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Physicians Perception of The Impact of E-health Reform on The Saudi Arabian Health System

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PHYSICIAN PERCEPTION OF THE IMPACT OF E-HEALTH REFORM ON THE SAUDI ARABIAN HEALTH SYSTEM

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Saeed Abdullah Alwadei

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To: Dean Tomás R. Guilarte
R. Stempel College of Public Health and Social Work

This dissertation, written by Saeed Abdullah Alwadei, and entitled Physician Perception of the Impact of E-health Reform on the Saudi Arabian Health System, has been approved regarding style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Florida International University, 2022

DEDICATION

This dissertation is dedicated to my mother, father, and wife for their contribution and support during my journey.

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ABSTRACT OF THE DISSERTATION

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Professor Timothy F. Page, Major Professor

The Ministry of Health (MOH) in the Kingdom of Saudi Arabia introduced e-health systems reform in 2011. The national e-health plan has already been in action; the MOH expected to implement the system throughout the country by 2021. The MOH manages about 60% of the hospitals in Saudi Arabia. In 2016, the government of Saudi Arabia introduced Vision 2030. One of the main objectives of the reform is to accelerate the implementation of primary and digital infrastructure projects. This research aims to evaluate the effectiveness of the e-health system reform in Saudi Arabia.

This research used a questionnaire to collect data from physicians who work at the Ministry of Health in Saudi Arabia to evaluate the outcome of the e-health system reform. The total responses used for the study was 188. An ordinary least squares (OLS) regression was used to measure physicians' perception of e-health's effect on MOH, patient referrals, and cost of care. The analysis included services provided by MOH to measure the effect of e-health. Collectively, these measures affect the patient's experience. Quality and

consistency, efficiencies, speed of patient's admission and examination, accuracy, and completeness of filling out reports were significantly impacted by electronic services. The analysis outcomes suggest that e-health improved patients' services and helped create a better environment for their visits and treatment.

The analysis investigated the effect of e-health on physician perceptions of patient referrals and waiting time. The outcomes indicate a significant enhancement in patient referrals in speed, accuracy and completeness, bed availability, viewing patient's medical history, and remote diagnosis. The e-health reform in Saudi Arabia has significantly enhanced patient referrals between the MOH primary care centers and hospitals, reduced the waiting time, and increased the number of referrals.

Physician perceptions on the cost of care were also included in the analysis. The analysis included accuracy, viewing patient's history, electronic services cost reduction, overall cost, and electronic training. The outcomes indicate no significant impact on the cost of care after introducing the e-health reform in Saudi Arabia except for remote training. The analysis shows that online training is affected significantly with e-health, which led to a cost reduction. The cost of care in Saudi Arabia has not been significantly impacted by the introduction of the e-health reform in Saudi Arabia. However, training can be effective for accuracy to contribute to cost reduction, and electronic services affect remote training, and e-health can reduce the cost of training.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

MOH	Ministry of Health
VRO	Vision Realization Office
NTP	National Transformation Program Primary
PCP	Care Physician
FIU	Florida International University Institutional
IRB	Review Board

Chapter 1

Physician Perceptions of the Impact of E-Health Reform on the Saudi Arabian Health System

Public Health Impact

Countries in the Arab world face challenges in delivering health care to their populations (Kronfol, 2012). Waiting times for referred appointments have been a problem, but research has suggested that electronic referrals can improve the efficiency of the referral process. Electronic referral increases the efficiency of the referral process, which helps avoid unnecessary referral and lead to an increase in the number of referral cases (Doumouras et al., 2017). The waiting time to see a specialist in Saudi Arabia can be months. Patients have to go to their primary care providers to do the initial diagnoses and tests. The waiting time differs depending on the patient's condition. However, the referral for the rare specialties, the waiting time, and rates vary (Shadd et al., 2011).

To solve some of these problems, The Ministry of Health in the Kingdom of Saudi Arabia introduced e-health in 2011. The MOH has constructed a National e-Health Strategy that aligns with its goals and business strategies. The national e-health plan has already been put into action, and the MOH expected to implement the system throughout the country by 2021(Ministry of Health, 2011b). The main objective of the reform is to have better care provided to patients in Saudi Arabia. E-health helps by having patients' complete files ready for doctors, and doctors can access advanced diagnostic tools and decision support services. However, managers and administration will fully understand the system by providing live data to a dashboard located in their offices so their response can be fast and accurate (Ministry of Health, 2013a).

The literature has shown that e-health provides a safe and effective alternative mechanism for the patient to be diagnosed (John et al., 2008). The modernizing of the health system through e-health strategies will offer health care providers a solution for

unnecessary appointments, leading to shorter waiting lists (Borooah et al., 2013). Research has demonstrated using an electronic referral or e-referral can prevent unnecessary visits and reduce waiting times for patients that need to be seen by specialists urgently (Straus et al., 2011). Modernizing the health system through e-health can reduce the cost of the health care services provided to the patient (Augestad et al., 2008). Transforming the health system by implementing e-health can increase cost effectiveness. It can be a crucial component in a strategic goal for the health system (Faustine & Boren, 2008). Furthermore, in the long run, e-health can yield a positive return on investment (Wang et al., 2003).

Health Systems Research Gaps

The implementation of the e-health system in Saudi Arabia has not been evaluated yet. The Saudi health reform started in 2011, and the MOH expected to implement the system throughout the country by 2021. Since 2021, the e-health system can be accessed from any hospital or primary care center in the Kingdom (Ministry of Health, 2013a).

Research on the effectiveness of e-health strategies has been mixed. Many physicians believe that e-health adds a great value to the services provided to the patient. The e-health system has the power to enhance the treatment outcome for the patient and reduce the waiting time (Bello et al., 2017). However, some physicians oppose use e-health systems because the systems threaten the patient's privacy, need regular maintenance, and are costly to implement (Bates, 2005).

Research Innovation

This research aims to evaluate the effectiveness of the e-health system reform in Saudi Arabia from the physicians' point of view. This research will contribute to the health systems research literature by looking at the impact of e-health on multiple outcomes.

Rationale of the Research

Publicly and privately sponsored health reforms aim to use health information technology to improve access to services and health outcomes (Batura et al., 2016). It is essential to examine the results of reform efforts so that improvements can be made on a national level and, on a global scale, future reform efforts can be evidence-based. The Saudi Health Council (SHC) has reported that in 2013 there were 15001 new cancer patients reported to MOH. The yearly report also stated that there are 7805 cancer patients for every 100 thousand among men and 8904 cases for every 100 thousand. The SHC indicated in their report that breast cancer in some cases represent 16.1% of all cancer patients and that is in the first place in terms of most cases reported (Saudi Health Council, 2016).

Furthermore, the MOH has reported that cardiovascular disease causes 42% of the Kingdome of Saudi Arabia non-communicable disease deaths in 2010. The report also noted that the number of cardiovascular diseases patients in the primary health centers climbed to 50213 Saudi men and 42790 women (Ministry of Health, 2013b). Moreover, the Saudi Center of Organ Transplant has reported that in 2017, the total number of kidney transplants inside the Kingdom of Saudi Arabia is 921 cases (Scottish Government, 2017).

The government of Saudi Arabia is going through a major health reform that includes more than 70 projects. The main project is the e-health system reform (Ministry of Health, 2011b). The objective of this reform is to improve health services delivery, access, quality, and safety (Ministry of Health, 2018a). This research evaluates the outcomes of the physician's perception on e-health reform in terms of the number of medical services provided for patients, patients' referrals, patients waiting time to see

specialists, and the cost of patients' treatment. To determine if the e-health system reform is making a difference on these aspects or not.

Saudi Health Care System

The Kingdom of Saudi Arabia is located in the southwest of Asia, occupying about 80% of the Arabian Peninsula. The Kingdom is divided into 13 administrative regions, and a governor governs each region that the Ministry of Interior appoints. The geography of the country differs from one part to another as well as the demographic characteristics. As of 2018, the population of Saudi Arabia is 33,413,660 people, with a growth rate of 2.52% (General Authority for Statistics, 2017, 2018; Khraif et al., 2016).

The Ministry of Health in the Kingdom of Saudi Arabia introduced e-health system reform in 2011. The MOH has constructed a National E-Health Strategy that aligns with its goals and business strategies. The national e-health plan has already been in action, and the MOH expected to implement the system throughout the country by 2021 (Ministry of Health, 2013a). The MOH manages about 60% of the hospitals in Saudi Arabia where the private sector operates the other 20%. The other 20% is governed by the armed forces and the national guard health services (Alsulame et al., 2016).

The 2030 Vision

In 2016, the government of Saudi Arabia introduced vision 2030. The main vision objective is to reduce the country's dependency on oil and diversify its economy (Vision 2030, 2021). To fulfill the vision's goals, the government has established under the supervision of the council of ministers the National Transformation Program (NTP) established; it aims to

- Accelerate the implementation of primary and digital infrastructure projects.

- Engage stakeholders in identifying challenges, co-creating solutions, and contributing to the program initiatives.

Concerning Health services, the objectives of the NTP are

- To have easy access to health services.
- Improve the quality and efficiency of health care services.
- Promote prevention against health risks.

The NTP is aiming by the end of 2020 to increase the residential areas health services coverage from 78% to 88% and increase the percentage of patients receiving medical care in the emergency room within 4 hours from 34–54% (National Transformation Program, 2016).

To fulfill the objectives of the 2030 vision, the MOH established the Vision Realization Office (VRO), and the office key objectives are the following:

- Meet the NTP aims for 2020 and the 2030 vision.
- Monitor and track the progress of the transformation initiatives and assess performance and quality.
- Improve the workplace environment and attract national talent.
- Ensuring the operation discipline alignment with the 2030 vision (Ministry of HEalth, 2018c).

E-Health in Saudi Arabia:

The Ministry of Health (MOH) in Saudi Arabia introduced the e-health system reform in 2011. The e-health strategy focuses on enabling system integration and having data accessible and exchangeable across the e-health network. The MOH E-Health vision is “A Safe, Quality Health System, based on Patient-Centric Care guided by standards,

enabled by eHealth" (Ministry of Health, 2018a). One of the primary objectives of the reform is to have better care provided to patients by having a patient's complete file ready for doctors. Doctors can have access to advanced diagnostic tools and decision support services. Furthermore, doctors have the necessary support clinically and administratively by enabling access to services such as automated referrals, a second opinion from colleagues, and teleconsultation from anywhere in the country (Ministry of Health, 2013a).

The e-health system reform aims to make managers and administration fully understand the system by providing live data to a dashboard located in their office so their response can be fast and accurate. The system can enable managers to have access to information that allows them to compare performance between regions. Furthermore, the e-health system will effectively help them plan for Hajj and Umrah since it will be a requirement for visitors to submit their health information at the time of their visa application (Ministry of Health, 2013a).

The e-health strategy focuses on enabling system integration and having data accessible and exchangeable across the e-health network. In 2018 only, the MOH spent 33 billion Saudi Riyal/9 billion USD for the health care system reform (Ministry of Finance, 2018a). The strategy is based on implementing a state-of-the-art e-health system all over the Kingdom. The project started in 2011 within a relatively short timeframe at two phases; each one extends for 5 years. There are more than 70 projects recognized to achieve the e-health vision (Ministry of Health, 2011b). Another objective of the reform is to have better care provided to patients in Saudi Arabia. e-health helps by having a patient's complete file ready for the doctor, and doctors can have access to advanced diagnostic tools and decision support services. Likewise, e-health allows doctors to have the necessary support

clinically and administratively. e-health enables access to services such as automated referrals, a second opinion from colleagues, and teleconsultation from anywhere in the country.

Strategy

The MOH has established a strategic plan to guide the e-health reform. This plan is guided by principles to ensure the success of the project; these principles are the following

- A strategy plan must bring into line with the MOH business plan.
- High clinical values and create a solid foundation that meets clinical and business requirements.
- Broad, then in-depth standards-based approach. The patient's file can be available for all the parties involved in the treatment process. Expertise exchange and standard adaptation are provided for the new technology.
- Manage change and reduce adaption risks by creating a transitional program that serves the strategic plan.
- Utilize e-health as a clinical and business enabler by establishing governance and planning mechanisms to drive e-health transition
- Develop possibilities and capabilities by creating and managing resources, and create an attractive environment for education of clinical development (Ministry of Health, 2011e).

The ministry of health has designed its e-health reform strategy to be aligned with the MOH business strategy plan. Based on the targets that the MOH is aiming to achieve, the e-health strategy goes side by side with the primary strategy to form a solid foundation

to achieve the desired outcome in both clinical and business targets Ministry of Health, 2011c).

Health Informatics

The MOH is aiming to make an impact over its services after the introduction of the e-health reform. The electronic services enable the MOH to perform efficiently and accelerate the services process for both patients and non-patient clients. Services such as medical licenses, purchasing services, geographic information system (GIS), patient reminders, and employment services are all aspects that the MOH aims to develop and improve. With electronic service facilities and individuals (medical staff and administrators), licenses will be issued faster reflecting on the health services all over the country. One crucial aspect of the electronic reform is the ability to send the location of the clinic or the hospital that the patient has an appointment at, which reduces the chance of getting lost or arriving late. Moreover, electronic service reminders will be sent to the patient, whether it is for the patient themselves or the patient's guardian in case of the kids and underage. Finally, in electronic recruitment, the MOH can list the job openings on their website. Any person interested in working there can merely choose the job and upload their resume in a matter of minutes. That will accelerate and ease the hiring process and increase the quality of credentials because it offers the chance for a broader population (Ministry of Health, 2018b).

Patient Services

After the full implementation of the e-health vision, the MOH anticipates that the health services delivery will be enhanced significantly, and it will impact patients of MOH facilities. Essential aspects such as communication will improve, and the MOH can reach

its patients on their preferred method of contact (SMS, Email, and phone call). Provide consultation via the web from any place with internet connectivity, reduce waiting time, and provide as much service as possible from the exact location are goals of the reform. These are just examples of services that MOH expects the e-health reform will improve, and modernize its services to meet patients' expectations (Ministry of Health, 2011a).

E-Health Today

Today, the central hospital in every region is operating its service electronically. However, the majority of the hospitals are not equipped with e-health. The MOH strategic plan is working on making every hospital in the Kingdom equipped with standardized, comprehensive clinical and administrative systems which will improve the quality of care provided for patients and increase the quality of performance of the medical and administrative staff as well (Ministry of Health, 2011d).

E-Health Effectiveness Research Mixed Arguments:

The introduction of e-health in health care services has inspired many scholars to conduct research and highlight the advantages and disadvantages of technology. Unlike other sectors, health care is based on patients and their health and wellbeing. The information circulating in the process is considered confidential and sensitive (Alkureishi et al., 2016; Scantlebury et al., 2017). Throughout the years, health informants emerged as one of the active areas of research. As a result, many arguments have been established to support or to oppose e-health. E-health has electronic sub-services such as electronic medical records (EMR), electronic referrals (e-referral), and electronic counseling (e-counsel) (Bello et al., 2017; Lumpkin, 2000).

In a systematic review conducted by (Alkureishi et al., 2016), the authors aimed to understand the nature and the quality of the relationship between doctors and patients after implementing the electronic medical records (EMR). The authors investigated the association by reviewing literature in behavioral analysis, studies examining the video communication between doctors and patients, and studies investigating EMR communications behaviors and their advantages and disadvantages. The authors concluded their review by highlighting doctors' and patients' perspectives. According to doctors, the EMR system interrupted patient-doctor interaction during the diagnosis. Doctors are trying to multitask by paying attention to the patient and simultaneously inputting the information into the system.

However, patients in most studies have reported that they are satisfied with their services, and EMR did not affect their relationship with their doctors. Furthermore, the patient indicated that EMR has facilitated and clarified the communication process between them and their physicians. EMR helped improve their relationship with their primary care physicians, and it improved the quality of the outcome as well. What is interesting in this review is that it pointed out that EMR can be positive and negative at the same time. As mentioned, doctors felt that the EMR impacted their relationship with their patients while they believed that EMR improved their relationship with their doctors.

E-consultation presents an improvement in access to health care for patients. However, e-consultation may present a problem for some specialties, such as kidney care delivery (Bello et al., 2017). A qualitative study conducted by Bello et al. evaluated beneficiaries' perception of e-consultation integration into the delivery of kidney care and identified potential barriers to the service. The author collected their data in eight focus

groups with four patient groups and four provider groups with a sample of 72 participants, 36 patients and 36 providers. The study was conducted at four locations across Canada. Accessibility and waiting time reduction was identified as the system's significant advantages. Nephrologist, however, has shown that consulting with the nephrology should be seen in person; patients also agreed.

Meanwhile, the focus groups have identified barriers such as technical issues that could cause a problem leading to longer waiting times. Another barrier would be knowledge of how to operate the e-consultation system in rural PCP clinics. Finally, if the practice has two different systems and cannot be integrated, it will delay seeing the patients and disrupt the clinic's workflow. Overcoming the barriers would improve care for patients with the kidney issues and improve the outcome of their treatments.

Despite research highlighting the negative aspects of e-health, research has demonstrated that e-health can reduce the cost of health services and enhance patient safety (Ramtohul, 2015). The author conducted a qualitative study aiming to analyze the user's decision to adopt E-health services. The author argued that the implementation of e-health minimizes the cost of the health service and increases safety. Using e-health applications such as e-consultation influences the cost of the benefits because it reduces the price on the providers who reflects on the cost of the health services. Moreover, the advancement in technology in our lives has influenced the providers' and patients' decisions in using e-health. Overall, e-health can enhance the quality of care for patients and minimize the cost of the services because it reduces the providers' cost.

Many health care systems implement E-health to improve their delivery of health care and increase organization efficiency in low-and-middle-income countries (Henry et

al., 2018). Henry et al. developed a framework for characterizing and evaluating the hospital e-health workforce in low- and middle-income countries. They surveyed three Ghana hospitals and then used a quasi-mixed qualitative and quantitative data method. To investigate the feasibility of E-health for the workforce, the survey included about 60% of E-health personnel. The authors concluded their study by pointing out that E-health is a strategy implemented by many countries to improve their efficiency and effectiveness. A critical barrier they face, however, is a trained workforce capable of operating the system. Workforce training is a necessity to ensure that the system outcomes meet expectations. Lack of training will create a shortage of staff, which will interfere with the hospitals' workflow.

Technical issues and difficulties present a barrier for many health care providers (Singh et al., 2011). A retrospective analysis study conducted by Singh et al. (2010) aimed to analyze and monitor referrals and communication between primary care physicians and specialists in a large multi-specialty VA facility. The referral requests were collected to five sub-specialty services between October 15, 2006, and December 15, 2007: cardiology, gastroenterology, neurology, pulmonary, and surgery. Forty-five days after the last request for referral on December 15, the authors reviewed the referral requests. They divided them into three categories: completed, discontinued (means not accepting the request or unnecessary referral), and unresolved. The number of referral requests issued during the study period was 61,931 of which 22,535 were discontinued, representing 36.4%, and the number of unresolved referrals was 0.8%, 474. The authors randomly selected 412 requests discontinued, and within 30 days, 52% of them lacked follow-up action between PCPs and specialists; 6.3% of all referrals were associated with an unexplained lack of subspecialist

follow-up actions, and 7.4% of discontinued referrals returned to PCPs were associated with an unexplained lack of follow-up. The authors concluded that the EHR is an excellent tool for PCPs and specialists to exchange information. However, they pointed out that the study reveals that breakdowns in referral communication could occur even when referrals are transmitted through an integrated EHR, leading to a lack of follow-up for electronic referrals between PCPs and specialists.

In a qualitative study conducted by Scantlebury et al. (2017) to examine the positive, negative, and obstacles of implementing the electronic health records, the authors conducted semi-structured interviews with 19 members of the United Kingdom's National Health Services (NHS) that represent different occupations. The interviews were conducted during the first year of system implementation. Time-consuming was an issue that some participants have pointed out besides technical issues. Other participants indicated that the system affected their relationship with their patients because they tended to focus more on the system and had to make an extra effort to avoid doing so. Moreover, the relationship with patients is sensitive, and when talking to the patient that must be done facing the patient, but with the system, medical practitioners turn away from the patient to focus on the computer, which gives the patients the feeling that they did not get the attention they need from the other side (Scantlebury et al., 2017).

The information health system is a great tool that has helped improve health care workflow, and it is essential to have a policy in place to ensure information security. Concerns about privacy and confidentiality, however, always exist (Conklin, 2006). Conklin conducted a qualitative analysis by asking health care managers to distribute the survey to all email users to help define peak usage times and identify the email user and

their purpose. The analysis objective is to help the author identify potential confidentiality and security issues. Many issues have been found for which email is being used. Up to 75% of email traffic was not associated with the work's activity. In addition, there is always a chance to receive a harmful virus that can reach the organization's network. More about, who responds to emails, ask the specialist to give advice, or not to the patients. What kind of information is included in the emails and if it contains sensitive data on how they are handled? Some solutions can be implemented to address this issue. Still, they are usually over the organization's budget, resulting in a delay in applying them or finding a cheap solution instead. They will not be as affected as they should be. The author concluded the article by stating that each health care organization must have a clear policy on email usage and the type of information included in the message's body. In general, the absence of a clear email and internet policy can cause problems for the organization. Employees need to know that all electronic communications and interactions are monitored and should act accordingly.

Despite the rapid changes in health care information processing, the confidentiality of the information and patients' privacy has been a concern for health care providers. The introduction of health informatics has made information processing much faster than it used to be. Information circulates to the organization within minutes and can be sent to another facility anywhere in the world if internet access is available. Therefore, legislators and policymakers had to pay attention to this issue and work continuously with health care providers to ensure that the health care providers' medical records for patients are secure and accessible (Lumpkin, 2000).

The introduction of health informatics presented health care organizations with privacy concerns. Lumpkin published an article on privacy and security concerns that could threaten patients' privacy and security. The author explains how an individual has the right to access their information and manage and control that access by the providers. Clear and strong regulations must be implemented to protect the privacy of information. Another barrier discussed by the author was confidentiality, and confidentiality was identified as the obligation to protect the information for the holder of identifiable health information. To ensure that information is kept safe, confidential personal data must be shared based on a set of policies and regulations. When the patient's information is shared, many complications could affect the country's entire health system, such as insurance. When insurance companies share confidential patient information, their decisions will be based on this information, affecting patients and health providers (Lumpkin, 2000).

Furthermore, e-health is recognized as a valuable tool. Yet, it has many issues that legislators must address, like privacy and security, and if it is ethical to use e-health or not (Kluge, 2007). Kluge indicated the importance of having laws and regulations to govern the information processed within the e-health system. Setting rule and regulations help create a security culture among users and protect patient confidentiality. E-health is a patient-centered system, so standards are designed to serve that purpose. Many health care providers expressed their concern about the profession's ethics and if it is possible to use the technology in the health care services. With e-health, there is always the risk of having a security breach or confidential information leaked which would violate the patients' privacy; having regulations and protocols in place will govern the system interactions concerning the data's ethics, security, and confidentiality.

Dissertation Overview

The first paper of the dissertation will assess the physician's perception on the effect of the e-health system on medical services provided to patients in Saudi Arabia. The question of this article will be, from a physician's point of view, will e-health significantly enhance the patient's care in MOH facilities in Saudi Arabia? The article's hypotheses is that e-health system reform will enhance patient's care in MOH facilities in Saudi Arabia.

The second paper of the dissertation will assess the physician's perception of the effect of the e-health system on patient's referral waiting times to see a specialist in Saudi Arabia. The question of this article will address whether e-health will significantly reduce the waiting time for a patient's referral in Saudi Arabia from a physician's point of view. The article's hypotheses is that e-health system reform will reduce the waiting time for patients to see specialists in Saudi Arabia.

The third paper of the dissertation will assess the physician's perception on the effect of the e-health system on the cost of care in Saudi Arabia. The question of this article will be whether e-health will significantly reduce the cost of care for patients in Saudi Arabia from a physician's point of view. The article's hypotheses is that e-health system reform will reduce patients' cost of care in Saudi Arabia.

Methods

This research has been approved by the FIU Institutional Review Board (IRB). The research used a survey answered by physicians who work for MOH in Saudi Arabia. The total number of responses was 188, with a completion rate of 68%. An OLS regression was used to analyze the outcomes, and the order logistic regression with a robust standard error

was also used to confirm the accuracy of the result. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA.

Limitation

This research has limitations that should be noted. Selection bias is possible in the study. The majority of the physicians is located in the major regions, all working for the MOH. Many other sectors like the armed forces, national guards, educational hospitals, and private hospitals are not included in the research. Another limitation was the lack of a control group. The control group serves as a baseline and allows us to minimize the effect of variables except for the four independent variables. It provides elements similar to the experimental group except for the variable added for the study, in this case, the health care services before the e-health reform. Construct validity and the possibility of interaction with different treatments are limitations to this study. The MOH is going through a significant reform in every operational aspect of the ministry.

The sample of this research is relatively small compared to the physician's population in Saudi Arabia. Therefore, the outcomes of this research may not be representative of the entire physicians working in different sectors in Saudi Arabia. The outcome of this research interacted may be affected by improvements other than the e-health reform. Finally, the world is currently experiencing a pandemic affecting all aspects of life. As for this study, the COVID pandemic affected accessibility to data due to government safety restrictions. It also affected physicians' participation in this research due to their schedules since they are fighting the virus in the front line. Access to physicians, due to the MOH's safety measures and precautions, contacting, and finding

physicians who agree to fill out the survey are minimized due to their busy schedules and the timeline of this research.

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Chapter 2

Physician Perceptions of the Impact of E-Health Reform on Patient's Care in Saudi Arabia

Abstract

Objective: This study aimed to examine the physician's perception of e-health reform in Saudi Arabia and its effect on patient care.

Method: An ordinary least squares (OLS) regression was used to measure physician's perception on e-health effectiveness on MOH patient care. Measures such as quality and consistency, efficiencies, speed of admitting patients and their examination, accuracy and completeness in filing reports, and satisfaction ratings are used in the analysis. The outcome of the regression analysis provided the answer to whether it enhanced medical services after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA.

Results: A total of 188 physicians participated in the study. The outcomes indicate a significant enhancement in medical services regarding quality and efficiency, admission and examination speed, accuracy and completeness of files, doctor-patient relationship, satisfaction, and medical errors.

Conclusion: The analysis results demonstrated that physicians have a positive reception toward e-health Reform. The outcome indicates that physicians believe that the e-health reform in Saudi Arabia has significantly enhanced patient care and increased satisfaction rates among physicians and staff.

Introduction

Saudi Arabia is a country in southwest Asia that covers about 80% of the Arabian Peninsula. The Kingdom is structured into 13 administrative regions, each led by a governor chosen by the Ministry of Interior. The country's geography and population traits vary from one region to the next. As of 2018, the population of Saudi Arabia is 33,413,660 people, with a growth rate of % 2.52 (General Authority for Statistics, 2018; Khraif et al., 2016).

In 2011, the Ministry of Health (MOH) initiated an e-health system reform. The e-health strategy emphasizes system integration as well as data accessibility and sharing across the e-health network. "A Safe, Quality Health System, based on Patient-Centric Care governed by Standards, enabled by eHealth," according to the Ministry of Health's e-health vision (Ministry of Health, 2018). One of the main goals of the reform is to give better care to patients by having a comprehensive patient file available to doctors. Advanced diagnostic technologies and decision support services are available to doctors. Furthermore, doctors have the necessary support clinically and administratively by enabling access for services such as automated referrals, a second opinion from colleagues, and teleconsultation from anywhere in the country (Ministry of Health, 2013a).

Saudi Arabia's government announced Vision 2030 in 2016. The fundamental goal of the vision is to reduce the country's reliance on oil and diversify its economy (Vision 2030, 2021). To achieve the vision's objectives, the government established the National Transformation Program (NTP), which aims to accelerate the implementation of primary and digital infrastructure projects while also engaging stakeholders in identifying challenges, co-creating solutions, and contributing to program initiatives under the supervision of the council of ministers.

After fully implementing the e-health vision, the MOH predicts that health care delivery will significantly improve, benefiting MOH patients. Communication will improve, and the MOH will contact its patients via their preferred form of contact (e.g., SMS, email, phone). The reform's goals include providing web consultations from places with internet access, reducing wait times, and providing as much service as feasible from the exact location. These are only a few of the services that the MOH anticipates will be improved and modernized as part of the e-health reform to fulfill patient expectations (Ministry of Health, 2011a).

In today's world, every major hospital in each region runs its operations electronically. However, the majority of hospitals are not equipped with e-health. The MOH's strategic plan is to provide every hospital in the Kingdom with standardized, comprehensive clinical and administrative systems to improve the quality of patient care and the performance of medical and administrative employees (Ministry of Health, 2011b).

Health Systems Research Gaps

The implementation of the e-health system in Saudi Arabia has not been evaluated yet. The Saudi health reform started in 2011. The MOH expected to implement the system throughout the country by 2021. Since 2021, the e-health system can be accessed from any hospital or primary care center in the Kingdom (Ministry of Health, 2013).

Research Innovation

This study aims to evaluate the physician's perception of the effectiveness of the e-health system reform on patient care in Saudi Arabia. This research will contribute to the health systems research literature by looking at the impact of e-health on multiple outcomes. The purpose of the study is to examine how e-health impacted patient care in

Saudi Arabia. This research will take into consideration physicians' perception of services as the quality and consistency, efficiencies, creating new health care products, the speed of admitting patients, the speed of patient examination, accuracy and completeness in filing reports, remote training and experience, doctor's relationship with their patients, staff satisfaction ratings, administrative staff satisfaction ratings, patient satisfaction ratings, and medical errors.

Rationale of the Research

Publicly and privately sponsored health reforms aim to use health information technology to improve access to services and health outcomes (Batura et al., 2016). It is essential to examine the results of reform efforts so that improvements can be made on a national level and, on a global scale, future reform efforts can be evidence-based. The government of Saudi Arabia is going through a major health reform that includes more than 70 projects. The main project is the e-health system reform (Ministry of Health, 2011a). The objective of this reform is to improve health services delivery, access, quality, and safety (Ministry of Health, 2018). This research evaluates the outcomes of the e-health reform in terms of the number of medical services to determine whether the e-health system reform is making a difference on these aspects.

Literature Review

Providing health care services for people with chronic diseases involves a lot of consideration and work on the part of health care providers (Olayiwola et al., 2016). Doctors carefully read their patients' information, records, and diagnoses before deciding on the appropriate treatment plan. The sooner the information is received, the better the outcome (Olayiwola et al., 2016). In addition to the electronic referral request, electronic

health records provide patient information to specialists. The office of the specialist then reads the file and decides the course of action be taken. Furthermore, suppose the patient needs an urgent appointment that can be managed. In that case, if the primary care physicians can provide the treatment, an electronic correspondent can be arranged between both practices to save the patient's time and keep the appointment open for other patients (Olayiwola et al., 2016).

Olayiwola et al. (2016) conducted a cluster-randomized, controlled intervention trial at the Community Health Center, Inc. (CHCI), in Connecticut from October 2011 to December 2013. E-consultations are being used more by physicians to improve communication with their patients and reduce the waiting time. Studies suggested that e-consultations minimizes the patient's waiting time and reduce the need to have a face-to-face consultation. However, no studies addressed the clinical outcome of consultations. CHCI is a recognized patient-centered medical home that provides medically underserved patients with comprehensive primary medical, behavioral, and dental care. The primary care clinicians participated in the study willingly. The study included all of the patients that were referred to a cardiologist by the primary care clinicians. The enrolled clinicians were block randomized into the intervention arm (e-consultation referral) or the control arm (traditional referral) of the study using fixed-size blocks of 4. At the 12 primary care centers of CHCI, all primary care clinicians were caring for adult patients.

Physicians of primary care were randomized to cardiologists in a control group (9 traditional) and intervention group (17 e-consultation). Both endpoints were analyzed using Cox's proportional hazard model, where the hazard of either a visit or an e-consultation was associated with study arm, sex, race, and age. The study result showed

that 69% of e-consultations were resolved without a cardiologist visit. In the intervention group, 52% of the referrals were sent electronically, and 48% were not. The average number of days to an e-consultation review was 5 compared to 29 and 24 among control patients. The number of emergency department visits continued to decline after 6 months of follow-up for e-consultation patients. The trial results stressed that the alternative means that e-health provides could be as safe and as effective as the traditional doctor's visit.

Previous research has shown that the e-health system can increase delivery system efficiency and provide alternative options other than what is available in the current system, resulting in shorter patient waiting times (Doumouras et al., 2017). Doumouras et al. conducted a longitudinal analysis to determine the impact of electronic referrals on the number of referrals compared to fax referrals. The data were collected for 2011–2015 from the references to bariatric surgery in the Ontario Bariatric Network. A total of 5,317 doctors made referrals from 2011 to 2015 to the Ontario Bariatric Network, and 68% increased referrals after the online system was implemented. Primary care specialists made up 88.3% of the cohort. The study showed a significant increase in referrals after a fax-based referral system was converted to internet. References to bariatric surgery more than doubled across the province, bringing more than 1,500 new referees into the system. Following the implementation of the electronic referral system, the study results indicated a significant increase in the number of patient referrals.

Prior research has demonstrated the possibility for the introduction of e-health to improve health care delivery in many aspects. Fiona Stanley Hospital (FSH) in Western Australia implemented a digital medical record and provided training to all staff as a part of the orientation program. Benwell et al. (2017) conducted a cohort study to evaluate

whether the close formal training program facilitates the efficient and accurate use of digital medical records in clinical practice. The data were collected through a questionnaire filled by junior doctors employed at FSH in 2015. The authors concluded the study by stating that there was a vast improvement in daily task performance. Formal training can be greatly beneficial if presented within proximity to the onset of employment. Providing training from a close range of users will significantly affect performance and knowledge acquisition (Benwell et al., 2017).

Research suggests that modernizing health systems by implementing e-health strategies can provide health care providers with a solution for avoiding unnecessary appointments that may result in a shorter waiting lists for patients. Patients may get their appointment earlier, which will improve their referral process and access to the services they need (Cameron et al., 2009). The authors conducted a prospective controlled study to evaluate electronic referrals' feasibility, safety, and medical efficacy at the hospital in service (HES). The authors conducted the study for 18 months from July 2005 to January 2007, receiving 346 electronic referrals and comparing them to paper referrals from the same practices before the study period. Compared to 85% of paper referrals, 63% of electronic referrals were classified as requiring an appointment. The study results showed that electronic referrals are more efficient than paper referrals and helped the specialist avoid unnecessary referrals.

Traveling can be costly and stressful for patients who travel long miles to follow up with their assigned doctor. Going more than 1000 Km from the patient's city and paying for the living and moving expenses during this trip cause stress and increase the financial burden for the patients and their companions. A patient's traveling time is significantly

correlated with higher mortality risks (Moist et al., 2008). Moist et al. conducted a prospective observational cohort to evaluate the effect of one-way traveling time to hemodialysis therapy on mortality, health-related quality of life, adherence, withdrawal from treatment, hospitalization, and transplantation. The data consisted of 20,994 patients who are enrolled in the dialysis treatment and completed the patient questionnaire. The authors concluded that traveling time significantly impacts the mortality risk and decreased health-related quality of life. The authors indicated that unnecessary patients traveling to see their physicians can harm their health, and health providers should consider decreasing traveling time during the referral process.

Electronic referral enhances hospital communications; the speed and accuracy of the information have helped the provider make a better decision regarding their services (Kim-Hwang et al., 2010). Kim-Hwang et al. conducted a paper-based referral study to determine the impact of electronic referrals on specialty referrals. The research took place at the General Hospital of San Francisco after the e-referral system was implemented. The authors based the study on 505,335 medical clinics and 205 surgical clinics. Visit-based questionnaires were added at randomly selected specialist clinic sessions by new patient charts before and after e-referral implementation. The results indicate that inappropriate referral via e-referral by medical specialty clinics is 2.6% compared to 6.4% via paper-based referrals. Inappropriate referral via e-referral to surgical specialty clinics is 2.1% compared to 9.8% of paper-based referrals. The authors argued that electronic referrals help improve communication between primary care physicians and specialists by facilitating communication before making the appointment. The electronic correspondence

allows a specialist to provide a pre-visit consultation by responding to the consultative question and making recommendations before visiting the patients.

The use of services such as e-consult can provide a safe alternative to in-person health care services and can serve the patient as effectively as face-to-face consultation (Wasfy et al., 2016). Wasfy et al. conducted a quantitative study at Massachusetts General Hospital to measure the effectiveness of e-consults on cardiac patients. The study's objective was to assess whether e-consult is effective, efficient, and accepted by patients compared to the traditional delivery method. Data were collected from January 13–December 31, 2014. In all, 165 e-consult requests and 1,642 traditional visits were included in the final dataset. The study's outcome reveals that age plays a role in service demand because the most e-consult requests came from the younger generation. Also, only 12% of patients with e-consult eventually had to make a traditional visit. The authors concluded their study by emphasizing that e-consult can help increase the number of patients seen by the cardiology department and increase the patient's satisfaction with the health services they receive.

Modernizing the health system through the implementation of e-health strategies provides a solution to increase the organization's efficiency. However, poor communication was an issue that many primary care providers and specialists highlighted as one of the leading causes of delay and late appointments (Straus et al., 2011). Straus et al. conducted a qualitative study to examine the implementation of an electronic referral system (e-referral) that creates direct contact between physicians and specialists. The authors collected data from the San Francisco area from four primary care clinics and three specialty clinics. At the time of their study, all primary care practices had been using e-

referral for almost 3 years in selected clinics. However, new specialty clinics have been added over time to the e-referral, and the system has been continuously improved during the study period. The system was perceived as providing support with co-management by providing PCP support to patients who did not see a specialist. Also, e-referral had adverse effects on work processes by shifting them to their workload. This happened because it became the responsibility of the PCP for some work that had been done by administrative staff. The authors concluded that the e-referral system implementation had increased clinicians' and administrators' satisfaction and improved communication and coordination among clinics. They expressed a positive attitude toward the service despite the negative effect of increasing the workload on PCPs and indicated that it increased workflow (Straus et al., 2011).

The growing number of referrals to specialists from primary care providers creates pressure on service providers. To improve communication between health care providers and reduce human errors, many health care providers have implemented e-health and started electronic services (Bouamrane & Mair, 2014). Bouamrane and Mair conducted a qualitative study to clarify the e-referral views of general practitioners to identify the factors that either accelerated or delayed referral processes. The authors interviewed 25 general practitioners (GPs) and one focus group to identify factors that might affect NHS Scotland's electronic referrals. Overall, GP expressed satisfaction with electronic referrals, and many of them confirmed that referral forms are the responsibility of their nurse. Furthermore, the study highlighted that electronic referral improved the organization's performance by enhancing and simplifying the follow-up process, tracking the clinic's requests, and providing confirmation on the request received. Also, for information

sharing, the study concluded that most GPs agreed that electronic referral had improved the communications process by delivering patients files to specialists instantly, and the electronic request trail availability.

Electronic communication lets patients be reached regadless of location. The patients' feeling of confidence and safety gives the ability to express themselves without hesitation clearly. Younger generations have integrated their lifestyle with technology, so using technology in treatment will enhance the outcome for the younger generations (Martin et al., 2011). Martin et al. conducted a systematic review to investigate the impact of e-health communication between patients and health care providers. For the study, the focus was on adolescent patients with mental health disorders. The review explored multiple interventions such as emails, video chats, and SMS and observed the technology's potential effect. The results rely on the patient's motivation to use the technology; the authors suggested that the motivation of the patient is correlated with the technology's impact. To get most of the electronic communication, an integrated model that includes verbal, written, and nonverbal methods between the patient and the practitioner. Martin et al. emphasized that parents and patients expressed satisfaction with networked communication technologies using electronic communication methods.

Many health care systems have implemented e-health to improve their delivery of health care and increase organization efficiency in low-and-middle-income countries (Henry et al., 2018). Henry et al. developed a framework for characterizing and evaluating the hospital eHealth workforce in low-and middle-income countries. The authors surveyed three Ghana hospitals and then used a quasi-mixed qualitative and quantitative data method. To investigate the feasibility of e-health for the workforce, the survey included

about 60% of e-health personnel. The authors pointed out that e-health has been implemented by many countries to improve their efficiency and effectiveness. However, they face the critical barrier of assembling a trained workforce capable of operating the system. Workforce training and training are a necessity to ensure that system outcomes meet expectations. Lack of training will create a shortage of staff that will interfere with the hospitals' workflow.

Widberg et al. (2020) investigated patients' experience in palliative care. E-health has the potential to improve patients' communications with health care providers and receive more information than the traditional method. The authors indicated that e-health increased patients' sense of safety because they feel safer after receiving more information from their physicians and increasing their awareness about their health. The authors concluded that e-health applications improve patients' accessibility and communication, ultimately increasing their awareness. On the organizational level, e-health sustained development and increased their efficiency in using their resources (Widberg et al., 2020).

The recommendation for the procedure is one of the critical features that e-health presents to health care professionals. For example, if the doctor prescribes a patient medication, the system will recommend the medications the doctor wants to prescribe based on the inputs. This feature will reduce medical errors and improve the quality and safety of patient services (Faustine & Suzanne, 2008). E-health improves the health system by providing accurate information on the history of the patient's medication and minimizes the occurrence of medical errors. Faustine and Suzanne conducted a systematic review to examine the benefits of an EMR and its contribution to health care delivery development in developed countries. Decision support tools provide essential information about their

patients to medical professionals. Providing the patient's history, including current drugs, allergies, and medical conditions, may improve the practitioners' course of action. This feature also reduces physicians and pharmacists medical errors.

Research Overview

This dissertation will assess physicians' perception of the effect of the e-health system on medical services provided to patients in Saudi Arabia. The question of this article is whether e-health will significantly enhance patient care in Saudi Arabia will be from a physician's point of view. The hypotheses is that e-health system reform will enhance patient care in Saudi Arabia.

Hypothesis Framework

The hypothesis is guided by the Donabedian model, a framework that assesses health care services through three categories (Donabedian, 2005). Avedis Donabedian described a framework for evaluating the quality of care that is flexible and applicable to different health care services situations. The Donabedian model is considered a preferred framework for many entities interested in health care research, quality and patient safety research, and health services research (Martinez et al., 2018). The model includes three categories: structure of care, care processes, and health outcome.

The model's structure is defined as the settings, which include the provider's credentials and qualifications and the organization's administrative system (Ayanian & Markel, 2016). The country's history and traditions set leadership; the health system must be successful so the government regulates and steers the whole health sector and sets strategies that can stand against any challenges that the health system might face in the future. It is critical for national health reform success to have a leadership that ensures the

health authorities and administrators take responsibility for managing the entire health system and overseeing the intended reform. Research has shown that guidance and leadership are essential aspects of management. The ability to make decisions, guide the progress, and enhance care delivery are all correlated to successful leadership and governance (Ayanian & Markel, 2016)

Moreover, the Donabedian model process was defined as the mechanism in which the care was delivered (Ayanian & Markel, 2016). An essential aspect that e-health affects significantly is health care delivery. E-health increases access to health care services by providing alternative methods to deliver services. E-health overcame many barriers for both patients and health care providers by creating electronic platforms that allow doctors to diagnose and follow up with their patients and prescribe their medication within a short time. Previous research has proven that e-health overcame many barriers for both patients and health care providers by creating electronic platforms that allow doctors to examination and follow-up with their patients and prescribe their medication within a matter of seconds (Wasfy et al., 2016).

Finally, in the Donabedian model, the outcome of the model reflects the impact on the patient. Moreover, the outcome in the model demonstrates the improvements and whether it is achieved the objectives or not (Ayanian & Markel, 2016). When multiple hospitals share the electronic health records in the region, the services' effect can reach a more significant population (Atasoy et al., 2018). Atasoy et al. conducted a review to measure the spillover effect of health informatics on regional health care costs. The study used hospital-level EHR adoption from the Healthcare Information and Management Systems Society (HIMSS) database, which includes information about the providers in the

region that uses EHR. The data indicate the majority of the health care providers have integrated EHR into their hospitals and practices. The widespread use of EHR has contributed to the decrease in the cost of health care services in the region. The study stressed that the spillover effect of the price could be more substantial when more hospitals share the same network. The study highlights the significant impact that EHR can have over the health care services outcomes in any given region. When many hospitals share the same network and patients can move between them, it will positively influence the cost of the services and improve the quality of care (Atasoy et al., 2018).

Method

The questionnaire is a document used to collect information from the respondent, and it can be self-administered or filled by an interviewer (Kelsey, 1996). Survey research allows for different types of data collection methods. This practical and credible approach has clear benefits in helping to describe and investigate the variables of interest and constructs of importance (Ponto, 2015). This survey presents an investigation to assess the effect of e-health system reform in Saudi Arabia from a physician's perspective. This study used this questionnaire's responses from physicians who work for the MOH to evaluate the outcome of the e-health system reform more accurately since they are the users of the system. The government of Saudi Arabia has introduced Vision 2030, and one of the vision objectives is to improve health care services. In accordance, the MOH has constructed a National E-Health Strategy that aligns with its goals and business strategies. The national e-health plan has already been in action, and the MOH expected to implement the system throughout the country by 2021 (Ministry of Health, 2013).

The respondents to this survey were physicians who are working for the MOH. This research has been approved by the FIU Institutional Review Board (IRB). The questionnaire was administered as following. First, a formal request was sent to the MOH to request their permission to ask physicians working for the ministry to participate in the survey. Second, after the MOH's permission, the physicians were contacted personally in person, over a phone call, or via email and were requested to give their consent to participate. Third, after their approval, the questionnaires were delivered electronically using SurveyMonkey. A link to the survey was sent to the respondents to access the questionnaire from their computers or smartphones. The respondents were informed about the research objectives and the value of their responses to the research outcome. The targeted date to start sending the questionnaires was September 15, 2020, and the estimated time anticipated to have the survey distributed to targeted physicians was 3 months. After the 3 months were finished, the data were collected.

Saudi Arabia's health reform aims to make primary care physicians the center of health services for patients in different regions (Al Saffer et al., 2021). Electronic health services can significantly impact the services provided for patients (Seçkin et al., 2019). Following Alsffer (2021) and Seçkin et al., an OLS regression with a robust standard error was used to model the physician's perception of the relationship between e-health usage and patient's care improvement. The outcome of the regression analysis provided the answers to whether or not it enhanced the patient care after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA.

The questionnaire was created with this study in mind. The survey's questions were adapted from surveys for e-health services found in other articles and questionnaires (Al Saffer et al., 2021; Parmanto et al., 2016; WHO, 2010). Al Saffer et al. examined the Saudi health system's primary health care centers. The study used OLS to analyze variables such as age, region, specialty communications, and medical errors for their measures included in the regression. The authors targeted the health care services and provided by the primary care centers in Saudi Arabia. The study included categorical measures such as region and specialty, which influenced the method used for this research.

Parmanto et al. (2016) conducted a telehealth usability and reliability study to investigate e-services and the effect they have on health care. Measures like satisfaction, communications, reports, speed of providing information and services, the relationship between physicians and their doctors, effeminacy, remote diagnostics and training, the system help to prevent errors, and satisfaction were selected measures to provide a clear understanding of electronic health services impact.

The World Health Organization (201) surveyed e-health and telehealth. The survey focused mainly on the different e-health applications and their effect on the cost of care and how electronic services impact the cost of care and provide the solution for the populations with low socioeconomic status. The survey also focused on patients' referrals and remote interactions the health care provided between health care providers and patients. The questions in the current study about cost, patient referrals, and remote diagnostics and training were chosen from this study (WHO, 2010).

The process began with outlining the research's objectives and measures, then searching online surveys relevant to e-health and electronic medical measures and selecting

appropriate questions for this study. The survey‘s questions addressed the current study’s research questions regarding the e-health system reform in Saudi Arabia. The MOH launched the e-health reform in 2011, a few years after Saudi Arabia’s government introduced Vision 2030. One of the 2030 vision objectives is transforming the health care services and making them entirely operate electronically. The MOH has established Vision Realization Office (VRO). The VRO objectives are to achieve the objectives of the 2030 vision (Ministry of Health, 2018c). The research question addresses different medical services from a physician’s point of view whether the e-health reforms affect them.

The physicians included in the research worked for the MOH. The questionnaire is divided into four sections and had 36 questions. The first part covered the participant’s basic information. The following part focused on electronic services and the perspective of physicians. The third section queried the physician’s perspective on the patient’s referrals and the influence of e-health. The final part of the survey discussed e-health and its effectiveness on health care costs in a health care setting. The link to the survey was delivered to physicians electronically.

The survey contained different questions with different answers; 13 questions have five choices, and they are evaluated in the dataset as the following: Very important (5), Somewhat important (4), Natural (3), Somewhat not important (2), and Not important (1). Ten questions of the survey included six different answers, and they are evaluated in the dataset as the following: Has improved considerably (6), Has somewhat improved (5), Has remained the same (4), Has declined (3), Has declined somewhat (2), and Has declined considerably (1). Finally, six questions came with five choices, and they are evaluated in

the dataset as the following: Strongly agree (5), Agree (4), Natural (3), Disagree (2), and Strongly disagree (1; for the full questionnaire, see Appendix 1).

For the current study, 13 questions were used for the analysis. The questions addressed the importance of e-health in improving quality and consistency, efficiencies, creating new health products and services, speed of admitting patients and examination completion, accuracy and completeness in filled reports, the effect of staff training on how to use e-health, satisfaction ratings, and medical errors.

The selection of variables used for this research was based on the patient's characteristics and origin. To the best of my knowledge, the survey covers many aspects that can collectively impact medical measures. These measures will serve as dependent variables in the analysis. Collectively, the variable of each question will emphasize the effect of e-health on medical services offered by the MOH. This study aims to examine whether the e-health reform enhanced medical services or not. One of the measures included in this study is quality improvement.

The physicians were asked if the e-health reform has impacted the quality of the services provided by their organization to their patients. Quality improvement shapes the framework of the system; it can identify the correct steps for procedures and ensure the best possible outcome. After the introduction of e-health, the quality and consistency are expected to be improved. So, quality improvement was included in the analysis as one of the measures to explain the influence of e-health on it. Moreover, the importance of e-health on the efficiency of the health organization is another aspect the survey touched upon. This variable measures the medical product in the health organization and if e-health has improved the workflow within the health organization.

The importance of e-health for creating new health care products and services was another measure in the study. The physicians were asked if e-health would enhance the process of creating new medical products that can be used in their services. The question aimed to measure the impact of e-health on the progress of innovation in the health care field. Also, expertise on using e-health was used as a measure in the analysis to investigate the importance of training and experience in using electronic services for staff to use e-health at total capacity. The purpose of this question was to highlight the importance of training and whether the respondents shared the same point of view.

Likewise, physicians were asked about the speed of admitting patients and examinations. This question investigates the impact that e-health made on the speed of admitting patients and the speed of their medical examinations and tests. The faster the admission, the sooner the doctor can see the patient. Admitting patients using traditional methods can be a long process. With e-health, the process can be faster, and the request can be tracked. Accordingly, the speed of admitting patients and examinations were dependent variables added to the analysis to measure the impact of e-health on these variables.

Furthermore, the accuracy and the completeness of the patient's files and reports as measures were used in the analysis to investigate the impact of e-health made over them. The survey was designed to examine the improvement made on the accuracy of the files and reports and the completeness from the physician's point of view. Accuracy and completeness of filing reports are essential for proper diagnostics. When specialists receive patients' information, accurate information and complete details increase the patient's chance of getting the appropriate treatment sooner. Because if there are any missing details,

the specialist will have to do the test again, which adds more time for the patient to receive the treatment. So, accuracy and completeness are measures added to the analysis to test the impact of e-health on both variables.

The questionnaire asked physicians whether using electronic health services affected their relationship with their patients. The doctor-patient relationship was a measure used in the analysis to investigate whether e-health improved their relationship with patients or negatively impacted it. Satisfaction ratings for medical staff, administrators, and patients were also measures that were used in the analysis. Doctors expressed their thoughts on how the e-health reform in Saudi Arabia has impacted satisfaction ratings and whether e-health has improved their satisfaction. These questions aimed to investigate whether electronic health services have made any changes in the organization and improved the ratings for employees and patients.

The last measure used as a dependent variable was medical errors. The survey included a question about medical errors and whether e-health made an impact. The purpose of the question was to get the physician's opinion on that matter and whether e-health improved their performance and reduced medical errors.

The analysis included more independent variables to test whether they influenced the outcome. The key variable included in the regressions was the frequency of usage. This variable is intended to measure how often physicians and their staff used e-health and how much it affected their performance. The survey included a question asking the physicians how many times they use e-health during the week. The answer included four different answers; none meant that doctors did not use electronic services at all, often (2–3 times a week), sometimes (4–5 times a week), and daily (use e-health every day). This question

represents the frequency of usage, the key variable. This study investigates the effect of e-health reform on the medical services in Saudi Arabia. Based on that, the questionnaire was created specifically to test e-health's impact on patients' care. The variables chosen for this study represent 13 different measures provided for patients using old methods without electronic services. The usage of electronic services was included in the regression to measure the difference between the traditional method and electronic services. For every dependent variable being tested, the results showed the effect of e-health on that variable and tested to see whether the difference were significant.

Another variable included in the regression was the gender (male/female) of the physician who participated in the survey as well as the region of the physician (Saudi Arabia has 13 administrative regions.), and this independent variable represents the region of the physician who answered the questionnaire. The physician's specialty was also included in the regression; this variable represents the specialty of the physicians who participated in the survey. The physician's experience was also included in the regression, and it indicates the number of years of practice that the physician had. The survey included 5-year groups: 1–5 years, 5–10 years, 10–15 years, 15–20 years, and 20+ years. The last independent variable was the age of the physicians. The survey experience was measured by groupage, and the survey had five different age groups: 18–25 years, 26–35 years, 36–45 years, 46–55 years, and 55+ years.

The regression model is

$$\boldsymbol{Y_{irt} = \beta_0 + \beta_1 Usage_i + \beta_2 Gender_i + \beta_3 Age_i + \beta_4 Region_i + \beta_5 \mathbf{Specialty}_i + \beta_6 Experience_i + \varepsilon_{it},}$$

where the $\boldsymbol{Y_{irt}}$ stand for the medical measure being offered for patients. The study included 13 different measures; each outcome measure will be tested separately to measure electronic services' effect on that particular service from a physician's point of view. For example, the first variable test in the study was quality and consistency improvement; in this case, Y will be quality and consistency improvement. $\boldsymbol{Usage_i}$ represents the frequency of the physicians or staff usage for e-health when performing their check-up for the patients; $\boldsymbol{Female_i}$ represents the patient's gender; $\boldsymbol{Age_i}$ represents the patient's age; $\boldsymbol{Region_r}$ represents the patient's health care facility region where that patient was referred from; $\mathbf{Specialty_i}$ represents the specialty of the physician that the patient was referred to, and $\boldsymbol{Experience_i}$ represents the years of experience of the specialist that the patient visited. The key independent variable is the frequency of e-health usage. The regression will include gender, age, specialty, experience, and region to have a clear view of whether these variables influence the outcome.

Results and Analysis

The results show each aspect the physicians were asked about and their input on that services area. The Ministry of Health had 41,201 physicians working in hospitals and primary care centers ("Statistical Yearbook," 2021). With a 68% completion rate, the total respondents were 188 physicians, representing 0.5% of the total physician at the MOH with different specialties.

The survey's responses produced a good representation of the population. Table 1 lists the characteristics of the respondents, and Table 2 shows the survey means. Out of the 188 respondents, 84% were males, and 16% were females. Most physicians work in MOH facilities in Riyadh, Jeddah, Al Madinah, Eastern region, Al Qaseem, and Asir region; 36%

of the responses were from physicians in Asir region, 24% from Riyadh, 16% from Al Madinah, and 16% from Jeddah (Makkah region); 36% of the participants were over 55 years old, 40% 46–55 years old, 20% 36–45 years old, and 4% 26–35 years old.

An ordered logistic regression model was performed for each measure to confirm the accuracy of the results of the regressions. The survey data contained categorical variables, and to perform the regression, dummy variables were used for these variables. An OLS model was used as the primary model for this research. An ordered logistic regression was performed to ensure that the measure's outcome of the regressions matched the OLS outcomes, and the results of both models' regressions were compared. The OLS measures' significance matched the ordered logistic regression outcomes and indicated the correctness of the results. The OLS model was used because it made it easier to illustrate and interpret the regression outcomes.

The hypothesis of the first paper is the e-health system reform will enhance medical examination in Saudi Arabia. In the survey, the question physicians were asked concerned the importance of e-health regarding the quality and consistency of health care in Saudi Arabia. Therefore, the quality and consistency of the health care system were an essential part of the analysis. The sample mean of the survey was 3.338, indicating a response between "agree" and "strongly agree." Regression results on the relationship between usage and quality and consistency, the outcome measure had a coefficient of 0.199 and a p-value of $< .001$, indicating a statistically significant relationship between usage and the quality and consistency measure (Table 3).

The other variables controlled for the dependent variable; specialty, gender, experience, and age were not significant and did not affect the quality and consistency of

the health care system in Saudi Arabia. As for the region measure, most regions were not significant except for Riyadh, Asir, and the Eastern regions. These three regions were significantly affected by electronic services, which led to quality and consistency enhancement. Thus, according to physicians, the outcome indicates that the quality and consistency of health care in Saudi Arabia have enhanced significantly after e-health's introduction. The quality and consistency improved after using electronic services. That will improve the framework of how the care is delivered and ultimately improve patient care in Saudi Arabia.

Moreover, physicians were asked about the importance of e-health in terms of efficiencies. The sample mean of the survey was 3.335, indicating a response between "agree" and "strongly agree." For regression results on the relationship between usage and efficiencies, the outcome measure had a coefficient of 0.155 and a p-value of 0.002, indicating a statistically significant relationship between usage and efficiencies measure (Table 4). As for the other variables controlled for, the dependent variable, specialty, gender, and experience were not significant and had no effect on the efficiencies except for age. Age was significant at 95% and influenced the efficiencies of the health care system with the introduction of e-health. Moreover, the Jazan, Makkah, Al Medina, and Al Qassim regions were significant, and e-health impacted the efficiencies of the health care system. Thus, a t-test was performed; according to physicians, the efficiencies have enhanced significantly after introducing e-health. The result suggests that e-health has a positive impact on efficiencies. It will create a more productive environment for physicians and staff to provide medical care for their patients.

Additionally, the survey asked about the importance of e-health in creating new health care products. The sample mean of the survey was 3.319, indicating a response between "agree" and "strongly agree." Regression results on the relationship between usage and the outcome measure had a coefficient of 0.18 and a p-value of 0.001, indicating a statistically significant relationship between usage and creating new health care products measures (Table 5). As for specialty measures, all specialties included in the regression were not significant except for cardiologists. According to the analysis outcomes, cardiologists were significantly affected by electronic services, and they helped them create new products after the introduction of e-health. The Al Jawf, Jazan, Al Medina, Najran, Al Qassim, and Tabuk regions were significantly affected by electronic services, which created new health care products after the introduction of e-health. The other variables controlled for the dependent variable, gender, experience, and age, were not significant and did not affect creating new health care products and services. Thus, a t-test was conducted according to physicians; the outcome indicates that creating new health care products has enhanced significantly after introducing e-health

Similarly, the questionnaire asked about the importance of e-health regarding the speed of admitting patients. The sample mean of the survey was 4.979, indicating a response between "improved considerably" and "improved somewhat." Regression results in the relationship between usage and speed of admitting patients, and the outcome measure had a coefficient of 0.027 and a p-value of 0.803, indicating no statistically significant relationship between usage and speed of admitting patients measures (Table 6). Still, t matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for expertise in electronic health services, the outcome

measure had a coefficient of 0.35 and a p-value of < 0.001, indicating a statistically significant relationship between training and speed of admission measures (Table 7).

When the medical staff has proper training on electronic services, the speed of admitting patients is significantly enhanced. The analysis outcomes indicated that cardiologists were significantly affected by electronic services, and their patient's admission speed was affected considerably after the introduction of e-health. The Tabuk region was significantly affected by electronic services, which means electronic services have significantly impacted the speed of patients' admission. The other variables controlled for the dependent variable, gender, and experience, and age was not significant and did not affect the speed of admitting patients.

Furthermore, the survey asked about the importance of e-health in terms of the speed of patient examination. The sample mean of the survey was 4.840, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between usage and speed of patient examination, the outcome measure had a coefficient of 0.101 and a p-value of 0.312, indicating no statistically significant relationship between usage and speed of admitting patients measure (Table 8). Still, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for expertise in electronic health services, the outcome measure had a coefficient of 0.304 and a p-value of < 0.01 (Table 9). When the medical staff has proper training in electronic services, the speed of completing the examination will be significantly enhanced. As for regions, in Jazan, Makkah, the Northern Borders, and Riyadh, the speed of patient examination was significantly affected by electronic services. The other variables controlled for the dependent variable, gender,

experience, specialty, and age were not significant and did not affect the speed of the patient's examination.

Moreover, the survey asked about the importance of e-health on accuracy in filling out reports. The sample mean of the survey was 5.117, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between usage and accuracy in filling out reports, the outcome measure had a coefficient of 0.063 and a p-value of 0.499, indicating no statistically significant relationship between usage and speed of admitting patients measures (Table 10). However, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for experience in electronic health services, the outcome measure had a coefficient of 0.418 and a p-value of < 0.001 (Table 11). When the medical staff has proper training on electronic services, the accuracy of filing reports will be significantly enhanced. The other variables controlled for the dependent variable, gender, experience, specialty, region, and age were not significant and did not affect the accuracy in filing reports.

Additionally, the survey asked about the importance of e-health in terms of completeness in filling out reports. The sample mean of the survey was 5.075, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between usage and completeness in filling out reports, the outcome measure had a coefficient of 0.188 and a p-value of 0.035, indicating a statistically significant relationship between usage and completeness of filling out reports measure (Table 12). Users aged 26–35 years who had 6–10 years of experience were significantly affected by electronic services. That indicates that the younger physicians with experience

significantly enhanced their completeness of filling out reports after introducing e-health. The other variables controlled for the dependent variable, gender, specialty, and region were not significant and did not affect the completeness in filling out reports.

The physicians were asked about the importance of e-health in terms of training and experience in using electronic services. The sample mean of the survey was 5.064, indicating a response between "improved considerably' and "improved somewhat." Regression results on the relationship between usage and training and experience, the outcome measure had a coefficient of 0.24 and a p-value of 0.002, indicating a statistically significant relationship between usage and training and experience measure (Table 13). The other variables controlled for the dependent variable, gender, and specialty were not significant and did not affect whether the medical staff has experience in using electronic services or not except for age.

However, training and experience of using electronics were significant with age; the outcomes had a coefficient of 2.216 and a p-value of 0.001 for 26–35 years age group; 36–45 years had a coefficient of 2.802, and a p-value of < 0.01; 46–55 years had a coefficient of 2.326 and a p-value of 0.004, and over 55 years age group had a coefficient of 2.43 and a p-value of 0.004 which means electronic services training and experience have an effect when it comes to age. As for the experience, 6–10 years' experience was significant and had a coefficient of -0.791 and a p-value of 0.067, which means physicians with fewer years of experience are more likely to be affected by electronic services training. Finally, all regions were not significant except for the Northern Border region. The Northern Border had a coefficient of 2.328 and a p-value of 0.049, which means that the Northern Border region is significantly affected by training in how to use e-health. So, a t-

test was conducted. According to physicians, the outcome indicates that training and experience in using electronic services have significantly enhanced the performance of the system users and helped them use the e-health system at total capacity.

Likewise, the questionnaire asked about the importance of e-health in terms of doctors' relationship with their patients. The sample mean of the survey was 4.452, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between usage and doctor's relationship with their patients, the outcome measure had a coefficient of 0.106 and a p-value of 0.335, indicating no statistically significant relationship between usage and doctor's relationship with their patient's measure (Table 14). The other variables controlled for the dependent variable, gender, experience, and age were not significant and did not affect the relationship between doctors and their patients except for specialty. As for specialty, cardiologists had a coefficient of 0.899 and a p-value of 0.076, which means that they impacted the relationship with their patients while using electronic services. The Northern Border and Tabuk regions were significant, which means that the physicians' relationship with their patients was affected after introducing electronic services. As for experience, 6–10 years' experience was significant and had a coefficient of -1.637 and a p-value of 0.002; 11–15 years' experience had a coefficient of -1.832 and a p-value of 0.016, and physicians with more than 20 years' experience had a coefficient of -1.728 and p-value, which means that e-health impacted physicians with these experience years in groups relationships with their patients. Thus, according to the physicians, the outcome indicates that doctors' relationship with their patients has not enhanced significantly after introducing e-health.

Moreover, a question asked was about the importance of e-health in terms of medical staff satisfaction ratings. The sample mean of the survey was 4.936, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between usage and medical staff satisfaction ratings showed that the outcome measure had a coefficient of 0.024 and a p-value of 0.795, indicating no statistically significant relationship between usage and medical staff satisfaction rating measure (Table 15). However, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for expertise in electronic health services, the outcome measure had a coefficient of 0.663 and a p-value of < 0.001 (Table 16). When the medical staff has proper training on electronic assistance, the medical staff satisfaction ratings is significantly improved. The other variables controlled for the dependent variable, gender, experience, region, and age were not significant and did not affect the medical staff satisfaction ratings except for specialty. Cardiologists had a coefficient of 1.031 and a p-value of 0.018, which means the cardiologist's staff satisfaction ratings were affected by e-health's introduction.

Likewise, the survey asked about the importance of e-health in terms of administrative staff satisfaction ratings. The sample mean of the survey was 4.798, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between usage and administrative staff satisfaction ratings, the outcome measure had a coefficient of 0.123 and a p-value of 0.218, indicating no statistically significant relationship between usage and administrative staff satisfaction rating measures (Table 17). However, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for experience

in electronic health services, the outcome measure had a coefficient of 0.513 and a p-value of < 0.01 (Table 18). When the administrative staff has proper training on electronic services, the administrative staff satisfaction ratings are significantly enhanced. The other variables controlled for the dependent variable, gender, experience, region, and age were insignificant and did not affect the administrative staff satisfaction ratings. Except for cardiologists, that means that administration working for cardiologists had a higher satisfaction rating after introducing electronic service.

Similarly, the survey asked about the importance of e-health in terms of patient satisfaction ratings. The sample mean of the survey was 4.787, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between usage and patient satisfaction ratings, the outcome measure had a coefficient of 0.053 and a p-value of 0.608, indicating no statistically significant relationship between usage and patient satisfaction rating measure (Table 19). However, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for experience in electronic health services, the outcome measure had a coefficient of 0.509 and a p-value of < 0.001 (Table 20). When the patients have proper training and are familiar with the electronic services, their satisfaction ratings significantly improve. The outcomes indicated that cardiologists and family physicians were significantly affected by electronic services. Cardiologist had a coefficient of 1.122 and a p-value of 0.018, and family physicians had a coefficient of 0.765 and a p-value of 0.066 that indicated that patients visiting cardiologists and family physicians had a higher satisfaction rating than the other specialties. Gender was also significantly impacted; gender had a coefficient of -0.51 and a p-value of 0.077, which means gender influenced

patients' satisfaction rating after using e-health. Jazan and Riyadh regions were significantly affected also. The Jazan region had a coefficient of 2.0213 and a p-value of 0.059, and the Riyadh region had a coefficient of 1.988 and a p-value of 0. 042. This means that Jazan and Riyadh regions had a higher patient satisfaction rating than the other regions after introducing electronic services.

The survey also questioned the importance of e-health in terms of medical errors. The sample mean of the survey was 4.090, indicating a response between "agree" and "strongly agree." Regression results on the relationship between usage and medical errors, the outcome measure had a coefficient of 0.083 and a p-value of 0.245, indicating no statistically significant relationship between usage and medical errors measure (Table 21). However, when factoring for training, the outcome measure had a coefficient of 0.045 and a p-value of 0.029 (Table 22). When medical staff goes through training to learn how to use electronic services, medical errors will be significantly reduced. Physicians 45–55 years old and over 55 years had a coefficient of -1.279 and -1.482, respectively, and a p-value of 0.083 and 0.055, respectively. This means physicians over 45 performed better, and medical errors were reduced after introducing e-health. Physicians who had 6–10 years of experience and physicians with over 20 years of experience were also significantly affected by e-health and reflected in their work with fewer medical errors. The Al Qassim region was also significant with a coefficient of 0.197 and a p-value of 0.054, which means Al Qassim reported fewer medical errors than other regions after using electronic services.

Discussion

One hundred eighty-eight respondents answered the questionnaire, and the first part investigated the effect of e-health on medical services. The questionnaire investigated

physicians' perception of the impact of e-health quality, consistency, and efficiencies from a physician's point of view. The analysis indicated that the e-health services had enhanced the quality and consistency of the services provided to patients and efficiencies of the services proved by the health care providers. Previous research has shown that electronic services can increase the quality of the services offered by the health care providers and can be more consistent with the quality level compared to the quality of services provided before e-health. Health services can also be enhanced by e-health and increase the efficiencies of the process (Domínguez-Mayo et al., 2015).

Other aspects of the questionnaire were the speed of medical examination for the patients and the rate of admitting them. The analysis has shown that electronic health services can significantly enhance both aspects. Physicians believe that e-health can improve the process of accepting new patients or following up patients faster, saving time for more patients to be seen by physicians. Previous studies have shown that electronic services positively impact the accelerating admission process and provide patients information faster, giving doctors a much clearer understanding of the patient's condition (Lau et al., 2012).

Additionally, outcomes of the analysis have shown that physicians believe that e-health help with the completeness of the reports filed by staff. E-health changed the data input method and made it easier for staff to fill out patients' information. The outcomes show that doctors are convinced those electronic services provide assistance to their staff and improve the care offered to patients in their health care organization. Previous studies have proven that electronic services provide staff with a faster method of data input, which

increases the efficiency of the workflow of the health care organization (Kirbiyik et al., 2014).

Regarding the accuracy of filing reports, the analysis shows that e-health does not significantly impact accuracy. However, when factoring for staff training on using electronic services, outcomes show that training is significant. That indicates that staff's having proper training on electronic services that will lead to a more efficient use of the system, leading to more accuracy of the information entering the system. Research has proven that training is essential to achieve the full potential of the electronic service. Users of the system cannot see the purpose of the system unless they are trained, and when training is completed, they can be more into the system and willing to learn and use electronic services (Scantlebury et al., 2017).

The doctor-patient relationship is an important characteristic that physicians pay great attention to. The analysis shows that physicians of some specialties think that electronic services have not enhanced their relationship with their patients. The analysis also indicates that e-health affects the relationship with the patient for some specialties due to the nature of that specialty. Research has shown that physicians consider their patients' age and level of education, so they provide sources of health information and follow up based on these factors. It is essential to understand the patient's situation so doctors can maintain a good relationship with their patients (Rider et al., 2014).

Moreover, staff rating satisfaction was not enhanced significantly, according to physicians. The analysis outcome shows that medical staff and administrative staff as well were not satisfied with their ratings and that training is essential for them to achieve the full potential of the electronic services and be satisfied with their ratings. The literature had

already shown that health organization employees have emphasized that they experienced technical difficulties and shutdowns due to their lack of experience with the new technology. Also, health providers pointed out that training on the new system is required for their staff to achieve the purpose of implementing the electronic services (Lau et al., 2012).

Moreover, the questionnaire analysis shows that patients' satisfaction rates were not significant, and doctors think e-health has not enhanced or changed that. The analysis also indicated that training patients are essential to reach the goals of using electronic services. Research has proven that training is crucial for patients to get the most out of electronic services. It also has demonstrated that basic knowledge or received educational sessions of the technology can be sufficient for patients to use electronic services to follow-ups with their physicians and schedule their appointment (Scantlebury et al., 2017; van Os-Medendorp et al., 2012).

The questionnaire asked respondents about the effect of e-health on reducing medical errors. The analysis indicates that electronic services do not have a significant impact on reducing medical errors. However, the analysis indicated that proper training for users would have a significant impact on medical errors. Prior research has shown that electronic services can improve the quality of the services provided for patients and reduce medical errors. E-health provides users with decision-making tools that help the user make the proper decision based on the information available on the system and the information provided by the physician or the user of the electronic services (Campanella et al., 2015; Ferguson et al., 2018).

The study had limitations. Respondents showed confusion about some questions. Their response was closest to what they believe was correct, yet they thought there was more to the answer than they provided. Depth was another limitation; survey questions were standardized were usually general questions understandable for the respondents. The respondents did not have the chance to explain when they had more complex answers. Another limitation was different interpretations of questions. The interpretation of the question differs among respondents, and that affects the validity and reliability of the results.

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Tables

Table 2.1

Sample Characteristics

Variable	Category	Percentage
Gender	Female	16.93 (n = 32)
	Male	83.07 (n = 156)
Age	18–25 Years	2.12 (n = 4)
	26–35 Years	19.05 (n = 35)
	36–45 Years	28.57 (n = 54)
	46–55 Years	31.22 (n = 59)
	Over 55 Years	19.05 (n = 36)
Experience	1–5 Years	8.99 (n = 16)
	6–10 Years	16.40 (n = 31)
	11–15 Years	17.46 (n = 33)
	16–20 Years	16.93 (n = 32)
	More than 2 years	40.21 (n = 76)
Region	Al Baha	1.06 (n = 2)
	Northern Border	1.06 (n = 2)
	Al Jawf	0.53 (n = 1)
	Al Medina	15.87 (n = 30)
	Al Qassim	1.06 (n = 2)
	Riyadh	29.63 (n = 56)
	Eastern	2.65 (n = 5)
	Asir	22.75 (n = 42)
	Ha'il	1.06 (n = 2)
	Makkah	8.99 (n = 17)
	Najran	10.58 (n = 20)
	Tabuk	2.65 (n = 5)
Frequency of Using E-health	None	9.52 (n = 18)
	Often (2–3 times a week)	30.16 (n = 56)
	Sometimes (4–5 times a week)	14.29 (n = 27)
	Daily	46.03 (n = 87)
Specialty	Family Physician	6.88 (n = 13)
	General Practitioner	5.29 (n = 10)
	Cardiologist	12.77 (n = 24)
	ENT	4.76 (n = 9)
	Neurologist	2.12 (n = 4)
	Pediatrician	15.96 (n = 30)

Note: Values in the table are percentages.

Table 2.2

Survey Means

Variable	Observations	Mean	Standard Deviation	Standard Error
Quality Improvement	188	4.389	0.681	0.05
Efficiencies	188	4.335	0.701	0.051
E-health Importance	188	4.319	0.705	0.052
Patient's admission speed	188	4.979	1.36	0.099
Patient's Examination Speed	188	4.84	1.323	0.097
Accuracy	188	5.117	1.164	0.085
Completeness	188	5.074	1.195	0.087
Expertise of e-health	188	5.064	1.078	0.079
Doctor-Patient Relationship	188	4.452	1.456	0.106
Medical Staff Satisfaction Ratings	188	4.936	1.226	0.089
Administrative Staff Satisfaction Ratings	188	4.798	1.345	0.098
Patient Satisfaction Ratings	188	4.787	1.347	0.099
Medical Errors	188	4.09	0.09	0.066

Table 2.3

Importance of E-health for Improving Quality and Consistency of Health Care in Saudi Arabia

Quality Improvement	**Coef.**	**St. Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**
E-health services usage	0.199	0.051	3.92	< 0.01***	0.099	0.299
Cardiologist	0.221	0.217	1.02	0.31	-0.208	0.65
ENT	-0.177	0.221	-0.8	0.424	-0.614	0.259
Family Physician	0.096	0.177	0.54	0.589	-0.254	0.445
General Practitioner	0.08	0.202	0.4	0.693	-0.319	0.479
Neurologist	0.215	0.191	1.13	0.262	-0.162	0.591
Pediatrician	0.085	0.158	0.54	0.59	-0.227	0.397
Gender	-0.061	0.147	-0.42	0.677	-0.351	0.229
26–35 Years Old	0.116	0.425	0.27	0.786	-0.724	0.956
36–45 Years Old	-0.044	0.463	-0.1	0.924	-0.959	0.871
46–55 Years Old	-0.256	0.497	-0.52	0.607	-1.238	0.726
Over 55 Years Old	-0.223	0.515	-0.43	0.665	-1.241	0.794
6–10 Years' Experience	-0.202	0.267	-0.75	0.452	-0.729	0.326
11–15 Years' Experience	0.082	0.305	0.27	0.788	-0.52	0.684
16–20 Years' Experience	0.104	0.331	0.31	0.754	-0.55	0.758
More than 20 Years	0.087	0.344	0.25	0.801	-0.592	0.766
Asir Region	0.806	0.256	3.15	0.002***	0.3	1.312
Eastern Region	0.966	0.29	3.33	0.001***	0.393	1.538
Ha'il Region	0.687	0.838	0.82	0.414	-0.969	2.343
Al Jawf Region	0.966	0.334	2.89	0.004***	0.305	1.626
Jazan Region	0.477	0.457	1.04	0.299	-0.426	1.38
Makkah Region	0.697	0.299	2.33	0.021**	0.107	1.288
Al Medina Region	0.351	0.266	1.32	0.189	-0.175	0.877
Najran Region	0.601	0.349	1.73	0.086*	-0.087	1.29
Northern Border Region	0.784	0.369	2.13	0.035**	0.056	1.512
Al Qassim Region	-0.734	0.962	-0.76	0.447	-2.635	1.167
Riyadh Region	0.982	0.246	3.99	< 0.01***	0.495	1.468
Tabuk Region	0.452	0.301	1.5	0.135	-0.143	1.048
Constant	2.16	0.448	4.82	< 0.01***	1.275	3.046

Mean dependent var	3.388	**SD dependent var**	0.681
R-squared	0.267	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.4

Importance of E-Health in Terms of Efficiencies

Efficiencies	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.155	0.048	3.25	0.001***	0.061	0.25
Cardiologist	0.036	0.241	0.15	0.881	-0.44	0.513
ENT	-0.262	0.19	-1.38	0.17	-0.637	0.113
Family Physician	0.306	0.159	1.92	0.057*	-0.009	0.621
General Practitioner	0.029	0.247	0.12	0.906	-0.458	0.517
Neurologist	0.28	0.199	1.41	0.161	-0.113	0.672
Pediatrician	0.092	0.156	0.59	0.556	-0.216	0.399
Gender	-0.046	0.143	-0.32	0.746	-0.33	0.237
26–35 Years Old	-0.803	0.239	-3.36	0.001***	-1.275	-0.332
36–45 Years Old	-1.133	0.328	-3.46	0.001***	-1.78	-0.486
46–55 Years Old	-1.404	0.382	-3.68	< 0.01***	-2.157	-0.65
Over 55 Years Old	-1.533	0.403	-3.8	< 0.01***	-2.329	-0.737
6–10 Years' Experience	-0.27	0.236	-1.14	0.254	-0.735	0.196
11–15 Years' Experience	0.243	0.305	0.8	0.427	-0.36	0.846
16–20 Years' Experience	0.392	0.327	1.2	0.232	-0.253	1.037
More than 20 Years	0.391	0.346	1.13	0.259	-0.291	1.074
Asir Region	-0.597	0.187	-3.2	0.002***	-0.966	-0.229
Eastern Region	-0.404	0.223	-1.81	0.072*	-0.845	0.036
Ha'il Region	-0.762	0.204	-3.74	< 0.01***	-1.164	-0.36
Al Jawf Region	-0.444	0.335	-1.33	0.186	-1.106	0.217
Jazan Region	-1.222	0.319	-3.83	< 0.01***	-1.851	-0.593
Makkah Region	-0.897	0.241	-3.72	< 0.01***	-1.373	-0.421
Al Medina Region	-1.078	0.204	-5.29	< 0.01***	-1.481	-0.675
Najran Region	-0.55	0.292	-1.89	0.061*	-1.126	0.026
Northern Border Region	-0.374	0.429	-0.87	0.384	-1.221	0.472
Al Qassim Region	-2.111	0.915	-2.31	0.022**	-3.918	-0.305
Riyadh Region	-0.586	0.182	-3.21	0.002***	-0.946	-0.226
Tabuk Region	-0.698	0.354	-1.97	0.05*	-1.397	0
Constant	4.582	0.258	17.78	< 0.01***	4.073	5.091

Mean dependent var	3.335	**SD dependent var**	0.701
R-squared	0.329	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.5

E-health Importance for Creating New Health Care Products and Services

E-health Importance	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.18	0.051	3.51	0.001***	0.079	0.281
Cardiologist	0.514	0.229	2.25	0.026**	0.062	0.966
ENT	0.256	0.258	0.99	0.323	-0.253	0.765
Family Physician	0.126	0.194	0.65	0.517	-0.257	0.51
General Practitioner	0.355	0.195	1.82	0.07*	-0.03	0.739
Neurologist	0.363	0.181	2.01	0.046**	0.006	0.719
Pediatrician	-0.036	0.154	-0.23	0.818	-0.339	0.268
Gender	-0.053	0.146	-0.36	0.716	-0.342	0.235
26–35 Years Old	0.202	0.614	0.33	0.743	-1.011	1.414
36–45 Years Old	0.084	0.637	0.13	0.895	-1.174	1.342
46–55 Years Old	-0.266	0.653	-0.41	0.684	-1.556	1.023
Over 55 Years Old	-0.126	0.674	-0.19	0.852	-1.457	1.205
6–10 Years' Experience	-0.134	0.281	-0.48	0.635	-0.689	0.422
11–15 Years' Experience	0.005	0.304	0.02	0.986	-0.596	0.606
16–20 Years' Experience	0.132	0.333	0.4	0.692	-0.525	0.789
More than 20 Years	0.185	0.34	0.55	0.586	-0.485	0.856
Asir Region	-0.756	0.185	-4.09	< 0.01***	-1.121	-0.391
Eastern Region	-0.541	0.287	-1.89	0.061*	-1.108	0.025
Ha'il Region	-0.254	0.537	-0.47	0.637	-1.314	0.806
Al Jawf Region	-1.815	0.28	-6.47	< 0.01***	-2.368	-1.261
Jazan Region	-1.006	0.59	-1.71	0.09*	-2.171	0.159
Makkah Region	-0.749	0.234	-3.2	0.002***	-1.21	-0.287
Al Medina Region	-1.186	0.201	-5.9	< 0.01***	-1.583	-0.79
Najran Region	-1.096	0.304	-3.6	< 0.01***	-1.697	-0.494
Northern Border Region	-0.785	0.324	-2.42	0.017**	-1.425	-0.145
Al Qassim Region	-2.153	0.934	-2.3	0.022**	-3.999	-0.308
Riyadh Region	-0.743	0.18	-4.12	< 0.01***	-1.098	-0.387
Tabuk Region	-1.218	0.225	-5.42	< 0.01***	-1.662	-0.774
Constant	3.578	0.608	5.89	< 0.01***	2.378	4.779

Mean dependent var	3.319	**SD dependent var**	0.705
R-squared	0.296	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.6

The Speed of Admitting Patients After Implementing E-health

Admission Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.027	0.111	0.24	0.808	-0.192	0.246
Cardiologist	1.229	0.555	2.21	0.028**	0.133	2.326
ENT	0.036	0.28	0.13	0.899	-0.517	0.588
Family Physician	0.455	0.513	0.89	0.377	-0.559	1.469
General Practitioner	0.076	0.516	0.15	0.883	-0.944	1.096
Neurologist	0.807	0.398	2.03	0.044**	0.021	1.593
Pediatrician	-0.186	0.349	-0.53	0.594	-0.876	0.503
Gender	-0.266	0.236	-1.13	0.261	-0.731	0.2
26–35 Years Old	1.114	0.865	1.29	0.2	-0.595	2.822
36–45 Years Old	0.94	1.09	0.86	0.39	-1.213	3.094
46–55 Years Old	0.867	1.067	0.81	0.418	-1.24	2.973
Over 55 Years Old	0.453	1.096	0.41	0.68	-1.712	2.618
6–10 Years' Experience	-0.28	0.455	-0.62	0.539	-1.178	0.619
11–15 Years' Experience	0.148	0.713	0.21	0.836	-1.26	1.556
16–20 Years' Experience	0.43	0.719	0.6	0.55	-0.989	1.85
More than 20 Years	0.365	0.698	0.52	0.602	-1.013	1.743
Asir Region	-1.249	0.396	-3.15	0.002***	-2.031	-0.466
Eastern Region	-0.631	0.442	-1.43	0.155	-1.503	0.241
Ha'il Region	0.696	0.687	1.01	0.312	-0.66	2.053
Al Jawf Region	-0.202	0.606	-0.33	0.739	-1.399	0.995
Jazan Region	-1.363	0.703	-1.94	0.054*	-2.751	0.026
Makkah Region	-0.962	0.401	-2.4	0.018**	-1.754	-0.171
Al Medina Region	-0.846	0.363	-2.33	0.021**	-1.563	-0.129
Najran Region	-1.574	0.741	-2.12	0.035**	-3.038	-0.11
Northern Border Region	0.303	0.387	0.78	0.436	-0.462	1.068
Al Qassim Region	-1.817	1.614	-1.13	0.262	-5.005	1.371
Riyadh Region	-0.79	0.321	-2.46	0.015**	-1.425	-0.156
Tabuk Region	-2.087	0.832	-2.51	0.013**	-3.73	-0.444
Constant	4.913	0.847	5.8	< 0.01***	3.24	6.586

Mean dependent var	4.979	**SD dependent var**	1.360
R-squared	0.147	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.7

The Speed of Admitting Patients After Implementing E-Health With Training

Patient Admission Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	-0.057	0.107	-0.53	0.594	-0.269	0.154
Experience with e-health	0.35	0.121	2.91	0.004***	0.112	0.589
Cardiologist	1.132	0.503	2.25	0.026**	0.14	2.125
ENT	0.105	0.284	0.37	0.711	-0.455	0.666
Family Physician	0.306	0.509	0.6	0.549	-0.699	1.31
General Practitioner	0.006	0.585	0.01	0.992	-1.149	1.161
Neurologist	0.844	0.409	2.06	0.041**	0.036	1.652
Pediatrician	-0.162	0.342	-0.47	0.637	-0.837	0.514
Gender	-0.197	0.235	-0.84	0.402	-0.661	0.266
26–35 Years Old	0.337	0.791	0.43	0.671	-1.225	1.899
36–45 Years Old	-0.042	1.024	-0.04	0.968	-2.065	1.981
46–55 Years Old	0.051	0.975	0.05	0.958	-1.874	1.977
Over 55 Years Old	-0.398	1	-0.4	0.691	-2.373	1.577
6–10 Years' Experience	-0.208	0.463	-0.45	0.654	-1.121	0.706
11–15 Years' Experience	0.248	0.751	0.33	0.742	-1.236	1.731
16–20 Years' Experience	0.363	0.738	0.49	0.623	-1.095	1.822
More than 20 Years	0.287	0.712	0.4	0.687	-1.12	1.694
Asir Region	-1.091	0.389	-2.81	0.006***	-1.858	-0.323
Eastern Region	-0.322	0.436	-0.74	0.461	-1.184	0.539
Ha'il Region	0.078	0.462	0.17	0.866	-0.834	0.99
Al Jawf Region	0.238	0.684	0.35	0.729	-1.114	1.59
Jazan Region	-1.327	0.601	-2.21	0.029**	-2.513	-0.141
Makkah Region	-0.873	0.38	-2.3	0.023**	-1.622	-0.123
Al Medina Region	-0.63	0.356	-1.77	0.079*	-1.333	0.073
Najran Region	-1.482	0.647	-2.29	0.023**	-2.761	-0.204
Northern Border Region	0.135	0.397	0.34	0.735	-0.65	0.919
Al Qassim Region	-1.698	1.298	-1.31	0.193	-4.262	0.867
Riyadh Region	-0.793	0.332	-2.39	0.018**	-1.449	-0.137
Tabuk Region	-1.877	0.928	-2.02	0.045**	-3.71	-0.044
Constant	4.108	0.88	4.67	< 0.01***	2.371	5.846

Mean dependent var	4.979	**SD dependent var**	1.360
R-squared	0.201	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.8

Speed in Completing Examinations After Implementing E-health

Patient Examination Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.101	0.11	0.91	0.363	-0.117	0.319
Cardiologist	1.042	0.308	3.38	0.001***	0.432	1.651
ENT	-0.113	0.428	-0.26	0.792	-0.958	0.732
Family Physician	0.462	0.393	1.17	0.242	-0.315	1.239
General Practitioner	0.087	0.617	0.14	0.888	-1.131	1.305
Neurologist	0.204	0.231	0.88	0.379	-0.253	0.661
Pediatrician	-0.239	0.325	-0.74	0.463	-0.881	0.402
Gender	0.165	0.288	0.57	0.569	-0.405	0.734
26–35 Years Old	-0.159	0.405	-0.39	0.696	-0.958	0.641
36–45 Years Old	0.617	0.531	1.16	0.247	-0.433	1.666
46–55 Years Old	0.657	0.567	1.16	0.248	-0.462	1.777
Over 55 Years Old	-0.103	0.656	-0.16	0.875	-1.4	1.193
6–10 Years' Experience	-0.033	0.474	-0.07	0.945	-0.969	0.904
11–15 Years' Experience	-0.311	0.508	-0.61	0.542	-1.315	0.693
16–20 Years' Experience	0.207	0.525	0.39	0.694	-0.83	1.244
More than 20 Years	-0.302	0.534	-0.57	0.573	-1.356	0.752
Asir Region	1.073	1.538	0.7	0.486	-1.964	4.11
Eastern Region	1.334	1.571	0.85	0.397	-1.769	4.437
Ha'il Region	1.884	1.533	1.23	0.221	-1.144	4.911
Al Jawf Region	1.899	1.636	1.16	0.248	-1.332	5.13
Jazan Region	1.922	1.517	1.27	0.207	-1.074	4.919
Makkah Region	1.967	1.528	1.29	0.2	-1.052	4.985
Al Medina Region	1.514	1.54	0.98	0.327	-1.527	4.556
Najran Region	1.049	1.558	0.67	0.502	-2.029	4.127
Northern Border Region	2.782	1.593	1.75	0.083*	-0.366	5.929
Al Qassim Region	1.104	1.971	0.56	0.576	-2.789	4.997
Riyadh Region	1.781	1.525	1.17	0.244	-1.23	4.792
Tabuk Region	0.738	1.744	0.42	0.673	-2.707	4.183
Constant	2.623	1.558	1.68	0.094*	-0.454	5.7

Mean dependent var	4.840	**SD dependent var**	1.323
R-squared	0.239	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.9

Speed in Completing Examinations After Implementing E-health With Staff Training

Patient Examination Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.028	0.111	0.25	0.803	-0.191	0.247
Experience with e-health	0.304	0.123	2.47	0.015**	0.061	0.547
Cardiologist	0.957	0.328	2.91	0.004***	0.309	1.606
ENT	-0.053	0.424	-0.12	0.901	-0.89	0.785
Family Physician	0.332	0.399	0.83	0.405	-0.455	1.12
General Practitioner	0.027	0.685	0.04	0.969	-1.326	1.379
Neurologist	0.236	0.208	1.14	0.257	-0.174	0.647
Pediatrician	-0.218	0.314	-0.69	0.488	-0.837	0.402
Gender	0.224	0.291	0.77	0.443	-0.351	0.798
26–35 Years Old	-0.832	0.678	-1.23	0.222	-2.171	0.507
36–45 Years Old	-0.235	0.77	-0.3	0.761	-1.755	1.286
46–55 Years Old	-0.05	0.761	-0.07	0.948	-1.552	1.453
Over 55 Years Old	-0.842	0.829	-1.02	0.311	-2.478	0.795
6–10 Years' Experience	0.03	0.491	0.06	0.952	-0.94	1
11–15 Years' Experience	-0.224	0.529	-0.42	0.672	-1.27	0.821
16–20 Years' Experience	0.149	0.526	0.28	0.778	-0.891	1.189
More than 20 Years	-0.369	0.537	-0.69	0.493	-1.43	0.692
Asir Region	1.21	1.673	0.72	0.471	-2.094	4.514
Eastern Region	1.602	1.688	0.95	0.344	-1.733	4.937
Ha'il Region	1.348	1.704	0.79	0.43	-2.018	4.713
Al Jawf Region	2.28	1.797	1.27	0.206	-1.269	5.829
Jazan Region	1.954	1.67	1.17	0.244	-1.344	5.252
Makkah Region	2.044	1.662	1.23	0.22	-1.238	5.327
Al Medina Region	1.702	1.681	1.01	0.313	-1.619	5.022
Najran Region	1.128	1.693	0.67	0.506	-2.215	4.472
Northern Border Region	2.636	1.726	1.53	0.129	-0.774	6.045
Al Qassim Region	1.208	1.923	0.63	0.531	-2.59	5.006
Riyadh Region	1.779	1.662	1.07	0.286	-1.504	5.061
Tabuk Region	0.919	1.906	0.48	0.63	-2.845	4.684
Constant	1.925	1.761	1.09	0.276	-1.554	5.404

Mean dependent var	4.840	**SD dependent var**	1.323
R-squared	0.282	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.10

The Accuracy in Filling out the Report After Implementing E-Health

Accuracy	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.063	0.092	0.69	0.491	-0.118	0.245
Cardiologist	0.252	0.344	0.73	0.465	-0.428	0.932
ENT	-0.123	0.407	-0.3	0.763	-0.927	0.681
Family Physician	0.48	0.363	1.32	0.188	-0.238	1.198
General Practitioner	0.588	0.52	1.13	0.26	-0.439	1.616
Neurologist	0.393	0.298	1.32	0.188	-0.195	0.982
Pediatrician	0.166	0.23	0.72	0.472	-0.289	0.621
Gender	-0.097	0.276	-0.35	0.725	-0.643	0.449
26–35 Years Old	0.741	0.968	0.77	0.445	-1.172	2.654
36–45 Years Old	0.68	1.176	0.58	0.564	-1.642	3.003
46–55 Years Old	0.581	1.142	0.51	0.612	-1.675	2.837
Over 55 Years Old	0.32	1.161	0.28	0.783	-1.974	2.613
6–10 Years' Experience	-0.307	0.558	-0.55	0.583	-1.408	0.795
11–15 Years' Experience	0.109	0.778	0.14	0.889	-1.427	1.644
16–20 Years' Experience	0.696	0.792	0.88	0.381	-0.868	2.259
More than 20 Years	0.482	0.76	0.64	0.526	-1.018	1.983
Asir Region	0.132	0.773	0.17	0.864	-1.394	1.659
Eastern Region	0.331	0.998	0.33	0.741	-1.641	2.302
Ha'il Region	0.811	0.963	0.84	0.401	-1.09	2.713
Al Jawf Region	-0.78	0.893	-0.87	0.384	-2.543	0.983
Jazan Region	1.024	0.849	1.21	0.229	-0.652	2.7
Makkah Region	0.272	0.744	0.37	0.715	-1.198	1.743
Al Medina Region	0.184	0.795	0.23	0.817	-1.385	1.754
Najran Region	0.475	0.825	0.58	0.565	-1.153	2.104
Northern Border Region	1.404	0.806	1.74	0.084*	-0.189	2.996
Al Qassim Region	-0.041	1.433	-0.03	0.977	-2.871	2.789
Riyadh Region	0.594	0.746	0.8	0.427	-0.879	2.066
Tabuk Region	0.488	0.766	0.64	0.525	-1.024	2.001
Constant	3.659	1.146	3.19	0.002***	1.397	5.922
Mean dependent var		5.117		**SD dependent var**		1.164
R-squared		0.127		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.11

The Accuracy in Filling out the Report After Implementing E-Health With Staff Training

Accuracy	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	-0.037	0.081	-0.46	0.646	-0.196	0.122
Experience with e-health	0.418	0.113	3.69	< 0.01***	0.195	0.642
Cardiologist	0.136	0.319	0.43	0.67	-0.494	0.766
ENT	-0.04	0.372	-0.11	0.914	-0.776	0.696
Family Physician	0.302	0.315	0.96	0.339	-0.32	0.923
General Practitioner	0.505	0.621	0.81	0.417	-0.721	1.731
Neurologist	0.438	0.294	1.49	0.138	-0.143	1.019
Pediatrician	0.196	0.216	0.91	0.365	-0.23	0.622
Gender	-0.016	0.257	-0.06	0.951	-0.524	0.492
26–35 Years Old	-0.186	0.89	-0.21	0.835	-1.943	1.571
36–45 Years Old	-0.492	1.073	-0.46	0.647	-2.612	1.628
46–55 Years Old	-0.392	1.039	-0.38	0.706	-2.446	1.661
Over 55 Years Old	-0.697	1.058	-0.66	0.511	-2.787	1.393
6–10 Years' Experience	-0.221	0.57	-0.39	0.699	-1.347	0.905
11–15 Years' Experience	0.228	0.76	0.3	0.765	-1.273	1.728
16–20 Years' Experience	0.616	0.765	0.81	0.422	-0.895	2.126
More than 20 Years	0.39	0.745	0.52	0.601	-1.082	1.862
Asir Region	0.321	0.942	0.34	0.734	-1.539	2.181
Eastern Region	0.699	1.028	0.68	0.497	-1.331	2.73
Ha'il Region	0.073	1.006	0.07	0.942	-1.913	2.06
Al Jawf Region	-0.255	1.097	-0.23	0.817	-2.421	1.912
Jazan Region	1.067	1.098	0.97	0.333	-1.102	3.235
Makkah Region	0.38	0.919	0.41	0.68	-1.435	2.194
Al Medina Region	0.442	0.953	0.46	0.643	-1.439	2.324
Najran Region	0.585	0.98	0.6	0.551	-1.35	2.52
Northern Border Region	1.203	0.959	1.25	0.211	-0.691	3.096
Al Qassim Region	0.101	1.244	0.08	0.935	-2.355	2.558
Riyadh Region	0.59	0.92	0.64	0.522	-1.227	2.407
Tabuk Region	0.739	0.948	0.78	0.437	-1.134	2.611
Constant	2.698	1.261	2.14	0.034**	0.207	5.189
Mean dependent var		5.117	**SD dependent var**			1.164
R-squared		0.231	**Number of observations**			188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.12

The Completeness in Filling out the Report After Implementing E-Health

Completeness	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.188	0.091	2.06	0.041**	0.008	0.368
Cardiologist	0.183	0.312	0.59	0.558	-0.433	0.8
ENT	0.116	0.308	0.38	0.707	-0.492	0.725
Family Physician	0.017	0.48	0.03	0.972	-0.932	0.965
General Practitioner	0.674	0.263	2.56	0.011**	0.155	1.192
Neurologist	0.345	0.303	1.14	0.256	-0.253	0.943
Pediatrician	-0.112	0.221	-0.51	0.613	-0.549	0.325
Gender	-0.27	0.264	-1.02	0.309	-0.792	0.252
26–35 Years Old	1.441	0.937	1.54	0.126	-0.409	3.291
36–45 Years Old	1.341	1.139	1.18	0.241	-0.91	3.591
46–55 Years Old	1.174	1.123	1.05	0.297	-1.044	3.391
Over 55 Years Old	0.827	1.144	0.72	0.471	-1.432	3.086
6–10 Years' Experience	-0.791	0.441	-1.79	0.075*	-1.662	0.08
11–15 Years' Experience	-0.202	0.673	-0.3	0.765	-1.531	1.127
16–20 Years' Experience	0.313	0.684	0.46	0.647	-1.038	1.664
More than 20 Years	0.277	0.669	0.41	0.68	-1.046	1.599
Asir Region	0.821	0.501	1.64	0.103	-0.169	1.811
Eastern Region	0.571	0.789	0.72	0.471	-0.988	2.129
Ha'il Region	1.767	0.893	1.98	0.05**	0.003	3.53
Al Jawf Region	0.694	0.544	1.28	0.204	-0.38	1.768
Jazan Region	1.098	0.543	2.02	0.045**	0.025	2.17
Makkah Region	1.071	0.439	2.44	0.016**	0.204	1.938
Al Medina Region	0.666	0.528	1.26	0.209	-0.377	1.71
Najran Region	1.291	0.587	2.2	0.029**	0.132	2.451
Northern Border Region	2.328	0.576	4.04	< 0.01***	1.191	3.464
Al Qassim Region	-1.929	0.804	-2.4	0.018**	-3.518	-0.341
Riyadh Region	1.325	0.472	2.81	0.006***	0.393	2.257
Tabuk Region	1.022	0.572	1.79	0.076*	-0.109	2.152
Constant	2.496	1.019	2.45	0.015**	0.484	4.509

Mean dependent var	5.074	**SD dependent var**	1.195
R-squared	0.258	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.13

Training and Experience in Using Electronic Services

Expertise	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.24	0.09	2.67	0.008***	0.063	0.418
Cardiologist	0.277	0.377	0.74	0.463	-0.467	1.021
ENT	-0.198	0.323	-0.61	0.54	-0.836	0.44
Family Physician	0.426	0.35	1.22	0.225	-0.264	1.117
General Practitioner	0.199	0.536	0.37	0.711	-0.86	1.258
Neurologist	-0.107	0.267	-0.4	0.69	-0.634	0.421
Pediatrician	-0.071	0.188	-0.38	0.708	-0.443	0.301
Gender	-0.195	0.232	-0.84	0.403	-0.654	0.264
26–35 Years Old	2.216	0.976	2.27	0.025**	0.288	4.143
36–45 Years Old	2.802	1.038	2.7	0.008***	0.752	4.851
46–55 Years Old	2.326	1.053	2.21	0.029**	0.246	4.406
Over 55 Years Old	2.43	1.065	2.28	0.024**	0.326	4.534
6–10 Years' Experience	-0.206	0.488	-0.42	0.674	-1.169	0.757
11–15 Years' Experience	-0.284	0.516	-0.55	0.583	-1.303	0.735
16–20 Years' Experience	0.191	0.541	0.35	0.724	-0.878	1.26
More than 20 Years	0.221	0.552	0.4	0.69	-0.87	1.312
Asir Region	-0.45	0.504	-0.89	0.373	-1.447	0.546
Eastern Region	-0.881	0.727	-1.21	0.227	-2.317	0.555
Ha'il Region	1.764	1.604	1.1	0.273	-1.405	4.933
Al Jawf Region	-1.255	0.733	-1.71	0.089*	-2.704	0.193
Jazan Region	-0.103	0.749	-0.14	0.891	-1.582	1.377
Makkah Region	-0.256	0.519	-0.49	0.623	-1.281	0.769
Al Medina Region	-0.616	0.56	-1.1	0.273	-1.722	0.489
Najran Region	-0.263	0.657	-0.4	0.69	-1.56	1.035
Northern Border Region	0.48	0.513	0.94	0.351	-0.533	1.493
Al Qassim Region	-0.341	1.085	-0.31	0.754	-2.484	1.803
Riyadh Region	0.008	0.49	0.02	0.987	-0.961	0.977
Tabuk Region	-0.599	0.87	-0.69	0.493	-2.318	1.12
Constant	2.297	1.033	2.22	0.028**	0.258	4.337
Mean dependent var		5.064	**SD dependent var**			1.078
R-squared		0.306	**Number of observations**			188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.14

The Importance of E-Health in Terms of Doctor's Relationship With Their Patients

Relationship	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.106	0.107	0.99	0.322	-0.105	0.317
Cardiologist	0.899	0.472	1.91	0.059*	-0.033	1.831
ENT	-0.054	0.609	-0.09	0.93	-1.256	1.148
Family Physician	0.528	0.499	1.06	0.292	-0.458	1.515
General Practitioner	0.38	0.474	0.8	0.424	-0.557	1.317
Neurologist	0.513	0.384	1.34	0.183	-0.245	1.271
Pediatrician	0.219	0.293	0.75	0.455	-0.359	0.798
Gender	-0.303	0.288	-1.05	0.294	-0.871	0.265
26–35 Years Old	-0.522	0.452	-1.16	0.25	-1.416	0.371
36–45 Years Old	0.286	0.823	0.35	0.728	-1.339	1.912
46–55 Years Old	0.259	0.848	0.31	0.76	-1.416	1.934
Over 55 Years Old	0.1	0.935	0.11	0.915	-1.747	1.947
6–10 Years' Experience	-1.637	0.46	-3.56	< 0.01***	-2.546	-0.729
11–15 Years' Experience	-1.832	0.769	-2.38	0.018**	-3.35	-0.314
16–20 Years' Experience	-1.118	0.763	-1.46	0.145	-2.626	0.389
More than 20 Years	-1.728	0.799	-2.16	0.032**	-3.307	-0.149
Asir Region	-0.879	0.702	-1.25	0.212	-2.265	0.507
Eastern Region	-1.638	1.055	-1.55	0.123	-3.722	0.446
Ha'il Region	-0.139	0.701	-0.2	0.843	-1.523	1.245
Al Jawf Region	-2.187	0.859	-2.55	0.012**	-3.883	-0.49
Jazan Region	-1.18	0.711	-1.66	0.099*	-2.585	0.225
Makkah Region	-1.005	0.708	-1.42	0.158	-2.403	0.394
Al Medina Region	-1.2	0.734	-1.63	0.104	-2.65	0.25
Najran Region	-0.857	0.84	-1.02	0.309	-2.516	0.802
Northern Border Region	-2.844	1.123	-2.53	0.012**	-5.061	-0.626
Al Qassim Region	-0.987	1.789	-0.55	0.582	-4.521	2.547
Riyadh Region	-0.688	0.688	-1	0.319	-2.047	0.672
Tabuk Region	-2.314	0.932	-2.48	0.014**	-4.156	-0.472
Constant	6.517	0.75	8.69	< 0.01***	5.035	7.998

Mean dependent var	4.452	**SD dependent var**	1.456
R-squared	0.233	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.15

The Effect of E-Health on Medical Staff Satisfaction Ratings

Medical Staff Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.024	0.104	0.24	0.814	-0.181	0.23
Cardiologist	1.031	0.364	2.83	0.005***	0.313	1.749
ENT	0.191	0.242	0.79	0.431	-0.287	0.668
Family Physician	0.111	0.38	0.29	0.771	-0.639	0.861
General Practitioner	-0.006	0.541	-0.01	0.991	-1.075	1.063
Neurologist	0.663	0.308	2.15	0.033**	0.054	1.272
Pediatrician	0.153	0.25	0.61	0.541	-0.34	0.647
Gender	-0.253	0.267	-0.95	0.344	-0.78	0.274
26–35 Years Old	0.436	0.841	0.52	0.605	-1.225	2.098
36–45 Years Old	0.982	0.903	1.09	0.278	-0.802	2.767
46–55 Years Old	1.029	0.956	1.08	0.283	-0.859	2.916
Over 55 Years Old	0.729	0.985	0.74	0.46	-1.217	2.674
6–10 Years' Experience	0.031	0.602	0.05	0.959	-1.158	1.22
11–15 Years' Experience	-0.085	0.638	-0.13	0.894	-1.345	1.175
16–20 Years' Experience	0.068	0.674	0.1	0.92	-1.263	1.399
More than 20 Years	-0.131	0.681	-0.19	0.848	-1.476	1.214
Asir Region	-1.295	0.652	-1.99	0.049**	-2.583	-0.007
Eastern Region	-0.691	0.851	-0.81	0.418	-2.37	0.989
Ha'il Region	-0.022	0.809	-0.03	0.978	-1.62	1.576
Al Jawf Region	0.322	0.841	0.38	0.703	-1.34	1.984
Jazan Region	-0.102	0.767	-0.13	0.894	-1.616	1.412
Makkah Region	-0.665	0.625	-1.06	0.289	-1.899	0.57
Al Medina Region	-0.751	0.657	-1.14	0.255	-2.049	0.547
Najran Region	-0.95	0.731	-1.3	0.196	-2.393	0.493
Northern Border Region	0.236	0.775	0.3	0.761	-1.295	1.767
Al Qassim Region	-1.007	1.346	-0.75	0.456	-3.666	1.652
Riyadh Region	-0.226	0.617	-0.37	0.715	-1.445	0.993
Tabuk Region	-0.466	0.956	-0.49	0.627	-2.353	1.422
Constant	4.789	0.926	5.17	< 0.01***	2.961	6.617

Mean dependent var	4.936	**SD dependent var**	1.226
R-squared	0.209	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.16

The Effect of E-Health on Medical Staff Satisfaction Ratings With Training

Medical Staff Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	-0.135	0.083	-1.64	0.104	-0.299	0.028
Experience with e-health	0.665	0.09	7.37	< 0.01***	0.487	0.843
Cardiologist	0.847	0.321	2.64	0.009***	0.213	1.48
ENT	0.322	0.205	1.58	0.117	-0.082	0.726
Family Physician	-0.172	0.337	-0.51	0.61	-0.839	0.494
General Practitioner	-0.138	0.329	-0.42	0.675	-0.789	0.512
Neurologist	0.734	0.281	2.61	0.01***	0.179	1.289
Pediatrician	0.2	0.221	0.91	0.366	-0.236	0.637
Gender	-0.124	0.22	-0.56	0.576	-0.559	0.312
26–35 Years Old	-1.036	0.855	-1.21	0.227	-2.726	0.653
36–45 Years Old	-0.88	0.9	-0.98	0.33	-2.658	0.898
46–55 Years Old	-0.517	0.926	-0.56	0.577	-2.347	1.312
Over 55 Years Old	-0.886	0.929	-0.95	0.341	-2.721	0.948
6–10 Years' Experience	0.168	0.466	0.36	0.72	-0.754	1.089
11–15 Years' Experience	0.104	0.505	0.21	0.838	-0.893	1.101
16–20 Years' Experience	-0.059	0.534	-0.11	0.911	-1.113	0.995
More than 20 Years	-0.277	0.548	-0.51	0.613	-1.36	0.805
Asir Region	-0.995	0.384	-2.59	0.01**	-1.755	-0.236
Eastern Region	-0.105	0.482	-0.22	0.828	-1.056	0.846
Ha'il Region	-1.194	1.483	-0.81	0.422	-4.124	1.735
Al Jawf Region	1.156	0.515	2.25	0.026**	0.14	2.172
Jazan Region	-0.034	0.387	-0.09	0.93	-0.798	0.73
Makkah Region	-0.495	0.396	-1.25	0.214	-1.277	0.288
Al Medina Region	-0.341	0.409	-0.83	0.405	-1.15	0.467
Najran Region	-0.775	0.441	-1.76	0.081*	-1.645	0.095
Northern Border Region	-0.083	0.564	-0.15	0.883	-1.196	1.03
Al Qassim Region	-0.78	0.679	-1.15	0.252	-2.122	0.561
Riyadh Region	-0.231	0.341	-0.68	0.499	-0.905	0.442
Tabuk Region	-0.068	0.471	-0.14	0.886	-0.998	0.863
Constant	3.263	0.807	4.04	< 0.01***	1.668	4.857

Mean dependent var	4.936	**SD dependent var**	1.226
R-squared	0.446	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.17

The Effect of E-Health on Administrators Staff Satisfaction Ratings

Administration Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.123	0.101	1.23	0.222	-0.075	0.322
Cardiologist	1.451	0.369	3.94	< 0.01***	0.723	2.179
ENT	0.096	0.486	0.2	0.844	-0.864	1.056
Family Physician	0.611	0.395	1.55	0.124	-0.169	1.391
General Practitioner	0.706	0.354	1.99	0.048**	0.007	1.404
Neurologist	0.801	0.263	3.05	0.003***	0.281	1.32
Pediatrician	0.363	0.253	1.44	0.153	-0.136	0.863
Gender	-0.111	0.291	-0.38	0.704	-0.685	0.463
26–35 Years Old	-0.067	0.524	-0.13	0.898	-1.101	0.967
36–45 Years Old	0.48	0.632	0.76	0.448	-0.768	1.729
46–55 Years Old	0.507	0.699	0.73	0.469	-0.873	1.887
Over 55 Years Old	-0.008	0.75	-0.01	0.992	-1.488	1.473
6–10 Years' Experience	-0.051	0.593	-0.09	0.931	-1.221	1.119
11–15 Years' Experience	-0.66	0.666	-0.99	0.324	-1.976	0.657
16–20 Years' Experience	-0.091	0.668	-0.14	0.892	-1.41	1.228
More than 20 Years	-0.234	0.69	-0.34	0.735	-1.598	1.129
Asir Region	-1.284	0.415	-3.09	0.002***	-2.104	-0.464
Eastern Region	-0.478	0.76	-0.63	0.53	-1.978	1.023
Ha'il Region	-0.621	0.408	-1.52	0.131	-1.427	0.186
Al Jawf Region	-0.387	0.54	-0.72	0.474	-1.454	0.679
Jazan Region	0.53	0.446	1.19	0.237	-0.352	1.411
Makkah Region	-0.976	0.38	-2.57	0.011**	-1.727	-0.226
Al Medina Region	-1.07	0.445	-2.41	0.017**	-1.948	-0.191
Najran Region	-1.402	0.555	-2.53	0.012**	-2.497	-0.307
Northern Border Region	1.104	0.402	2.75	0.007***	0.311	1.897
Al Qassim Region	0.01	0.973	0.01	0.992	-1.913	1.933
Riyadh Region	-0.204	0.349	-0.58	0.56	-0.894	0.486
Tabuk Region	-0.524	0.53	-0.99	0.324	-1.57	0.522
Constant	4.91	0.46	10.67	< 0.01***	4.001	5.819

Mean dependent var	4.798	**SD dependent var**	1.345
R-squared	0.261	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.18:
The Effect of E-Health on Administrators Staff Satisfaction Ratings With Training

Administration Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0	0.085	0	0.999	-0.168	0.168
Experience with e-health	0.513	0.101	5.07	< 0.01***	0.313	0.712
Cardiologist	1.309	0.377	3.48	0.001***	0.565	2.053
ENT	0.197	0.474	0.42	0.678	-0.74	1.134
Family Physician	0.393	0.389	1.01	0.315	-0.376	1.161
General Practitioner	0.604	0.36	1.68	0.095*	-0.107	1.314
Neurologist	0.856	0.244	3.51	0.001***	0.374	1.338
Pediatrician	0.4	0.226	1.77	0.078*	-0.046	0.845
Gender	-0.011	0.277	-0.04	0.969	-0.558	0.536
26–35 Years Old	-1.203	0.776	-1.55	0.123	-2.736	0.33
36–45 Years Old	-0.956	0.85	-1.12	0.263	-2.635	0.724
46–55 Years Old	-0.685	0.886	-0.77	0.44	-2.435	1.064
Over 55 Years Old	-1.253	0.924	-1.36	0.177	-3.078	0.572
6–10 Years' Experience	0.054	0.57	0.1	0.924	-1.072	1.181
11–15 Years' Experience	-0.514	0.647	-0.79	0.428	-1.792	0.764
16–20 Years' Experience	-0.189	0.639	-0.3	0.767	-1.451	1.073
More than 20 Years	-0.348	0.673	-0.52	0.606	-1.676	0.981
Asir Region	-1.053	0.556	-1.89	0.06*	-2.152	0.046
Eastern Region	-0.026	0.702	-0.04	0.971	-1.413	1.361
Ha'il Region	-1.525	1.148	-1.33	0.186	-3.792	0.743
Al Jawf Region	0.256	0.669	0.38	0.702	-1.065	1.578
Jazan Region	0.582	0.697	0.84	0.405	-0.794	1.958
Makkah Region	-0.845	0.543	-1.56	0.122	-1.918	0.227
Al Medina Region	-0.754	0.585	-1.29	0.2	-1.91	0.402
Najran Region	-1.267	0.682	-1.86	0.065*	-2.615	0.08
Northern Border Region	0.858	0.558	1.54	0.126	-0.244	1.96
Al Qassim Region	0.185	0.695	0.27	0.791	-1.189	1.558
Riyadh Region	-0.208	0.517	-0.4	0.688	-1.229	0.813
Tabuk Region	-0.217	0.625	-0.35	0.728	-1.451	1.016
Constant	3.733	0.818	4.56	< 0.01***	2.117	5.348

Mean dependent var	4.798	**SD dependent var**	1.345
R-squared	0.378	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.19

The Effect of E-Health on Patient's Satisfaction Ratings

Patient Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.053	0.116	0.46	0.649	-0.176	0.281
Cardiologist	1.122	0.442	2.54	0.012**	0.249	1.996
ENT	0.181	0.535	0.34	0.736	-0.877	1.238
Family Physician	0.765	0.367	2.09	0.039**	0.041	1.489
General Practitioner	0.246	0.565	0.43	0.664	-0.87	1.361
Neurologist	-0.773	1.012	-0.76	0.446	-2.772	1.226
Pediatrician	0.198	0.291	0.68	0.497	-0.377	0.774
Gender	-0.51	0.237	-2.15	0.033**	-0.977	-0.042
26–35 Years Old	0.381	0.537	0.71	0.479	-0.68	1.443
36–45 Years Old	1.04	0.641	1.62	0.107	-0.226	2.306
46–55 Years Old	1.226	0.69	1.78	0.077*	-0.136	2.589
Over 55 Years Old	0.946	0.752	1.26	0.21	-0.539	2.432
6–10 Years' Experience	-0.496	0.512	-0.97	0.335	-1.507	0.516
11–15 Years' Experience	-1.095	0.583	-1.88	0.062*	-2.246	0.055
16–20 Years' Experience	-0.378	0.587	-0.64	0.521	-1.538	0.782
More than 20 Years	-0.895	0.607	-1.47	0.143	-2.094	0.305
Asir Region	1.218	1.134	1.07	0.284	-1.021	3.458
Eastern Region	1.569	1.174	1.34	0.183	-0.749	3.887
Ha'il Region	1.719	1.154	1.49	0.138	-0.559	3.998
Al Jawf Region	2.346	1.262	1.86	0.065*	-0.146	4.838
Jazan Region	2.213	1.146	1.93	0.055*	-0.049	4.476
Makkah Region	1.282	1.136	1.13	0.261	-0.962	3.526
Al Medina Region	1.455	1.14	1.28	0.204	-0.796	3.705
Najran Region	1.315	1.248	1.05	0.294	-1.151	3.78
Northern Border Region	2.108	1.136	1.85	0.065*	-0.136	4.352
Al Qassim Region	1.861	1.662	1.12	0.264	-1.421	5.143
Riyadh Region	1.988	1.115	1.78	0.076*	-0.214	4.19
Tabuk Region	1.622	1.186	1.37	0.173	-0.721	3.964
Constant	3.045	1.19	2.56	0.011**	0.695	5.395
Mean dependent var		4.787		**SD dependent var**		1.347
R-squared		0.215		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.20

The Effect of E-Health on Patient's Satisfaction Ratings With Training

Patient Satisfaction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	-0.069	0.107	-0.65	0.516	-0.28	0.141
Experience with e-health	0.509	0.103	4.95	< 0.01***	0.306	0.712
Cardiologist	0.981	0.405	2.42	0.016**	0.182	1.781
ENT	0.281	0.544	0.52	0.606	-0.794	1.357
Family Physician	0.548	0.325	1.69	0.093*	-0.093	1.19
General Practitioner	0.144	0.391	0.37	0.712	-0.628	0.917
Neurologist	-0.719	0.995	-0.72	0.471	-2.684	1.247
Pediatrician	0.234	0.285	0.82	0.412	-0.329	0.798
Gender	-0.41	0.201	-2.04	0.043**	-0.808	-0.013
26–35 Years Old	-0.746	0.616	-1.21	0.228	-1.962	0.47
36–45 Years Old	-0.385	0.707	-0.54	0.587	-1.782	1.011
46–55 Years Old	0.043	0.725	0.06	0.953	-1.389	1.476
Over 55 Years Old	-0.29	0.784	-0.37	0.712	-1.838	1.259
6–10 Years' Experience	-0.391	0.425	-0.92	0.36	-1.231	0.449
11–15 Years' Experience	-0.951	0.529	-1.8	0.074*	-1.995	0.094
16–20 Years' Experience	-0.475	0.512	-0.93	0.355	-1.487	0.536
More than 20 Years	-1.007	0.544	-1.85	0.066*	-2.081	0.068
Asir Region	1.448	1.349	1.07	0.285	-1.217	4.112
Eastern Region	2.017	1.38	1.46	0.146	-0.709	4.743
Ha'il Region	0.822	1.686	0.49	0.627	-2.508	4.152
Al Jawf Region	2.984	1.416	2.11	0.037**	0.187	5.781
Jazan Region	2.266	1.36	1.67	0.098*	-0.42	4.951
Makkah Region	1.412	1.364	1.04	0.302	-1.282	4.105
Al Medina Region	1.768	1.344	1.32	0.19	-0.886	4.422
Najran Region	1.448	1.427	1.01	0.312	-1.37	4.266
Northern Border Region	1.864	1.352	1.38	0.17	-0.806	4.533
Al Qassim Region	2.035	1.544	1.32	0.189	-1.015	5.084
Riyadh Region	1.984	1.336	1.49	0.14	-0.655	4.623
Tabuk Region	1.926	1.379	1.4	0.164	-0.797	4.65
Constant	1.876	1.407	1.33	0.184	-0.902	4.655

Mean dependent var	4.787	**SD dependent var**	1.347
R-squared	0.330	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.21

The Effect of E-Health on Medical Errors

Medical Errors	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.083	0.072	1.15	0.252	-0.059	0.225
Cardiologist	0.191	0.307	0.62	0.534	-0.415	0.797
ENT	-0.03	0.3	-0.1	0.92	-0.623	0.563
Family Physician	0.141	0.287	0.49	0.623	-0.425	0.707
General Practitioner	0.515	0.383	1.34	0.181	-0.241	1.27
Neurologist	-0.65	0.534	-1.22	0.225	-1.704	0.404
Pediatrician	-0.123	0.183	-0.68	0.5	-0.484	0.237
Gender	-0.044	0.214	-0.21	0.837	-0.466	0.378
26–35 Years Old	-0.463	0.668	-0.69	0.489	-1.782	0.856
36–45 Years Old	-0.401	0.735	-0.55	0.586	-1.852	1.05
46–55 Years Old	-0.909	0.765	-1.19	0.237	-2.42	0.602
Over 55 Years Old	-1.095	0.788	-1.39	0.166	-2.652	0.461
6–10 Years' Experience	0.574	0.44	1.31	0.194	-0.294	1.443
11–15 Years' Experience	0.608	0.534	1.14	0.257	-0.447	1.663
16–20 Years' Experience	0.711	0.547	1.3	0.195	-0.369	1.791
More than 20 Years	0.951	0.57	1.67	0.097*	-0.174	2.077
Asir Region	-0.395	0.426	-0.93	0.355	-1.237	0.447
Eastern Region	-0.641	0.588	-1.09	0.277	-1.802	0.52
Ha'il Region	-0.039	0.648	-0.06	0.952	-1.319	1.242
Al Jawf Region	-0.549	0.582	-0.94	0.346	-1.698	0.599
Jazan Region	-0.474	0.676	-0.7	0.484	-1.808	0.86
Makkah Region	-0.754	0.491	-1.53	0.127	-1.724	0.217
Al Medina Region	-0.962	0.464	-2.08	0.04**	-1.878	-0.047
Najran Region	-0.766	0.519	-1.48	0.142	-1.79	0.259
Northern Border Region	0.274	0.482	0.57	0.571	-0.678	1.226
Al Qassim Region	-1.849	0.952	-1.94	0.054*	-3.729	0.031
Riyadh Region	-0.396	0.423	-0.94	0.351	-1.233	0.44
Tabuk Region	-1.075	0.542	-1.98	0.049**	-2.146	-0.005
Constant	4.437	0.673	6.59	< 0.01***	3.108	5.766
Mean dependent var		4.090		**SD dependent var**		0.900
R-squared		0.159		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 2.22

The Effect of E-Health on Medical Errors With Training

Medical Errors	Coef.	St.	t-value	p-value	[95%	Interval]

		Err.			Conf	
E-health services usage	0.045	0.075	0.6	0.55	-0.103	0.192
Experience with e-health	0.159	0.079	2.02	0.045**	0.003	0.315
Cardiologist	0.147	0.296	0.5	0.62	-0.438	0.732
ENT	0.001	0.325	0	0.997	-0.64	0.642
Family Physician	0.073	0.282	0.26	0.795	-0.483	0.63
General Practitioner	0.483	0.424	1.14	0.257	-0.355	1.32
Neurologist	-0.633	0.542	-1.17	0.244	-1.704	0.437
Pediatrician	-0.112	0.175	-0.64	0.521	-0.457	0.233
Gender	-0.013	0.208	-0.06	0.95	-0.423	0.397
26–35 Years Old	-0.815	0.648	-1.26	0.21	-2.094	0.464
36–45 Years Old	-0.847	0.72	-1.18	0.242	-2.27	0.576
46–55 Years Old	-1.279	0.756	-1.69	0.093*	-2.772	0.214
Over 55 Years Old	-1.482	0.786	-1.88	0.061*	-3.035	0.071
6–10 Years' Experience	0.607	0.461	1.32	0.19	-0.304	1.518
11–15 Years' Experience	0.653	0.556	1.17	0.242	-0.446	1.752
16–20 Years' Experience	0.681	0.574	1.19	0.237	-0.453	1.814
More than 20 Years	0.916	0.596	1.54	0.126	-0.261	2.093
Asir Region	-0.324	0.484	-0.67	0.505	-1.28	0.632
Eastern Region	-0.501	0.61	-0.82	0.412	-1.705	0.703
Ha'il Region	-0.319	0.577	-0.55	0.581	-1.459	0.82
Al Jawf Region	-0.35	0.665	-0.53	0.6	-1.663	0.964
Jazan Region	-0.458	0.756	-0.61	0.546	-1.95	1.035
Makkah Region	-0.713	0.534	-1.34	0.183	-1.767	0.341
Al Medina Region	-0.864	0.523	-1.65	0.1	-1.897	0.168
Najran Region	-0.724	0.568	-1.28	0.204	-1.845	0.397
Northern Border Region	0.197	0.538	0.37	0.714	-0.866	1.261
Al Qassim Region	-1.795	0.856	-2.1	0.038**	-3.485	-0.104
Riyadh Region	-0.398	0.485	-0.82	0.414	-1.356	0.561
Tabuk Region	-0.98	0.624	-1.57	0.118	-2.212	0.252
Constant	4.072	0.751	5.42	< 0.01***	2.589	5.555
Mean dependent var	4.090			**SD dependent var**		0.900
R-squared	0.184			**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Chapter 3

Physicians Perception of The Impact of E-health Reform on Patient's Referral Between the MOH Primary Care Centers and Hospitals

Abstract

Objective: This study aimed to examine physicians' perception of whether e-health reform in Saudi Arabia has enhanced the patient's referrals between the Ministry of Health (MOH) primary care centers and hospitals.

Method: An ordinary least squares (OLS) regression was used to model the relationship between e-health and patients' referrals. Measures related to referrals such as physician perceptions of bed availability, viewing patient's history, hospital and doctor's reputation, physician's communications, and remote diagnostics are used in the analysis. The outcome of the regression analysis provided the answer to whether or not it enhanced the patient's referrals after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA.

Results: A total of 188 physicians participated in the questionnaire. The outcomes indicate a significant enhancements in patient referrals in terms of speed, accuracy and completeness, bed availability, viewing patient's medical history, and remote diagnosis.

Conclusion: The analysis results demonstrated that physicians have a positive reception toward e-health reform. Physicians believed that e-health reform in Saudi Arabia has significantly enhanced patient referrals between the MOH primary care centers and hospitals, reduced the waiting time, and increased the number of referrals.

Introduction

The MOH in Saudi Arabia introduced the e-health system reform in 2011 (Ministry of Health, 2018a). One of the primary objectives of the reform is to have better care provided to patients by having a patient's complete file ready for the doctors. In 2016, the government of Saudi Arabia introduced vision 2030. The main vision objective is to reduce the country's dependency on oil and diversify its economy (Vision 2030, 2021).

Improving patient referral is one of MOH's objectives, as is increasing its efficiencies. Implementing E-health strategies can help health care organizations avoid making needless appointments, leading to shorter wait times (Cameron et al., 2009). Electronic referral enhances hospital communications; the speed and accuracy of the information have helped the provider make a better decision regarding their services (Kim-Hwang et al., 2010).

The MOH expects that once the e-health vision is completely implemented, health service delivery will be greatly improved, affecting patients in MOH facilities. Communication will improve, and the MOH will be able to contact its patients via their preferred form of contact (e.g., SMS, email, phone). The reform's goals include providing web consultations from anywhere with internet access, reducing wait times, and providing as much assistance as feasible from the actual location (Ministry of Health, 2011).

Electronic systems optimize the referral process, improve practice workflow, and improve communication between providers and patients (Shadd et al., 2011). The introduction of e-health has improved the care provided for patients, including referrals. It can enhance the workflow, increase referrals, and help provide services for patients.

Today, hospitals in every region are operating their services electronically. The MOH's strategic aim is to equip every hospital in the Kingdom with standardized, comprehensive clinical, and administrative systems to enhance patient referrals and reduce waiting times.

Health Systems Research Gaps

This study aims to evaluate the physician's view of the implementation of e-health in Saudi Arabia, and its effect on patient referrals. The Saudi health reform started in 2011, and the MOH expected to implement the system throughout the country by 2021. sicnce 2021, the E-health system can be accessed from any hospital or primary care center in the Kingdom (Ministry of Health, 2013).

Research Innovation

This study aims to evaluate the effectiveness of the e-health system reform on the patient referral within MOH facilities in Saudi Arabia from the physicians' perspective. This research will contribute to the health systems research literature by looking at the impact of e-health on multiple outcomes. This study aims to examine the effect of e-health on patient referrals and waiting time. The question of this study concerned whether e-health will significantly reduce the waiting time for a patient's referral in Saudi Arabia from a physician's point of view. The article's hypothesis was that the e-health system reform will reduce the waiting time for patients to see specialists in Saudi Arabia. This research will take in consideration aspects of the speed of patient's admission and examination, accuracy and completeness of the reports failing, viewing patient's history, experience in using e-health, bed availability, hospital reputation, hospital-based doctor reputation, specialist reputation, physician's communications, past patient's experience, and remote diagnostics.

Rationale of the Research

Health reforms, both public and private, seek to enhance access to services and health outcomes by using health information technology (Batura et al., 2016). It is critical to assess the effects of reform efforts so that enhancements may be made on a national level and future reform efforts can be evidence-based on a global scale. Saudi Arabia's government is undergoing a significant health transformation that involves more than 70 initiatives. The major project is the transformation of the e-health system (Ministry of Health, 2011). The objective of this reform is to improve health care delivery, access, quality, and safety (Ministry of Health, 2018a). This research evaluates physicians' perceptions of the outcomes of the e-health reform in terms of the patient's referrals and waiting time to determine if the e-health system reform is making a difference on these aspects or not.

Literature Review

It takes a lot of care and effort from health care providers to provide health care services for patients with chronic conditions (Olayiwola et al., 2016). Doctors read their patients' information, charts, and diagnoses carefully and decide the best treatment course. The sooner the data arrive, the better the outcome (Olayiwola et al., 2016). In addition to the electronic referral request, electronic health records provide patient information to specialists. The office of the specialist then reads the file and decides the course of action to be taken. Furthermore, suppose the patient needs an urgent appointment that can be managed. In that case, if the primary care physicians can provide the treatment, an electronic correspondent can be arranged between both practices to save the patient's time and keep the appointment open for other patients (Olayiwola et al., 2016).

Olayiwola et al. (2016) conducted a cluster-randomized, controlled intervention trial at the Community Health Center, Inc. (CHCI), in Connecticut between October 2011 and December 2013. E-consultations are being used more by physicians to improve communication with their patients and reduce the waiting time. Previous studies suggested that e-consultations minimizes the patient's waiting time and reduce the need to have a face-to-face consultation. However, no studies addressed the clinical outcome of consultations. CHCI is a recognized patient-centered medical home that provides medically underserved patients with comprehensive primary medical, behavioral, and dental care. The primary care clinicians participated in the study willingly. The study included all of the patients that were referred to a cardiologist by the primary care clinicians. The enrolled clinicians were block randomized into the intervention arm (e-consultation referral) or the control arm (traditional referral) of the study using fixed-size blocks of 4. At the 12 primary care centers of CHCI, all primary care clinicians were caring for adult patients.

Physicians of primary care were randomized to cardiologists in a control group (9 traditional) and intervention group (17 e-consultation). Both endpoints were analyzed using Cox's proportional hazard model, where the hazard of either a visit or an e-consultation was associated with the study arm, sex, race, and age. The study result showed that 69% of e-consultations were resolved without a cardiologist visit. In the intervention group, 52% of the referrals were sent electronically, and 48% were not. The average number of days to an e-consultation review was 5 compared to 29 and 24 among control patients. The number of emergency department visits continued to decline after 6 months

of follow-up for e-consultation patients. The trial results stressed alternative means that e-health provides could be safe and as effective as the traditional doctor's visit.

Prior research has shown e-health strategies can reduce the waiting time to see specialists (Ben-Assuli et al., 2013). Waiting time is a problem experienced by many health care providers. Addressing the issue may exhaust the practice resources without having a permanent solution. The introduction of an e-health system in Fife, Scotland, provided a solution capable of enhancing patient's services and reducing the waiting time for specialists to see them. In addition, before referral or approval, the system provides the information to the specialist office and decides whether to refer the patient or whether the primary care physician can prove the treatment (Borooah et al., 2013).

Borooah et al. (2013) conducted a retrospective analysis in Fife to study the impact of the heavy load of the ophthalmic services have on the number of appointments for new outpatients resulting in a longer waiting time for specialists. The hospital of HES has introduced a new regional ophthalmic referral service with digital imaging operated electronically. The new system's people were trailed using the current information technology frame. The study collected service delivery data prospectively for all the attendances before (2006) and the year following (2008) when the system was introduced. The authors emphasized the need to develop innovative ways to make more efficient use of the current capacity of the health system. Waiting time was a main issue the study aimed to highlight to show how electronic referrals can reduce appointments for new outpatients, resulting in shorter waiting times. Borooah et al. observed a total population of 16,176. The results indicated a significant reduction in waiting times for patients, and a significant reduction in emergency appointments. Borooah et al. concluded by stressing the

importance of innovation and how long-term data has demonstrated the effectiveness of electronic referrals in reducing patient waiting times, the technology effect also reduced emergency appointments.

Research suggests that modernizing health systems by implementing e-health strategies can provide health care providers with a solution for avoiding unnecessary appointments that may result in shorter waiting lists for patients. Patients may get their appointment earlier, which will improve their referral process and access to the services they need (Cameron et al., 2009). The authors conducted a prospective controlled study to evaluate electronic referrals' feasibility, safety, and medical efficacy at the hospital eye service (HES). The authors gathered data for 18 months from July 2005 to January 2007, receiving 346 electronic referrals and comparing them to paper referrals from the same practices before the study period. Compared to 85% of paper referrals, 63% of electronic referrals were classified as requiring an appointment. The study results showed that electronic referrals are more efficient than paper referrals and helped the specialist avoid unnecessary referrals.

Research has demonstrated that the e-health system facilitates the referral process, enhances the practice's workflow, and improves communication between providers and patients (Shadd et al., 2011). The authors conducted a cross-sectional retrospective analysis of 10 primary care practices in Ontario, Canada, using an EHR database of primary care to describe referrals to specialist physicians. There were 24,856 patients perceived in the cohort. The study included all patients who visited their family physician from April 1, 2007, to March 31, 2008. The results showed that 31.3% had at least one referral, and referral numbers from rural areas to patients were significantly higher than in towns.

Additionally, the results suggest that the workflow increased, and referral rates were high, correlating to visits by primary care physicians.

The growing number of referrals to specialists from primary care providers creates pressure on service providers. To improve communication between health care providers and reduce human errors, many health care providers have implemented e-health and have started electronic services (Bouamrane & Mair, 2014). Bouamrane and Mair conducted a qualitative study to clarify the e-referral views of general practitioners to identify the factors they felt were either accelerated or delayed referral processes. The authors interviewed 25 general practitioners (GPs) and one focus group to identify factors that might affect National Health System Scotland's electronic referrals. Overall, GPs expressed satisfaction with electronic referrals, and many of them confirmed that referral forms were their nurses' responsibility. Furthermore, Bouamrane and Mair highlighted that electronic referrals improved the organization's performance by enhancing and simplifying the follow-up process, tracking the clinic's requests, and confirming the request received. Regarding information sharing, the authors concluded that most GPs agreed that electronic referrals have improved the communications process by delivering patient files to specialists instantly and using electronic request trail availability.

The ability to reduce waiting time for patients to see specialists is a significant contribution by the e-health system (Augestad et al., 2008). Augestad et al. conducted a randomized controlled trial to test the effectiveness of the one-stop strategy, an electronic referral system implemented in the National Health Network of Norway, in decreasing waiting times and increasing the cost-effectiveness of selected day-case surgical procedures. The authors obtained their data from the University Hospital patient registry.

The sample size was 120 patients for the regular patient pathway. Patients were examined at the surgical outpatient clinic before day case outpatient surgery (control groups) and one-stop strategy (treatment groups). The study's outcome emphasized that e-health can reduce the patient's waiting time for many health conditions. Also, e-health enhanced communication between primary and secondary providers, enhancing the referral process and helping to lower the waiting process. The study also concluded that electronic referrals had improved the examination and treatment for patients (Augestad et al., 2008).

Electronic referral enhances hospital communications; the speed and accuracy of the information helped the provider make better decisions regarding their services (Kim-Hwang et al., 2010). Kim-Hwang et al. conducted a paper-based referral study to determine the impact of electronic referrals on specialty referrals. The research took place at the General Hospital of San Francisco after the e-referral system was implemented. Visit-based questionnaires were added at randomly selected specialist clinic sessions by new patient charts before and after e-referral implementation. The results indicate that inappropriate referral via e-referral by medical specialty clinics is 2.6% compared to 6.4% via paper-based referrals. Inappropriate referrals via e-referral to surgical specialty clinics is 2.1% compared to 9.8% of paper-based referrals. The authors argued that electronic referrals help improve communication between primary care physicians and specialists by facilitating communication before making the appointment. The electronic correspondence allows a specialist to provide previsit consultation by responding to the consultative questions and making recommendations before visiting the patients.

Modernizing the health system through e-health strategies provides a solution to increase the organization's efficiency. However, many primary care providers and

specialists highlighted poor communication as a leading causes of delay and late appointments (Straus et al., 2011). Straus et al. conducted a qualitative study to examine the implementation of an electronic referral system (e-referral) that creates direct contact between physicians and specialists. The authors collected data from the San Francisco area from four primary care clinics and three specialty clinics. Straus et al. found that all primary care practices had used e-referral for almost 3 years in selected clinics. However, new specialty clinics have been added over time to e-referral, and the system has been continuously improved during the study period. The system was perceived as providing support with comanagement by providing PCP support to patients who did not see a specialist. Also, e-referral had adverse effects on work processes by shifting the workload. The workload shift happened because it became the responsibility of the PCP because of work that had been done by administrative staff. The authors concluded their study that e-referral system implementation had increased clinicians' and administrators' satisfaction and improved communication and coordination among clinics. They expressed a positive attitude toward the service despite the negative effect of increasing the workload on PCPs and indicated that it increased workflow (Straus et al., 2011).

Cullinan et al. (2020) used retrospective analysis study to investigate the effect that e-health can make on prioritizing patient referrals based on their health condition urgency. The author investigated that those electronic services can identify specific health conditions and accelerate their referral to receive treatment on time. The study's outcome indicated that e-health system tools were able to identify the health condition and prioritize their referral (Cullinan et al., 2020). The authors concluded their study by stating that the tools implemented within the e-health system can identify a specific gene to help them accelerate

the referral process. The tool can be applied in different settings and specialties. They emphasized that the e-health system can reduce patients' waiting time and accelerate the referral process for the much needed patients.

Research Overview

This dissertation will assess physicians' perception of the effect of the e-health system on patient's referral in Saudi Arabia. The question of this article is whether e-health significantly reduces the waiting time for a patient's referral in Saudi Arabia from a physician's point of view. The article's hypotheses is that e-health system reform reduces the waiting time for patients to see specialists in Saudi Arabia.

Method

From a physician's viewpoint, this questionnaire examines the impact of e-health system reform in Saudi Arabia. Because they're the system's users, the responses from physicians who work for the MOH were used in this study to evaluate the outcome of the e-health system reform more reliably. Guided by Alsffer (2021) and Seçkin et al. (2019), an OLS regression with a robust standard error was used to model the relationship between e-health usage and patient's referrals. An ordered logistic regression was performed to ensure that the measure's outcome of the regressions matched the OLS outcomes, and the results of both models' regressions were compared. The outcome of the regression analysis provided the answers to whether or not it enhanced the patient's referrals after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA. The physicians included in the research that are working for the MOH. The questionnaire was divided into four sections and had 36 questions (for more details about the survey see Chapter 2).

This study applied 13 questions for this study's analysis. The questions addressed the impact of e-health on patient's referrals and waiting time to see a specialist. Thirteen different measures were applied to the investigation, and collectively they affected patient referrals. These measures are speed of patient admission, speed of patient examination, accuracy of reports that are filled out, completeness of report filing, viewing patient history, experience in using e-health, bed availability, hospital reputation, hospital-based doctor reputation, specialist reputation, physician's communications, past patient experience, and remote diagnostics.

The survey covers many measures that can collectively impact patients' referrals and waiting time. This study aims to examine whether the e-health reform increases patient referral and reduces waiting time. The selection of variables used for this research was based on the patients' characteristics and origin. The first variable investigated in the analysis was the speed of admitting patients. Admitting patients is the first step in the referral process. The faster the admission, the sooner the doctor can see the patient. Admitting patients using traditional methods can be a long process. The request is usually sent by fax to the referred hospital, and response can take some time. However, with e-health, the process can be faster, and the request can be tracked. Accordingly, the speed of admitting patients was the first dependent variable added to the analysis to measure the impact of e-health on this variable.

Moreover, the analysis included the speed of the patient's examination, the referral usually for patients with chronic conditions, so time is a crucial element in the treatment. The sooner the patient is seen by a specialist, the higher the chances of receiving the treatment on time. Accordingly, the speed of the patients' examinations was added as a

measure in the analysis to investigate the influence of e-health on it. Expertise on using e-health was also used as a measure. The survey asked physicians whether training their staff on using electronic services were necessary to use e-health at its total capacity. The purpose of this question was to highlight the importance of training and whether the respondents agreed.

Furthermore, the accuracy and the completeness of the patient's files and reports as measures were used in the analysis to investigate the impact of e-health had on them. The survey was designed to examine the improvement made on the accuracy of the files and reports and the completeness from the physicians' point of view. Accuracy and completeness of filling out reports are essential for proper diagnostics. When specialists receive patients' information, accurate information and complete details increase the patient's chance of getting the appropriate treatment sooner because, if there are any missing details, the specialist will have to do the test again, which adds more time for the patient to receive the treatment. So, accuracy and completeness are measures added to the analysis to test the impact of e-health on both variables. Similarly, expertise on using e-health was used as a measure in the analysis to investigate the importance of training and experience in using electronic services for staff to use e-health at total capacity. The purpose of this question was to highlight the importance of training and whether the respondents agreed.

Viewing a patient's history by specialists is a variable used as a measure. E-health provides many features for physicians and staff, such as viewing a patient's history. The purpose of this variable was to examine whether e-health has any significant influence over it and whether there were any significant differences from traditional methods. Bed

availability is another issue for patient referrals. The anticipation of introducing e-health included that it would solve this problem and lead to more bed availability for patients. Bed availability was added to the analysis to measure whether e-health has a significant impact on it and if electronic services increased the efficiency of bed vacancy.

Additionally, hospital reputation is associated with patient's perceptions. When a doctor decides to refer, patients tend to have a preference to in which hospital they want to get their treatment. Based on their evaluation from what they read or hear, patients usually decide and request a specific hospital to transfer to. However, with the introduction of e-health, patients can see what hospitals have to offer and have access to other patients' reviews. In the analysis, the hospital's reputation was taken into account and used as a measure to test whether e-health significantly affected the hospital's reputation.

Likewise, with hospital-based doctor reputation and specialist reputation, patients tend to request doctors by name because they heard of that physician. A physician's reputation is associated with a patient's perception of the physician's characteristics. Patients have access to online information, and they can read about physicians' specialties and their reviews. Patients also can visit the hospital website and read the doctors' profiles. Based on that, hospital-based doctor reputation and specialist reputation were added to the analysis and used as a measure to investigate whether electronic services influenced patients' decisions on their referrals.

Additionally, physician communications play an essential role in referrals. Suppose primary care physicians (PCP) provide the specialist with complete information about the patient's case. That would allow the specialist to decide if the patient needs the referral or provide the consultation without having the patient transferred. Communication and

remote diagnostics were added to the analysis as a measure to test if e-health has significantly affected patient referrals or not. Also, previous hospital experiences substantially impact satisfaction with recent hospital experience, which cannot be overlooked. Physicians were asked if the patients' past experience affected their hospital or specialist choice. The patient's past experience was added to the analysis to investigate if there is a significant influence on their referrals.

The independent variables included in the analysis are referrals, gender, specialty, experience, and age. The key variable in the regression was the outpatient referral. Outpatient referrals in the survey means the referrals that occurred using e-health, electronic referrals. The questionnaire included a question about the level of improvement of outpatient referrals after using e-health. The current study investigated the effect of electronic services on patient referrals in Saudi Arabia. Part of the survey was designed to measure the impact of e-health on patient referrals. The study included 13 variables that collectively affected the efficiency and speed of patient referral and were performed with traditional methods. The regression included the electronic outpatient referral to measure the difference between paperwork and electronic referrals. For every variable included in the analysis, the outcome showed the effect of electronic referrals on these variables and whether it were significant.

Another variable included in the regression was the gender (male/female) of the physicians who participated in the survey. Also, the region of the physician, Saudi Arabia, has 13 administrative regions, and this independent variable represents the region of the physician who answered the questionnaire. The physician's specialty was also included in the regression. This variable represents the specialty of the physicians who participated in

the survey. The physicians' experience was also included in the regression, indicating the number of years of practice that the physician has used electronic referrals. The survey included 5-year groups 1–5 years, 5–10 years, 10–15 years, 15–20 years, and 20+ years. The last independent variable was age. This variable represents the age of the physician participating in the questionnaire. The survey experience was measured by groupage, and the survey had five different age groups: 18-25 years, 26–35 years, 36–45 years, 46–55 years, and over 55 years.

The regression model is as follows:

$$\boldsymbol{Y_{irt}} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\mathbf{Out\_referrals}_{\boldsymbol{i}} + \boldsymbol{\beta_2 Gender_i} + \boldsymbol{\beta_3 Age_i} + \boldsymbol{\beta_4 Region_i} + \boldsymbol{\beta_5}\mathbf{Specialty}_{\boldsymbol{i}} + \boldsymbol{\beta_6 Experience_i} + \boldsymbol{\varepsilon_{it}},$$

where the $\boldsymbol{Y_{irt}}$ represents the outcome measures included in the regression. The analysis included 13 measures. They are speed of patient's admission and examination, accuracy and completeness of the reports failing, viewing patient's history, experience in using e-health, bed availability, hospital reputation, hospital-based doctor reputation, specialist reputation, physician's communications, past patient's experience, and remote diagnostics. Each measure will be tested separately to assess electronic services effect on that particular service, $\mathbf{Out\_referrals}_{\boldsymbol{i}}$ represents patients that have been referred using electronic referral service to a specialist that is out of the health care center where the patient was first seen. Outpatient referrals in the survey mean the referrals that occurred using e-health electronic referrals. The questionnaire included this question about the level of improvement of outpatient referrals after using e-health. $\boldsymbol{Female_i}$ represents the patient's gender, $\boldsymbol{Age_i}$ represents the patient's age. $\boldsymbol{Region_r}$ represents the patient's health care facility region where that patient was referred from. $\mathbf{Specialty}_{\boldsymbol{i}}$ represents the specialty of

the physician that the patient was referred to, and $\boldsymbol{Experience_i}$ represents the years of experience of the specialist that the patient visited. The independent variable is the electronic outpatient referrals. The regression will include gender, age, specialty, experience, and region to clearly understand whether these variables influence the outcome or not.

Results and Analysis

The outcomes show the impact of each element that the doctors were asked about and their input on that particular service area. Representing various specializations, 188 physicians responded. Table 1 lists the respondents' characteristics, and Table 2 presents the survey means. The question of this study was whether e-health will significantly reduce the waiting time for a patient's referral in Saudi Arabia, from a physician's point of view. The article's hypothesis was that e-health system reform will reduce the waiting time for patients to see specialists in Saudi Arabia. An ordered logistic regression was performed to ensure that the measure's outcome of the regressions matched the OLS outcomes, and the results of both models' regressions were compared. The OLS measures' significance matched the ordered logistic regression outcomes and indicated the correctness of the results.

The first variable tested was the speed of admitting patients. The questionnaire asked about the importance of e-health regarding the speed of admitting patients. The sample mean of the survey was 4.979, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between electronic referrals and speed of admitting patients showed an outcome measure with a coefficient of 0.384 and a p-value of < 0.01, indicating a statistically significant

relationship between electronic referrals and the speed of admitting patients measure (Table 3). Specialty cardiologists were significant with a coefficient of 1.149 and a p-value of 0.015, a significant relationship between electronic referrals from cardiology clinics and speed of admitting patients. The other variables controlled for the dependent variable, gender, age, experience, and region were not significant and did not affect the speed in admitting patients. Thus, a t-test was performed, and the electronic services had a significant impact on the speed of admitting patients according to the physicians.

Furthermore, the survey asked about the importance of e-health in terms of the speed of completing a patient examination. The sample mean of the survey was 4.840, indicating a response between "improved somewhat" and "has remained about the same." Regression results on the relationship between electronic referrals and speed of completing a patient examination, the outcome measure had a coefficient of 0.473 and a p-value of < 0.01, indicating a statistically significant relationship between electronic referrals and the speed of completing patient examination measure (Table 4). The specialty of cardiology was statistically significant. The outcome measure had a coefficient of 0.965 and a p-value of 0.02, which means the patients visiting cardiology clinics were referred faster than those of the other specialties. The Asir, Eastern, Ha'il, Jazan, Makkah, Al Medina, Northern Borders, and Riyadh regions were all statistically significant. These regions had faster patient examinations than the other regions after introducing e-health. The other variables controlled for the dependent variable; gender and experience were not significant. They did not affect the speed of completing a patient examination. Thus, a t-test was conducted regarding the physicians. The outcome indicates that e-health significantly impacted the speed in completing patient examinations.

Moreover, a survey a question asked about the importance of e-health on accuracy in filling out reports. The sample mean of the survey was 5.117, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between electronic referrals and accuracy in filling out reports gave an outcome measure with a coefficient of 0.347 and a p-value of < 0.01, indicating a statistically significant relationship between electronic referrals and accuracy in filling out reports measure (Table 5). The other variables controlled for the dependent variable, gender, experience, specialty, region, and age, which were not significant and did not affect the accuracy in filling out reports. Accordingly, a t-test was conducted, and the outcome indicated that electronic services had a significant effect on the accuracy in filling out the report according to the physicians.

Additionally, the survey asked about the importance of e-health in terms of completeness in filling out reports. The sample mean of the survey was 5.074, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between electronic referral and completeness in filling out reports; the outcome measure had a coefficient of 0.394 and a p-value of < 0.01, indicating a statistically significant relationship between electronic referral and completeness of filling out reports measures (Table 6). The other variables controlled for the dependent variable, gender, specialty, and age were not significant and did not affect the completeness in filling out reports except for in a few regions. The Asir, Ha'il, Jazan, Makkah, Najran, Northern Border, Al Qassim, and Riyadh regions were statistically significant. This means the patient's location positively influences the completeness of filling out the report for an outpatient referral. Physicians aged 26–35 years were statistically significant with a

coefficient of 1.322 and a p-value of 0.049, which means physicians' completeness of filling files with that age was affected after using electronic services. Therefore, a t-test was conducted, and the outcome indicated that e-health has significantly impacted the completeness of filling out reports according to physicians.

The physicians were asked about the importance of e-health in terms of training and experience in using electronic services. The sample mean of the survey was 5.064, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between electronic referrals and training and experience; the outcome measure had a coefficient of 0.201 and a p-value of 0.004, indicating a statistically significant relationship between electronic referrals and training and experience measure (Table 7). The other variables controlled for the dependent variable; gender, and experience were not significant and did not affect whether medical staff has experience in using electronic referrals or not except for age. As for age, all age groups were statistically significant, which means that age impacts training and experience in using electronic referrals. The Ha'il region was statistically significant with a coefficient of 2.219 and a p-value of 0.037, which means that the training of using e-health in the Ha'il region effect was more significant than the rest of the regions in Saudi Arabia. Therefore, a t-test was conducted, and the outcome indicated that training and experience in using electronic referrals were significantly affected after introducing e-health according to physicians.

Likewise, the questionnaire asked about the importance of e-health on patients' referral-based by viewing patient's complete history during an examination. The sample mean of the survey was 5.112, indicating a response between "improved considerably" and

"improved somewhat." Regression results on the relationship between electronic referral and viewing patient's complete history, the outcome measure had a coefficient of 0.414 and a p-value of < 0.01, indicating a statistically significant relationship between electronic referral and viewing patient's complete history measure (Table 8). As for the other variables controlled for, the dependent variable, gender, age, experience, and region were not significant and did not affect viewing the patient's complete history during the examination. As for specialties, family physicians were statistically significant with a coefficient of 0.679 and p-value of 0.028, which means that family physicians' referral decisions were significantly impacted after using electronic services. Thus, a t-test was conducted. According to physicians, the outcome indicates that viewing a patient's complete history during the test were significantly impacted after the introduction of e-health.

Moreover, physicians were asked about the importance of e-health on patient referrals based on the availability of beds. The sample mean of the survey was 3.596, indicating a response between "important" and "somewhat important." Regression results on the relationship between electronic referral and availability of beds, the outcome measure had a coefficient of 0.063 and a p-value of 0.477, indicating no statistically significant relationship between electronic referral and availability of beds measure (Table 9). As for the other variables controlled for, the dependent variable, gender, age, experience, and specialty were insignificant and did not affect the availability of beds except for region. Thus, a t-test was conducted. According to physicians, the outcome indicated that electronic services significantly affected the availability of beds.

Furthermore, the questionnaire asked about the importance of e-health on patient's referral based on the hospital's reputation. The sample mean of the survey was 3.739, indicating a response between "very important" and "important." For regression results on the relationship between electronic referral and patient's referral based on the hospital's reputation, the outcome measure had a coefficient of 0.059 and a p-value of 0.44, indicating no statistically significant relationship between electronic referral and patient's referral based on the hospital's reputation measure (Table 10). As for the other variables controlled for, the dependent variable, age, gender, experience, specialty, and region, were not significant and did not affect the outpatient referral except for gender. Thus, a t-test was conducted, and the result suggested the hospital's reputation was not significantly affected after the introduction of e-health according to the physicians.

Moreover, a question was asked about the importance of e-health on patient referral based on hospital-based physicians' reputation. The sample mean of the survey was 3.824, indicating a response between "important" and "somewhat important." Regression results on the relationship between electronic referral and patient referral was based on the hospital-based physicians' reputation. The outcome measure had a coefficient of 0.003 and a p-value of 0.971, indicating no statistically significant relationship between electronic referral and patient's referral based on the hospital-based physicians' reputation measure (Table 11). As for specialty, cardiologists and pediatricians were statistically significant, which means that these two specialties impacted electronic referrals. The other variables controlled for, the dependent variable gender, age, experience, and region, were not significant and had no effect on the referral based on the reputation of hospital-based physicians. Thus, a t-test was conducted. According to physicians, the outcome indicated

that the reputation of hospital-based physicians was not significantly affected by the introduction of e-health.

The questionnaire also asked about the importance of e-health on patient referral based on the reputation of specialists practicing at the hospital. The sample mean of the survey was 3.830, indicating a response between "important" and "somewhat important." For regression results on the relationship between electronic referral and patient referral based on the reputation of specialist's reputation, the outcome measure had a coefficient of 0.011 and a p-value of 0.881, indicating no statistically significant relationship between electronic referral and patient's referral based on the reputation of specialist's reputation measure (Table 12). As for the other variables controlled for, the dependent variable gender, age, experience, and region were not significant and had no effect on patient's referrals based on the reputation of the specialist practicing in the hospital except region. As for specialty, cardiologists, neurologists, and pediatricians were statistically significant, meaning that these specialties had different influences on patient referrals based on the reputation of specialists practicing at the hospital. So, a t-test was conducted. According to physicians, the outcome indicates that patients' referrals based on the reputation of specialists practicing at the hospital has not significantly changed after the introduction of e-health.

Moreover, physicians were asked about the importance of e-health on the communications between physicians. The sample mean of the survey was 4.048, indicating a response between "very important" and "important." Considering the regression results on the relationship between electronic referral and communication between physicians, the outcome measure had a coefficient of 0.054 and a p-value of 0.452, indicating no

statistically significant relationship between electronic referral and communications between physician's measures (Table 13). As for the other variables controlled for, the dependent variables of gender, age, experience, region, and specialty were not significant and had no effect on patients' referrals based on the reputation of the specialist practicing in the hospital except a region. Therefore, a t-test was conducted; according to physicians, the outcome indicates that communications between physicians have not significantly changed after the introduction of e-health.

Further, the questionnaire asked about the importance of e-health on patients' past experiences. The sample mean of the survey was 3.793, indicating a response between "important" and "somewhat important." Concerning regression results on the relationship between electronic referral and patients' past experiences, the outcome measure had a coefficient of 0.08 and a p-value of 0.269, indicating a statistically significant relationship between electronic referral patients' past experiences measure (see Table 14). As for the other variables controlled for, the dependent variables of gender, age, experience, region, and specialty were not significant and had no effect on patient's referrals based on the patients' past experiences except a region. Consequently, a t-test was conducted, and according to physicians, the outcome indicates that patient's referrals based on their past experiences have significantly changed after the introduction of e-health.

The questionnaire also asked about the importance of e-health on how remote diagnostics will help physicians serve more patients and reduce the waiting time for both patients and hospitals. The sample mean of the survey was 4.186, indicating a response between "strongly agree" and "agree." Regression results on the relationship between electronic referral and remote diagnostics; the outcome measure had a coefficient of 0.125

and a p-value of 0.025, indicating a statistically significant relationship between electronic referral remote diagnostics measure (Table 15). As for the other variables controlled for, the dependent variable gender, age, experience, specialty, and region were not significant and had no effect on remote diagnostics for patients. Al Qassim region was statistically significant with a coefficient of -2.77 and a p-value of 0.001. That means there is a significant relationship between electronic referrals and remote diagnostics in the Al Qassim region. Therefore, a t-test was conducted, and according to physicians, the outcome indicates that e-health significantly impacted remote diagnostics.

Discussion

The current study investigated the effect of e-health reform on patient referrals. The questionnaire was given to 188 physicians working at hospitals and primary care centers managed by the MOH. Aspects the survey examined included the speed of admitting patients and the speed of their examination, if they saw any increases in the number of patient referrals. According to physicians, the outcome indicates that the speed in admitting patients and their examination increased patient referrals significantly after introducing e-health. The literature has shown that electronic services have increased the referral process's efficiency and higher admission rates with electronic services. Moreover, electronic services enhance the workflow of the health organization, which increases the efficiency of the workflow, which will lead to more patients' being admitted and examined (Shadd et al., 2011; Kim-Hwang et al., 2010).

Additionally, physicians think that e-health has increased the accuracy and the completeness of the report filed. The analysis shows that electronic services significantly enhance the accuracy and completeness of the file reports after introducing e-health in

Saudi Arabia. The analysis revealed that electronic health services have significantly affected the number of patient referrals. Research has proven that electronic health services can optimize the workflow of the health organization and avoid repetitive consultations. It is also has been proven that e-health can increase the rates of accuracy and completeness of reports filed in the system and that provide physicians with required information during patient's consultation and referral requests (Ferguson et al., 2018; Scott et al., 2015).

Moreover, the survey inquired about the necessity of experience and training on using e-health. The outcomes prove that training is essential to achieve the total capacity of electronic health services. The results show that training is significantly correlated with increasing the number of patient referrals. Prior research has proven that training electronic services users is crucial for operating the system. To achieve the full potential of the technology, they must be trained. Also, training improves the efficiency of the organization's workflow, which will enhance the outcomes of health services provided by the health organization (Glaser et al., 2017; Scantlebury et al., 2017).

Furthermore, respondents were asked about viewing the patient's complete history during the examination if it affects patient referrals. The analysis indicates that physicians think that viewing patients' complete information has significantly enhanced patient referrals. Research has proven that viewing a patient's medical history improves the quality of the services provided for patients and increases the workflow's efficiency.

In addition, the results of the analysis show that after the introduction of e-health, the availability of beds has expanded significantly, resulting in more patient referrals. Physicians think the electronic services help health organizations avoid unnecessary referrals, which will help provide more patients to be seen by specialists and help manage

bed availability so patients can find a bed for their care. Prior research has demonstrated the possibility for the introduction of e-health to improve health care delivery in many aspects. Modernizing health systems by implementing e-health strategies can provide health care providers with a solution for avoiding unnecessary appointments that may result in shorter waiting lists for patients. Patients may get their appointment earlier, which will improve their referral process and access to the services they need (Cameron et al., 2009).

Physicians were asked if hospital reputation affects the referral process. The analysis indicates that the hospital's reputation is not significant for patient referral. The outcomes also show that hospital-based physicians' reputations and the specialist reputation were not significantly affecting the patient's referrals process; this means, when the patient is being referred to a specialist, the decision is based on the availability of the physician and the waiting time. Research suggests that most health care providers do not operate based on product differentiation such as quality, reputation, personal recommendation, and cost. The geography and time affect the decision of the referral (Shahian et al., 2000). Previous research has also proven that e-health can reduce the patient's waiting time for many health conditions. Also, e-health enhanced communication between primary and secondary providers, enhancing the referral process and helping to lower the waiting process (Augestad et al., 2008).

The questionnaire asked physicians about their communication with other physicians if it improved after introducing e-health. The analysis shows that communications between physicians have not significantly affected patient referrals after the introduction of e-health. There are many reasons for their opinion; the most popular would be the barrios using the system. Previous research has shown that e-health can be a

great tool to improve communications between physicians, but barriers such as technical issues could cause a problem that could lead to longer waiting times. Another barrier would be knowledge of how to operate the e-consultation system in rural PCP clinics. Finally, if the practice has two different systems and cannot be integrated, it will delay seeing the patients and disrupt the clinic's workflow. Overcoming the barriers would improve care for patients and improve the outcome of their treatments (Bello et al., 2017). Furthermore, research has also demonstrated that the e-health system facilitates the referral process, enhances the practice's workflow, and improves communication between providers and patients (Shadd et al., 2011).

Furthermore, according to physicians, the analysis shows that patient's referrals based on their past experiences have significantly changed after the introduction of e-health. Prior research has proven that patients' experiences with long waiting lists and communication delays have affected their treatments. e-health systems can increase delivery system efficiency and provide alternative options other than what is available in the current system, resulting in shorter patient waiting times and better patient experiences (Doumouras et al., 2017). In addition to the electronic referral request, electronic health records provide patient information to specialists. The office of the specialist then reads the file and decides the course of action to be taken. Furthermore, suppose the patient needs an urgent appointment that can be managed. In that case, if the primary care physicians can provide the treatment, an electronic correspondent can be arranged between both practices to save the patient's time and keep the appointment open for other patients (Olayiwola et al., 2016).

Likewise, remote diagnostics can provide alternative means for specialist visits. The questionnaire asked physicians if remote diagnostics would help physicians serve more patients and reduce the waiting time for patients and hospitals. The outcomes indicated that remote diagnostics has significantly reduced patients' and hospitals' waiting time after introducing e-health. Prior research has demonstrated that the use of services such as e-consult can provide a safe alternative to in person health care services and can serve the patient as effectively as face-to-face consultation. Moreover, electronic health services can help increase the number of patients seen by specialists. It will also increase the patient's satisfaction with the health services they receive (Wasfy et al., 2016).

The study had limitations; respondents have shown their confusion about some questions. Their response was closest to what they believed was correct, yet they think there is more to the answer they provided. Depth was another limitation the survey had; survey questions are standardized, and the questions asked are usually general questions that are understandable for respondents. The respondents do not have the chance to explain when they have more complex answers. Another limitation was different interpretations of questions. The interpretation of the question differs between respondents, affecting the validity and reliability of the results.

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Tables

Table 3.1

Sample Characteristics

Variable	Category	Percentage
Gender	Female	16.93 (n = 32)
	Male	83.07 (n = 156)
Age	18–25 Years	2.12 (n = 4)
	26–35 Years	19.05 (n = 35)
	36–45 Years	28.57 (n = 54)
	46–55 Years	31.22 (n = 59)
	Over 55 Years	19.05 (n = 36)
Experience	1–5 Years	8.99 (n = 16)
	6–10 Years	16.40 (n = 31)
	11–15 Years	17.46 (n = 33)
	16–20 Years	16.93 (n = 32)
	More than 2 years	40.21 (n = 76)
Region	Al Baha	1.06 (n = 2)
	Northern Border	1.06 (n = 2)
	Al Jawf	0.53 (n = 1)
	Al Medina	15.87 (n = 30)
	Al Qassim	1.06 (n = 2)
	Riyadh	29.63 (n = 56)
	Eastern	2.65 (n = 5)
	Asir	22.75 (n = 42)
	Ha'il	1.06 (n = 2)
	Makkah	8.99 (n = 17)
	Najran	10.58 (n = 20)
	Tabuk	2.65 (n = 5)
Frequency of Using E-health	None	9.52 (n = 18)
	Often (2–3 times a week)	30.16 (n = 56)
	Sometimes (4–5 times a week)	14.29 (n = 27)
	Daily	46.03 (n = 87)
Specialty	Family Physician	6.88 (n = 13)
	General Practitioner	5.29 (n = 10)
	Cardiologist	12.77 (n = 24)
	ENT	4.76 (n = 9)
	Neurologist	2.12 (n = 4)
	Pediatrician	15.96 (n = 30)

Note: Values in the table are percentages.

Table 3.2

Survey Means

Variable	Observations	Mean	Standard Deviation	Standard Error
Speed of Patient's Admission	188	4.979	1.360	0.099
Speed of Patient's Exam	188	4.840	1.323	0.096
Accuracy of Reports	188	5.117	1.164	0.085
Completeness of Reports	188	5.074	1.195	0.087
Experience in e-health	188	5.064	1.078	0.079
Viewing Patient's History	188	5.112	1.106	0.081
Bed Availability	188	3.596	1.315	0.099
Hospital Reputation	188	3.739	1.100	0.086
Hospital-based Doctor Reputation	188	3.824	1.063	0.082
Specialist's Reputation	188	3.830	1.066	0.082
Physician's Communication	188	4.048	1.009	0.078
Past Patient's Experience	188	3.793	1.057	0.079
Remote Diagnosis	188	4.186	0.854	0.062

Table 3.3

Speed of Admitting Patients After Using Electronic Referral

Admission Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.384	0.109	3.53	0.001***	0.169	0.599
Cardiologist	1.149	0.455	2.52	0.013**	0.25	2.048
ENT	0.191	0.339	0.56	0.575	-0.48	0.861
Family Physician	0.459	0.54	0.85	0.397	-0.607	1.524
General Practitioner	-0.098	0.536	-0.18	0.855	-1.156	0.96
Neurologist	0.804	0.343	2.35	0.02**	0.127	1.481
Pediatrician	-0.196	0.322	-0.61	0.543	-0.833	0.44
Gender	-0.186	0.22	-0.85	0.398	-0.62	0.248
26–35 Years Old	0.949	0.958	0.99	0.323	-0.943	2.841
36–45 Years Old	0.536	1.174	0.46	0.648	-1.782	2.855
46–55 Years Old	0.493	1.139	0.43	0.666	-1.756	2.741
Over 55 Years Old	0.105	1.154	0.09	0.928	-2.174	2.384
6–10 Years' Experience	-0.068	0.493	-0.14	0.891	-1.041	0.906
11–15 Years' Experience	0.519	0.795	0.65	0.515	-1.05	2.088
16–20 Years' Experience	0.507	0.762	0.67	0.507	-0.998	2.013
More than 20 Years	0.486	0.74	0.66	0.512	-0.976	1.948
Asir Region	-0.774	0.33	-2.34	0.02**	-1.427	-0.121
Eastern Region	-0.293	0.361	-0.81	0.418	-1.006	0.42
Ha'il Region	1.688	1.138	1.48	0.14	-0.559	3.935
Al Jawf Region	0.079	0.592	0.13	0.894	-1.091	1.249
Jazan Region	-0.989	0.788	-1.26	0.211	-2.545	0.566
Makkah Region	-0.627	0.397	-1.58	0.116	-1.411	0.156
Al Medina Region	-0.445	0.335	-1.33	0.187	-1.107	0.218
Najran Region	-1.381	0.601	-2.3	0.023**	-2.568	-0.195
Northern Border Region	0.595	0.365	1.63	0.105	-0.126	1.316
Al Qassim Region	-1.838	1.445	-1.27	0.205	-4.693	1.016
Riyadh Region	-0.623	0.317	-1.96	0.051*	-1.249	0.004
Tabuk Region	-1.727	0.854	-2.02	0.045**	-3.415	-0.04
Constant	2.856	1.087	2.63	0.009***	0.71	5.003

Mean dependent var	4.979	**SD dependent var**	1.360
R-squared	0.236	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.4

Speed in Completing Examinations After Using Electronic Referral

Patient Examination Speed	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.473	0.096	4.92	< 0.01***	0.283	0.663
Cardiologist	0.965	0.27	3.58	< 0.01***	0.432	1.498
ENT	0.051	0.396	0.13	0.899	-0.732	0.833
Family Physician	0.455	0.346	1.32	0.19	-0.228	1.137
General Practitioner	-0.127	0.742	-0.17	0.864	-1.593	1.339
Neurologist	0.239	0.302	0.79	0.429	-0.356	0.835
Pediatrician	-0.243	0.289	-0.84	0.401	-0.813	0.327
Gender	0.258	0.287	0.9	0.369	-0.308	0.824
26–35 Years Old	-0.34	0.514	-0.66	0.509	-1.355	0.675
36–45 Years Old	0.118	0.626	0.19	0.851	-1.118	1.354
46–55 Years Old	0.218	0.654	0.33	0.739	-1.074	1.511
Over 55 Years Old	-0.508	0.709	-0.72	0.474	-1.907	0.891
6–10 Years' Experience	0.26	0.527	0.49	0.622	-0.781	1.302
11–15 Years' Experience	0.215	0.561	0.38	0.702	-0.892	1.322
16–20 Years' Experience	0.387	0.572	0.68	0.499	-0.742	1.516
More than 20 Years	-0.082	0.598	-0.14	0.89	-1.263	1.099
Asir Region	1.701	1.666	1.02	0.309	-1.589	4.99
Eastern Region	1.867	1.67	1.12	0.265	-1.432	5.166
Ha'il Region	3.086	1.857	1.66	0.099*	-0.582	6.754
Al Jawf Region	2.357	1.811	1.3	0.195	-1.22	5.934
Jazan Region	2.411	1.667	1.45	0.15	-0.881	5.703
Makkah Region	2.426	1.663	1.46	0.147	-0.858	5.71
Al Medina Region	2.074	1.672	1.24	0.217	-1.229	5.376
Najran Region	1.346	1.685	0.8	0.425	-1.981	4.674
Northern Border Region	3.127	1.677	1.86	0.064*	-0.186	6.439
Al Qassim Region	1.139	1.929	0.59	0.556	-2.672	4.95
Riyadh Region	2.023	1.661	1.22	0.225	-1.257	5.303
Tabuk Region	1.237	1.908	0.65	0.518	-2.532	5.006
Constant	0.169	1.789	0.09	0.925	-3.364	3.702

Mean dependent var	4.840	**SD dependent var**	1.323
R-squared	0.377	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.5

Accuracy in Filling out the Report After Using Electronic Referral

Accuracy	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.347	0.107	3.25	0.001***	0.136	0.558
Cardiologist	0.192	0.374	0.51	0.608	-0.546	0.931
ENT	0.001	0.389	0	0.998	-0.767	0.769
Family Physician	0.477	0.354	1.35	0.18	-0.222	1.176
General Practitioner	0.431	0.594	0.73	0.469	-0.743	1.605
Neurologist	0.413	0.266	1.55	0.122	-0.112	0.939
Pediatrician	0.162	0.201	0.81	0.421	-0.235	0.559
Gender	-0.028	0.279	-0.1	0.919	-0.58	0.523
26–35 Years Old	0.605	1.099	0.55	0.583	-1.565	2.775
36–45 Years Old	0.315	1.282	0.25	0.807	-2.218	2.847
46–55 Years Old	0.255	1.251	0.2	0.838	-2.215	2.726
Over 55 Years Old	0.02	1.27	0.02	0.988	-2.488	2.527
6–10 Years' Experience	-0.097	0.583	-0.17	0.868	-1.249	1.055
11–15 Years' Experience	0.483	0.794	0.61	0.544	-1.085	2.052
16–20 Years' Experience	0.814	0.797	1.02	0.308	-0.76	2.388
More than 20 Years	0.632	0.775	0.82	0.415	-0.897	2.162
Asir Region	0.586	0.837	0.7	0.485	-1.067	2.239
Eastern Region	0.704	0.976	0.72	0.472	-1.224	2.631
Ha'il Region	1.695	1.321	1.28	0.201	-0.913	4.304
Al Jawf Region	-0.461	0.99	-0.47	0.642	-2.416	1.493
Jazan Region	1.377	0.94	1.46	0.145	-0.48	3.234
Makkah Region	0.602	0.828	0.73	0.468	-1.034	2.238
Al Medina Region	0.584	0.876	0.67	0.506	-1.145	2.314
Najran Region	0.684	0.914	0.75	0.455	-1.121	2.488
Northern Border Region	1.659	0.898	1.85	0.067*	-0.115	3.432
Al Qassim Region	-0.025	1.333	-0.02	0.985	-2.658	2.607
Riyadh Region	0.765	0.829	0.92	0.357	-0.871	2.402
Tabuk Region	0.846	0.846	1	0.319	-0.826	2.517
Constant	1.849	1.358	1.36	0.175	-0.832	4.53

Mean dependent var	5.117	**SD dependent var**	1.164
R-squared	0.223	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.6

Completeness in Filling out the Report After Using Electronic Referral

Completeness	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.394	0.108	3.63	< 0.01***	0.18	0.608
Cardiologist	0.154	0.324	0.47	0.636	-0.486	0.793
ENT	0.21	0.242	0.87	0.387	-0.268	0.688
Family Physician	-0.008	0.383	-0.02	0.984	-0.764	0.749
General Practitioner	0.495	0.437	1.13	0.259	-0.368	1.358
Neurologist	0.435	0.268	1.62	0.107	-0.094	0.964
Pediatrician	-0.102	0.188	-0.54	0.587	-0.473	0.269
Gender	-0.199	0.252	-0.79	0.432	-0.697	0.299
26–35 Years Old	1.322	1.142	1.16	0.249	-0.933	3.577
36–45 Years Old	0.923	1.297	0.71	0.478	-1.639	3.485
46–55 Years Old	0.841	1.278	0.66	0.511	-1.682	3.365
Over 55 Years Old	0.527	1.298	0.41	0.685	-2.035	3.09
6–10 Years' Experience	-0.497	0.493	-1.01	0.315	-1.472	0.477
11–15 Years' Experience	0.342	0.689	0.5	0.621	-1.018	1.702
16–20 Years' Experience	0.594	0.687	0.86	0.389	-0.763	1.951
More than 20 Years	0.567	0.679	0.83	0.405	-0.774	1.907
Asir Region	1.41	0.298	4.74	< 0.01***	0.823	1.998
Eastern Region	1.195	0.513	2.33	0.021**	0.181	2.209
Ha'il Region	2.738	1.32	2.07	0.04**	0.131	5.345
Al Jawf Region	1.249	0.498	2.51	0.013**	0.266	2.232
Jazan Region	1.549	0.485	3.19	0.002***	0.591	2.507
Makkah Region	1.526	0.246	6.2	< 0.01***	1.04	2.012
Al Medina Region	1.233	0.329	3.75	< 0.01***	0.583	1.883
Najran Region	1.631	0.426	3.83	< 0.01***	0.79	2.473
Northern Border Region	2.592	0.525	4.94	< 0.01***	1.555	3.63
Al Qassim Region	-1.807	0.978	-1.85	0.066*	-3.738	0.124
Riyadh Region	1.58	0.293	5.4	< 0.01***	1.002	2.158
Tabuk Region	1.524	0.314	4.85	< 0.01***	0.903	2.144
Constant	0.576	1.246	0.46	0.644	-1.885	3.038

Mean dependent var	5.074	**SD dependent var**	1.195
R-squared	0.358	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.7

Training and Experience in Using Electronic Referral

Training and Expertise	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.201	0.084	2.4	0.018**	0.036	0.366
Cardiologist	0.309	0.385	0.8	0.423	-0.451	1.07
ENT	-0.208	0.3	-0.69	0.488	-0.801	0.384
Family Physician	0.389	0.313	1.24	0.216	-0.229	1.007
General Practitioner	0.107	0.635	0.17	0.866	-1.146	1.361
Neurologist	0.022	0.287	0.08	0.939	-0.545	0.588
Pediatrician	-0.048	0.187	-0.26	0.798	-0.416	0.321
Gender	-0.168	0.242	-0.69	0.488	-0.645	0.309
26–35 Years Old	2.199	1.099	2	0.047**	0.028	4.371
36–45 Years Old	2.585	1.144	2.26	0.025**	0.326	4.845
46–55 Years Old	2.202	1.159	1.9	0.059*	-0.087	4.492
Over 55 Years Old	2.328	1.171	1.99	0.048**	0.017	4.64
6–10 Years' Experience	0.013	0.493	0.03	0.98	-0.96	0.986
11–15 Years' Experience	0.14	0.504	0.28	0.781	-0.855	1.136
16–20 Years' Experience	0.516	0.531	0.97	0.332	-0.533	1.565
More than 20 Years	0.518	0.548	0.95	0.346	-0.564	1.599
Asir Region	-0.057	0.282	-0.2	0.841	-0.615	0.501
Eastern Region	-0.313	0.524	-0.6	0.552	-1.348	0.723
Ha'il Region	2.219	1.852	1.2	0.233	-1.438	5.877
Al Jawf Region	-0.732	0.693	-1.06	0.292	-2.1	0.636
Jazan Region	0.189	0.654	0.29	0.772	-1.102	1.481
Makkah Region	0.076	0.306	0.25	0.803	-0.528	0.68
Al Medina Region	-0.187	0.379	-0.49	0.622	-0.934	0.561
Najran Region	0.039	0.489	0.08	0.937	-0.926	1.004
Northern Border Region	0.584	0.301	1.94	0.054*	-0.01	1.179
Al Qassim Region	-0.148	0.756	-0.2	0.844	-1.641	1.344
Riyadh Region	0.214	0.26	0.82	0.412	-0.299	0.727
Tabuk Region	-0.222	0.588	-0.38	0.706	-1.383	0.939
Constant	1.486	1.191	1.25	0.214	-0.866	3.838
Mean dependent var		5.064		**SD dependent var**		1.078
R-squared		0.302		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.8

Viewing Patient's History Using Electronic Referral

Patient History	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.414	0.109	3.79	< 0.01***	0.198	0.629
Cardiologist	0.124	0.242	0.51	0.61	-0.354	0.601
ENT	-0.167	0.261	-0.64	0.523	-0.682	0.348
Family Physician	0.679	0.302	2.25	0.026**	0.083	1.276
General Practitioner	-0.124	0.321	-0.39	0.699	-0.757	0.509
Neurologist	0.123	0.421	0.29	0.77	-0.708	0.954
Pediatrician	0.127	0.214	0.59	0.555	-0.296	0.549
Gender	-0.008	0.201	-0.04	0.969	-0.405	0.389
26–35 Years Old	-0.187	0.524	-0.36	0.721	-1.222	0.847
36–45 Years Old	-0.542	0.591	-0.92	0.361	-1.709	0.626
46–55 Years Old	-0.986	0.651	-1.52	0.132	-2.271	0.299
Over 55 Years Old	-1.13	0.691	-1.63	0.104	-2.495	0.236
6–10 Years' Experience	-0.372	0.452	-0.82	0.412	-1.264	0.521
11–15 Years' Experience	0.113	0.5	0.23	0.821	-0.873	1.1
16–20 Years' Experience	0.394	0.496	0.8	0.428	-0.585	1.374
More than 20 Years	0.283	0.543	0.52	0.603	-0.789	1.355
Asir Region	-0.163	0.335	-0.49	0.628	-0.823	0.498
Eastern Region	0.226	0.495	0.46	0.649	-0.753	1.204
Ha'il Region	1.213	0.876	1.38	0.168	-0.518	2.944
Al Jawf Region	0.392	0.489	0.8	0.424	-0.574	1.357
Jazan Region	0.402	0.343	1.17	0.243	-0.276	1.08
Makkah Region	-0.208	0.362	-0.57	0.566	-0.924	0.507
Al Medina Region	-0.022	0.342	-0.06	0.949	-0.699	0.654
Najran Region	0.528	0.388	1.36	0.175	-0.238	1.294
Northern Border Region	1.208	0.416	2.9	0.004**	0.386	2.031
Al Qassim Region	0.255	0.389	0.66	0.512	-0.512	1.023
Riyadh Region	0.315	0.293	1.08	0.284	-0.264	0.894
Tabuk Region	-0.535	0.578	-0.92	0.357	-1.677	0.607
Constant	3.405	0.775	4.4	< 0.01***	1.875	4.936
Mean dependent var		5.112	**SD dependent var**			1.106
R-squared		0.357	**Number of observations**			188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.9:

The Impact of Using Electronic Referral on Beds' Availability

Bed Availability	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.063	0.092	0.69	0.491	-0.118	0.245
Cardiologist	0.318	0.429	0.74	0.46	-0.529	1.165
ENT	-0.481	0.488	-0.99	0.326	-1.446	0.483
Family Physician	-0.179	0.336	-0.53	0.596	-0.843	0.485
General Practitioner	0.837	0.456	1.83	0.069*	-0.065	1.738
Neurologist	-0.66	0.639	-1.03	0.303	-1.921	0.601
Pediatrician	-0.148	0.257	-0.58	0.565	-0.655	0.359
Gender	-0.434	0.281	-1.55	0.124	-0.989	0.121
26–35 Years Old	-0.234	0.894	-0.26	0.794	-1.999	1.532
36–45 Years Old	0.307	1	0.31	0.759	-1.668	2.283
46–55 Years Old	0.572	1.045	0.55	0.585	-1.491	2.636
Over 55 Years Old	0.686	1.094	0.63	0.532	-1.475	2.846
6–10 Years' Experience	0.182	0.634	0.29	0.774	-1.069	1.434
11–15 Years' Experience	0.026	0.738	0.04	0.972	-1.431	1.483
16–20 Years' Experience	0.093	0.766	0.12	0.904	-1.42	1.606
More than 20 Years	-0.061	0.78	-0.08	0.937	-1.601	1.478
Asir Region	-0.097	0.339	-0.29	0.775	-0.766	0.572
Eastern Region	0.379	0.474	0.8	0.424	-0.556	1.315
Ha'il Region	-1.51	0.57	-2.65	0.009***	-2.636	-0.385
Al Jawf Region	0.318	0.567	0.56	0.575	-0.802	1.439
Jazan Region	0.704	0.356	1.98	0.05**	0.001	1.407
Makkah Region	-0.163	0.438	-0.37	0.71	-1.029	0.703
Al Medina Region	-1.107	0.377	-2.94	0.004***	-1.851	-0.364
Najran Region	0.19	0.517	0.37	0.713	-0.831	1.211
Northern Border Region	-0.128	0.351	-0.36	0.717	-0.822	0.567
Al Qassim Region	-1.746	0.884	-1.98	0.05**	-3.492	0
Riyadh Region	-0.14	0.261	-0.54	0.591	-0.656	0.375
Tabuk Region	-0.158	0.347	-0.46	0.65	-0.844	0.528
Constant	3.499	0.945	3.7	< 0.01***	1.633	5.365

Mean dependent var	3.596	**SD dependent var**	1.315
R-squared	0.196	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.10

Effect of Hospital Reputation on Patient Referral

Hospital Reputation	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.059	0.081	0.72	0.471	-0.102	0.22
Cardiologist	0.48	0.328	1.47	0.145	-0.167	1.127
ENT	-0.229	0.418	-0.55	0.584	-1.054	0.596
Family Physician	0.383	0.25	1.53	0.128	-0.111	0.878
General Practitioner	0.288	0.45	0.64	0.523	-0.6	1.176
Neurologist	0.468	0.639	0.73	0.465	-0.795	1.73
Pediatrician	-0.244	0.259	-0.94	0.349	-0.756	0.269
Gender	0.206	0.26	0.79	0.429	-0.307	0.72
26–35 Years Old	0.43	0.644	0.67	0.505	-0.841	1.701
36–45 Years Old	0.462	0.747	0.62	0.537	-1.013	1.938
46–55 Years Old	0.619	0.806	0.77	0.444	-0.973	2.21
Over 55 Years Old	0.81	0.844	0.96	0.339	-0.858	2.478
6–10 Years' Experience	-0.4	0.529	-0.76	0.451	-1.446	0.645
11–15 Years' Experience	0.286	0.643	0.45	0.657	-0.983	1.556
16–20 Years' Experience	0.267	0.671	0.4	0.691	-1.059	1.594
More than 20 Years	0.111	0.679	0.16	0.871	-1.23	1.451
Asir Region	-0.147	0.341	-0.43	0.667	-0.819	0.526
Eastern Region	-0.028	0.689	-0.04	0.968	-1.389	1.334
Ha'il Region	-0.093	0.429	-0.22	0.828	-0.939	0.753
Al Jawf Region	-0.422	0.604	-0.7	0.485	-1.616	0.771
Jazan Region	-0.197	0.676	-0.29	0.771	-1.533	1.139
Makkah Region	-0.616	0.388	-1.59	0.114	-1.383	0.15
Al Medina Region	-0.492	0.382	-1.29	0.2	-1.247	0.263
Najran Region	-0.527	0.447	-1.18	0.24	-1.409	0.355
Northern Border Region	0.488	0.386	1.26	0.208	-0.275	1.252
Al Qassim Region	-0.624	0.518	-1.21	0.23	-1.647	0.398
Riyadh Region	-0.096	0.305	-0.32	0.753	-0.698	0.506
Tabuk Region	-0.462	0.797	-0.58	0.563	-2.036	1.111
Constant	2.846	0.728	3.91	< 0.01***	1.408	4.284
Mean dependent var		3.739		**SD dependent var**		1.100
R-squared		0.158		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.11

Effect of Hospital-Based Doctor on Patient Referral

Doctor Reputation	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.003	0.069	0.04	0.969	-0.133	0.139
Cardiologist	0.72	0.274	2.62	0.01**	0.178	1.262
ENT	-0.445	0.349	-1.27	0.205	-1.135	0.245
Family Physician	0.076	0.308	0.25	0.805	-0.531	0.684
General Practitioner	0.424	0.379	1.12	0.265	-0.325	1.173
Neurologist	0.582	0.436	1.33	0.184	-0.28	1.444
Pediatrician	-0.578	0.248	-2.33	0.021**	-1.067	-0.088
Gender	-0.023	0.263	-0.09	0.931	-0.543	0.497
26–35 Years Old	-0.333	0.557	-0.6	0.551	-1.432	0.766
36–45 Years Old	-0.229	0.66	-0.35	0.73	-1.533	1.075
46–55 Years Old	-0.178	0.739	-0.24	0.81	-1.637	1.282
Over 55 Years Old	-0.299	0.777	-0.38	0.701	-1.833	1.236
6–10 Years' Experience	-0.198	0.444	-0.44	0.657	-1.075	0.68
11–15 Years' Experience	0.373	0.537	0.7	0.488	-0.687	1.434
16–20 Years' Experience	0.258	0.586	0.44	0.66	-0.899	1.415
More than 20 Years	0.387	0.608	0.64	0.525	-0.813	1.587
Asir Region	0.059	0.296	0.2	0.843	-0.526	0.644
Eastern Region	-0.112	0.616	-0.18	0.856	-1.329	1.105
Ha'il Region	-0.474	0.469	-1.01	0.314	-1.401	0.453
Al Jawf Region	-0.331	0.506	-0.65	0.514	-1.33	0.668
Jazan Region	-0.135	0.723	-0.19	0.853	-1.563	1.294
Makkah Region	-0.031	0.29	-0.11	0.916	-0.604	0.543
Al Medina Region	-0.327	0.331	-0.99	0.324	-0.98	0.326
Najran Region	-0.365	0.355	-1.03	0.306	-1.067	0.337
Northern Border Region	0.329	0.616	0.53	0.594	-0.889	1.547
Al Qassim Region	-0.521	0.488	-1.07	0.288	-1.486	0.444
Riyadh Region	0.187	0.227	0.82	0.411	-0.261	0.635
Tabuk Region	-1.185	0.659	-1.8	0.074*	-2.487	0.117
Constant	3.885	0.676	5.75	< 0.01***	2.55	5.219
Mean dependent var		3.824		**SD dependent var**		1.063
R-squared		0.179		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.12

Effect of Specialist Reputation on Patient Referral

Specialist Reputation	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.011	0.069	0.16	0.876	-0.126	0.148
Cardiologist	0.746	0.313	2.39	0.018**	0.128	1.363
ENT	-0.312	0.4	-0.78	0.436	-1.103	0.478
Family Physician	-0.078	0.273	-0.29	0.775	-0.617	0.461
General Practitioner	-0.268	0.32	-0.84	0.403	-0.9	0.364
Neurologist	1.139	0.306	3.72	< 0.01***	0.534	1.744
Pediatrician	-0.498	0.243	-2.05	0.042**	-0.977	-0.018
Gender	-0.037	0.273	-0.13	0.894	-0.575	0.502
26–35 Years Old	-1.089	0.396	-2.75	0.007***	-1.872	-0.307
36–45 Years Old	-0.91	0.525	-1.73	0.085*	-1.946	0.127
46–55 Years Old	-0.798	0.624	-1.28	0.203	-2.029	0.434
Over 55 Years Old	-0.801	0.658	-1.22	0.226	-2.101	0.499
6–10 Years' Experience	-0.125	0.425	-0.29	0.77	-0.965	0.715
11–15 Years' Experience	0.364	0.518	0.7	0.483	-0.659	1.387
16–20 Years' Experience	0.262	0.565	0.46	0.644	-0.855	1.379
More than 20 Years	0.3	0.59	0.51	0.611	-0.864	1.465
Asir Region	0.622	0.466	1.33	0.184	-0.298	1.542
Eastern Region	-0.237	0.899	-0.26	0.793	-2.012	1.538
Ha'il Region	0.224	0.503	0.45	0.656	-0.769	1.217
Al Jawf Region	-0.141	0.58	-0.24	0.808	-1.287	1.004
Jazan Region	0.748	0.506	1.48	0.142	-0.253	1.748
Makkah Region	0.69	0.442	1.56	0.121	-0.184	1.564
Al Medina Region	0.184	0.495	0.37	0.71	-0.793	1.161
Najran Region	0.076	0.558	0.14	0.891	-1.026	1.179
Northern Border Region	0.667	0.751	0.89	0.376	-0.816	2.15
Al Qassim Region	-0.006	0.613	-0.01	0.992	-1.216	1.204
Riyadh Region	0.547	0.433	1.26	0.209	-0.309	1.402
Tabuk Region	0.275	0.709	0.39	0.698	-1.125	1.676
Constant	4.029	0.648	6.21	< 0.01***	2.748	5.309

Mean dependent var	3.830	**SD dependent var**	1.066
R-squared	0.197	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.13

Effect of Doctor's Communication Using Electronic Referral

Communication	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.054	0.066	0.82	0.414	-0.076	0.184
Cardiologist	0.563	0.244	2.3	0.023**	0.08	1.046
ENT	-0.245	0.442	-0.56	0.58	-1.117	0.627
Family Physician	0.052	0.282	0.18	0.854	-0.505	0.609
General Practitioner	0.602	0.308	1.96	0.052*	-0.006	1.21
Neurologist	-0.246	0.439	-0.56	0.576	-1.113	0.621
Pediatrician	-0.067	0.252	-0.27	0.79	-0.565	0.431
Gender	-0.062	0.241	-0.26	0.796	-0.539	0.414
26–35 Years Old	-0.888	0.483	-1.84	0.068*	-1.842	0.066
36–45 Years Old	-0.829	0.548	-1.51	0.133	-1.912	0.254
46–55 Years Old	-0.841	0.643	-1.31	0.193	-2.111	0.43
Over 55 Years Old	-0.944	0.677	-1.4	0.165	-2.28	0.392
6–10 Years' Experience	0.101	0.501	0.2	0.841	-0.889	1.091
11–15 Years' Experience	0.393	0.547	0.72	0.473	-0.687	1.474
16–20 Years' Experience	0.339	0.615	0.55	0.582	-0.876	1.554
More than 20 Years	0.365	0.62	0.59	0.557	-0.86	1.59
Asir Region	0.733	0.466	1.57	0.117	-0.187	1.653
Eastern Region	0.744	0.61	1.22	0.225	-0.461	1.948
Ha'il Region	-0.115	0.553	-0.21	0.836	-1.208	0.978
Al Jawf Region	-0.127	0.581	-0.22	0.827	-1.274	1.02
Jazan Region	0.526	0.448	1.17	0.243	-0.359	1.411
Makkah Region	0.668	0.484	1.38	0.17	-0.288	1.624
Al Medina Region	0.241	0.475	0.51	0.613	-0.698	1.179
Najran Region	0.566	0.508	1.11	0.267	-0.438	1.57
Northern Border Region	-0.249	0.775	-0.32	0.748	-1.781	1.282
Al Qassim Region	-0.052	0.604	-0.09	0.932	-1.246	1.142
Riyadh Region	0.642	0.44	1.46	0.147	-0.228	1.511
Tabuk Region	0.358	0.593	0.6	0.547	-0.814	1.53
Constant	3.754	0.618	6.08	< 0.01***	2.534	4.974

Mean dependent var	4.048	**SD dependent var**	1.009
R-squared	0.118	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.14

Effect of Past Patient's Experience on Patient Referral

Past Patient Experience	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.08	0.084	0.95	0.345	-0.087	0.247
Cardiologist	0.583	0.214	2.72	0.007***	0.16	1.005
ENT	-0.481	0.425	-1.13	0.259	-1.32	0.358
Family Physician	0.464	0.239	1.94	0.054*	-0.008	0.936
General Practitioner	0.651	0.252	2.59	0.011**	0.154	1.148
Neurologist	-0.788	0.739	-1.07	0.288	-2.248	0.672
Pediatrician	-0.074	0.246	-0.3	0.764	-0.56	0.412
Gender	0.172	0.234	0.74	0.463	-0.29	0.634
26–35 Years Old	-0.443	0.491	-0.9	0.368	-1.414	0.527
36–45 Years Old	-0.605	0.589	-1.03	0.306	-1.768	0.559
46–55 Years Old	-0.593	0.687	-0.86	0.39	-1.95	0.765
Over 55 Years Old	-0.721	0.734	-0.98	0.328	-2.171	0.729
6–10 Years' Experience	-0.33	0.425	-0.78	0.439	-1.168	0.509
11–15 Years' Experience	0.183	0.521	0.35	0.726	-0.846	1.212
16–20 Years' Experience	0.227	0.577	0.39	0.695	-0.913	1.366
More than 20 Years	0.061	0.61	0.1	0.921	-1.145	1.266
Asir Region	0.502	0.53	0.95	0.345	-0.545	1.549
Eastern Region	0.853	0.676	1.26	0.208	-0.481	2.188
Ha'il Region	0.725	0.556	1.3	0.195	-0.374	1.824
Al Jawf Region	-0.054	0.602	-0.09	0.928	-1.242	1.134
Jazan Region	0.862	0.562	1.53	0.127	-0.248	1.971
Makkah Region	0.57	0.527	1.08	0.281	-0.471	1.611
Al Medina Region	0.319	0.559	0.57	0.568	-0.784	1.423
Najran Region	0.79	0.544	1.45	0.149	-0.285	1.864
Northern Border Region	0.154	1.437	0.11	0.915	-2.684	2.993
Al Qassim Region	0.181	0.64	0.28	0.778	-1.083	1.444
Riyadh Region	0.719	0.498	1.44	0.151	-0.265	1.702
Tabuk Region	-0.007	0.544	-0.01	0.99	-1.081	1.067
Constant	3.129	0.761	4.11	< 0.01***	1.627	4.631

Mean dependent var	3.793	**SD dependent var**	1.057
R-squared	0.182	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 3.15

Effect of Patient's Remote Diagnostics on Patient Referral

Remote Diagnostics	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
Outpatient Referrals	0.125	0.065	1.94	0.055*	-0.003	0.253
Cardiologist	0.131	0.262	0.5	0.617	-0.386	0.649
ENT	0.078	0.281	0.28	0.781	-0.477	0.633
Family Physician	-0.021	0.32	-0.06	0.948	-0.652	0.611
General Practitioner	0.046	0.336	0.14	0.891	-0.618	0.71
Neurologist	0.311	0.217	1.43	0.155	-0.118	0.74
Pediatrician	0.063	0.182	0.35	0.731	-0.296	0.422
Gender	-0.013	0.183	-0.07	0.942	-0.374	0.347
26–35 Years Old	0.334	0.476	0.7	0.484	-0.606	1.274
36–45 Years Old	0.16	0.548	0.29	0.771	-0.923	1.242
46–55 Years Old	-0.079	0.606	-0.13	0.897	-1.275	1.118
Over 55 Years Old	0.07	0.641	0.11	0.913	-1.196	1.337
6–10 Years' Experience	0.244	0.322	0.76	0.449	-0.392	0.88
11–15 Years' Experience	0.05	0.401	0.13	0.9	-0.741	0.842
16–20 Years' Experience	0.444	0.434	1.02	0.308	-0.413	1.3
More than 20 Years	0.341	0.47	0.73	0.469	-0.587	1.268
Asir Region	-0.087	0.453	-0.19	0.848	-0.982	0.808
Eastern Region	0.054	0.569	0.1	0.924	-1.069	1.178
Ha'il Region	0.622	0.848	0.73	0.465	-1.054	2.297
Al Jawf Region	0.228	0.575	0.4	0.692	-0.907	1.363
Jazan Region	0.787	0.439	1.79	0.075*	-0.08	1.654
Makkah Region	-0.411	0.504	-0.82	0.416	-1.406	0.584
Al Medina Region	-0.596	0.48	-1.24	0.216	-1.544	0.352
Najran Region	-0.29	0.508	-0.57	0.568	-1.294	0.713
Northern Border Region	0.14	0.538	0.26	0.795	-0.923	1.203
Al Qassim Region	-2.77	0.638	-4.34	< 0.01***	-4.029	-1.51
Riyadh Region	-0.084	0.442	-0.19	0.849	-0.957	0.789
Tabuk Region	-0.131	0.491	-0.27	0.791	-1.101	0.84
Constant	3.386	0.707	4.79	< 0.01***	1.989	4.782
Mean dependent var		4.186	**SD dependent var**			0.854
R-squared		0.262	**Number of observations**			188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Chapter 4

Physicians Perception of The Impact of E-health Reform on The Cost of Care in Saudi Arabia

Abstract

Objective: This study examined physicians' perception of whether the e-health reform in Saudi Arabia has reduced the MOH cost of care for patients in Saudi Arabia.

Method: An ordinary least squares (OLS) regression was used to model the relationship between e-health and cost of care. The analysis included physicians' perception of accuracy, viewing patient's history, electronic services cost reduction, overall cost, and electronic training. The outcome of the regression analysis provided the answer to whether or not it reduces the MOH cost of care for the patients after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypotheses and models estimated with STATA.

Results: A total of 188 physicians participated in the questionnaire. From the physician's point of view, the outcomes indicate no significant impact on the cost of care after introducing the e-health reform in Saudi Arabia except for remote training. The analysis shows that online training is affected significantly with e-health, leading to cost reduction.

Conclusion: The expectation is that e-health will positively impacts the cost for both patients and providers. Based on the results mean, physicians believe that e-health can help save cost, yet the outcomes showed no correlation between electronic services and cost reduction.

Introduction

The Ministry of Health (MOH) in Saudi Arabia introduced the e-health system reform in 2011. The e-health strategy focuses on enabling system integration and having data accessible and exchangeable across the e-health network. In 2018, only the MOH spent 33 billion Saudi Riyal/9 billion USD for the health care system reform (Ministry of Finance, 2018). The MOH manages about 60% of the hospitals in Saudi Arabia, where the private sector operates the other 20%. The other 20% is governed by the armed forces and the national guard health services (Alsulame et al., 2016).

Saudi Arabia's government announced Vision 2030 in 2016. The fundamental goal of the vision is to reduce the country's reliance on oil and diversify its economy (Vision 2030, 2021). To achieve the vision's objectives, the government established the National Transformation Program (NTP), which aims to accelerate the implementation of primary and digital infrastructure projects while also engaging stakeholders in identifying challenges, co-creating solutions, and contributing to the program initiatives under the supervision of the council of ministers.

The primary goal of electronic health services is to reduce the cost of health care services. The use of an e-health system can improve the efficiency of the health care system while also lowering the cost (Koutras et al., 2015). Most studies on electronic health services report global benefits, and, on average, the capital recovering process is fast. Moreover, when the e-health system is used, it is expected to reduce the expenditure on health services and help provide financial sources for other services (Russo et al., 2016).

E-health reform expects to enable the MOH to reduce the cost of care and provide care for patients with the highest quality standards. The increasing prices of health services

and expenditures made the MOH put a significant reform to facilitate the cost and make their expenditure accurately planed. e-health implementation enhances their operations and helped eliminate unnecessary costs (Ministry of Health, 2013).

Health Systems Research Gaps

The implementation of the e-health system in Saudi Arabia has not been evaluated yet. The Saudi health reform started in 2011. The MOH expected to implement the system throughout the country by 2021. By 2021, the e-health system can be accessed from any hospital or primary care center in the Kingdom (Ministry of Health, 2013).

Research Innovation

This study evaluates physicians' perception of the effectiveness of the e-health system reform on the cost of care for patients in Saudi Arabia. This research will contribute to the health systems research literature by looking at the impact of e-health on multiple outcomes. This study aims to examine e-health's effect on the cost of care in Saudi Arabia. This study included nine variables that collectively affect the cost of care for patients. Measures included in the study are accuracy in filling out reports, viewing patient's history, electronic services cost reduction, replacing paperwork with electronic services, overall cost, remote diagnostics, electronic training time saving, and electronic training cost saving.

Rationale of the Research:

Publicly and privately sponsored health reforms aim to use health information technology to improve access to medical care and health outcomes (Batura et al., 2016). It is essential to examine the results of reform efforts so that improvements can be made on a national level, and a global scale future reform efforts can be evidence-based. The

government of Saudi Arabia is going through a major health reform that includes more than 70 projects. The main project is the e-health system reform (Ministry of Health, 2011). The objective of this reform is to improve health services delivery, access, quality, and safety (Ministry of Health, 2018a). This study aimed to evaluate physicians' view of the e-health reform outcomes regarding the cost of care to determine if the e-health system reform is making a difference in these aspects.

Literature Review

System-Level Cost Savings:

Implementing the e-health system introduces many options for services that can be provided for patients and providers. Health care services cost increases year after year, and health care organizations continually look for solutions that reduce the cost and increase their revenues (Armstrong et al., 2014). E-health provides solutions that can increase their income and reduce the cost of the health care services offered by the organization or the practice. However, implementing e-health comes with barriers such as the initial high cost of implementing the system, maintenance cost, and employee and patient's training (Hillestad et al., 2005). Furthermore, many researchers have proposed solutions that can help providers overcome these barriers, such as facilitating the system and making subsystem tools that small practices can use and the government incentives to encourage providers to purchase the system. Many research designs have been used to analyze the economic value and investment of the e-health system. However, many researchers have the limitation of not being able to generalize the results due to the statistical bias of the analysis (Anderson, 2007).

The literature has shown that electronic systems affect patient costs. Also, from a social and health care system perspective, electronic services can be cost-effective (Armstrong et al., 2014). Armstrong et al. conducted a prospective cost-effectiveness analysis aiming to assess the cost of the health services provided for breast cancer patients using a mobile application in their follow-up. The analysis compared the cost of in-person and electronic follow-up and evaluated the effectiveness of both methods. Part of the evaluation is the cost of services. Cost data were derived from administrative data for breast reconstruction patients at Women's College Hospital (WCH) in Toronto and billed costs for QoC Health Inc.'s mobile app. The data were observed from the date of the surgery for 30 days. The authors indicated that this period is sufficient to perform an accurate analysis based on breast cancer literature. The International Health Technology Assessment (HTA) recommended that a microcosting approach obtain the societal perspective data. The outcomes imply that the electronic follow-up is costing significantly less than in-person follow-up. Furthermore, the study demonstrated that the electronic appointments had made a significant societal saving. This approach can provide high-quality services for patients with lower socioeconomic status (Armstrong et al., 2014).

Health informatics can reduce the prices of health care services (Hillestad et al., 2005). A systematic review by Hillestad et al. estimated the current adoption of EMR systems and the potential savings, costs, and health and safety benefits. The authors indicated that using the EHR system in hospitals and ambulatory care could save the U.S. health system more than $77 billion a year on average. Significant savings would be counted for services such as transcription, laboratory tests, drug use, radiology, patient length of stay, and medical records. The review implied that, especially for senior patients,

EHR saves costs in overprescribing medication. The author estimated that more than 200,000 avoidable drug events could be eliminated by EHR, saving more than $1 billion a year across the country. Saving this amount can reflect positively on the prices of the services of the patient. All in all, electronic health records help in reducing the cost of the patient's health care services by eliminating unnecessary expenses.

Research has shown that health informatics applications reduce the cost of the health care services provided for patients (Ekeland et al., 2010). In a systematic review conducted by Ekeland et al. assessed the effectiveness of telemedicine application and its impact on the services. The authors reviewed articles in major databases. They included studies with high-quality reviews, 80 studies in total, and 91% of the studies emphasized the contribution of telemedicine in reducing the cost of services, especially for patients with chronic conditions. Moreover, electronic services helped reduce traveling time and cost for patients and reduced hospital admission, which led to a reduction at the expense of the health services provided. The review implied that the use of electronic services could yield more revenue to the organization and reduce and save the cost of health care services. Furthermore, technology is advancing rapidly, and many alternatives are invented every day that will lead to competition between products, ultimately reducing the prices of the products and reflecting on the costs of the services.

The primary anticipation of health informatics in health care services is cost reduction. e-health system offers the opportunity to enhance the efficiency of the health care system and reduce the cost and time for the health service provided for patients (Koutras et al., 2015). A review conducted by Koutras et al. investigated the use of e-health and mobile applications to monitor patients. The review also investigated the

socioeconomic impact of e-health services on the patients as well. The studies included in the review were searched at Medline database, and they were published from January 1, 2000, to September 31, 2014. In the review, several studies have assessed the use of e-health on the follow-up. Among the studies, two randomized trials investigated the patient's follow-up preference.

The results of these studies indicate that patients prefer electronic follow-up. However, there was no significant variability because most eligible patients refused to participate in the study. The review indicated that alongside all the benefits the patients could gain from health informatics, a reduction in the cost of health services is significant. Moreover, another randomized controlled study examined Skype as a follow-up instead of the report letter in the review. The study indicated a higher patient satisfaction with patients who used Skype. The review assessed the patient's follow-up with their physicians; the assessment indicated that electronic services are feasible and caused a price reduction for the services. The systematic review pointed out that web-based follow up has shown a statistically significant difference in saving travel costs for patients. Moreover, for patients in rural areas, electronic services reduce the traveling time and cost for patients. Overall, electronic health care services provide patients convenience and significantly reduce the cost of health care services (Koutras et al., 2015).

Research has shown that the e-health system helps health care providers save costs and cover the value of the implementation within a few years (Gallego et al., 2010). Gallego et al. conducted a systematic review to compile indicators of cost and cost savings of the electronic health records. To provide decision-makers with signs and studies they can rely on when deciding on implementing the electronic health record and analyzing other

indicators related to cost-saving, the review indicated that the electronic health record implantation saves and improves transcriptions, financial transactions such as billing and reimbursements, and storage and charts related activities. The authors concluded their review by stating that most studies on electronic health records report global benefits and, on average, the capital recovering process is fast. In the review, all studies have at least one indicator for cost. The review indicated that the providers recover their implantation fast and increases revenue and cost-saving. Many studies in the review pointed out that the cost could fully be recovered within the first year. On average, the cost recovery ratio is 76.5%.

Furthermore, the annual cost ratio shows that the annual benefit can cover the incurred annual costs. According to eight studies in the review, the annual benefit is 308.6% of ongoing costs. The high benefit ratio is triggered mainly by savings on medical, chart-related activities, transcript costs, and a higher revenue resulting from improved coding (Gallego et al., 2010).

Prior research has shown that electronic health care delivery, services such as telemedicine and tele rehabilitation increase health care providers' costs (Bendixen et al., 2009). The authors conducted a study to examine the effect on health care costs of the Veterans Administration (VA) telerehabilitation program. The study was a pre-post retrospective design; the study duration was 12 months preregistration and 12 months postenrolment. The dependent variables in the study were health care costs incurred by the VHA for inpatient and outpatient. Costs presented exclude costs of contracts of medical services. Cost data for health care were obtained through the VHA. The total cost of the daycare hospital bed (BDOC) decreased by 46% in cost. There were no significant differences in the types of clinic visits before and after enrollment. There were also no

changes to the emergency department data. Furthermore, the results show a significant decrease in the cost of hospitalization; however, for whole services, the difference is not significant.

Moreover, research has shown that the e-health system decreases hospital cost and increase savings (Russo et al., 2016). The authors carried out a retrospective analysis of all telemedicine visits to the VA hospital in White River Junction, Vermont. The objective of the analysis was to examine the results of the telemedicine system implemented by the VA health care system. The visit to telemedicine included in the study took place from 2005–2013. For 1,859 patients, the study included 5,695 visits. Many patients had to drive to see the doctor face-to-face because of the hospital's location, and the average journey distance was 145 miles and 142 minutes per patient. In addition, 47.1 patients were eligible for travel pay savings over the study period with a total of $164,394, with an average of $18,555 per year or $28.86 per telemedicine visit. By 2013, the telemedicine visit was attended by a large patient number, resulting in 3.5% savings from traveling payments. Overall, the findings show that telemedicine significantly reduced the VA health care system's cost of services. If the system used more, that could reduce the expenditure on the patient's services and help provide a resource to provide more services for the patients.

Furthermore, prior research has proven that in the long run, e-health can yield a positive return on investment (Wang et al., 2003). The authors performed a cost-benefit study to analyze the financial effects of electronic medical record systems in ambulatory primary care settings from the perspective of the health care organization. Net financial costs or benefits per provider over 5 years were the primary outcome measure. Using an internally developed electronic medical recording system at Partners HealthCare System,

preliminary data were obtained from several internal medicine clinics, and there were 2,500 patients in the panel. The implementation of electronic medical records involves two categories of costs: system costs and induced costs. System costs include software and hardware costs, training, implementation, and ongoing support and maintenance. Those involved in the transition from a paper to an electronic system are induced costs. It is assumed that initial costs would be paid at the beginning of year one and that benefits would be acquired at the end of each year. Net benefit was the primary outcome measured. In the base case, a discount rate of 5% was used, and in the sensitivity analysis ranged from 0% to 10%. The analysis outcome indicated 33% saving in drugs, 17% radiology usage, a15% decreased billing errors, and 15% improvements in charge capture in the 5-year cost-benefit model. In conclusion, the analysis emphasized that EMR has increased the financial return of the organization.

Le Moullec et al. (2020) investigated the cost-effectiveness of e-health compared to traditional methods. The authors indicated that after COVID, e-health's use became widely accepted to protect patients and medical professionals. The anticipation is that electronic services are cost-effective and help patients and organizations to save costs on health care. The analysis of the study indicated that the cost-effectiveness depends on the health care setting, country, and other variables. However, e-health applications can reduce the cost of care and improve the expenditure of health care organizations (Le Moullec et al., 2020).

Prior research has demonstrated that electronic medical records reduce the cost of treating patients with chronic conditions (Hoverman et al., 2011). The authors conducted a retrospective cohort study for cancer patients from July 1, 2006, to June 31, 2007, at U.S.

oncology network practices. The study aimed to assess the effect of two different studies' methods of treatment for cancer patients. The first method used EMR in the process of therapy. The second method using the traditional treatment method. The study included 910 patients from 11 states. Of the total study population, 756 patients (83%) were treated in EMR, and 154 (17%) were treated with the traditional method. Using EMR in the treatment process lowered the cost of the treatment significantly ($P < 0.05$). The authors emphasized that electronic medical records help reduce the cost of the treatment for patients with chronic conditions without exposing patients to any harm.

Additionally, providing health care services in rural areas can be expensive; many health care systems worldwide used health informatics to minimize the cost of the services offered to patients in rural areas (Wang et al., 2016). The authors conducted a cross-sectional 12-year analysis, from May 2002 to December 2013, of a telemedicine program in China's western regions. The information was acquired from the West China Hospital (TCWCH) Telemedicine Center. The study measured the impact of teleconsultation by changing clinical care through calling local physicians 90 days after telemedicine sessions. A total of 11,987 teleconsultations were conducted between 2002 and 2013. There were 1,463 repeated among them. Thirty-two hospitals (12.9 %) sent over 100 consultations each over the 12 years, while 134 hospitals (53.8 %) sent less than 10 consultations, and 83 hospitals (33.3 %) sent 10–100 consultations. The analysis showed that in the first year of operation, the total cost of the telemedicine project was $ 16,941 compared to $ 21,207 when patients traveled to the hospital or $ 25,160 when specialists traveled to the patient. Telemedicine network cost $ 176,243 in 2013, whereas the face-to-face health care model cost $ 803,847 when patients traveled to the hospital or $ 1,383,148 when specialists

traveled to the patient. Overall, the teleconsultation project's aggregate cost over 12 years was $ 889,885, while the traditional consultation cost was $ 3,254,410, a net saving of $ $2,364,525. The study was concluded by indicating that services like telemedicine reduce the costs for the health system and increase the efficiency of services.

E-health systems can be implemented at a high cost. However, the cost can be redeemed in the long run (Holroyd-Leduc et al., 2011). Holroyd-Leduc et al. measured the impact of EMR/EHR in ambulatory practices of primary care. The authors included 30 studies that fulfilled their criteria for inclusion. Like any new method of intervention, the health care delivery process has positive and negative impacts. The review revealed that the benefits of providing access to electronic services are clear. However, there are disadvantages that it is possible to identify electronic services such as the usage difficulty when implementing the system and the training requirements that doctors and employees must meet. The productivity of the office/clinic tends to be lower than usual when the system first operates because of the time spent inputting the data into the system. With time, however, this issue seems to be disappearing. The cost of the system is one disadvantage that any office, clinic, or even a hospital has to face. The cost is usually high initially, but in the long run, the benefit can be redeemed. However, the implementation cost must be properly planned before the decision is taken to obtain the system. EMR/EHR has proven to be beneficial in the long run in terms of cost savings, and with a few years, the system can return its cost (Holroyd-Leduc et al., 2011).

Online education and training are being used more often. In health care, online services training provides patients who travel long distances to receive their health care services (Knapp, Chan, Anaya, & Goetz, 2011). The authors conducted a quantitative

analysis to analyze and evaluate an alternative online training program for patients with HIV. The study took place at the V.A. Healthcare system in West LA. The authors aim to use this model in all of the V.A. health care systems in the U.S. There were two groups in the study, the in-person group (control) with 16 participants and the online group (intervention) with 20 participants, making the total study population 36 participants. The analysis results implied that the V.A. health care systems online training service costs less than traditional training sessions, which can be cost-effective.

Research Overview

This dissertation paper will assess physicians' perception of the effect of the e-health system on the cost of care in Saudi Arabia. The question of this article will be, from a physician's point of view, will e-health significantly reduce the cost of care for patients in Saudi Arabia? The article's hypotheses will be: The e-health system reform will reduce patients' cost of care in Saudi Arabia.

Method

This survey presents an investigation to assess the effect of e-health system reform in Saudi Arabia from a physician's perspective. This study used this questionnaire's responses from physicians who work for the MOH to evaluate the outcome of the e-health system reform more accurately since they are the users of the system. Following Alsffer (2021) and Seçkin, et al. (2019), an OLS regression with a robust standard error was used to model the relationship between e-health usage and cost of care. An ordered logistic regression was performed to ensure that the measure's outcome of the regressions matched the OLS outcomes, and the results of both models' regressions were compared. The outcome of the regression analysis provided the answers to whether or not it affected the

cost of care after the e-health reform in Saudi Arabia. As for the significance test, a t-test was conducted to test the hypothesis, and models estimated with STATA (for more details about the survey, see Chapter 2).

This paper applied nine questions to the analysis. The question addressed accuracy in filling out reports, viewing patient's history, electronic services cost-saving, long-run cost-saving, replacing paperwork with electronic services, overall cost, remote patient's diagnostics, electronic training saving time, and electronic training saving cost. The selection of variables used for this research was based on the patient's characteristics and origin. To the best of my knowledge, this is the first research conducted to evaluate the effect of the e-health system reform in Saudi Arabia. The survey covers many aspects that can collectively impact the cost of care.

The accuracy of the patient's files and reports as measures was used in the analysis to investigate the impact of e-health. The survey was designed to examine the improvement made on the accuracy of the files and reports from the physician's point of view. Accuracy of filling out reports is essential for proper diagnostics. When specialists receive patients' information, accurate information and complete details increase the patient's chance of getting the appropriate treatment sooner. Because if there are any missing details, the specialist will have to do the test again, which lowers the cost by avoiding unnecessary tests and save the staff's time. So, to test the impact of e-health, accuracy is a measure that was added to the analysis.

Viewing a patient's history by specialists is a variable that was added as a measure. e-health provides many features for physicians and staff, and viewing a patient's history is one of these features. The purpose of this variable was to examine if e-health has any

significant influence over it and if there is any significant difference from the traditional method. This variable was chosen because having the patient's information present for doctors during diagnostics saves time and the cost of any missing test that the patient has already taken. Yet the results were not provided to the doctor.

Similarly, adding patient's remote diagnoses to the analysis was necessary. When the PCP offers the information to the specialist if the patient needs a referral, the specialist can see the patient's file and decide if the patient needs the referral or the treatment can be offered at the PCP office. Remote diagnoses can save time and cost for both patient and physician. So, this variable was added to the analysis to measure the effect of e-health on cost.

Additionally, the analysis included electronic service's effect on cost-saving as a measure. The data were collected from physicians who work for MOH, most of whom had worked in managerial positions. After the permission was granted from the ethical committee to reach out to physicians, responses were acquired from people who were at a senior executive level at the ministry at Riyadh. The answers given in the survey were based on their involvement and working experience. That is because people who have experience in budgeting and management will be more accurate, especially when it comes to cost and expenditure. The purpose of this question was to investigate whether e-health had any impact on cost or not. The primary anticipation of e-health implementation in almost every health organization in the world was to reduce cost. So, adding this variable to the regressions was necessary for the analysis.

Moreover, replacing paperwork with electronic services was a variable used as a measure in the study. Improving ways of communication and reducing paper use was one

of the objectives of using e-health. Adding the replacement of paperwork with electronic services was necessary to the analysis to measure the impact of e-health on the cost of care.

This study aims to measure the impact of e-health on the cost of care. Likewise, long-term cost-saving and overall cost savings were added to the analysis. Long-run cost-saving means the organization's cost savings for an extended period; the hospital implements electronic services, hoping to save more every year. Implementing e-health costs a lot, but it can yield a positive return on investment (Wang et al., 2003). Adding long-run savings was necessary to measure the effect e-health had on cost savings if it is significant or not. Overall cost means, in this context, the amount of cost reduced annually. E-health provides many alternatives for the traditional methods and reduces the cost of supplies the organization uses in its operations. So, the overall cost was added to the analysis to measure the effect of electronic services if it has a significant impact or not.

The usage of online education and training is becoming more common. Patients who travel long distances to receive health care services can benefit from online services training (Knapp et al., 2011). Electronic services offer access to the user, and that includes training. Medical staff must achieve a certain number of learning hours every year to stay updated with everything new in their field. Many people need to take leave from their work to attend conferences and workshops to obtain their credits; that means they must spend their time elsewhere and pay for their trip. So, adding online training to the analysis was necessary to measure the impact of e-health on both time and cost of training and if there is any significant impact.

The analysis included more variables that served as an independent variables to test whether they influenced the outcome. The key variable that was included in the regressions

was the frequency of usage. This variable is intended to measure how often physicians and their staff use e-health and how it affects their performance. The survey included a question asking the physicians how many times they use electronics during the week. The answer included four different answers; none means that doctors do not use electronic services, often (2–3 times a week), sometimes (4–5 times a week), and daily (use e-health every day). This question represents the frequency of usage, the key variable. This study investigates the effect of e-health reform on the cost of care in Saudi Arabia. Based on that, the questionnaire was created specifically to test e-health's impact on cost. The variables were chosen for this study signify nine different measures that have been provided for patients using the old methods and without using electronic services. The usage of electronic services was included in the regression to measure the difference between the traditional method and electronic services. For every dependent variable being tested, the result showed the effect of e-health on that variable and tested to see if the difference was significant or not.

Another variable included in the regression was the gender of the physician (male/female) who participated in the survey. Also, the region of the physician, Saudi Arabia, has 13 administrative regions, and this independent variable represents the region of the physician who answered the questionnaire. The physician's specialty was also included in the regression. This variable represents the specialty of the physicians who participated in the survey. The physician's experience was also included in the regression, indicating the number of years of practice that the physician has. The survey included 5-year groups: 1–5 years, 5–10 years, 10–15 years, 15–20 years, and 20+ years. The last independent variable was age. This variable represents the age of the physician participating in the questionnaire.

The survey experience was measured by groupage, and the survey had five different age groups: 18–25 years, 26–35 years, 36–45 years, 46–55 years, and over 55 years.

The regression model is the following:

$$\boldsymbol{Y_{irt} = \beta_0 + \beta_1 Usage_i + \beta_2 Gender_i + \beta_3 Age_i + \beta_4 Region_i + \beta_5 \mathbf{Specialty}_i + \beta_6 Experience_i + \varepsilon_{it}},$$

where the $\boldsymbol{Y_{irt}}$ represents the physicians' perception measures. The study included the physicians' perception of nine different aspects. The measures are accuracy in filling out reports, viewing patient's history, electronic services cost reduction, replacing paperwork with electronic services, overall cost, remote diagnostics, electronic training time saving, and electronic training cost-saving. Each service will be tested separately to measure electronic services' effect on that particular service. $\boldsymbol{Usage_i}$ represents the frequency of the physicians or staff usage for electronic services when performing their services for the patients. $\boldsymbol{Female_i}$ stand for the patient's gender. $\boldsymbol{Age_i}$ stand for the patient's age. $\boldsymbol{Region_r}$ stand for the patient's health care facility region where that patient was referred from. $\mathbf{Specialty}_i$ stand for the specialty of the physician that the patient was referred to. $\boldsymbol{Experience_i}$ stand for the years of experience of the specialist that the patient visited. The key independent variable is the frequency of electronic services usage. The regression included gender, age, specialty, experience, and region to understand whether these variables influence outcomes or not.

Results and Analysis

The results show that each aspect affected the physicians and their input on that services area. The total respondents were 188 physicians with different specialties. Table 1 lists the characteristics of the respondents, and Table 2 shows the survey means. The

hypothesis was: The e-health system reform will reduce patients' cost of care in Saudi Arabia. An ordered logistic regression was performed to ensure that the measure's outcome of the regressions matched the OLS outcomes, and the results of both models' regressions were compared. The OLS measures significance matched the ordered logistic regression outcomes and indicated the correctness of the results.

Moreover, in the survey, a question was asked about the importance of e-health on accuracy in filling out reports. The sample mean of the survey was 5.117, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between usage and accuracy in filling out reports; the outcome measure had a coefficient of 0.063 and a p-value of 0.499, indicating no statistically significant relationship between usage and speed of admitting patients measured (Table 3). However, it matters whether the medical staff is trained and has experience with electronic services. When the regression was factored for experience in electronic health services, the outcome measure had a coefficient of -0.037 and a p-value of < 0.001 (Table 4). When the medical staff has proper training on electronic services, the accuracy of filing reports will be significantly enhanced. The other variables controlled for the dependent variables of gender, experience, specialty, region, and age were not significant and did not affect the accuracy in filing reports.

Likewise, the questionnaire asked about the importance of e-health on viewing a patient's complete history during an examination. The sample mean of the survey was 5.112, indicating a response between "improved considerably" and "improved somewhat." Regression results on the relationship between electronic services and viewing patient's complete history, the outcome measure had a coefficient of 0.041 and a p-value of 0.627,

indicating no statistically significant relationship between electronic services and viewing patient's complete history measure (Table 5). However, the physician's responses mean was 5.112, indicating a response between "improved considerably" and "improved somewhat"; they believed that e-health affected the process of viewing a patient's information. Still, the outcome did not correlate with the usage of electronic services. Family physicians were statistically significant with a coefficient of 0.677 and a p-value of 0.05, which means family physicians were significantly affected by electronic services and improved their diagnoses after viewing the patient's history. As for the other variables controlled for, the dependent variable gender, age, experience, and region were not significant and did not affect viewing the patient's complete history during the examination. Thus, a t-test was conducted. According to physicians, the outcome indicates that viewing a patient's full history during the test was not significantly impacted after the introduction of e-health.

Furthermore, the survey asked about the importance of e-health on electronic services contributed to the cost reduction of health services. The sample mean of the survey was 3.830, indicating a response between "agree" and "neutral." Regression results on the relationship between electronic services and cost reduction, the outcome measure had a coefficient of 0.123 and a p-value of 0.129, indicating no statistically significant relationship between electronic services and cost reduction (Table 6). Therefore, a t-test was conducted to test the hypothesis. From the physician's point of view, the outcome indicates that electronic services did not significantly affect the cost of care in Saudi Arabia. However, the physician's mean was 3.830, indicating a response between "agree" and "neutral"; their answer is agreeing that e-health contributes to cost reduction. Still, the

outcome did not correlate with the usage of electronic services. The other variables controlled for the dependent variable gender, age, experience, specialty, and region were not significant and did not affect the cost of care after using the electronic services.

Additionally, the physicians were asked about the importance of e-health on long-term cost reduction and how, in the long run, electronic services contribute to the cost reduction of health services. The sample mean of the survey was 4.112, indicating a response between "strongly agree" and "agree." Regression results on the relationship between electronic services and long-term cost reduction; the outcome measure had a coefficient of -0.002 and a p-value of 0.976, indicating no statistically significant relationship between electronic services and long-term cost reduction (Table 7). Physicians aged 36 and older were statistically significant, meaning that physicians aged 36 and older believe that electronic services can save cost in the long run. Moreover, physicians who have 6 or more years of experience are statistically significant. That means that physicians with 6 years or more of experience believes that e-health can reduce the cost in the long run. As for the other variables controlled for, the dependent variable gender, specialty, and region were not significant. Accordingly, a t-test was conducted to test the hypothesis. From the physician's point of view, the outcome indicates that electronic service usage did not significantly affect the cost of care in Saudi Arabia in the long run. However, the physician's answers mean was 4.112, indicating a response between "strongly agree" and "agree;" physicians believe that e-health can help reduce the cost in the long run, but the outcome did not correlate with the usage of electronic services.

In the questionnaire, the physicians were asked about the impact of e-health on replacing paperwork with electronic services in communications. The sample mean of the

survey was 4.245, indicating a response between “strongly agree” and “agree.” Regression results on the relationship between electronic services and replacing paperwork with electronic services in communications; the outcome measure had a coefficient of 0.068 and a p-value of 0.273, indicating no statistically significant relationship between electronic services and replacing paperwork with electronic services in communications (Table 8). Thus, a t-test was conducted to test the hypothesis. From the physician’s point of view, the outcome indicates that replacing paperwork with electronic services in communication was not significantly impacted by e-health. However, the physician’s answers mean was 4.245, indicating a response between “strongly agree” and “agree;” physicians believe that e-health can help reduce the cost by replacing paperwork with electronic communications, but the outcome did not correlate with the usage of electronic services.

General practitioners were statistically significant with a coefficient of 0.607 and a p-value of 0.05, which means that general practitioners believe that replacing paperwork with electronic services communication can reduce the cost. Moreover, physicians aged 36–45 years were statistically significant with a coefficient of -0991 and a p-value of 0.096. That means physicians in that age group think that replacing paperwork with electronic communication can reduce the cost. Physicians with 6-15 years of experience were also significant, and they believe that using electronic communication can reduce the cost. The other variables controlled for the dependent variable gender and region were not significant and did not affect the cost of replacing paper with electronic services

Moreover, the questionnaire asked about the importance of e-health on overall cost reduction. The sample mean of the survey was 4.287, indicating a response between “strongly agree” and “agree.“ Regression results on the relationship between electronic

services and overall cost reduction, the outcome measure had a coefficient of 0.084 and a p-value of 0.153, indicating no statistically significant relationship between usage of electronic services and overall cost reduction (Table 9). Therefore, a t-test was conducted to test the hypothesis. From the physician's point of view, the outcome indicates that electronic services did not significantly affect the overall cost of care for patients and hospitals. Nevertheless, the physician's answers mean was 4.287, indicating a response between "strongly agree" and "agree." Physicians believe that e-health can help reduce overall cost, but the outcome did not correlate with the usage of electronic services. Al Qassim region was statistically significant with a coefficient of -1.276 and a p-value of 0.099, which means that there is significant relationship between usage of electronic services and overall cost reduction. The other variables controlled for the dependent variable, gender, age, experience, and specialty. were not significant and did not affect the overall cost.

Likewise, the survey asked about the importance of e-health on cost reduction and how remote diagnostics will help physicians serve more patients and reduce the cost of care for both patients and hospitals. The sample mean of the survey was 4.186, indicating a response between "strongly agree" and "agree." Regression results on the relationship between e-health and remote diagnostics, the outcome measure had a coefficient of 0.076 and a p-value of 0.231, indicating no statistically significant relationship between e-health remote diagnostics measure (Table 10). So, a t-test was conducted to test the hypothesis. The outcome indicates that electronic services did not significantly impact remote diagnostics. Yet, the physician's answers mean was 4.186, indicating a response between "strongly agree" and "agree"; physicians believe that remote patient's diagnoses can help

reduce the cost of care, but the outcome did not correlate with the usage of electronic services. General practitioners were statistically significant with a coefficient of 0.723 and a p-value of 0.023, meaning they believe there is a statistically significant relationship between e-health remote diagnostics. Moreover, Makkah, Al Medina, and Al Qassim regions were statistically significant, meaning there is a statistically significant relationship between e-health remote diagnostics. The other variables controlled for the dependent variable age and experience were not significant except for gender. The gender had a coefficient of 0.309 and a p-value of 0.064, which means that gender significantly influenced by how likely to accept conducting remote diagnostics.

Additionally, the questions asked were about the importance of e-health on remote training for medical staff to improve their skills and save time. The sample mean of the survey was 4.191, indicating a response between "strongly agree" and "agree." Regression results on the relationship between e-health and remote training for medical staff to improve their skills and save time. The outcome measure had a coefficient of 0.127 and a p-value of 0.06, indicating a statistically significant relationship between e-health remote training measures (Table 11). Thus, a t-test was conducted to test the hypothesis. The outcome suggests that e-health significantly impacted training. That led to saving the medical staff time, spending more time with patients, and improving their skills in the hospital. The other variables controlled for the dependent variable gender, age, experience, specialty, and region were not significant and did not affect doing electronic training to improve their employee's skills and save time.

The questionnaires also asked about the importance of e-health training for medical staff to improve their skills and reduce hospital costs. The sample mean of the survey was

4.160, indicating a response between “strongly agree” and “agree.” Regression results on the relationship between e-health and remote training for medical staff to improve their skills and reduce hospital costs. The outcome measure had a coefficient of 0.15 and a p-value of 0.038, indicating a statistically significant relationship between e-health remote training measures (Table 12). As for the other variables controlled for, the dependent variable gender, age, experience, specialty, and region were not significant and did not affect electronic training. Thus, a t-test was conducted to test the hypothesis. The outcome indicates that e-health significantly affected training, which means the hospital saves more on the medical staff training.

Discussion

A total of 188 people responded to the survey, and the third section investigated the impact of e-health on health care costs from physicians’ perspective. The survey looked at the influence of e-health accuracy, replacing paperwork with electronic services, remote medical diagnostics, and remote training from a physician’s perspective. According to the findings, physicians believed that e-health services had no significant impact on these aspects.

The investigation demonstrates that e-health has no significant effect on accuracy when it comes to filling out reports. However, staff training on how to use electronic services is important. As a result, if employees are properly trained in electronic services, they will be able to use the system more efficiently, resulting in more accurate data entering the system. Electronic health services have been shown in studies to improve a healthy organization’s workflow and minimize the level of repeat visits. E-health has also improved the accuracy and completeness of reports filed in the system and provided

physicians with necessary information during patient consultations and referral requests. However, its economic feasibility has not been very well established (Ferguson et al., 2018).

Furthermore, having patient's complete information accessible to physicians during their patients' examination was added to the analysis; however, the outcome indicates that electronic services had no significant impact on it. Research has shown that viewing patients' information and delivering it to specialists during referral requests gives the specialist the chance to view the file and decide whether the patient needs the referral or be treated by the primary care physician (Pagliari et al., 2005; Prez-Cuevas et al., 2012). However, physicians oppose using e-health systems because the systems threaten the patient's privacy, needs regular maintenance, and are costly to implement (Bates, 2005).

The survey showed that physicians believe that electronic services do not impact the short- and long-term costs. The results indicated that e-health had not significantly affected the cost, and it remained the same. The expectation is always that e-health positively impacts the cost for both patients and providers. Physicians believe that e-health can help save cost, yet the outcomes showed no correlation between electronic services and cost reduction. When comparing the cost between electronic services and old methods, the cost has not changed, and they still pay the same amount of money. It is understandable because the implementation of e-health costs a great deal of money, and the maintenance also costs a great deal. Prices will drop with technological advancement because new inventions will be introduced to the health sector (Minetaki et al., 2011).

Likewise, physicians were asked about replacing paperwork with electronic services. The outcome indicated that replacing paperwork with electronic communications

was not significantly impacted by e-health reform. The analysis also included remote patient diagnoses, and the result shows that e-health reform did not significantly impact remote diagnosis. That can be related to the load of the facility. Lamminen et al. (2001) compared teleconsultation and regular consultation and concluded that the department's load could make a difference in cost. In the beginning, the cost was about the same, but the higher the number of consultations, the more the electronic consultation saved (Lamminen et al., 2001).

The analysis results show that electronic training for employees is effective and saves time and improves their skills. Moreover, the outcomes indicate that e-health reform had a significant effect on training and impacted the cost. Research has shown that electronic training is effective and can be delivered faster in case of emergencies, and it has a significantly lower cost than traditional training (Knapp et al., 2011; Otu et al., 2021).

The study had limitations. For some questions, respondents have shown their confusion. Their response was closest to what they believe was correct, yet they think there is more to the answer they provided. Another limitation the survey had was depth; survey questions are standardized, and the questions asked are usually general questions that are understandable for respondents. The respondents do not have the chance to explain when they have more complex answers. Another limitation was different interpretations of questions. The interpretation of the question differs between respondent and that affect the validity and reliability of the results.

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Tables

Table 4.1

Sample Characteristics

Variable	Category	Percentage
Gender	Female	16.93 (n = 32)
	Male	83.07 (n = 156)
Age	18–25 Years	2.12 (n = 4)
	26–35 Years	19.05 (n = 35)
	36–45 Years	28.57 (n = 54)
	46–55 Years	31.22 (n = 59)
	Over 55 Years	19.05 (n = 36)
Experience	1–5 Years	8.99 (n = 16)
	6–10 Years	16.40 (n = 31)
	11–15 Years	17.46 (n = 33)
	16–20 Years	16.93 (n = 32)
	More than 2 years	40.21 (n = 76)
Region	Al Baha	1.06 (n = 2)
	Northern Border	1.06 (n = 2)
	Al Jawf	0.53 (n = 1)
	Al Medina	15.87 (n = 30)
	Al Qassim	1.06 (n = 2)
	Riyadh	29.63 (n = 56)
	Eastern	2.65 (n = 5)
	Asir	22.75 (n = 42)
	Ha'il	1.06 (n = 2)
	Makkah	8.99 (n = 17)
	Najran	10.58 (n = 20)
	Tabuk	2.65 (n = 5)
Frequency of Using e-health	None	9.52 (n = 18)
	Often (2–3 times a week)	30.16 (n = 56)
	Sometimes (4–5 times a week)	14.29 (n = 27)
	Daily	46.03 (n = 87)
Specialty	Family Physician	6.88 (n = 13)
	General Practitioner	5.29 (n = 10)
	Cardiologist	12.77 (n = 24)
	ENT	4.76 (n = 9)
	Neurologist	2.12 (n = 4)
	Pediatrician	15.96 (n = 30)

Note: Values in the table are percentages.

Table 4.2

Survey Means

Variable	Observations	Mean	Standard Deviation	Standard Error
Accuracy	188	5.117	1.164	0.085
Viewing Patient's History	188	5.112	1.106	0.081
Electronic services Cost Reduction	188	3.830	1.015	0.074
Long-Run Cost Reduction	188	4.112	0.898	0.065
Replacing Paperwork with Electronic Services	188	4.245	0.783	0.0571
Overall Cost	188	4.287	0.733	0.0534
Remote Diagnostic	188	4.186	0.829	0.0605
Electronic Training Time Saving	188	4.191	0.869	0.0634
Electronic Training Cost Saving	188	4.159	0.911	0.066

Note: Physicians believe that e-health reform can impact cost, but the analysis outcomes did not correlate with the usage of electronic services.

Table 4.3

The Accuracy in Filling out the Report After Implementing E-Health

Accuracy	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.063	0.092	0.69	0.491	-0.118	0.245
Cardiologist	0.252	0.344	0.73	0.465	-0.428	0.932
ENT	-0.123	0.407	-0.3	0.763	-0.927	0.681
Family Physician	0.48	0.363	1.32	0.188	-0.238	1.198
General Practitioner	0.588	0.52	1.13	0.26	-0.439	1.616
Neurologist	0.393	0.298	1.32	0.188	-0.195	0.982
Pediatrician	0.166	0.23	0.72	0.472	-0.289	0.621
Gender	-0.097	0.276	-0.35	0.725	-0.643	0.449
26–35 Years Old	0.741	0.968	0.77	0.445	-1.172	2.654
36–45 Years Old	0.68	1.176	0.58	0.564	-1.642	3.003
46–55 Years Old	0.581	1.142	0.51	0.612	-1.675	2.837
Over 55 Years Old	0.32	1.161	0.28	0.783	-1.974	2.613
6–10 Years' Experience	-0.307	0.558	-0.55	0.583	-1.408	0.795
11–15 Years' Experience	0.109	0.778	0.14	0.889	-1.427	1.644
16–20 Years' Experience	0.696	0.792	0.88	0.381	-0.868	2.259
More than 20 Years	0.482	0.76	0.64	0.526	-1.018	1.983
Asir Region	0.132	0.773	0.17	0.864	-1.394	1.659
Eastern Region	0.331	0.998	0.33	0.741	-1.641	2.302
Ha'il Region	0.811	0.963	0.84	0.401	-1.09	2.713
Al Jawf Region	-0.78	0.893	-0.87	0.384	-2.543	0.983
Jazan Region	1.024	0.849	1.21	0.229	-0.652	2.7
Makkah Region	0.272	0.744	0.37	0.715	-1.198	1.743
Al Medina Region	0.184	0.795	0.23	0.817	-1.385	1.754
Najran Region	0.475	0.825	0.58	0.565	-1.153	2.104
Northern Border Region	1.404	0.806	1.74	0.084*	-0.189	2.996
Al Qassim Region	-0.041	1.433	-0.03	0.977	-2.871	2.789
Riyadh Region	0.594	0.746	0.8	0.427	-0.879	2.066
Tabuk Region	0.488	0.766	0.64	0.525	-1.024	2.001
Constant	3.659	1.146	3.19	0.002***	1.397	5.922

Mean dependent var	5.117	**SD dependent var**	1.164
R-squared	0.127	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.4

Accuracy in Filling out the Report After Implementing E-Health With Staff Training

Accuracy	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	-0.037	0.081	-0.46	0.646	-0.196	0.122
Experience with e-health	0.418	0.113	3.69	< 0.01***	0.195	0.642
Cardiologist	0.136	0.319	0.43	0.67	-0.494	0.766
ENT	-0.04	0.372	-0.11	0.914	-0.776	0.696
Family Physician	0.302	0.315	0.96	0.339	-0.32	0.923
General Practitioner	0.505	0.621	0.81	0.417	-0.721	1.731
Neurologist	0.438	0.294	1.49	0.138	-0.143	1.019
Pediatrician	0.196	0.216	0.91	0.365	-0.23	0.622
Gender	-0.016	0.257	-0.06	0.951	-0.524	0.492
26–35 Years Old	-0.186	0.89	-0.21	0.835	-1.943	1.571
36–45 Years Old	-0.492	1.073	-0.46	0.647	-2.612	1.628
46–55 Years Old	-0.392	1.039	-0.38	0.706	-2.446	1.661
Over 55 Years Old	-0.697	1.058	-0.66	0.511	-2.787	1.393
6–10 Years' Experience	-0.221	0.57	-0.39	0.699	-1.347	0.905
11–15 Years' Experience	0.228	0.76	0.3	0.765	-1.273	1.728
16–20 Years' Experience	0.616	0.765	0.81	0.422	-0.895	2.126
More than 20 Years	0.39	0.745	0.52	0.601	-1.082	1.862
Asir Region	0.321	0.942	0.34	0.734	-1.539	2.181
Eastern Region	0.699	1.028	0.68	0.497	-1.331	2.73
Ha'il Region	0.073	1.006	0.07	0.942	-1.913	2.06
Al Jawf Region	-0.255	1.097	-0.23	0.817	-2.421	1.912
Jazan Region	1.067	1.098	0.97	0.333	-1.102	3.235
Makkah Region	0.38	0.919	0.41	0.68	-1.435	2.194
Al Medina Region	0.442	0.953	0.46	0.643	-1.439	2.324
Najran Region	0.585	0.98	0.6	0.551	-1.35	2.52
Northern Border Region	1.203	0.959	1.25	0.211	-0.691	3.096
Al Qassim Region	0.101	1.244	0.08	0.935	-2.355	2.558
Riyadh Region	0.59	0.92	0.64	0.522	-1.227	2.407
Tabuk Region	0.739	0.948	0.78	0.437	-1.134	2.611
Constant	2.698	1.261	2.14	0.034**	0.207	5.189

Mean dependent var	5.117	**SD dependent var**	1.164
R-squared	0.231	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.5

Viewing Patient's History After Implementing E-Health

Patient History	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.041	0.084	0.49	0.624	-0.125	0.207
Cardiologist	0.206	0.226	0.91	0.363	-0.24	0.652
ENT	-0.329	0.262	-1.26	0.21	-0.846	0.188
Family Physician	0.677	0.337	2.01	0.046**	0.012	1.343
General Practitioner	0.063	0.308	0.2	0.838	-0.546	0.672
Neurologist	0.119	0.315	0.38	0.706	-0.502	0.741
Pediatrician	0.136	0.252	0.54	0.59	-0.361	0.633
Gender	-0.093	0.216	-0.43	0.669	-0.52	0.335
26–35 Years Old	-0.014	0.423	-0.03	0.974	-0.849	0.822
36–45 Years Old	-0.106	0.531	-0.2	0.842	-1.155	0.943
46–55 Years Old	-0.587	0.609	-0.96	0.337	-1.79	0.616
Over 55 Years Old	-0.759	0.656	-1.16	0.249	-2.055	0.537
6–10 Years' Experience	-0.606	0.411	-1.47	0.143	-1.418	0.206
11–15 Years' Experience	-0.299	0.482	-0.62	0.537	-1.251	0.654
16–20 Years' Experience	0.296	0.511	0.58	0.563	-0.713	1.305
More than 20 Years	0.139	0.543	0.26	0.798	-0.933	1.211
Asir Region	-0.681	0.436	-1.56	0.12	-1.542	0.179
Eastern Region	-0.16	0.676	-0.24	0.813	-1.495	1.175
Ha'il Region	0.149	0.46	0.32	0.747	-0.761	1.058
Al Jawf Region	0.068	0.534	0.13	0.898	-0.986	1.122
Jazan Region	-0.005	0.432	-0.01	0.99	-0.859	0.848
Makkah Region	-0.578	0.44	-1.31	0.191	-1.446	0.291
Al Medina Region	-0.466	0.396	-1.18	0.242	-1.249	0.317
Najran Region	0.309	0.432	0.72	0.475	-0.544	1.163
Northern Border Region	0.896	0.43	2.08	0.039**	0.047	1.746
Al Qassim Region	0.267	0.586	0.46	0.649	-0.891	1.426
Riyadh Region	0.128	0.371	0.35	0.73	-0.605	0.861
Tabuk Region	-0.932	0.785	-1.19	0.236	-2.482	0.617
Constant	5.606	0.524	10.7	< 0.01***	4.572	6.64

Mean dependent var	5.112	**SD dependent var**	1.106
R-squared	0.202	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.6

The Effect of E-Health on Cost Reduction

Cost Reduction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.123	0.082	1.5	0.136	-0.039	0.284
Cardiologist	0.148	0.425	0.35	0.728	-0.691	0.987
ENT	0.382	0.245	1.56	0.121	-0.102	0.867
Family Physician	0.196	0.303	0.65	0.518	-0.402	0.795
General Practitioner	0.385	0.375	1.03	0.305	-0.355	1.125
Neurologist	-0.232	0.566	-0.41	0.682	-1.349	0.885
Pediatrician	0.317	0.212	1.49	0.138	-0.103	0.736
Gender	0.024	0.23	0.1	0.918	-0.43	0.477
26–35 Years Old	-0.651	0.529	-1.23	0.221	-1.695	0.394
36–45 Years Old	-0.508	0.627	-0.81	0.419	-1.746	0.731
46–55 Years Old	-0.801	0.672	-1.19	0.235	-2.128	0.526
Over 55 Years Old	-0.452	0.706	-0.64	0.523	-1.847	0.942
6–10 Years' Experience	-0.139	0.423	-0.33	0.742	-0.975	0.697
11–15 Years' Experience	-0.064	0.53	-0.12	0.905	-1.111	0.984
16–20 Years' Experience	0.007	0.559	0.01	0.991	-1.097	1.11
More than 20 Years	-0.227	0.589	-0.39	0.701	-1.389	0.936
Asir Region	1.089	0.789	1.38	0.169	-0.469	2.646
Eastern Region	-0.201	0.803	-0.25	0.803	-1.786	1.384
Ha'il Region	0.998	0.916	1.09	0.278	-0.812	2.807
Al Jawf Region	1.294	0.894	1.45	0.15	-0.472	3.059
Jazan Region	1.182	0.983	1.2	0.231	-0.76	3.124
Makkah Region	0.619	0.843	0.73	0.464	-1.046	2.284
Al Medina Region	0.367	0.818	0.45	0.654	-1.249	1.983
Najran Region	0.726	0.946	0.77	0.444	-1.143	2.595
Northern Border Region	1.558	0.863	1.8	0.073*	-0.147	3.263
Al Qassim Region	-0.129	1.196	-0.11	0.914	-2.491	2.234
Riyadh Region	0.816	0.79	1.03	0.304	-0.746	2.377
Tabuk Region	1.019	0.909	1.12	0.264	-0.777	2.815
Constant	3.309	0.877	3.77	< 0.01***	1.577	5.041

Mean dependent var	3.830	**SD dependent var**	1.015
R-squared	0.156	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.7

The Effect of E-Health on Long-Run Cost

Long Term Cost Reduction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.039	0.067	0.57	0.567	-0.094	0.171
Cardiologist	0.116	0.284	0.41	0.684	-0.446	0.678
ENT	0.25	0.274	0.91	0.363	-0.291	0.792
Family Physician	0.15	0.294	0.51	0.611	-0.431	0.731
General Practitioner	0.056	0.438	0.13	0.899	-0.81	0.921
Neurologist	0.285	0.338	0.84	0.401	-0.383	0.952
Pediatrician	-0.028	0.176	-0.16	0.875	-0.376	0.321
Gender	-0.074	0.205	-0.36	0.719	-0.478	0.331
26–35 Years Old	-0.911	0.507	-1.8	0.074*	-1.912	0.091
36–45 Years Old	-1.276	0.648	-1.97	0.051*	-2.556	0.005
46–55 Years Old	-1.355	0.673	-2.02	0.046**	-2.684	-0.027
Over 55 Years Old	-1.371	0.701	-1.96	0.052*	-2.755	0.013
6–10 Years' Experience	0.658	0.419	1.57	0.118	-0.17	1.486
11–15 Years' Experience	1.057	0.554	1.91	0.058*	-0.038	2.152
16–20 Years' Experience	0.997	0.583	1.71	0.089*	-0.154	2.148
More than 20 Years	0.99	0.596	1.66	0.099*	-0.187	2.168
Asir Region	0.433	0.21	2.06	0.041**	0.018	0.847
Eastern Region	-0.73	0.311	-2.35	0.02**	-1.344	-0.115
Ha'il Region	-0.074	0.704	-0.1	0.917	-1.465	1.318
Al Jawf Region	0.871	0.527	1.65	0.1	-0.17	1.912
Jazan Region	0.341	0.345	0.99	0.324	-0.34	1.023
Makkah Region	-0.373	0.387	-0.96	0.337	-1.138	0.393
Al Medina Region	-0.22	0.304	-0.72	0.47	-0.821	0.381
Najran Region	0.044	0.359	0.12	0.903	-0.666	0.753
Northern Border Region	0.771	0.365	2.11	0.036**	0.051	1.492
Al Qassim Region	-1.096	0.846	-1.3	0.197	-2.766	0.574
Riyadh Region	0.259	0.215	1.2	0.23	-0.166	0.683
Tabuk Region	0.353	0.504	0.7	0.485	-0.643	1.348
Constant	4.272	0.44	9.71	< 0.01***	3.403	5.141

Mean dependent var	4.112	**SD dependent var**	0.898
R-squared	0.168	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.8

Effect of E-Health on Replacing Paperwork With Electronic Services

Replacing Paper with Electronic Services	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.068	0.055	1.22	0.223	-0.042	0.177
Cardiologist	0.011	0.242	0.04	0.964	-0.467	0.489
ENT	0.211	0.198	1.06	0.289	-0.181	0.602
Family Physician	0.212	0.175	1.21	0.229	-0.134	0.559
General Practitioner	0.607	0.288	2.11	0.037**	0.039	1.175
Neurologist	0.287	0.339	0.85	0.399	-0.383	0.957
Pediatrician	-0.076	0.159	-0.48	0.632	-0.389	0.237
Gender	0.026	0.16	0.17	0.869	-0.289	0.342
26–35 Years Old	-0.768	0.392	-1.96	0.051*	-1.542	0.005
36–45 Years Old	-0.991	0.551	-1.8	0.074*	-2.08	0.097
46–55 Years Old	-0.997	0.574	-1.74	0.084*	-2.132	0.137
Over 55 Years Old	-1.067	0.595	-1.79	0.075*	-2.243	0.108
6–10 Years' Experience	0.616	0.36	1.71	0.089*	-0.095	1.327
11–15 Years' Experience	0.877	0.525	1.67	0.097	-0.16	1.915
16–20 Years' Experience	0.662	0.536	1.24	0.219	-0.396	1.72
More than 20 Years	0.844	0.54	1.56	0.12	-0.222	1.91
Asir Region	0.478	0.168	2.84	0.005***	0.146	0.809
Eastern Region	0.097	0.405	0.24	0.81	-0.703	0.898
Ha'il Region	0.471	0.404	1.17	0.246	-0.328	1.27
Al Jawf Region	0.448	0.382	1.17	0.243	-0.307	1.203
Jazan Region	0.577	0.302	1.91	0.058*	-0.021	1.174
Makkah Region	0.147	0.232	0.63	0.527	-0.311	0.605
Al Medina Region	-0.068	0.223	-0.3	0.762	-0.508	0.372
Najran Region	0.119	0.322	0.37	0.711	-0.516	0.755
Northern Border Region	0.698	0.36	1.94	0.054*	-0.012	1.408
Al Qassim Region	-1.093	0.861	-1.27	0.206	-2.794	0.608
Riyadh Region	0.273	0.161	1.7	0.092*	-0.045	0.59
Tabuk Region	0.583	0.389	1.5	0.136	-0.186	1.352
Constant	3.978	0.3	13.24	< 0.01***	3.384	4.571

Mean dependent var	4.245	**SD dependent var**	0.783
R-squared	0.165	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.9

The Effect of E-Health on Overall Cost

Overall Cost Reduction	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.084	0.061	1.36	0.174	-0.037	0.205
Cardiologist	0.118	0.254	0.46	0.643	-0.384	0.62
ENT	0.122	0.199	0.61	0.541	-0.272	0.516
Family Physician	0.225	0.197	1.14	0.255	-0.164	0.614
General Practitioner	0.217	0.282	0.77	0.441	-0.339	0.774
Neurologist	-0.474	0.155	-3.07	0.003***	-0.78	-0.169
Pediatrician	-0.11	0.159	-0.69	0.489	-0.423	0.203
Gender	0.029	0.175	0.17	0.869	-0.318	0.375
26–35 Years Old	0.269	0.459	0.59	0.559	-0.638	1.175
36–45 Years Old	0.397	0.523	0.76	0.449	-0.637	1.43
46–55 Years Old	0.131	0.552	0.24	0.813	-0.96	1.221
Over 55 Years Old	0.256	0.567	0.45	0.652	-0.864	1.377
6–10 Years' Experience	0.159	0.419	0.38	0.704	-0.668	0.987
11–15 Years' Experience	0.163	0.467	0.35	0.727	-0.759	1.086
16–20 Years' Experience	-0.001	0.492	0	0.998	-0.974	0.971
More than 20 Years	0.04	0.514	0.08	0.937	-0.974	1.055
Asir Region	-0.005	0.468	-0.01	0.991	-0.93	0.919
Eastern Region	-0.682	0.678	-1.01	0.316	-2.021	0.658
Ha'il Region	0.324	0.684	0.47	0.637	-1.027	1.674
Al Jawf Region	0.087	0.58	0.15	0.881	-1.058	1.233
Jazan Region	-0.394	0.579	-0.68	0.497	-1.537	0.749
Makkah Region	-0.282	0.495	-0.57	0.57	-1.261	0.696
Al Medina Region	-0.585	0.5	-1.17	0.244	-1.572	0.403
Najran Region	-0.439	0.538	-0.82	0.416	-1.502	0.624
Northern Border Region	0.011	0.604	0.02	0.985	-1.181	1.203
Al Qassim Region	-1.276	0.657	-1.94	0.054*	-2.573	0.021
Riyadh Region	-0.191	0.466	-0.41	0.683	-1.112	0.73
Tabuk Region	-0.261	0.593	-0.44	0.661	-1.432	0.91
Constant	3.936	0.547	7.2	< 0.01***	2.856	5.016

Mean dependent var	4.287	**SD dependent var**	0.733
R-squared	0.147	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.10

The Effect of E-Health on Remote Diagnoses

Remote Diagnostics	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]
E-health services usage	0.076	0.059	1.29	0.198	-0.04	0.192
Cardiologist	0.006	0.391	0.02	0.987	-0.766	0.779
ENT	-0.012	0.223	-0.05	0.959	-0.453	0.43
Family Physician	0.196	0.289	0.68	0.499	-0.375	0.766
General Practitioner	0.723	0.319	2.27	0.025**	0.093	1.353
Neurologist	0.407	0.273	1.49	0.138	-0.132	0.946
Pediatrician	0.162	0.165	0.98	0.328	-0.164	0.488
Gender	0.096	0.224	0.43	0.67	-0.347	0.538
26–35 Years Old	-0.624	0.525	-1.19	0.237	-1.662	0.413
36–45 Years Old	-0.68	0.591	-1.15	0.252	-1.846	0.487
46–55 Years Old	-0.798	0.652	-1.22	0.223	-2.085	0.49
Over 55 Years Old	-0.544	0.662	-0.82	0.412	-1.851	0.763
6–10 Years' Experience	0.392	0.456	0.86	0.391	-0.508	1.293
11–15 Years' Experience	0.369	0.515	0.72	0.474	-0.647	1.386
16–20 Years' Experience	0.54	0.537	1.01	0.316	-0.52	1.6
More than 20 Years	0.47	0.557	0.84	0.4	-0.63	1.57
Asir Region	-0.565	0.21	-2.69	0.008***	-0.979	-0.151
Eastern Region	-0.491	0.457	-1.08	0.283	-1.393	0.41
Ha'il Region	-0.328	0.38	-0.86	0.388	-1.078	0.422
Al Jawf Region	-0.765	0.419	-1.83	0.07*	-1.592	0.062
Jazan Region	-0.342	0.297	-1.15	0.252	-0.929	0.245
Makkah Region	-1.051	0.306	-3.43	0.001***	-1.656	-0.445
Al Medina Region	-1.235	0.298	-4.14	< 0.01***	-1.824	-0.646
Najran Region	-0.555	0.418	-1.33	0.186	-1.38	0.27
Northern Border Region	-0.417	0.385	-1.08	0.28	-1.177	0.343
Al Qassim Region	-2.296	0.512	-4.48	< 0.01***	-3.307	-1.285
Riyadh Region	-0.605	0.2	-3.02	0.003***	-1	-0.209
Tabuk Region	-0.628	0.436	-1.44	0.152	-1.488	0.233
Constant	4.783	0.392	12.21	< 0.01***	4.009	5.556

Mean dependent var	4.186	**SD dependent var**	0.829
R-squared	0.215	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.11

Effect of E-Health on Training Time

Online Training Save	Coef.	St.	t-value	p-value	[95%	Interval]

Time		Err.			Conf	
E-health services usage	0.127	0.064	1.99	0.048**	0.001	0.252
Cardiologist	0.436	0.234	1.86	0.064*	-0.026	0.897
ENT	-0.147	0.243	-0.61	0.545	-0.626	0.332
Family Physician	0.202	0.286	0.71	0.48	-0.362	0.766
General Practitioner	0.452	0.384	1.18	0.241	-0.307	1.212
Neurologist	0.678	0.223	3.04	0.003***	0.238	1.119
Pediatrician	-0.125	0.173	-0.72	0.471	-0.466	0.217
Gender	-0.076	0.228	-0.33	0.741	-0.526	0.375
26–35 Years Old	-0.476	0.461	-1.03	0.304	-1.387	0.435
36–45 Years Old	-0.74	0.689	-1.07	0.284	-2.101	0.62
46–55 Years Old	-0.539	0.694	-0.78	0.438	-1.91	0.832
Over 55 Years Old	-0.606	0.717	-0.85	0.399	-2.021	0.81
6–10 Years' Experience	0.215	0.437	0.49	0.624	-0.649	1.078
11–15 Years' Experience	0.444	0.617	0.72	0.473	-0.775	1.663
16–20 Years' Experience	0.514	0.638	0.81	0.422	-0.746	1.774
More than 20 Years	0.469	0.637	0.74	0.463	-0.79	1.728
Asir Region	0.608	0.685	0.89	0.376	-0.744	1.96
Eastern Region	-0.373	0.853	-0.44	0.663	-2.058	1.312
Ha'il Region	0.682	0.802	0.85	0.397	-0.902	2.266
Al Jawf Region	0.604	0.791	0.76	0.446	-0.958	2.167
Jazan Region	0.672	0.709	0.95	0.345	-0.728	2.072
Makkah Region	0.227	0.713	0.32	0.75	-1.181	1.635
Al Medina Region	0.027	0.731	0.04	0.97	-1.417	1.471
Najran Region	-0.104	0.734	-0.14	0.887	-1.553	1.345
Northern Border Region	-0.653	0.763	-0.86	0.393	-2.159	0.853
Al Qassim Region	-0.247	0.855	-0.29	0.773	-1.936	1.442
Riyadh Region	0.361	0.686	0.53	0.599	-0.995	1.717
Tabuk Region	-0.091	0.737	-0.12	0.902	-1.547	1.365
Constant	3.739	0.752	4.97	< 0.01***	2.253	5.224
Mean dependent var		4.191		**SD dependent var**		0.869
R-squared		0.198		**Number of observations**		188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

Table 4.12

Effect of E-Health on Training Cost

Online Training Save	Coef.	St.	t-	p-value	[95%	Interval]

Cost		Err.	value		Conf	
E-health services usage	0.15	0.069	2.17	0.032**	0.013	0.287
Cardiologist	0.324	0.289	1.12	0.264	-0.247	0.896
ENT	-0.144	0.238	-0.6	0.546	-0.615	0.327
Family Physician	-0.032	0.268	-0.12	0.905	-0.561	0.497
General Practitioner	0.378	0.298	1.27	0.205	-0.21	0.966
Neurologist	0.572	0.378	1.51	0.132	-0.174	1.318
Pediatrician	-0.061	0.171	-0.36	0.721	-0.398	0.276
Gender	-0.175	0.222	-0.79	0.432	-0.613	0.264
26–35 Years Old	-0.457	0.479	-0.95	0.342	-1.403	0.489
36–45 Years Old	-0.587	0.698	-0.84	0.402	-1.967	0.792
46–55 Years Old	-0.361	0.722	-0.5	0.618	-1.786	1.064
Over 55 Years Old	-0.471	0.738	-0.64	0.525	-1.929	0.988
6–10 Years' Experience	0.052	0.441	0.12	0.907	-0.82	0.923
11–15 Years' Experience	0.289	0.628	0.46	0.646	-0.951	1.529
16–20 Years' Experience	0.065	0.671	0.1	0.923	-1.26	1.39
More than 20 Years	0.219	0.664	0.33	0.741	-1.091	1.53
Asir Region	0.382	0.633	0.6	0.547	-0.868	1.632
Eastern Region	-0.41	0.867	-0.47	0.637	-2.122	1.302
Ha'il Region	0.432	0.752	0.57	0.567	-1.055	1.918
Al Jawf Region	0.629	0.739	0.85	0.396	-0.831	2.088
Jazan Region	0.218	0.659	0.33	0.741	-1.083	1.52
Makkah Region	-0.1	0.684	-0.15	0.883	-1.451	1.25
Al Medina Region	-0.151	0.665	-0.23	0.821	-1.465	1.163
Najran Region	-0.589	0.73	-0.81	0.421	-2.03	0.853
Northern Border Region	-0.879	0.711	-1.24	0.218	-2.283	0.525
Al Qassim Region	-0.566	0.832	-0.68	0.497	-2.209	1.076
Riyadh Region	0.147	0.633	0.23	0.816	-1.103	1.397
Tabuk Region	-0.112	0.703	-0.16	0.873	-1.501	1.276
Constant	4.088	0.709	5.77	< 0.01***	2.689	5.488

Mean dependent var	4.160	**SD dependent var**	0.911
R-squared	0.157	**Number of observations**	188

Note: Results are from an ordinary least square (OLS) model. *, **, *** denote statistical significance at the 10%, 5%, 1% level, respectively.

CONCLUSION

The MOH in the Kingdom of Saudi Arabia introduced e-health in 2011. The MOH has constructed a National e-Health Strategy that aligns with its goals and business strategies. In 2016, the government of Saudi Arabia introduced Vision 2030. One of the main objectives of the reform is to accelerate the implementation of primary and digital infrastructure projects. This research aimed to evaluates the physicians' perceptions of the effectiveness of the e-health system reform in Saudi Arabia.

This research used a questionnaire to collect data from physicians who work at the MOH in Saudi Arabia to evaluate the outcome of the e-health system reform. The survey was created with this research in mind. The survey included questions that addressed the research questions for Saudi Arabia's e-health system reform. The study covered aspects of services provided by the MOH that impact patient care, patient referrals and waiting time, and the cost of care.

Electronic services improve patients' accessibility and communication, ultimately increasing their awareness. On the organizational level, e-health sustained development and increased its efficiency in using their resources (Widberg et al., 2020). Physicians' responses indicated that e-health made a positive impact on patient's care in Saudi Arabia. Aspects like hospital communications and the speed and accuracy of the information provided by the system have helped them make more accurate decisions. The physicians' perceptions of the e-health system affected patient's care and improved.

The analysis covered different medical care services provided by the Ministry of Health to assess physicians' view of the impact of e-health. Electronic services substantially impact quality and consistency, efficiency, patient admittance and

examination speed, accuracy, and completeness of report filling. According to the physician, the analysis findings suggest that e-health improved patients' care and helped create a better environment for their visits and treatment.

E-health systems can prioritize referrals based on the patient's condition, and they can be applied in different settings and specialties. This indicates that e-health systems can reduce patients' waiting time and accelerate the referral process for the much needed patients (Cullinan et al., 2020). The analysis considers factors such as bed availability, viewing patient records, hospital and doctor reputation, physician's communications, and remote diagnostics. These factors collectively impact referrals and waiting time.

The analysis results showed an improvement in patient referrals regarding speed, accuracy, completeness, bed availability, examining the patient's medical history, and remote diagnosis from the physician's viewpoint. Physicians' responses indicated that the Saudi Arabia's e-health reform has improved patient referrals between MOH primary care facilities and hospitals, shortened wait times, and increased the number of referrals.

Implementing the e-health system introduced many options for services provided for patients and providers. Furthermore, e-health applications can reduce the cost of care and improve the expenditure of health care organizations (Le Moullec et al., 2020). Health care services cost increases year after year, and health care organizations continually look for solutions that reduce the cost and increase their revenues cost of care was also included in the analysis.

Physicians were asked about their perspective on the cost of care after introducing e-health. The study included measures such as accuracy, viewing patient's history, electronic services cost reduction, overall cost, and electronic training. From the

physicians' point of view, the analysis results indicated no significant impact on the cost of care after introducing the e-health reform in Saudi Arabia. Indeed, the physicians' survey showed that their answers ranged between "strongly agree" and "agree," meaning that they thought e-health was positively impacting the cost of care, although the analysis result showed no correlation between e-health and cost of care.

Appendix:

1. **Basic Information of participant:**

1.1. If you are a doctor, what is your medical specialty?

Family Physician

General Practitioner

Internal Medicine-Physician

Surgeon

Obstetrician/Gynecologist (OB/GYN)

Cardiologist

Dermatologist

Endocrinologist

Infectious Disease Physician

Nephrologist

Ophthalmologist

ENT

Pulmonologist

Neurologist

Radiologist

Oncologist

Other:

1.2. Gender:

Male Female

1.3. What is your Age group?

18-25

26-35

36-45

46-55

Over 55

1.4. What Region are you working at:

Al Bahah

Al Hudud ash Shamaliyah-(Northern Border)

Al Jawf

Al Madinah al Munawwarah (Medina)

Al Qasim

Ar Riyad (Riyadh)

Ash Sharqiyah (Eastern)

Asir

Ha'il

Jazan

Makkah al Mukarramah-(Mecca)

Najran

Tabuk

1.5. Your first-time using E-health services in Saudi Arabia was at the year:

2011	2014	2017
2012	2015	2018
2013	2016	2019

1.6. How often you use E-health services?

None	Often (2-3 times a week)
Sometimes	Daily

1.7. How many years have you been practicing medicine (post-internship)?

1-5 years	10-15 year	More than 20 years
5-10 year	15-20 years	

1.8. Your practice managed by:

MOH Administration	Armed Forces Administration
National Guard Administration	Privet Sector

1.9. How important is e-health for improving the quality and consistency of health care in Saudi Arabia?

Not important	Neutral	Very important
Somewhat important	Important	

1.10. In terms of efficiencies, E-health importance is:

Not important	Neutral	Very important
Somewhat important	Important	

1.11. How important is e-health for creating new health care products and services?

Not important	Neutral	Very important
Somewhat important	Important	

2. **The following set of questions deals with medical examination services after implementing electronic health services. These services are performed during routine examinations. Please rate the level of improvement for each service.**

2.1. Speed in Admitting patients:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.2. Speed in completing examinations:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.3. Accuracy in filling out your report:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.4. Completeness in filling out your report:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.5. Expertise of medical staff in using the electronic system:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.6. Personal relationship with patients

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.7. Inpatient's referrals:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.8. Outpatient's referrals:

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.9. Viewing patient's full history during examination:

Improved considerably	Has remained about the same	Has declined- considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.10. In your opinion, how have medical staff satisfaction ratings changed at your organization since the introduction of electronic services?

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.11. In your opinion, how have administrative staff satisfaction ratings changed at your organization since the introduction of electronic services?

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

2.12. In your opinion, how have patient satisfaction ratings changed at your organization since the introduction of electronic services?

Improved considerably	Has remained about the same	Has declined considerably
Improved somewhat		I Don't know
	Has declined somewhat	

3. **Professional referrals may be made based on a number of factors. For each of the following items, please indicate the extent to which you think each is important in selecting a hospital for your patients.**

3.1. The Availability of Bed

Not important Neutral Very important

Somewhat important Important

3.2. The level of illness condition of the patient

Not important Neutral Very important

Somewhat important Important

3.3. Your satisfaction with the medical staff

Not important Neutral Very important

Somewhat important Important

3.4. The reputation of the hospital

Not important Neutral Very important

Somewhat important Important

3.5. The reputation of hospital-based physicians:

Not important Neutral Very important

Somewhat important Important

3.6. The reputation of specialists practicing at the hospital:

Not important Neutral Very important

Somewhat important Important

3.7. Communication between you and the consulting physician:

Not important Neutral Very important

Somewhat important Important

3.8. Past experiences of patients:

Not important Neutral Very important

Somewhat important Important

3.9. Convenience of hospital for patient and family:

Not important	Neutral	Very important
Somewhat important	Important	

3.10. Patient hospital preference:

Not important	Neutral	Very important
Somewhat important	Important	

4. The following set of questions deals with cost of medical services after implementing electronic health services. Please rate the level of improvement for each service:

4.1. Electronic services reduce the cost of care for patients:

Strongly Agree	Unsure	Strongly Disagree
Agree	Disagree	

4.2. In the Long run, electronic services will contribute in reducing the cost of care in the country:

Strongly Agree	Unsure	Strongly Disagree
Agree	Disagree	

4.3. Replacing paperwork with electronic services in communications will reduce the cost on the hospital in the long run:

Strongly Agree	Unsure	Strongly Disagree
Agree	Disagree	

4.4. Electronic services will reduce medical errors on the hospital:

Strongly Agree	Unsure	Strongly Disagree
Agree	Disagree	

4.5. Electronic services will reflect on the overall cost on the hospital:

Strongly Agree	Unsure	Strongly Disagree
Agree	Disagree	

4.6. Remote diagnostics will help physicians to serve more patients and reduce the waiting time for both patients and hospitals:

Strongly Agree Unsure Strongly Disagree

Agree Disagree

4.7. Remote diagnostics will help physicians to serve more patients and reduce the cost of care for both patients and hospitals:

Strongly Agree Unsure Strongly Disagree

Agree Disagree

4.8. Electronic training for medical staff will improve their skills, and save their time:

Strongly Agree Unsure Strongly Disagree

Agree Disagree

4.9. Electronic training for medical staff will improve their skills and reduce the cost on hospitals:

Strongly Agree Unsure Strongly Disagree

Agree Disagree

VITA

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