Original Research Article

How Strategically the Saudi Healthcare is Delivered or Designed in Macro or Micro Levels in an Informatics Field

Abdulmajeed Hamdan Alshammari[1*], Fahad Hamed Alshammari[1], Rabah Hammad Alshammari[1], Faisal Hamdan Alshammari[1], Talal Hamed Alshammari[1]

[1]Hafr Al Batin Health, KSA

*Corresponding author: Abdulmajeed Hamdan Alshammari
Hafr Al Batin Health, KSA

Abstract

This study aims to explore, identify and understand the design and the strategy for healthcare delivery at both macro and micro levels in an informatics field in the Kingdom of Saudi Arabia. For both patients and professionals, health information technology offers greater quality, safer treatment, and much more. Despite their potential, they are expensive to create and execute. The success of applied information technology in healthcare, on the other hand, is determined by user acceptance and utilisation. This study offers a framework for analysing how health professionals view and intend to use health information technology. To define the primary factors to be assessed, thorough literature research was done. As a measuring methodology, a questionnaire was created and sent to the experts, who are information systems professionals with at least five years of experience. According to a five-point Likert scale, the replies were generally highly agreed, with roughly 79 per cent agreeing. Female respondents were more accepting of electronic data storage than male ones. Other notable distinctions between occupations were also discovered.
Keywords: healthcare delivery, health information technology, safer treatment, Non-technical concerns.

1.1 INTRODUCTION

Although health information technology (HIT) has the potential to enhance healthcare by increasing efficiency and safety, it has yet to reach its full potential. Non-technical concerns like as poor usability, which affect communication and workflow, are a major hindrance to HIT success. As a result, HIT necessitates the creation of user-friendly, context-appropriate technologies. If HIT applications are to be effective, implementation issues like the influence on workflow must be addressed early in the planning and design stages. One way to accomplish this is to involve users. Although the word "user engagement" has a variety of meanings in the literature, we use it to refer to "any direct contact with users" (Saputra, 2019).

Digital technologies have a significant impact on many aspects of modern life, including employment. We use the term "digitalization" to refer to all types of digital technology, such as artificial intelligence (AI) and mobile apps. Digitalization can be as simple as swapping digital information for the paper, or it can be as complicated as including computers and machines that conduct a wide range of functions. From self-service checkouts at big supermarkets, IKEA, and the post office to automated warehouses, it's becoming increasingly clear that robots aren't just executing tasks, but are also stealing employment away from humans (Crico, 2018). While some are concerned about human displacement when robots undertake activities that should have been handled by robots in the first place, others contend that robots only execute duties that should have been performed by robots in the first place, and never by people (Alshammari, 2019).

In the realm of medical informatics, healthcare data is an emerging application development area. Electronic healthcare applications can improve service quality by extracting insights from data while lowering costs, or they can improve operational health decision-making results, and these systematic solutions are currently widely used. For electronic health records, clinical decision support, and personal or hospital data management, large amounts of internal and external data, diverse medical data sources, and reporting requirements have prompted a push to use sophisticated analytic system solutions. Such systems assist management decision-making for clinical treatment and

Citation: Abdulmajeed Hamdan Alshammari, Fahad Hamed Alshammari, Rabah Hammad Alshammari, Faisal Hamdan Alshammari, Talal Hamed Alshammari (2022). How Strategically the Saudi Healthcare is Delivered or Designed in Macro or Micro Levels in an Informatics Field. *Saudi J Eng Technol, 7*(11): 550-565.

550

successful hospital operations, as well as evidence production for health care decisions in the hospital or organizational contexts, using native data. Healthcare analytics systems require rigorous planning and validation when patient privacy, quality of care, security, and evidence-based therapies are all on the line.

In Saudi Arabian hospitals, a lot of work is being done to employ information technology (IT), and Al-Harbi endeavoured to identify the motivation, challenges, and advantages of research at King Abdul-Aziz Medical City (KAMC). The findings of this study concluded that the usage of IT has benefitted healthcare professionals in the long run and that it has aided patients and physicians in maintaining continual surveillance of their illnesses. Paules Ciprés presented a cloud computing-based KAU-Health strategy for developing a real-time interface for getting vital information for quick decision-making. From a citizen's perspective, the advent of e-Health in Saudi Arabia aids people in personalizing information for an alternative diagnosis. This also aids in obtaining an enhanced version of information from the most recent medical journals, associations, and other sources from the perspective of a healthcare practitioner (Altamimi, 2020).

1.2 Problem Statement

Although established development methodologies have been used to implement solution design and development projects, more impact would be gained by paying attention to how an appropriate abstraction of the design artefact contributes to more general knowledge and analytic solution innovation, with researchers encouraged to report in ways that benefit both research and professional practice. Traditional solution design approaches have fallen short of allowing for the creation of new knowledge and innovation. A prototyping method for developing a healthcare analytics system for real-time analysis. These solution development methodologies focused on specific solution development aspects rather than looking at knowledge contribution and solution innovation. Despite much useful work, piecemeal examples do not clarify transferrable principles (Alsalman, 2020). In healthcare, however, systematic analysis is patchy, with most reviews focusing either on domain-specific problems or specific technological

interventions (e.g., Bates et al. for clinical analytics innovations (Jadi, 2020).

The area of healthcare is involved with the handling of patient-sensitive data. Security and privacy of these data are very important. While doing the online transfer of these secret data over the public network, it can be viewed and/or modified by the attackers. It can be also accessed by unauthorized persons who can break the privacy of the patient's data.

1.3 Research Questions

How strategically the Saudi healthcare delivered or designed at macro or micro levels?

1.4 Research Objective

This study aims to explore, identify and understand the design and the strategy for healthcare delivery at both macro and micro levels in an informatics field in the Kingdom of Saudi Arabia.

1.5 Study design

A descriptive cross-sectional design is selected for this study because it fits with the objectives of the study.

1.6 Study Settings

This study was carried out in Saudi Arabia. All experts who are specialists in Information Systems with at least five years of experience in the systems analysis and design field will be invited to participate in this study.

1.7 Population under study

All experts who are specialists in Information Systems with at least five years of experience in the systems analysis and design field will be invited to participate in this study.

1.9 Data Collection Tool

The questionnaire consists of six parts with 31 questions as illustrated in Annex (1). The first part, first part of the questionnaire included the simple demographics of the respondents like gender, age, residence place, educational level and also the place of work of the respondents. The rest of the questionnaire is designed to understand the professionals' views about the factors given in Table (1).

Table 1: Factors to be measured

Factor	Explanation
Storing patients' records electronically	For the adaptation of new technology, the records will be stored electronically.
Access patients' data	Data access is convenient and timely and will be easier.
Importance of sharing patients' data	Easy data sharing.
Patients' data security	Security issues to emerge.
Impact on managerial functions	The way managerial functions are performed will be changed.

1.10 Study Variables

Demographic variables (age, gender and educational status, working place and number of years of experience).

1.11 Sampling Technique

The data has been collected using a questionnaire-based survey. To have a 95% confidence level with a plus or minus 5% margin of error in the results.

1.12 Sample size

The sample consists of 265 experts which are specialists in information systems with at least five years of experience and have been selected using the simple random sampling technique where self-administrated questionnaires have been distributed.

1.13 Pilot Study

A pilot study has been conducted before starting the data collection as a pre-test to point out weaknesses in wording, translation to Arabic, predict response rate, determine the real time needed to fill the questionnaire and identify areas of vagueness and test the validity and suitability of the questionnaire.

1.14 Reliability and validity

Validation and reliability tests are done for a sample test of 30 checklists (not included in the sample study). Then, a questionnaire has been written in English and Arabic for ease of understanding to ensure that accurate information was obtained.

1.15 Data Management & Statistical Analysis

Data analysis has been conducted using (SPSS 19), and Microsoft Excel. The gathered data and then the instruments have been reviewed, coding the data, appropriate entry method, coding variables, data cleaning then, frequencies and cross-tabulation.

1.16 Ethical considerations

The study considers the following ethical considerations:

- **Informed consent:** The researcher recruits willing participants after having fully explained the purpose of the research.
- **A consent** form has been given on time thus allowing participants to have enough time to read and understand, thereafter verbal explanation of possible risks and advantages is discussed with each participant.
- **The ethical approval** obtained from the local committee for research ethics in Hafr Albatin Health.
- **Confidentiality:** The researcher describes how confidentiality was maintained throughout the study; and that includes privacy, signing of confidentiality clauses and safe storage of research data.
- **Permission** has been sought from the participants during the observation times.
- **Anonymity:** The participants have been coded instead of using real names. Principle of respect for human dignity: there is no cohesion or exploitation of participants as a means of persuading or forcing them to participate, and freedom of withdrawal will not be infringed upon participants.

2.0 LITERATURE REVIEW

Kalgotra, (2021) Conducted a research paper to understand the different types of information support needed during a COVID-19 pandemic crisis. Adapting phases from the pandemic crisis management lifecycle, this author suggested five different overlapping phases of the Pandemic Information Support Lifecycle (PISL) which are awareness information support, preventive care information support, active information support, confidence-building information support and evaluation information support. The authors establish a taxonomy for mobile app-based information assistance to evaluate the proposed PISL by looking at the emergence of new mobile applications during the present COVID-19 pandemic. The suggested lifecycle outlines future phases of information support for the continuing COVID-19 pandemic, as well as particular areas that require more study and development of mobile-based information assistance.

The applied app taxonomy is complete, but in earlier pandemics, such as Ebola, apps only supplied awareness and prevention-related information. This taxonomy is relevant to all sorts of applications providing informational assistance for the COVID-19 pandemic since it covers apps that focus on maintaining user-level information as well as apps that broadcast just generic information. Statistics, e-Health, healthcare, and resource management applications disseminate generic information and are not user-profile dependent.

It's important to highlight that the current research has certain limitations. To begin, we looked at the descriptions that developers had provided for each app in the marketplace. Furthermore, developers may not always include all of an app's aims in the description, but we feel the description contains the app's core objective and important information. As a result, this restriction is considerably alleviated. Note that we did not include user-generated content, such as user reviews, in our classification of applications because it was outside the scope of this research.

Kwak, (2020) Researched to design of a healthcare app for the elderly who believe or know they have a hearing loss, called Hearing Rehabilitation for Older Adults (HeRO), which is available on a mobile device and then validated its likelihood of acceptability among older users. The elderly performed a self-reported questionnaire to screen the level of hearing

loss under the HeRO web server system, which featured four types of customized training for the aged auditory system (i.e., syllable, phrase, discourse, and working memory). The HeRO program may be able to help users overcome the limitations of traditional auditory rehabilitation, which is the main reason for their readiness and purpose. The word "Geron technology" refers to technology that helps the elderly with issues and/or challenges related to ageing, as well as providing healthy, independent, and social communication. The technology acceptance model (TAM) was utilized to determine if the HeRO contents and functions were user-friendly to senior people. Forty-four older individuals were invited to utilize the created app for ten days and subsequently complete a 25-item TAM questionnaire. Each subcategory's Cronbach's coefficient was extremely high. Using principal component analysis, the concept validity of all subcategories was shown to have high eigenvalues. Furthermore, because the elderly quickly accept it and find it easy to manipulate, our regression model statistically confirmed a persuasive desire to utilize the healthcare application. The authors anticipate that current technologies will be used by the general public as well as older people interested in learning more about digital health. Finally, focused technology, particularly health-related technology, should be studied and developed to suit the requirements of older individuals, according to this viewpoint. Finally, the findings of this study showed that older individuals found the HeRO application to help improve auditory communication.

Miah, (2020) Conducted a study to look at the breadth of healthcare analytics research, specifically how design and development techniques are used. By evaluating existing design patterns, this study intended to create a deeper grasp of the methodological insights for healthcare analytics systems. According to the findings, healthcare analytics is a new solution design sector that DSR is uniquely qualified to help with design standards for healthcare analytics solutions. As our research in Supplementary Appendix C shows, we predicted that the DSR would be a more effective technique. The seven design criteria are regarded as critical foundations for aiding in the development of successful healthcare analytics systems. Our point of view is objective because we relied on the analyses' results.

Qualifying articles from 2010 to mid-2018 were sourced and classified using six popular electronic databases. For relevant information on public healthcare, a total of 52 articles on healthcare analytics solutions were chosen. The papers were examined using known content analysis techniques by the study team. Various techniques, such as prototyping, traditional software engineering, agile approaches, and others, have been utilized to build analytics solutions, according to the analysis, but few indicate the usage of

design science, despite its obvious benefits. Throughout the content analysis, key issue areas are discovered, indicating research objectives in the discipline.

Aljohani, (2019) Conducted a study aimed to identify the current state of m-health applications in Saudi Arabia, to highlight and understand factors that influence patients' adoption and acceptance of m-health services and to validate the hypotheses developed in the next research stages. Despite the vital role those mobile applications will play in the implementation of healthcare plans in the Saudi Vision 2030, several factors may influence the process. Due to the conflict of interest, lack of exposure, resistance to change, as well as limited technical knowledge of the apps, the Saudi Arabian society may inadvertently impede the government's objectives. All the challenges could be related to individual perceptions, technical complexities, social influence, as well as organizational reliability and preparedness. The earlier the authorities identify the issues and respond to them, the faster it will be to succeed in the implementation of mobile health (m-health) and the subsequent attainment of Vision 2030 health goals. This study conducted a review of the literature in this context. The proposed model and factors identified will be tested to understand patients' perceptions of m-health applications. Furthermore, the current research results will be beneficial to increase the adoption rates of m-health in Saudi Arabia. The government should encourage citizens to download and utilize the applications to have access to all relevant information.

The author recommended that the appropriate ministry should use change efficacy and change valence to solve organizational problems. If the issues raised above are adequately addressed, the Saudi Arabian government will be able to realize its Vision 2030 and the National Transformation Program, which aims to improve the quality, accessibility and affordability of healthcare.

Alghamdi, (2020) conducted a review to summarise the existing literature on the current status of TH applications used during COVID-19 in Saudi Arabia and discusses the extent to which TH can support public health measures. According to the author's point of view TH mobile applications (such as Seha, Mawid, Tawakklna, Tabaud, and Tetamman) have shown to be excellent instruments for delivering healthcare to COVID-19 patients and tracking their progress. In Saudi Arabia, TH has been critical in limiting the spread of COVID-19 and in helping to flatten the growth curve.

The influence of TH applications on the development of COVID-19 in Saudi Arabia needs more investigation. The authors mentioned that TH mobile applications have shown to be excellent instruments for delivering healthcare to COVID-19 patients and

tracking their progress. In Saudi Arabia, TH has been critical in limiting the spread of COVID-19 and in helping to flatten the growth curve. The influence of TH applications on the development of COVID-19 in Saudi Arabia needs more investigation.

(Alsalman, 2020) aimed to identify search in both most existing free Apps for m-Health applications (App) which excited Google Play stores to review those that use the gamification approach to manage diabetes type 1. The author used the following keywords to find the Apps in both English and Arabic languages, "game for type 1 diabetes" and "gamification for type 1 diabetes". It was identified eight gamified applications related to type 1 diabetes. Seven of these applications were in English language and only one application was in the Arabic language. It is noticed that this number is really small concerning the approximately 7000 mobile applications that are now widely used in the health sector for various purposes such as the management of chronic diseases like diabetes. The different themes that were used in the reviewed applications were caring for a character, questionnaires, and telling stories. Hence, based on the theme of the application the applications were categorized into three main categories. They were taking care of a character, quizzes, and the storytelling theme. Moreover, no application included the social networking feature (Alsalman, 2020).

Saputra, (2019) Conducted a study related to nursing information systems that combine nursing, information science, and computer science to process and manage data so that it may be used as knowledge in nursing practice. The purpose of this study is to offer a comprehensive knowledge of nursing information systems and to connect them to nursing care language that may be utilized in healthcare settings. Clinical and community contexts make up nursing information systems in health care. This report outlined a strategy for doing a literature review by accessing databases in scientific journals such as SCIENCE DIRECT and ELSEVIER. This paper includes 39 articles published between 2011 and 2016. A nursing Information System, it was discovered, are a mix of nursing, information, and computer science that manages and processes data into knowledge for use in nursing practice. Using NNN Linkage language, the authors introduce a nursing information design system. Standards of nursing care, standard operating procedures, nurse credit value computation, list of nursing diagnoses, list of nursing interventions, implementation reports, statistics reports, and nursing care resumes are all part of the Nursing Information System. The process of nursing information system design has been conducted through stages consisting of need analysis, system analysis, clinical data collection, design and development, and system release (Saputra, 2019).

Pires, (2020) this current research paper illustrated an analysis of using mobile health applications by healthcare professionals and their patients. Furthermore, this article aimed to evaluate the scientific validation of these mobile health applications and also to assess if the results provided by these applications have an underlying sound scientific foundation. The author of this study analyzed literature references and the use of mobile health applications available in online application stores. A substantial portion of these mobile health applications, it was discovered, offers information regarding scientific validation. Some mobile health apps, on the other hand, have not been verified. Finally, management is in charge of data security, ROI, authentication, and authorisation. Furthermore, blockchain is increasingly being used in healthcare applications. It is a novel technology, and it appears to be appealing as a goal. The use of big data in public health is growing, and it will be a focus of our future study. Because it is a vital field, the most important future path is stress validation of mobile apps before they get to market. As a result, the major contribution of this study is to give a thorough examination of the usability and perceived quality of mobile health applications, as well as the problems associated with scientific validation.

Jadi, (2020) discussed using mobile health services (MHS) which intends to minimize personal interaction hours between patients and doctors in a real-time healthcare environment. The growing number of pilgrims visiting Saudi Arabia (SA) necessitates such an arrangement for the benefit of both pilgrims and service providers. If a virus spreads throughout the Kingdom, authorities and healthcare providers would face a difficult challenge, particularly in dealing with patients who arrive during Ramadan. The current Coronavirus danger has most people worried, and nearly every country in the globe is bracing itself to deal with such a situation. Working with the tourist flow is always a challenge when you're dealing with a well-known pilgrim site. As a result, the proposed MHS makes use of the most up-to-date applications of neural networks (NN), artificial intelligence (AI), big data (BD), and predictive data analytics (PDA) to improve healthcare operations. The risk prediction and mitigation procedure of numerous occurrences had a 95 per cent accuracy rate at the start of this study. AI and BD applications are being widely utilized to upgrade patient data and information at a faster rate to improve overall healthcare service performance. Finally, the suggested technique is capable of efficiently overcoming language obstacles and can also assist persons with speech and listening impairments. The proposed EHS's risk prediction and mitigation accuracy were determined to be 95%, which is a significant improvement above the existing m-health service provider. Big data and AI applications are being tested for various IoT processes to create a smart healthcare environment (Jadi, 2020).

The goal Altamimi study was to create and verify the Smartphone Impact Scale (SIS), a tool that

can accurately quantify smartphone usage among healthcare workers. Methods: To investigate the influence of smartphone usage among healthcare workers, we created a generic instrument. Through an online questionnaire-based survey, 1436 healthcare professionals from diverse locations in Saudi Arabia took part in this study. Content validity index (CVI), component analysis, internal consistency, and test-retest reliability analysis were used to establish the SIS' psychometric characteristics. It was obtained that, A 23-item scale was selected for reliability and validity analysis. CVI was determined to be 0.824 on average. Internal consistency was 0.91 using Cronbach's alpha, while test-retest reliability was 0.85. Factors 1 and 2 have Cronbach's alpha values of 0.875 and 0.803, respectively. The confirmatory factor analysis was performed. The article recommended that to design its harmful reduction methods, policymakers will require direction; hence, the present scale will assist healthcare policymakers in developing legal laws and policies that balance the use of those technologies' advantages with organizational security and patient privacy (Altamimi, 2020).

Shati, (2020) conducted a study aimed at using the Compelling Systems Design (PSD) paradigm and an expert evaluation technique, to identify and comprehend the design of mHealth applications by identifying their persuasive elements. This article examines the different persuasive characteristics used in the MOH's latest "Sea & Mawid" Apps, which were made available to the general public. The findings indicated that persuasive characteristics were used extensively, particularly those linked to credibility support, conversation support, and primary task support. The implementation and design of social support elements were found to be lacking; this might be owing to the nature of the applications or a developer's lack of understanding.

Zamri, (2021) the goal of this research study is to give an overview of how useful mHealth applications are in healthcare management. mHealth apps play a critical role in the prevention and treatment of noncommunicable and infectious illnesses, particularly during the COVID-19 epidemic. As a result, people of various backgrounds and ages must learn how to use mHealth apps, notably the 'MySejahtera app. As a result, the classifications, functions, benefits, and drawbacks of mHealth applications are discussed. PUBMED, Google Scholar, UpToDate, and other electronic databases, as well as web sources, were used to compile the data. From May 2011 to November 2020, a variety of periodicals, books, papers, and reports were gathered and analysed depending on their relevancy. This study concluded that noncommunicable illnesses, particularly chronic diseases, can be helped by mHealth, which is a one-of-a-kind technology.

Tang, (2018) aimed to share our real-world experience with a variety of user involvement methods in the design and implementation of a clinical communication and collaboration platform aimed at assisting an interprofessional team of clinicians in providing care to complex hospitalised patients. In a major community teaching hospital, we built and deployed an electronic clinical communication and collaboration platform. A mix of technical and healthcare specialists made up the design team. To support quick iterative design and user input, the agile software development technique was employed. We used a range of user-centred, user co-design, and participatory design approaches to include clinician users at various phases of the development lifecycle. Over 24 months, 36 software versions were released. Improvements in user interface design, the discovery of software problems, the introduction of additional modules that aided workflow, and early identification of essential modifications to the scope of the project have all come from user engagement.

Yingta, (2020) created a conceptual framework that identifies important usability, utility, and user experience design goals for mHealth apps that improve their utility. This paper includes a review of the literature as well as a recommended methodology for identifying design goals that have been demonstrated to be relevant or are frequently absent. Occupational health apps seldom suit end users' backgrounds, work settings, or dynamics, according to the study. In turn, in the later stages of our project, these defined design goals will be used as assessment points with end-users.

Alanzi, (2021) the goal of this study is to assess the MAWID mobile application, which was developed by the Saudi Arabian Ministry of Health and is used to organise primary care hospital visits as well as track and trace COVID-19. Data on three key aspects, including Ease of Use, Satisfaction, and Benefits of the MAWID application among its users, was collected via an online questionnaire-based survey. 345 people out of a total of 2542 people only completed part of the survey, while 204 people didn't use the app at all. After eliminating 549 invalid replies, a total of 1993 responses were included in the data analysis.

MAWID was referred to as a simple-to-use application by 82.1 per cent of the participants, 79.8% of the participants were extremely happy with the application, and the majority of the participants reflected on the prospective benefits of using the programme. In terms of the Ease of Use and Satisfaction levels connected with the MAWID application, T-test results indicated significant variations between males and females, as well as young and older participants.

Aljedaani & Babar (2021). The goal of this review article was to identify and assess the stated

security problems that mHealth app developers encounter. In addition, our research attempted to create a conceptual framework for the issues that mHealth app development companies confront while building safe apps. Knowing about these issues can assist to mitigate the danger of building insecure mHealth apps. The systematic literature review technique has been used. Since the introduction of the main app stores in 2008, we chose research that was published between January 2008 and October 2020. The author utilised a theme analysis approach to analyse the collected data after selecting 32 main studies based on established criteria. Based on the stated criteria, 32 articles out of 1867 were included in this review. Nine obstacles that might stymie the development of safe mHealth applications.

Hidayat-ur-Rehman, (2021). The goal of this study is to reduce COVID-19 transmission by strengthening social measures and investigating the impact of mobile applications in achieving this goal. A thorough examination of the function of mobile applications was conducted, and the effectiveness of these applications was assessed using a survey method. According to the findings of the study, users believe that the applications are successful in achieving the goals for which they were created. Efficiency, simplicity of use, user happiness, purpose fulfilment, usefulness and helpfulness were among the key performance indicators (KPIs) covered in the study. The average number of respondents who agreed that these apps are performing according to the specified KPIs for Tetamman, Tabaud, and Tawakkalna is 86.6 per cent, 80.5 per cent, and 90 per cent, respectively.

Tebeje, (2021) did a review in the period between January 1 and May 25, 2020, literature was thoroughly searched without language restrictions or publication status to highlight e-assistance health for person-centred health care during the COVID-19 pandemic.

PubMed, ScienceDirect, and CINAHL were used, as well as MedRxiv and Web of Science. Each recovered record was evaluated separately by two researchers. The researchers rescreened all of the studies that were included. The systematic review followed the criteria for recommended reporting items in systematic reviews and meta-analyses.

3. DATA ANALYSIS, PRESENTATION & INTERPRETATION

3.1 Introduction
This chapter focuses on analysing, presenting and interpreting the data collected. The results are presented in the following order: the results of the pilot study, questionnaire response and return rate, social and demographic characteristics of respondents, and measuring the five sections of the questionnaire which are electronic storage and its foreseen outcomes, data sharing, data access, supporting the managerial functions and supporting for data security.

3.2 Validity and reliability of the pilot study
The initial image of the questionnaire was presented to the supervisors who are experienced and competent, to benefit from their expertise and to explore their views on the extent of the linguistic integrity and scientific accuracy of the questionnaire paragraphs, and the extent of each paragraph belonging to the field you represent, and modify, add or delete what they deem appropriate and their comments were taken Concerning the planning of the tool, its form, importance, accuracy and consistency and the system of scoring the results. The researcher amended this in light of the recommendations and opinions of the supervisor, thus obtaining the final image of the questionnaire as shown in Appendix 1.

The validity of the internal consistency and the consistency of the questionnaire of the sample of (30) questionnaires for a group of experts who are specialists in information systems with at least five years of experience were tested and not participating in the main sample of the study. All the questionnaire answers were entered in SPSS for analysis. Before the results are analysed, reliability analyses were applied and the reliability index Cronbach's Alpha was 0.931 for all questions. All scores were satisfactory. The respondents were 70% male and 30% female with 23.3% of an age range less than 35, 50% from the age of 35 to 50 years, and 26.7 % more than 50 years old.

3.3. Socio-demographic characteristics of the respondents
Respondents were asked to indicate gender, age, residence place, educational level and also the place of work in the survey questionnaire. Table (2) shows the distribution of their responses by gender, age, place of residence and level of education, working place, and years of education, respectively.

Table 2: Distribution of respondents' socio-demographic characteristics (n = 265)

Characteristic	Frequency	%
Gender		
Male	163	61.5
Female	102	38.5
2- Age		
18 – 35	154	58

Characteristic	Frequency	%
35 – 50	107	40.5
Greater Than 50	4	1.5
3- Place of Residence		
City	227	86
Rural	38	14
4- Education Level		
diploma (3 years)	41	15.5
Bachelor's Degree	155	58.5
Master's degree	57	51.5
PhD degree	12	4.5
5- Years of Experience		
1-5 years	29	11
6-10 years	157	59
More than 10 years	79	30
6- Place of work		
Ministry of Health	167	63
University Hospitals	32	12
Military Hospital	24	9
Privet Hospitals	421	16

3.4 Relationship between Socio-Demographic Factors and electronic storage and its foreseen outcomes.

Table (3) shows the relationship between respondent socio-demographic characteristics and electronic storage and its foreseen outcomes.

Table 3: Correlation between socio-demographic factors and electronic storage and its foreseen outcomes (Variable 1)

		1- Gender	2- Age	3- Place of Residence	4-Education Level	5- Years of Experience
VAR.1	Pearson Correlation	.159**	.004	-.256**	.025	.127*
	Sig. (2-tailed)	.002	.931	.000	.631	.013
	N	265	265	265	265	265

3.5 Relationship between Socio-Demographic Factors and support for data sharing

Table (4) shows the relationship between respondent socio-demographic characteristics and the support for data sharing.

Table 4: Correlation between socio-demographic factors and support for data sharing (Variable 2)

		1-Gender	2-Age	3- Place of Residence	4-Education Level	5- Years of Experience
VAR.2	Pearson Correlation	.198**	-.028	-.305**	.066	.117*
	Sig. (2-tailed)	.000	.582	.000	.194	.022
	N	265	265	265	265	265

3.6 Relationship between Socio-Demographic Factors and Data Access

Table (5) shows the relationship between respondent socio-demographic characteristics and the attitude variable of data access.

Table 5: Correlation between socio-demographic factors and data access (Variable 3)

		1-Gender	2-Age	3- Place of Residence	4-Education Level	5- Years of Experience
VAR3	Pearson Correlation	.245**	.011	-.241**	.031	.103*
	Sig. (2-tailed)	.000	.825	.000	.542	.044
	N	265	265	265	265	265

3.7 Relationship between Socio-Demographic Factors and the Support for Managerial Functions

Table (6) shows the relationship between respondent socio-demographic characteristics and the attitude variable of the support for managerial functions.

Table 6: Correlation between socio-demographic factors and supporting for managerial functions (Variable 4)

		1-Gender	2-Age	3- Place of Residence	4-Education Level	5- Years of Experience
VAR4	Pearson Correlation	.237**	.021	-.147**	.041	.109*
	Sig. (2-tailed)	.000	.623	.000	.747	.037
	N	265	265	265	265	265

3.8 Relationship between Socio-Demographic Factors and the Data Security

Table (7) shows the relationship between respondent socio-demographic characteristics and the attitude variable of data security.

Table 7: Correlation between socio-demographic factors and the support for managerial functions (Variable 5)

		1-Gender	2-Age	3- Place of Residence	4-Education Level	5- Years of Experience
VAR5	Pearson Correlation	.237**	.021	-.147**	.041	.109*
	Sig. (2-tailed)	.000	.623	.000	.747	.037
	N	265	265	265	265	265

3.9 Electronic storage and its foreseen outcomes:

Sampled respondents were requested to respond to a series of questions to assess their knowledge of electronic storage and its foreseen outcomes. Table (8) shows the results of this electronic storage and its foreseen outcomes assessment among the participant. The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions.

Table 8: Electronic storage and its foreseen outcomes the participants

Variable Questions		Frequency	Per cent
1- Keeping patient records in electronic forms in all departments is necessary.	Strongly agree	214	80.75%
	Agree	41	15.47%
	Neutral	7	2.64%
	Disagree	2	0.75%
	Strongly Disagree	1	0.38%
	Total	**265**	**100.0**
2- Accessing patients' information conveniently is important.	Strongly agree	187	70.57%
	Agree	66	24.91%
	Neutral	7	2.64%
	Disagree	2	0.75%
	Strongly Disagree	3	1.13%
	Total	**265**	**100.0**
3- Sharing patients' information with other colleagues is important.	Strongly agree	150	56.60%
	Agree	80	30.19%
	Neutral	12	4.53%
	Disagree	9	3.40%
	Strongly Disagree	14	5.28%
	Total	**265**	**100.0**
4- Sharing patients' data is important.	Strongly agree	134	50.57%
	Agree	75	28.30%
	Neutral	23	8.68%
	Disagree	16	6.04%
	Strongly Disagree	17	6.42%
	Total	**265**	**100.0**
5- IT systems are necessary for performing managerial functions.	Strongly agree	187	70.57%
	Agree	72	27.17%
	Neutral	6	2.26%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.0**

3.10 IT Support for Data Sharing

Sampled respondents were requested to respond to a series of questions to assess the IT support for data sharing. Table (9) shows the results of this electronic storage and its foreseen outcomes data sharing assessment among the participant. The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions.

Table 9: IT Support and Data Sharing from the point of view of the participants

Variable Questions		Frequency	Per cent
6- Communication between data stored in different departments is necessary	Strongly agree	196	73.96%
	Agree	61	23.02%
	Neutral	7	3.02%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
7- A communication network within the clinic will provide for an increase in data sharing.	Strongly agree	178	67.17%
	Agree	70	26.42%
	Neutral	15	5.66%
	Disagree	2	0.75%
	Strongly Disagree		0.00%
	Total	**265**	**100.00%**
8- Sharing data with colleagues at the clinic will increase service quality.	Strongly agree	184	69.43%
	Agree	66	24.91%
	Neutral	10	3.77%
	Disagree	3	1.13%
	Strongly Disagree	2	0.75%
	Total	**265**	**100.00%**
9- Researching with data integrated from other clinics will provide more consistent results.	Strongly agree	195	73.58%
	Agree	63	23.77%
	Neutral	6	2.26%
	Disagree		0.00%
	Strongly Disagree		0.00%
	Total	**265**	**100.00%**
10- Researching with data integrated from other clinics will provide more accurate results.	Strongly agree	173	65.28%
	Agree	40	15.09%
	Neutral	51	19.25%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**

3.11 IT Support for Data Access

Sampled respondents were requested to respond to a series of questions to assess the IT support for data sharing. Table (10) shows the results of this electronic storage and its foreseen outcomes in IT support for data access assessment among the participant. The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions.

Table 10: IT Support and Data Access from the point of view of the participants

Variable Questions		Frequency	Per cent
11- A communication network within a clinic will provide time-saving for accessing data.	Strongly agree	194	73.21%
	Agree	60	22.64%
	Neutral	9	3.40%
	Disagree	2	0.75%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
12- If data is stored in electronic form I can access data faster.	Strongly agree	183	69.06%
	Agree	71	26.79%
	Neutral	11	4.15%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**

Variable Questions		Frequency	Per cent
13- Accessing data conveniently will increase service quality.	Strongly agree	189	71.32%
	Agree	68	25.66%
	Neutral	8	3.02%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
14- Making comparisons and inquiries about patient data instantly will be beneficial.	Strongly agree	202	76.23%
	Agree	56	21.13%
	Neutral	7	2.64%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
15- Remote access to data will provide improvement for my research work	Strongly agree	197	74.34%
	Agree	60	22.64%
	Neutral	8	3.02%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
16- Storing data in electronic forms will ease data access for research studies.	Strongly agree	207	78.11%
	Agree	54	20.38%
	Neutral	4	1.51%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**

3.12 IT Support for Managerial Functions

Sampled respondents were requested to respond to a series of questions to assess the IT support for Managerial functions. Table (11) shows the results of this IT support and managerial functions assessment among the participant. The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions.

Table 11: IT Support and Data Access from the point of view of the participants

Variable Questions		Frequency	Per cent
17- Having a communication network within the clinic will provide better management of the clinic.	Strongly agree	161	60.75%
	Agree	87	32.83%
	Neutral	15	5.66%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
18- Having a communication network within the clinic will increase participation in the decision-making process.	Strongly agree	184	69.43%
	Agree	66	24.91%
	Neutral	10	3.77%
	Disagree	3	1.13%
	Strongly Disagree	2	0.75%
	Total	**265**	**100.00%**
19- Having a communication network within the clinic will increase efficiency.	Strongly agree	190	71.70%
	Agree	64	24.15%
	Neutral	11	4.15%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
20- Having a communication network within the clinic will increase coordination between employees.	Strongly agree	174	65.66%
	Agree	57	21.51%
	Neutral	30	11.32%
	Disagree	4	1.51%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**

3.13 IT Support for Data Security

Sampled respondents were requested to respond to a series of questions to assess IT support for data security. Table (12) shows the results of this IT support and data security assessment among the participant. The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions.

Table 12: IT Support and Data security from the point of view of the participants

Variable Questions		Frequency	Per cent
21- Storing data in electronic form will ease patient follow-ups.	Strongly agree	208	78.49%
	Agree	52	19.62%
	Neutral	5	1.89%
	Disagree	0	0.00%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
22- Determining access hierarchy for patients' data is necessary for ethical issues.	Strongly agree	176	66.42%
	Agree	73	27.55%
	Neutral	14	5.28%
	Disagree	2	0.75%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
23- Storing data in electronic form will ensure restricted access to patients' data.	Strongly agree	183	69.06%
	Agree	66	24.91%
	Neutral	13	4.91%
	Disagree	3	1.13%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**
24- Determining the access hierarchy will be beneficial for ethically protecting patients'	Strongly agree	192	72.45%
	Agree	60	22.64%
	Neutral	11	4.15%
	Disagree	2	0.75%
	Strongly Disagree	0	0.00%
	Total	**265**	**100.00%**

4.0 SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION & RECOMMENDATIONS

4.1 Introduction

This chapter presents a summary of the most significant findings and conclusions from this study of How strategically Saudi healthcare is delivered or designed at the macro or micro levels in an informatics field. It also presents the study's limitations and recommendations.

4.2 Validity and reliability of the pilot study

The reliability of the tool elements was tested using the Alpha-Cronbach (α) test of all variables = 0.93 which was considered acceptable. Responses were recorded and analysed using statistical software (IBM-SPSS), version 25.0. Descriptive statistics (percentage and number) were applied. A value of p 0.05 was considered statistically significant.

4.3 Demographic data

A total of 265 participated in this study, male (57.8%) and female (42.2%). Their median ages were and a median age of 35 – 50 years. Results from Table 4.2 indicate that an almost equal number of males (61.5%) and females (38.5%) participated in the study

as respondents. The respondent means age was 28.5 years with a range of 18 to greater than 50 years and a median age of 35 – 50 years as shown in Table (2). The majority of the study participants (58.5%) held a higher university degree certificate.

4.4 Summary & Discussion of the Research Findings

This descriptive and quantitative study, conducted among specialists in information systems with at least five years of experience, in Saudi Arabia, highlights electronic storage and its foreseen outcomes, its support for data sharing, IT support for data access, IT support for managerial functions & IT support for data security.

Results indicate that several 163 males and 102 females participated in the study as respondents. The majority of the study participants were in age between 18 and 35 years old. Most of the participants (86%) have a city as a place of residence. The majority of the participant held a bachelor's degree certificate. Most of the participants were working in the ministry of health and the least of them were working in military hospitals.

These findings show that there was no statistically significant correlation between the age of the respondents and the electronic storage and its foreseen outcomes. However, there was a statistically significant positive correlation between the education level and electronic storage and its foreseen outcomes. There was also a significant correlation between the level of the number of years of experience and the electronic storage and its foreseen outcomes. Participants with Bachelor's degrees have higher electronic storage and foreseen outcomes compared to those with the lowest education degrees Certificate.

These findings show that there was no statistically significant correlation between the age of the respondents, the living arrangements and the employment type with supporting the data sharing. However, there was a statistically significant positive correlation between education level and data sharing. There was also a significant correlation between the years of experience and the same variable of data sharing. Participants with university degrees and higher reported higher data sharing compared to those with the lowest education degrees Certificate.

The findings show that there was no statistically significant correlation between the age of the respondents, the living arrangements and the employment type with the practices of data access. However, there was a statistically significant positive correlation between the education level and the data access variable. There was also a significant correlation between the place of residence and the same variable of the participants. Participants with higher years of experience have higher data access compared to those with the lowest degree of experience.

Part 1, As a measuring methodology, a questionnaire was created and sent to the experts, who are information systems professionals with at least five years of experience. According to a five-point Likert scale, the replies were generally highly agreed, with roughly 79 per cent agreeing. Female respondents were more accepting of electronic data storage than male ones. Other notable distinctions between occupations were also discovered.

Part 2, illustrates how professionals feel about the need of sharing knowledge. The results in this section demonstrate that they feel that keeping data in electronic formats will improve data sharing, yet they are opposed to exchanging data with other clinics. In summary, the results suggest that the professionals polled feel that keeping data in electronic form and on communication, the network will make data exchange easier and more effective.

Part 3, The goal of this survey is to find out how people feel about data availability. The findings demonstrate that they feel that having easy access to data will improve the level of service they provide at the IVF clinic. As previously stated, the convenience of obtaining patients' data is the most essential aspect for the responders. They believe that storing data in electronic form will allow for speedier access.

Part 4, Its purpose is to assess how a communication network affects management activities. The findings suggest that the majority of respondents feel that a communication network will improve personnel cooperation inside the clinic. Then they feel it will boost productivity. When compared to other portions, the respondents' levels of agreement are low.

The result of the current study confirms that It supports both data sharing & data access, almost (74%) of respondents reported that they strongly agreed that communication between data stored in different departments is necessary, and around (23%) was agreed. The participants confirmed that A communication network within the clinic will provide for an increase in data sharing by around (67%). The majority of the respondents strongly agreed that sharing data with colleagues at the clinic will increase service quality. On the other hand, a moderate percentage of participants agreed with the same idea. While participants strongly agreed (74%) researching with data integrated from other clinics will provide more consistent and accurate results. Most of the participants (73%) strongly agreed that A communication network within a clinic will provide time-saving for accessing data. Furthermore, they strongly agreed with a high percentage that If data is stored in electronic form, they can access data faster and accessing data conveniently will increase the service quality.

Part 5, displays the data security outcomes For ethical reasons, the respondents feel it is critical to identify patients' data access rights. When compared to other issues, however, the level of agreement for "keeping patients' data in electronic formats will strengthen data security" and "this will give access limits" is low. As a consequence, it is possible to conclude that the respondents are under-informed or unaware of the potential of an information system with a properly configured database management system. With well-designed instructive sessions and training, it may be able to raise their awareness.

The basic concept of the standard precautions was almost adequate. The majority of respondents answered correctly all questions on the components of the concept of standard precautions. There was a significant correlation between age and supporting managerial functions. These findings indicate that the majority of the study participants reported that keeping patient records in electronic forms in all departments & accessing patient information conveniently is important and can increase the efficiency of data delivery. An acceptable percentage of the respondents reported that

Sharing patients' information with other colleagues is important. The majority of the respondents indicated that sharing patient data between medical staff is important. When the participants have been asked whether IT systems are necessary for performing managerial functions., the majority of them strongly agreed.

The participants strongly agreed that IT has great support for managerial functions. As they strongly agreed all the item which includes having a communication network within the clinic will provide better management in the clinic, increase participation in the decision-making process, and increase efficiency, and coordination between employees.

Following the research objectives, the interpretations of findings and conclusions are presented in the following section:

4.5 Relationship between Socio-Demographic Factors and electronic storage and its foreseen outcomes variable

These findings show that there was no statistically significant correlation between the age of the respondents and the electronic storage and its foreseen outcomes. However, there was a statistically significant positive correlation between the education level and the knowledge variable (p<0.01). There was also a significant correlation between the education level and electronic storage and its foreseen outcomes (p<0.01) .Participants with university degrees and higher reported higher agreement to electronic storage and its foreseen outcomes compared to those with the lowest education degrees Certificate.

4.6 Relationship between Socio-Demographic Factors and the support for data sharing Variable

These findings show that there was no statistically significant correlation between the age and gender of the respondents, the place of residence and the working place with the support for data sharing of the participants. However, there was a statistically significant positive correlation between the education level and the sharing of the participant variable (p<0.01). There was also a significant correlation between the years of experience and the same variable of the sharing of the participants (p<0.01) .Participants with university degrees and higher reported higher agreed to the sharing of the participation rates compared to those with the PhD holders.

4.7 Relationship between Socio-Demographic Factors and the Data Access

These findings show that there was no statistically significant correlation between the age and gender of the respondents, the place of residence and the working place with the support for data access of the participants. However, there was a statistically significant positive correlation between the education

level and the sharing of the participant variable (p<0.01). There was also a significant correlation between the years of experience and the same variable of the **Access** of the participants (p<0.01) .Participants with university degrees and higher reported higher agreed to the **Access** of the participation rates compared to those with the PhD holders.

4.8 Relationship between Socio-Demographic Factors and the supporting for managerial functions

These findings show that there was no statistically significant correlation between the gender and gender of the respondents, the place of residence and the working place with the supporting managerial functions of the participants. However, there was a statistically significant positive correlation between the education level and the sharing of the participant variable (p<0.01). There was also a significant correlation between the years of experience and the same variable of the support for managerial functions of the participants (p<0.01) .Participants with university degrees and higher reported higher agreed to the supporting for managerial functions of the participate rates compared to those with PhD holders.

4.9 CONCLUSION

There are many studies and research papers about how Saudi healthcare is delivered or designed in the informatics field. Many different studies investigate the users' acceptance, perception or usage levels of already implemented technology used in healthcare systems. Since implementing new technology is a costly and time-consuming process, conducting an assessment after implementation is neither suitable nor enough. This study proposes a technology acceptance measurement model used in the healthcare system. The model aims to measure the users' point of view about healthcare information delivery. This study focuses on expertise rather than the technology itself. Primarily, the critical factors to determine the technology acceptance of the users are investigated. After the investigation of major factors, the questions – to analyse these factors in more detail – are determined for each factor. This study will help HIS providers for designing and implement more effective and efficient systems in healthcare institutions. This questionnaire provides a better understanding of the users' perceptions and also determines the barriers to technology acceptance. The questionnaire has been designed not for only physicians but all professionals in the healthcare institution. The results of the questionnaire can also be used to make comparisons with assessment results after the implementation. Comparison results can provide answers to questions like; 'What hinders better technology adoption?', 'What can be done for a smoother transition from paper forms to digital forms?', and 'What can be done to satisfy professionals' expectations from newly implemented IT?' On the other hand, the results of the questionnaire enlighten users' perceived knowledge about IT and provide insight into

at what point the professionals will need training. Repeating the survey for more valid and accurate results in other clinics is essential.

4.10 RECOMMENDATIONS
Based on the findings of the study, the following recommendations are made to improve the Saudi healthcare delivery or design in the informatics field:
1. The HIS providers can use the results for designing and implementing more effective and efficient systems in healthcare institutions.
2. The users' perceptions and also determine the barriers to technology acceptance have to go deeper.
3. Based on our findings, the identification and consistent use of rigorous methods for IT system design will help move the discipline of Public Health Informatics forward.

Authors Contributions
This work was carried out in collaboration among all authors. All read and approved the final manuscript.

REFERENCES
*   Alghamdi, S., Alqahtani, J., & Aldhahir, A. (2020). Current status of telehealth in Saudi Arabia during COVID-19. *Journal of Family and Community Medicine*, 27(3), 208-211.
*   Aljohani, N., & Chandran, D. (2019). Adoption of M-Health Applications: The Saudi Arabian Healthcare Perspectives. Australasian Conference on Information Systems, 2019, Perth Western Australia.
*   Kalgotra, P., Gupta, A., & Sharda, R. (2021). Pandemic information support lifecycle: Evidence from the evolution of mobile apps during COVID-19. *Journal of Business Research*, 134, 540-559.
*   Kwak, C., Kim, S., You, S., & Han, W. (2020). Development of the Hearing Rehabilitation for Older Adults (HeRO) Healthcare Mobile Application and Its Likely Utility for Elderly Users. *International Journal of Environmental Research and Public Health*, 17, 3998; doi:10.3390/ijerph17113998.
*   Miah, S., Gammack, J., & Hasan, N. (2020). Methodologies for designing healthcare analytics solutions: A literature analysis. *Health Informatics Journal*, 26(4), 2300-2314.
*   Tang, T., Limc, M., Mansfieldc, E., McLachlanf, A., & Quan, S. (2018). Clinician user involvement in the real world: Designing an electronic tool to improve interprofessional communication and collaboration in a hospital setting. *International Journal of Medical Informatics*, 110, 90-97.
*   Alsalman, D., Ali, Z., Alnosaier, Z., Alotaibi, N., & Alanzi, T. (2020). Gamification for Diabetes Type 1 Management: A Review of the Features of Free Apps in Google Play and App Stores. *Journal of Multidisciplinary Healthcare*, 13, 425-432.
*   Pires, I., Marques, G., Garcia, N., Flórez-Revuelta, F., Ponciano, V., & Oniani, S., (2020). A Research on the Classification and Applicability of the Mobile Health Applications. *Journal of Personalized Medicine*, 10, 11. doi:10.3390/jpm10010011.
*   Saputra, C., & Arif, Y. (2019). Nursing Informatics System in Health Care Delivery. The 1st PANIHC The 1st Payung Negeri International Health Conference Volume 2019.
*   Jadi, A. (2020). Mobile Health Services in Saudi Arabia-Challenges and Opportunities. *International Journal of Advanced Computer Science and Applications*, 11(4), 165-170.
*   Altamimi, T., Alex, J., Khan, M., & Nair, B. (2020). Development and validation of a Smartphone Impact Scale among healthcare professionals. *Journal of Taibah University Medical Sciences*, 15(5), 387-397.
*   Saputra, C., & Arif, Y. (2019). Nursing Informatics System in Health Care Delivery. The 1st PANIHC the 1st Payung Negeri International Health Conference Volume 2019.
*   Pires, I., Marques, G., Garcia, N., Flórez-Revuelta, F., Ponciano, V., & Oniani, S. (2020). A Research on the Classification and Applicability of the Mobile Health Applications. *Journal of Personalized Medicine*, 10, 11; doi:10.3390/jpm10010011.
*   Shati, A. (2020). Mhealth Applications Developed by The Ministry of Health for Public Users in Ksa: A Persuasive Systems Design Evaluation. *Health Informatics - An International Journal (HIIJ)*, 9(1), 1-13.
*   Zamri, N., Begum, F., & Mohideen, S. (2021). The Practicality of Mobile Applications in Healthcare Administration and COVID-19 Pandemic. The Malaysian Journal of Islamic Science, Special Issue: Healthcare in Pandemic Era: "The New Norm", 1. eISSN: 2289-4799.
*   Yingta, N., Nocera, J., Brew, O., & Ur Rehman, I. (2020). Usefulness Design Goals of Occupational mHealth Apps for Healthcare Workers. http://repository.uwl.ac.uk/id/eprint/8171/
*   Alanzi, T., Althumairia, A., Aljaffarya, A., Alfayeza, A., Alsalmana, D., Alanezib, F., Alhodaibc, H., AlShammarid, M., AL-Dossarye, R., Al-Rayesa, S., Hariria, B., & AlThani, B. (2021). Evaluation of the Mawid mobile healthcare application in delivering services during the COVID-19 pandemic in Saudi Arabia. International Health, 1-10. doi:10.1093/inhealth/ihab018
*   Aljedaani, B., & Babar, A. (2021). Challenges with Developing Secure Mobile Health Applications: Systematic Review. *JMIR Mhealth Uhealth*, 9(6), e15654.

- Hidayat-ur-Rehman, I., Ahmad, A., Ahmed, M., & Alam, A. (2021). Mobile Applications to Fight against COVID-19 Pandemic: The Case of Saudi Arabia. *TEM Journal*, 10(1), 69-77. ISSN 2217-8309.

- Tebeje, T., & Klein, J. (2021). Applications of e-Health to Support Person-Cantered Health Care at the Time of COVID-19 Pandemic. *Telemedicine and e-HEALTH*, 27(2), 150-158.