS for improving patients' health outcomes.

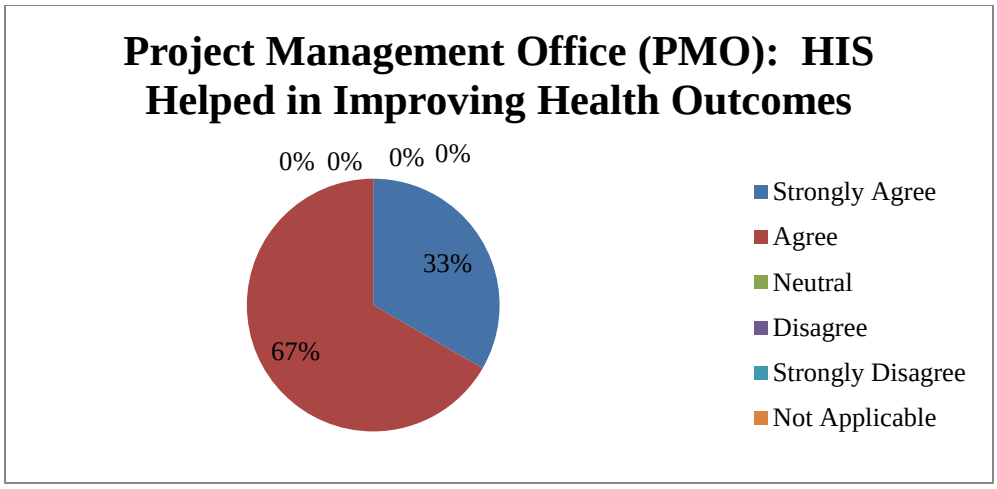

Figure 76: PMO HIS helped in improving patients' health outcomes.

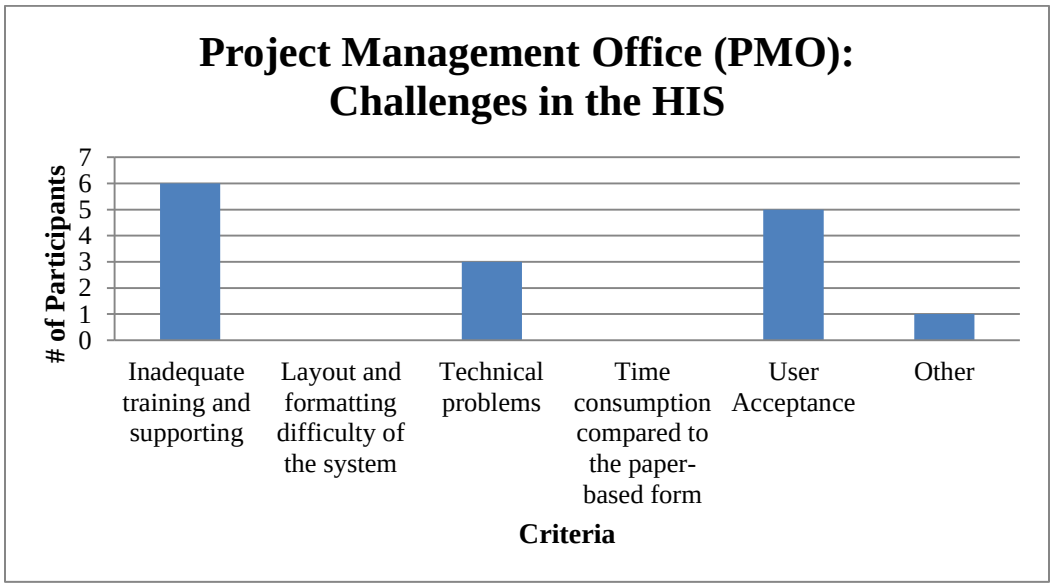

Figure 77: PMO HIS challenges.

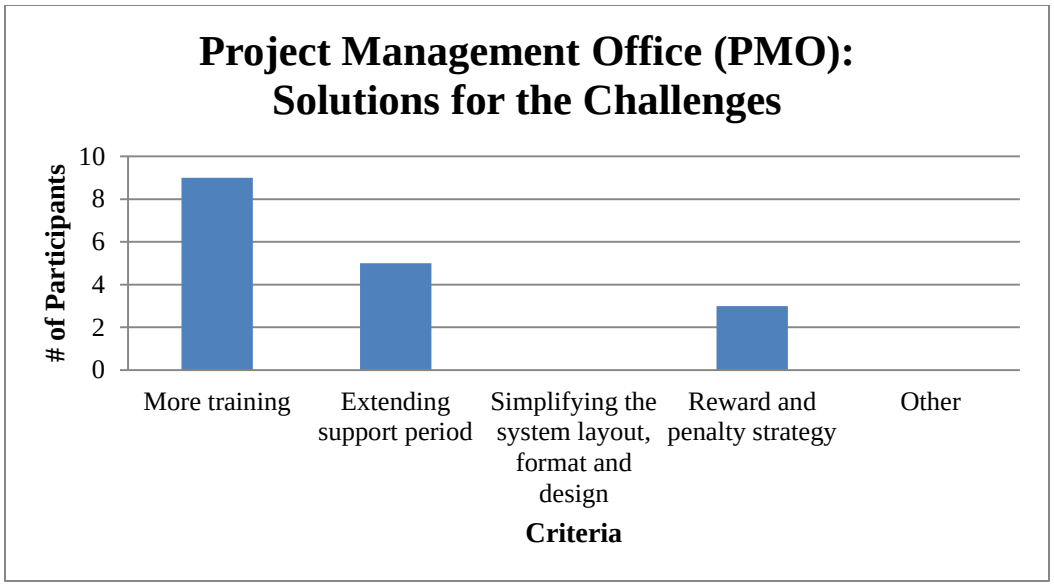

Figure 78: PMO HIS solutions for challenges.

Appendix (H): Results Validity

A Sample Size Table for Proportions

Degree of Accuracy = ± .05		Proportion of Sample Size = 0.5		Confidence Level = 95%	
Population	Sample	Population	Sample	Population	Sample
10	9	230	144	1400	301
15	14	240	147	1500	305
20	19	250	151	1600	309
25	23	260	155	1700	313
30	27	270	158	1800	316
35	32	280	162	1900	319
40	36	290	165	2000	322
45	40	300	168	2200	327
50	44	320	174	2400	331
55	48	340	180	2600	334
60	52	360	186	2800	337
65	55	380	191	3000	340
70	59	400	196	3500	346
75	62	420	200	4000	350
80	66	440	205	4500	354
85	69	460	209	5000	356
90	73	480	213	6000	361
95	76	500	217	7000	364
100	79	550	226	8000	366
110	85	600	234	9000	368
120	91	650	241	10000	369
130	97	700	248	15000	374
140	102	750	254	20000	376
150	108	800	259	30000	379
160	113	850	264	40000	380
170	118	900	269	50000	381
180	122	950	273	60000	381
190	127	1000	277	70000	382
200	131	1100	284	120000	382
210	136	1200	291	160000	383
220	140	1300	296	1,000,000	383

*This table tells you the number of people you must survey to accurately represent the views of the population under study. Accurate here means reliable at the .005 reliability level. In other words, the chances of the results being funky is 5/100.

Table 7: Sample size.

(Adapted from "How statistically valid are your survey results" n.d.).